Western Society of Naturalists

104th Meeting Program

Monterey, California, USA

Western Society of Naturalists
~ 2023 ~

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Easy Access QR codes

LONG PROGRAM WITH ABSTRACTS (QR CODE TAKES YOU TO THE "PAST NEWSLETTERS & PROGRAMS" PAGE OF THE WSN WEBSITE, THEN SCROLL DOWN AND CLICK THE LINK TO THE 2023 PROGRAM)	**CODE OF CONDUCT REPORTING FORM (ANONYMOUS)**

The Western Society of Naturalists enthusiastically thanks the following for supporting the 2023 annual meeting. *Thank you!*

Sea Grant California Est. 1973

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Sea Grant University of Southern California

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COUNCIL ON OCEAN AFFAIRS, SCIENCE & TECHNOLOGY (COAST)

NOVEMBER 9 - NOVEMBER 12, 2023

Welcome to the 104th Annual Meeting of the Western Society of Naturalists!

WSN's roots can be traced back to 1910 when a group of biologists, concerned about the lack of scientific meetings on the West Coast, formed the Biological Society of the Pacific (BSP; call this our larval phase). The BSP was intended to include "any person interested in scientific work of a research nature." In 1915, the American Society of Naturalists invited the BSP to join as a Pacific chapter under the ASN banner. Although the BSP voted in favor, the merger was eventually rejected by the ASN Executive Committee, who felt that WSN might not be sufficiently selective in admitting members. Thus, the BSP formally metamorphosed into the Western Society of Naturalists in 1916.

The first annual meeting of the society that would become WSN featured four scientific presentations and a dinner. Since then, our meetings and our society have grown substantially. We are excited to welcome over 600 participants to this year's meeting, hundreds of excellent talks, and a variety of social events to promote networking among different groups. We are also in a period of increased commitment to our society's diversity, equity and inclusion of all naturalists. We proudly welcome *everyone* who is interested in scientific work of a research nature.

Thanks to Volunteers – we appreciate you!

This meeting could not happen without substantial volunteer contributions from many people. The WSN Secretariat thanks the President and President-elect, Treasurer (Andy!), Student Committee, the Diversity, Equity and Inclusion Committee, the local Members-at-Large, the judges of posters and talks, the professional and student volunteers (Cass and Danielle! Cal Poly undergrads!), and all those who keep our society going!

WSN COVID POLICY

- WSN will adhere to local, state and federal guidelines.
- Please use common sense and care when deciding to attend the meeting, and how to protect yourself and others.

ACCESSIBILITY

- **Presentations**: Subtitles will be auto-generated for all presentations and shown live on the big screen. The front row of seating is reserved for those who will benefit most from real-time captioning (e.g., attendees who are deaf or hard of hearing, people with learning disabilities, or those for whom English is a second language). If you have feedback on improving captioning for future meetings, please bring your thoughts to the Business Meeting or share with a member of the DEIC.
- **Food**: Vegetarian, vegan, and gluten-free options will be available whenever food is provided at the conference venue. We will make every effort to mark these options. If you have dietary restrictions that are not met, please let us know so that we can be more inclusive at future meetings.
- **Restrooms**: We plan to designate one or more restrooms as gender-inclusive for conference attendees. Please check posted signage during the meeting or ask a DEIC member if you have trouble locating a nonbinary restroom.
- **Priority Seating (Poster Sessions and Socials)**: Seating is limited at poster sessions and events like the Attitude Adjustment Hour (AAH). We will provide priority seating to serve those with physical

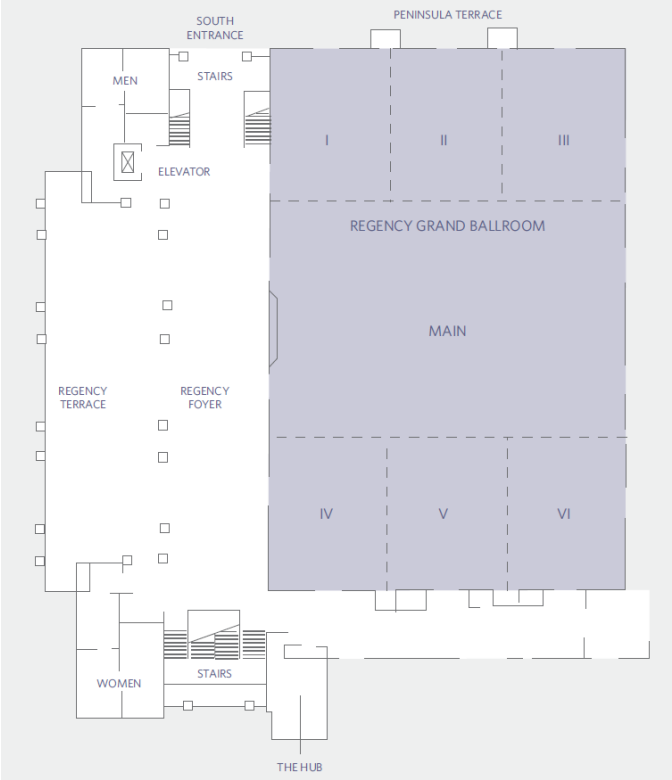
limitations (e.g., people with physical disabilities, attendees who are pregnant or accompanied by small children, elderly participants). Though everyone is welcome to use these seats, we ask folks to yield to anyone in greater need.

- **Student Travel Awards**: The Student Committee developed a new format for student travel awards, using a standardized scoring rubric to generate fewer but more meaningful awards. This year, 10 students will receive $500 each to help offset the costs of attending the meeting.
- **Travel**: Do you need a ride to WSN? Do you have space in your vehicle? Post info on the WSN Ride Share Board.
- **Affinity Group Mixers**: Affinity group mixers are designed to help members from underrepresented groups gather, build community, and bolster a sense of belonging within WSN. BIPOC, LGBTQIA2S+, First Generation College Students (Past and Present), and Disability groups can be found on the schedule. Please note that you must identify as a member of the group that you intend to join.

HOTEL FLOOR PLAN

Events will take place in the hotel conference center, including breakout rooms and ballroom. On the main level, that includes the Regency Ballroom/Regency Main, Regency 1-3 (I-III), Regency 4-6 (IV-VI). On the ground floor, that includes Spyglass, Big Sur, Cypress, and Windjammer. The Foyers on both levels will be used for coffee breaks and the poster session.

Second (Main) Floor



Ground Floor (Downstairs)

DEI COMMITTEE PROGRAMMING

We have numerous programs offered by the Diversity, Equity and Inclusion Committee (DEIC). These activities and efforts include:

- **Affinity stickers:** Available for name badges at registration, these stickers are used to identify first-time attendees and one's membership to various underrepresented groups to help build community within WSN.
- **Mentorship program:** This program is designed to help first-time attendees and students network with professionals and senior scientists. The **mentorship mixer** (open to pre-registrants) is Friday during lunch. If you signed up, you should have received instructions from the organizers. We are excited about this initiative to make the WSN meetings more inclusive! The mentorship program is sponsored by CSU COAST. Contact deic@wsn-online.org with questions.
- **DEI Symposium:** Our plenary will highlight ways to support safe and inclusive field work with speakers sharing LGBTQ+, disabled, and BIPOC perspectives. This session was made possible by the generous support of CSU COAST.
- **Code of Conduct:** See the back page of the Program for the full Code of Conduct. Please report any concerns or issues directly to a member of the DEIC or the Secretariat, or by using our online reporting form (anonymous or self-identifying, at your discretion).
- **New DEIC Members**: We are currently soliciting **four new members** for three-year terms (any career stage). Get in touch with us (deic@wsn-online.org) if you are interested in assisting with these efforts and developing new ways to make WSN more inclusive and accessible. **Later career stage individuals are especially encouraged to apply.**
- **Demographic survey:** For anyone still wishing to complete this year's demographic survey, a QR code is available at the DEIC table near registration.

JOIN THE STUDENT COMMITTEE

We are currently soliciting self-nominations from our student membership to join the Student Committee for our 2023 and 2024 annual meetings! We have three positions to fill this year, replacing outgoing members. We are looking for 2 graduate students and one undergraduate. To self-nominate, please complete the self-nomination form by November 4, 2023. Appointees will be notified by November 9th, 2023:

NETWORKING AND SOCIALIZING

One of the best parts of WSN meetings is the opportunity to meet new people, network, and catch up with friends. There are several ways to do this:

- **The old fashion way:** Walk up to people, introduce yourself, and start talking about science. You can do it!
- **Go online:**
    - We are online at https://www.wsn-online.org.
    - In addition, we maintain a WSN Twitter account (@WSN_Secretariat), where you can find information about the Society and our annual meeting, and connect with your colleagues. Our Student Committee also maintains separate accounts on Twitter (@WSN_Students) and Instagram (@wsn_students). Additionally, the Diversity, Equity, and Inclusion Committee can be found on Twitter (@wsn_deic). If you have an opportunity that would be appropriate for distribution via the WSN social media accounts (fellowships, small grants, student

opportunities, etc.), please reach out to the Secretariat, Student Committee, or DEI Committee through these platforms.
    - Want your work, field site, study organism, or recent publication to be featured on WSN's Instagram feed? Send a photo and a short blurb to @wsn_students or @westernsocietyofnaturalists. Material will be accepted at any time on a rolling basis.
- **Attend an affinity group mixer**
    - BIPOC, LGBTQIA2S+, First Generation College Students (Past and Present), and Disability groups can be found on the schedule.
    - Contact deic@wsn-online.org with questions.

AUCTION

Proceeds from the auction will support the Student Travel Fund for next year! We have two different auctions:

- **Silent Auction:** Conducted in the hotel starting Thursday Nov. 9th, 6pm and closing Saturday Nov. 11th at 8:00pm, just before the Presidential Address. Winners will be announced at the end of the special live auction ceremony! We will be accepting PayPal, checks, and Square payments. View items in person and bid online! https://www.32auctions.com/wsnauction2023
- **Live Auction:** Join the live auction extravaganza! We will be auctioning off art, excursions, and other fun stuff. The live auction is Saturday, Nov. 11th starting at 9:00 pm.
- **Submission** deadline for donating auction items is Nov.1st. We already have lots of great items! Use this link to submit any last minute items before Wednesday, Nov. 1st. For questions, contact Leeza-Marie Rodriguez (leeza-marie@ucsb.edu).

STUDENT WORKSHOP (THURSDAY)

Reproducible coding in R - reproducibility for Self & reproducibility for Others

- Location: Regency Ballroom
- Workshop hosts: Alex Davis and Cole Brookson

Join us for a hands-on workshop on reproducible coding in R! Those working in ecological and related research areas are more commonly expected to have a working knowledge of reproducible workflows for their statistical and computational analyses, with more journals and granting bodies implementing requirements for code uploading and transparency. In this workshop led by Alex Davis and Cole Brookson, we'll do a whirlwind tour through some tools that you can use to improve your reproducibility skills in R. Since reproducibility starts with making sure we can repeat our own analysis, we'll start with reproducibility on our own machines: how to manage working directories and repositories with the "here" package & RProjects, how to interface with data on the web, and how to develop "one-click" scripts so that re-doing an analysis can truly be done in one click. This will encompass the majority of the workshop and include hands-on components so participants can practice on their own machines. After this, we'll do a brief survey of other tools that allow code and analysis pipelines to be re-usable for others. We'll briefly discuss version control with Git/GitHub, package controls with the "renv" package, and some other helpful tools. This is oriented towards beginners, but we expect all participants to at least have R/RStudio downloaded and have a basic working knowledge of coding in R.

STUDENT ORGANIZED SYMPOSIUM (FRIDAY)

Highlighting Research at the Intersection of Restoration and Commercial Aquaculture

Chair: Ariadne Reynolds

Location: Regency Ballroom

As scientists and resource managers search for methods to restore native species and increase global food supplies, aquaculture techniques are becoming increasingly important in advancing the fields of restoration ecology and commercial seafood production. The student symposium will bring together four aquaculture practitioners and researchers from across the west coast with expertise in kelp, mollusc, and finfish aquaculture to discuss their experiences in advancing commercial aquaculture and contributing to native species restoration.

Speakers

- Leslie Booher- Co-Founder, Sunken Seaweed
- Nathan Churches- CSO and Co-Founder, Holdfast Aquaculture
- Doug Bush- Managing Member/ GM, The Cultured Abalone
- Mike Shane- Director of Fisheries Replenishment Operations, Hubbs-Seaworld Research Institute

Partial funding for this session was provided by CA Sea Grant.

DIVERSITY, EQUITY AND INCLUSION SYMPOSIUM (FRIDAY)

Safe and Inclusive Field Work

- Chair: Christina Vasquez
- Location: Regency Ballroom

Field training is an important component to the development of essential skills in the natural sciences. However, there is a lack of information regarding methods to ensure a safe and inclusive field experience for people of all abilities and backgrounds. Thus, the goal of the DEIC symposium will be to discuss field work best practices by focusing on the following three topics: 1) field work perspectives from LGBTQ+ scientists, 2) awareness of BIPOC experiences in the field, and 3) accessibility to/in the field for people with disabilities. The DEIC symposium will bring awareness to field accessibility and provide solutions for creating a more safe and inclusive field environment.

Funding for this session was provided by CSU COAST.

Panelists:

- Will Ryan, Ph.D., Assistant Professor, Towson University
- Reilly Boyt, M.S. student, Oregon State University, Founder of Disabilities Within Ocean Sciences
- Valeria Ramirez-Castañeda, Ph.D. candidate, UC Berkeley

PRESIDENTIAL SYMPOSIUM (SATURDAY)

Reshaping Landscapes: Urban Ecology Paving the Road to Equitable and Sustainable Cities

- Organizer: Bonnie Becker
- Location: Regency Ballroom

Most classical ecological studies focus on wild places and seek to remove the effects of human interference. Urban Ecology flips this script and explores the bidirectional interactions between people and their environment. This interactive symposium will explore the relationship between urban ecology, social justice, and the transformation of cities. The structure of the symposium intends to disrupt the "sage on the stage" approach and include opportunities for students to lead a public dialog.

Funding for this session was provided by sponsors of the meeting.

Speakers

- Christopher Schell, Ph.D., Assistant Professor, UC Berkeley
- Nyeema Harris, Ph.D., Knobloch Family Associate Professor of Wildlife and Land Conservation, Yale University
- Eliza Heery, Ph.D., Assistant Professor, UW Tacoma

Student Rapporteurs

- Corryn Knapp, M.S. student, San Francisco State University
- Tyler Hall, undergraduate student, UW Tacoma
- Matt Hess, M.S. student, San Jose State University
- Marlenne Ortega, undergraduate student and McNair Scholar, California State University Monterey Bay

PRESENTATIONS

Contributed Talks, Plenary and Symposia
The contributed talks will be held in concurrent sessions in different breakout rooms in the hotel.

- 15-minute talks include time for Q&A, unless the speaker uses all 15 minutes.
- 5-minute talks will have a multi-talk Q&A period approximately every 15 minutes.

Please exercise courtesy when moving between breakout rooms by opening/closing the doors quietly and only after the speaker has finished (i.e., after the applause).
Plenary and symposia will be held in large-capacity rooms, with an integrated Q&A period during or at end of scheduled time.

Posters
There will be two poster sessions Friday afternoon; each presenter will be assigned to one of the back-to-back poster sessions. The presenter will stand beside their poster during their assigned poster session, discuss their research, and answer questions about it. It is an opportunity to meet people interested in the work, exchange ideas about the project, and converse about other aspects of science. Judging for best student poster will take place throughout each session, and questions addressed to presenters constitute one of the criteria on which student posters are judged.

Presenters are requested to put up posters between 1 and 2 pm (for the first poster session) and during the break between poster sessions (for the second poster session).

SCHEDULE AT A GLANCE

THURSDAY, NOVEMBER 9, 2023

TIME	*EVENT INFORMATION*	*LOCATION*
1600-2000	Registration Desk Opens	***Regency Foyer***
1700-1900	STUDENT WORKSHOP *Reproducible coding in R: Reproducibility for Self & Others*	***Regency 1-3***
1900-2200	STUDENT MIXER *No-host at Hotel Bar*	***Sea Root Bar (no-host)***

FRIDAY, NOVEMBER 10, 2023

TIME	*EVENT INFORMATION*	*LOCATION*
0800-0810	MEETING WELCOME Secretariat & Diversity, Equity, and Inclusion Committee	***Regency Ballroom***
0810-0940	STUDENT ORGANIZED SYMPOSIUM (Chair: Ariadne Reynolds) *Research at the Intersection of restoration and commercial aquaculture*	***Regency Ballroom***
0940-1000	COFFEE BREAK	***Regency Foyer***
1000-1025	LIFETIME ACHIEVEMENT AWARD (Mark Hixon) *Scientific Life Lessons Learned* Nominator: Brian Tissot	***Regency Ballroom***
1025-1030	RAFE SAGARIN AWARD (Frankie Gerraty & Zoe Zilz)	***Regency Ballroom***
1030-1100	NATURALIST OF THE YEAR (Eric Sanford) *Building Natural History Skills Through Experiential Learning* Nominators: Jay Stachowicz & Rick Grosberg	***Regency Ballroom***
1100-1230	DEI SYMPOSIUM sponsored by CSU COAST *Safe and Inclusive Fieldwork;* Chair: Christina Vasquez	***Regency Ballroom***
1230-1400	MENTORSHIP MIXER sponsored by (CSU COAST)	***Spyglass***
1230-1430	BREAK FOR LUNCH (*not provided)*	
1330-1430	JEMBE SESSION: HOW TO PUBLISH A PAPER (please eat first)	***Big Sur***
1430-1545	POSTER SESSION I	***Foyers***
1545-1615	COFFEE BREAK	***Terrace or Foyer***
1615-1730	POSTER SESSION II	***Foyers***
1730-1815	BIPOC AFFINITY GROUP MIXER I* *Black, Indigenous, People of Color*	***Big Sur***
1815-1900	LGBTQIA2S+ AFFINITY GROUP MIXER II* *Lesbian, Gay, Bisexual, Transgender, Queer/Questioning, Intersex, Asexual, Two-spirit +*	***Cypress***
1830-2000	ATTITUDE ADJUSTMENT HOUR (AAH) (*heavy appetizers; cash bar)*	***Regency Ballroom***

*Affinity groups provide safe spaces for people with historically marginalized identities to gather, build community, and bolster a sense of belonging in WSN.
You must identify as a member of any affinity group that you intend to join.
WSN attendees are encouraged to participate in as many affinity groups as they identify with. Contact deic@wsn-online.org with questions.

SATURDAY, NOVEMBER 11, 2023

TIME	*EVENT INFORMATION*	*LOCATION*
0830-1000	PRESIDENTIAL SYMPOSIUM *Reshaping Landscapes: Urban Ecology Paving the Road to Equitable and Sustainable Cities* Chair: Bonnie Becker	***Regency Ballroom***
1000-1030	COFFEE BREAK	***Regency Foyer***
1030-1200	CONTRIBUTED TALKS (7 CONCURRENT SESSIONS)	***Regency Main, Reg 1-3, Reg 4-6, Cypress, Big Sur, Windjammer, Spyglass***
1200-1330	LUNCH (*not provided*)	
1200-1245	FIRST GEN AFFINITY GROUP MIXER III* *First Generation College Students - Past and Present*	***Big Sur Room***
1245-1330	DISABILITY AFFINITY GROUP MIXER IV* *People with medically or self-diagnosed conditions that impact their daily activities, including (but not limited to) physical abilities, neurodivergence, and chronic illness.*	***Cypress Room***
1330-1500	CONTRIBUTED TALKS (7 CONCURRENT SESSIONS)	***Regency Main, Reg 1-3, Reg 4-6, Cypress, Big Sur, Windjammer, Spyglass***
1500-1530	COFFEE BREAK	***Regency Foyer***
1530-1730	CONTRIBUTED TALKS (7 CONCURRENT SESSIONS)	***Regency Main, Reg 1-3, Reg 4-6, Cypress, Big Sur, Windjammer, Spyglass***
1745-1915	ANNUAL BUSINESS MEETING	***Big Sur Room***
1930-2130	BANQUET APPETIZERS (*provided)*	***Regency Ballroom***
2000-2030	PRESIDENTIAL ADDRESS WSN President: Bonnie Becker	***Regency Ballroom***
2100-2400	GALA: WSN AUCTION, GAMES, MUSIC, and ENTERTAINMENT Theme: *Study Organisms*	***Regency Ballroom***

SUNDAY, NOVEMBER 12, 2022

TIME	*EVENT INFORMATION*	*LOCATION*
0900-1030	CONTRIBUTED TALKS (7 CONCURRENT SESSIONS, including speed talk)	***Regency Main, Reg 1-3, Reg 4-6, Cypress, Big Sur, Windjammer, Spyglass***
1030-1100	COFFEE BREAK	***Regency Foyer***
1100-1230	CONTRIBUTED TALKS (7 CONCURRENT SESSIONS)	***Regency Main, Reg 1-3, Reg 4-6, Cypress, Big Sur, Windjammer, Spyglass***
1230-1300	BREAK	***Regency Foyer***
1300-1345	SPECIAL PLENARY SPEAKER *Between a Rock and Hot Place on Ocean Conservation* Catherine Drew Harvell	***Regency Ballroom***
1345	MEETING ADJOURNMENT	***Regency Ballroom***

OFFSITE FOOD

There are many great food options in the Monterey area, but not very many in walking distance. Most of Monterey's nightlife is centered around Alvarado St in downtown Monterey. Here are a few restaurant/market suggestions in order of how far they are from the venue.

East of the Hyatt (still Monterey but towards Seaside)

- Del Monte Bar and Grill (0.3 miles): Close and surprisingly not expensive restaurant at a golf course. Open 8am to 6pm daily.
- Monterey Pines Grill and Bar (0.9 miles): Another surprisingly not expensive restaurant at a golf course. Part of the navy but open to the public. Open 7am to 5pm daily.
- Monterey Cookhouse (1.0 miles): Diner food. Open 11:30 to 9pm/10pm Friday and Saturday.
- 3 Mundos Sandwich Shop (1.1 miles): Sandwiches. Open Mon - Fri 11am to 9pm. Sat/Sun 9am - 5pm.
- Bi-rite Market (1.2 miles): Market with fresh made sandwiches. Open 7am to 4:30pm. Closed on Sunday.
- Grandma's Kitchen (1.2 miles): Diner food. Open daily 7am to 8pm (9pm on Saturday)
- Safeway (1.5 miles): grocery store open 5am to 2am daily.

West of the Hyatt (towards downtown Monterey)

- Randy's Sandwich shop (0.3 miles): Hole-in-the-wall sandwich shop with breakfast options, chips, and sodas. **CASH ONLY**. Open 6:30am to 2pm, closed Saturday and Sunday.
- Ambrosia (1.2 miles): Indian food. Open daily for lunch: 11:30am to 2:45pm; dinner: 4pm to 9pm.
- Ocean Sushi (1.2 miles): Small sushi restaurant with made to order and pre-made food. Small dine-in area. Open 11:30am to 7pm Monday through Saturday.
- Trader Joes (1.2 miles): Open 8am to 9pm daily.
- Ikes sandwiches (1.2 miles): Right next to Trader Joes. Bay area chain sandwich shop, open 10am to 9pm daily.
- Alta Bakery: Bakery and coffee shop with a nice garden outdoor area. Open 7am to 4pm daily.
- Heirloom Pizza (1.3 miles): Deep dish and regular pizza. Open 5pm to 9pm.
- Midici Pizza (1.3 miles): Wood-fired pizza. Open weekdays 4pm to 11pm weekends 12pm to 1am.
- Pacific Bowls and Rolls (1.3 miles): Sushi and rice bowls. Open 11:30am to 7pm daily (8pm Friday and Saturday).
- Revival Ice cream (1.3 miles): Hipster ice cream. Open 12pm to 9pm daily.
- Old Monterey Cafe (1.3 miles): Small breakfast cafe. Open daily 6:45am to 2:30pm
- Papa Chanos (1.3 miles): fairly inexpensive Mexican food. Open daily 10am to 11pm.
- Bagel Bakery (1.3 miles): Bagel sandwiches, omelets on a bagel etc.
- Alvarado Brewing (1.4 miles): Local brewery with a full bar and restaurant. Open 11:30am to 10pm Daily (11pm Sat/Sun).
- Ad Astra (1.3 miles): Bakery with great bread and baked goods. Open 7am - 5pm daily.

WSN CODE OF CONDUCT

The annual meeting is intended to foster the exchange of scientific ideas, provide participants with an opportunity to present research findings, establish and renew collaborations, facilitate recruitment of students and staff to laboratories and institutions, and to learn, teach, and network with an international community of scientists. WSN is committed to creating an environment in which all attendees can participate without harassment, discrimination, or violence of any type.

All meeting participants must be treated with respect, regardless of race, ethnicity, gender identity, sexual orientation, ability, religion, language, professional status, institution, or age. All meeting participants including, but not limited to, members, volunteers, attendees, vendors, exhibitors, contractors, and guests are expected to abide by the WSN Code of Conduct, which applies to all events at the meeting, all meeting-related activities, and social media communications associated with WSN.

Expected behaviors include (but are not limited to):

- Treating all participants and meeting facilities with respect and consideration.
- Communicating openly with respect for others, critiquing ideas not individuals.
- Avoiding personal attacks directed toward others.
- Respecting the rules and policies of the meeting venue, hotels, or any venue.
- Abiding by principles of academic integrity and ethical professional conduct.

Unacceptable behaviors include (but are not limited to):

- Behaviors that imply or indicate that someone does not belong at the WSN meeting based on any personal characteristic or identity.
- Any unwanted attention, sexual advances, and comments about appearance.
- Verbal harassment, including comments, epithets, slurs, threats, and stereotyping that are offensive, hostile, disrespectful, or unwelcome.
- Non-verbal harassment, including actions or distribution, display, or discussion of any written or graphic material toward an individual or group that ridicules, denigrates, insults, belittles, or shows hostility, aversion, or disrespect.
- Bullying, intimidation, stalking, shaming, and assault.
- Retaliation for reporting harassment.
- Reporting an incident in bad faith.

Consequences: The WSN Secretariat reserves the right to enforce this Code of Conduct in any manner deemed appropriate. Violators will first be asked to cease these behaviors. Failure to comply may result in escalating consequences including expulsion from the meeting, prohibition from future meetings, or revocation of WSN membership.

Reporting: If you are the subject of unacceptable behavior or have witnessed any such behavior, please notify a member of the WSN Secretariat and/or Diversity, Equity, and Inclusion Committee (DEIC) either on-site or via email (secretariat@wsn-online.org; deic@wsn-online.org). You can also communicate violations by completing the online reporting form, which presents an opportunity for anonymity. Anyone experiencing or witnessing behavior that constitutes an immediate or serious threat to individual or public safety is advised to contact security or local law enforcement.

Contributed Talks

† eligible for Best Student Paper Award

Saturday 10:30 - 12:00

Time	Session 1: Applied Ecology I *Chair: Will White* Location: REGENCY 1-3	Session 2: Ecosystem Assessment *Chair: Mary Donovan* Location: REGENCY MAIN	Session 3: Population Biology and Ecology I *Chair: Tanya Rogers* Location: REGENCY 4-6	Session 4: Physiological Ecology I *Chair: Craig Norrie* Location: SPYGLASS	Session 5: Conservation and Restoration I *Chair: Sean Anderson* Location: BIG SUR	Session 6: Community Ecology I *Chair: Jarrett Byrnes* Location: CYPRESS
10:30 - 10:45	QUANTIFYING CORAL LOSS AND COMMUNITY CHANGE FROM CORAL BLEACHING USING UNDERWATER PHOTOGRAMMETRY AND AI-ASSISTED IMAGE SEGMENTATION **†Kopecky, K.L.**	THE EFFECTS OF DEAD-IN-PLACE POCILLOPORA CORALS ON CORAL REEF COMMUNITY STRUCTURE **Scafidi, K.C.**	TURNING UP THE HEAT ON MARINE TURTLE POPULATION DYNAMICS **†Quennessen, V.I.**	EFFECTS OF DAILY TEMPERATURE RANGE (DTR) AND THERMAL PRIMING ON ACQUIRED THERMAL RESISTANCE IN TROPICAL REEF CORALS **†Cheh, A.S.**	FRIEND OF FOE? EFFECT OF EELGRASS ON FILTER FEEDER BIOMASS AND CONDITION INDEX IN A MULTI-HABITAT LIVING SHORELINE **†Quintana, B.**	DOES URBANIZATION ALTER VERTEBRATE SCAVENGING ASSEMBLAGES AND ECOSYSTEM FUNCTIONS ON CALIFORNIA BEACHES? **†Gerraty, F.D.**
10:45 - 11:00	THE SMOKING BARNACLE – MARINE SCIENCE AS A FORENSIC TOOL IN SUBTIDAL CRIME SCENE INVESTIGATIONS **Morris, K.**	EDNA FISH FAUNAL ANALYSIS OF ESTUARINE MARINE PROTECTED AREAS IN CALIFORNIA **†Abrecht, M.**	POPULATION GENETICS OF THE MUSSEL *MYTILUS CALIFORNIANUS* IN BAJA CALIFORNIA, MEXICO **†Pérez-Salido, A.P.; Abadía-Cardoso, A.; García, V.; Crandall, E.; Schramm-Urrutia, Y.**	PACIFIC OYSTER PERFORMANCE UNDER MULTIPLE INTERACTING CLIMATE CHANGE STRESSORS **Norrie, C.R.**	CLIMATE CHANGE REDUCES LONG-TERM POPULATION BENEFITS FROM MARINE PROTECTED AREAS THROUGH SELECTIVE PRESSURES ON SPECIES MOVEMENT **†Caughman, A.C.**	SPATIOTEMPORAL DRIVERS OF PARROTFISH DISTRIBUTION AND THEIR IMPLICATIONS ON DYNAMIC HABITAT SHIFTS AROUND MOOREA, FRENCH POLYNESIA **Castañeda, N.**
11:00 - 11:15	CHARACTERIZING EXPOSURE OF CA MPAS TO PROJECTED MID AND END OF CENTURY CLIMATE CONDITIONS **†Sridhar, N.**	DISCONTIGUOUS REEF FEATURES MAY PROVIDE REFUGIA FOR GIANT KELP AMONG PURPLE URCHIN AGGREGATIONS **†Leggett, T.**	MODELING THE EFFECTS OF DISPERSAL AND SCALE ON TICK-BORNE PATHOGEN RISK IN HETEROGENEOUS ENVIRONMENTS **†Freedman, A.S.**	EFFECTS OF MARINE HEAT WAVE CONDITIONS AND FOOD AVAILABILITY ON PURPLE SEA URCHINS **†Munstermann, M.J.**	EXPLORATIONS OF PLACE THROUGH MARINE SCIENCE, LITERATURE, HISTORY, AND ART ABOARD THE HISTORIC *WESTERN FLYER* **Mostow, R.S.**	NON-CONCURRENT CLIMATE INDUCED RANGE MOVEMENT IN HERBIVORE AND PRIMARY PRODUCER **†Cortese, M.R.**
11:15 - 11:30	LINKS BETWEEN DEFINING OCEAN CLIMATE VARIABILITY AND THE RESILIENCE OF FISHED POPULATIONS ACROSS MULTIPLE TIME SCALES **White, J.W.**	EFFECTS OF THERMAL STRATIFICATION ON KELP FOREST PERSISTENCE AND THEIR COMMUNITIES ON CATALINA ISLAND **†Villanueva, A.X.**	PARASITE PIONEERS: A LOTERÍA GAME PROVIDING PARASITE EDUCATION TO CHILDREN **†Stroumza, A.**	EFFECTS OF NUTRIENT AVAILABILITY ON THE THERMAL OPTIMA AND SENSITIVITIES OF GALÁPAGOS SEAWEEDS **†Capone, H.E.**	REFRESHING MITIGATION: GUIDANCE FOR IMPROVING FUTURE OUT-OF-KIND RESTORATION ACROSS CALIFORNIA'S COASTAL ZONE **Anderson, S.S.**	OH SH**T! I FORGOT TO MEASURE THAT! COPING WITH OMITTED VARIABLE BIAS FOR THE CAUSAL ANALYSIS OF OBSERVATIONAL DATA **Byrnes, J.E.K.**
11:30 - 11:45	CONSEQUENCES OF JAPANESE EELGRASS ESTABLISHMENT FOR MANILA CLAMS IN PUGET SOUND, WASHINGTON **†Griffin, J.E.**	REMOTELY OPERATED VEHICLES (ROVS) IN BULL KELP FORESTS - AN OPEN-SOURCE BENTHIC SURVEY METHODOLOGY WITH AN EYE TOWARDS AUTONOMOUS OPERATIONS **Randell, Z.**	EVALUATING OFFSHORE WIND FARMS AS OTHER EFFECTIVE CONSERVATION MEASURES AND THEIR IMPLICATIONS FOR FISHERIES MANAGEMENT **†Campbell, M.C.; White, W.; Samhouri, J.**	THERMAL PLASTICITY HAS HIGHER FITNESS COSTS IN MORE THERMALLY TOLERANT FAMILIES OF TIGRIOPUS CALIFORNICUS **Bogan, S.**	COMPARISON OF FISH RECRUITMENT ON AN ARTIFICIAL REEF AND ADJACENT NATURAL REEFS **†Huang, J.L.**	THE INFLUENCE OF MARINE PROTECTED AREAS ON THE DIETARY NICHES OF CALIFORNIA REEF FISHES **†Gutterman, M.E.**

Time	Session 1: Applied Ecology I *Chair: Will White* Location: REGENCY 1-3	Session 2: Ecosystem Assessment *Chair: Mary Donovan* Location: REGENCY MAIN	Session 3: Population Biology and Ecology I *Chair: Tanya Rogers* Location: REGENCY 4-6	Session 4: Physiological Ecology I *Chair: Craig Norrie* Location: SPYGLASS	Session 5: Conservation and Restoration I *Chair: Sean Anderson* Location: BIG SUR	Session 6: Community Ecology I *Chair: Jarrett Byrnes* Location: CYPRESS
11:45 - 12:00	INVESTIGATING THE THERMAL RESPONSE OF PARASITIC DISEASE WITH ECTOTHERMIC INTERMEDIATE HOST IN THE ERA OF GLOBAL WARMING **†Aslan, I.H.**	ROLE OF HERBIVOROUS REEF FISHES IN RESILIENCE-BASED MANAGEMENT **Donovan, M.K.**	CHAOS IS NOT RARE IN NATURAL ECOSYSTEMS **Rogers, T.L.**	MAKING SENSE OF THE ARMS RACE: INTEGRATED ANALYSIS OF PHENOTYPIC PLASTICITY DURING ECHINOID LARVAL DEVELOPMENT **Pace, D.A.**	RECENT HEATWAVE SHIFTS CORAL REEF COMMUNITIES IN UNEXPECTED WAYS **†Swaminathan, S.D.**	REDUCTION OF TOP-DOWN CONTROL RESULTS IN DISSIMILARITY IN COMMUNITY COMPOSITION AND ALTERNATIVE PATHS LEADING TO CORAL- OR ALGAL-DOMINANCE ON A CORAL REEF **Speare, K.E.**

Contributed Speed Talks

† eligible for Best Student Paper Award

Saturday 10:30 - 12:00

Time	Session 7: Speed Talk General Session I *Chair: Chris Harley* Location: WINDJAMMER
10:30 - 10:35	WASHINGTON STATE ACIDIFICATION NEARSHORE MONITORING NETWORK (ANEMONE): COMMUNITY SCIENCE, EDUCATION, AND WORKFORCE DEVELOPMENT **Anderson, K.N.**
10:35 - 10:40	MOVEMENT OF WEANED NORTHERN ELEPHANT SEAL PUPS DURING THEIR FIRST AT-SEA FORAGING MIGRATION **†Saenger, K.**
10:40 - 10:45	STORYTELLING AND ETHICS IN SCIENCE: LESSONS FROM LIVING AND LEARNING IN FORT BRAGG, CA **†Blundell, M.Z.**
10:45 - 10:50	Q&A PERIOD
10:50 - 10:55	WHEN THEY GO LOW, WE GO HIGH: A TIDAL HEIGHT COMPARISON OF OYSTER CARDIAC AND GAPE ACTIVITY **†Kalbach, G.M.**
10:55 - 11:00	UTILIZING CORALNET FOR UNDERSTORY KELP SPECIES AND SUBSTRATE TYPE DETECTION IN ELLIOTT BAY, WA: A CLASSIFIER TRAINING APPROACH **Williams, M.**
11:00 - 11:05	USING HYDROACOUSTICS TO EXAMINE THE RELATIONSHIP BETWEEN THE VERTICAL DISTRIBUTION OF FISH AND ENVIRONMENTAL FACTORS **†Diaz, L.C.**
11:05 - 11:10	Q&A PERIOD
11:10 - 11:15	THERMAL REFUGIA ARE BEING LOST AS CONTROL OF INTERTIDAL ZONATION SHIFTS FROM EMERSION TIME TO THERMAL STRESS **Harley, C.**
11:15 - 11:20	EFFECTS OF TEMPERATURE ON THE GROWTH RATE AND SETTLEMENT OF OLYMPIA OYSTER (OSTREA LURIDA) LARVAE **†Rodman, C.C.**
11:20 - 11:25	WHY ARE COCONUT CRABS (BIRGUS LATRO L.) SMALLER AND RARER IN COCONUT PLANTATIONS ON A PACIFIC ATOLL? **†Burnett, M.W.**
11:25 - 11:30	Q&A PERIOD
11:30 - 11:35	HEAT STRESS: CHANGING DISTRIBUTION OF FUCUS EVANESCENS & FUCUS GARDNERI IN THE ALASKAN INTERTIDAL **†Bower, E.H.; Valladares, S.**
11:35 - 11:40	INVESTIGATING IMPACTS OF MARINE HEATWAVES ON A PRIMARY DRIVER OF KELP FOREST RECOVERY AND DECLINE: STRONGYLOCENTROTUS PURPURATUS **†McDonald, A.M.**
11:40 - 11:45	NORTHERN SEA OTTER (ENHYDRA LUTRIS KENYONI) POPULATION AND FORAGING ANALYSIS IN WASHINGTON STATE **Olsen, A.Y.**
11:45 - 11:50	USE OF A CALIFORNIA WETLAND: HARBOR SEAL (PHOCA VITULINA) HAUL-OUT PATTERNS IN ELKHORN SLOUGH **†Nicholson, E.H.**
11:50 - 11:55	Q&A PERIOD
11:55 - 12:00	Q&A PERIOD

Contributed Talks

† eligible for Best Student Paper Award

Saturday 13:30 - 15:00

Time	Session 8: Applied Ecology II *Chair: Katie Cieri* Location: REGENCY 1-3	Session 9: Special Session: Marine disease ecology in a changing world I *Chair: Olivia Graham* Location: REGENCY MAIN	Session 10: Population Biology and Ecology II *Chair: Will White* Location: REGENCY 4-6	Session 11: Physiological Ecology II *Chair: Aaron Galloway* Location: SPYGLASS	Session 12: Conservation and Restoration II *Chair: Kate Thomas* Location: BIG SUR	Session 13: Community Ecology II *Chair: Corey Garza* Location: CYPRESS
13:30 - 13:45	BRINGING MARINE HEATWAVES INTO THE LAB: HOW TO ENGINEER HEATING EVENTS IN AN EXPERIMENTAL SETTING **†Ritger, A.L.**	MARINE HERBIVORES FACILITATE TRANSMISSION OF A SEAGRASS PATHOGEN **Graham, O.J.**	LOCAL ADAPTATION OF THERMAL SENSITIVITY IN POPULATIONS OF CALIFORNIA GRUNION. IMPLICATIONS FOR RESILIENCE IN A WARMING OCEAN **†Lundquist, A.J.; Johnson, D.W.**	CHARACTERIZING THE EFFECTS OF MULTIPLE STRESSORS ON THE PHYSIOLOGY OF BERING SEA SNOW CRAB **Bacus, S.C.**	DRIVERS OF MACROALGAE RESILIENCE AND REASSEMBLY IN NEARSHORE CORAL REEFS **†Gallagher, J.P.**	AN ENERGY CRUNCH HYPOTHESIS TO EXPLAIN THE COLLAPSE OF MUSSEL BEDS IN THE SOUTHERN CALIFORNIA BIGHT **Garza, C.**
13:45 - 14:00	MOLECULES IN PREDATOR URINE ENHANCE SURVIVAL OF A KEY ECOSYSTEM ENGINEER **Belgrad, B.**	CONTRIBUTION OF THE MICROBIOME TO EELGRASS WASTING DISEASE **Maher, R.L.**	SIGNS OF RESILIENCE: SURVIVORSHIP AND GROWTH OF CORALS IN HAWAIʻI TWO YEARS POST-BLEACHING **†Winston, M.**	UPTAKE AND EXPORT OF NITROGEN BY MACROSYSTIS HOLDFASTS **†Hess, M.H.**	LIMITED GENOMIC EVIDENCE FOR POPULATION COLLAPSE IN THE CRITICALLY ENDANGERED BLACK ABALONE (HALIOTIS CRACHERODII) **Wooldridge, T.B.**	EXPLORING MOBILE PREDATOR DIETS AS A PATHWAY FOR REEF-PELAGIC CONNECTIVITY **†Arnoldi, N.S.**
14:00 - 14:15	EFFECTS OF OYSTER AQUACULTURE ON ELASMOBRANCH ABUNDANCE AND HABITAT USE IN A LARGE COASTAL ESTUARY **†Harman, R.M.**	DO OYSTERS REDUCE OR INCREASE TRANSMISSION OF EELGRASS WASTING DISEASE? **Alma, L.**	IS IT A SIMPLE NORTHWARD MARCH WITH CLIMATE CHANGE? EVIDENCE FOR MULTIPLE LONG-DISTANCE COLONIZATION EVENTS OF KELLET'S WHELK BEYOND THE HISTORIC RANGE **López, C.**	STUNTED GROWTH IN JUVENILE DUNGENESS CRABS EXPOSED TO RAPID, INTENSE UPWELLING EVENTS **†Walker, B.J.**	CAN CORALLINE ALGAE HABITAT BOLSTER THE CLIMATE RESILIENCE OF WASHINGTON'S ENDANGERED PINTO ABALONE? **†Bates, E.H.**	THE RELATIONSHIP BETWEEN HABITAT FRAGMENTATION AND CORAL DIVERSITY IN MOOREA, FRENCH POLYNESIA, AND ST. JOHN, US VIRGIN ISLANDS **†Dahl, A.**
14:15 - 14:30	TOP-DOWN CONTROL OF INVASIVE EUROPEAN GREEN CRABS BY SOUTHERN SEA OTTERS IN CENTRAL CALIFORNIA **Jeppesen, R.**	SCALED MODELS OF EELGRASS WASTING DISEASE: FROM LEAVES TO MEADOWS **Hofmann, E.E.; Groner, M.L.**	WE'RE HAVING A HEATWAVE! TURNING UP THE HEAT TURNS DOWN THE CALORIES IN CRANGON SHRIMP **†Zuelow, A.N.**	COMPARATIVE GENOMICS AND TRANSCRIPTOMICS OF MARINE INTERTIDAL (FAMILY STICHAEIDAE) PRICKLEBACKS TO BETTER UNDERSTAND DIETARY DIVERSITY **Heras, J.**	LONG-TERM MONITORING FROM THE *WESTERN FLYER*, A RESTORED FISHING VESSEL WITH A LITERARY PAST **Thomas, K.N.**	EXPLORING THE ROLE OF SEX-BASED DIFFERENCES IN TROPHIC INTERACTIONS: THE CASE OF KELP FORESTS **Gissi, E.**
14:30 - 14:45	COMPOSITION AND DISTRIBUTION OF FISH ASSEMBLAGES IN CAP DE CREUS NATURAL PARK IN RELATION TO DEPTH AND LEVELS OF MARINE PROTECTION **†Cieri, K.P.**	EELGRASS WASTING DISEASE MAPPING USING UAVS: A SEASCAPE-SCALE PREDICTIVE APPROACH **Yang, B.**	ECOLOGICAL SUCCESS OF NO-TAKE MARINE PROTECTED AREAS: A GLOBAL META-ANALYSIS INFORMED BY POPULATION DYNAMICS THEORY **Hopf, J.**	MITIGATING OCEAN ACIDIFICATION IN SHELLFISH-AQUACULTURE: THE STORY OF AN ABALONE AND SEAWEED CO-CULTURE **†Kolander, N.R.**	WAVE, LIGHT, AND DISSOLVED OXYGEN EXPOSURES DRIVE NOVEL COASTAL EELGRASS (ZOSTERA PACIFICA) TRANSPLANT PERFORMANCE **†Sanders, R.**	CHARACTERIZING THE IMPACT OF NUTRIENT ENRICHMENT ON ORGANIC MATTER EXUDATES OF REEF-BUILDING CORAL AND MACROALGAE **†Mullenmeister, C.A.**

Time	Session 8: Applied Ecology II *Chair: Katie Cieri* Location: REGENCY 1-3	Session 9: Special Session: Marine disease ecology in a changing world I *Chair: Olivia Graham* Location: REGENCY MAIN	Session 10: Population Biology and Ecology II *Chair: Will White* Location: REGENCY 4-6	Session 11: Physiological Ecology II *Chair: Aaron Galloway* Location: SPYGLASS	Session 12: Conservation and Restoration II *Chair: Kate Thomas* Location: BIG SUR	Session 13: Community Ecology II *Chair: Corey Garza* Location: CYPRESS
14:45 - 15:00	ECOLOGICAL IMPACTS OF THE INVASIVE EUROPEAN GREEN CRAB (CARCINUS MAENAS) IN WASHINGTON **Rubinoff, B.**	FIRST RARE, THEN EVERYWHERE: UNCOVERING THE DIVERSITY AND ECOLOGICAL ROLE OF SEAGRASS-ASSOCIATED PHYTOMYXID PARASITES **†Kolátková, V.**	GENOMIC PATTERNS OF POPULATION STRUCTURE IN OCHRE SEA STARS CHALLENGE PREVIOUS REPORTS OF RANGE-WIDE PANMIXIA **†Duffin, P.J.**	BENTHIC MARINE INVERTEBRATE HERBIVORES DIVERSIFY THEIR ALGAL DIETS IN WINTER WHEN KELPS ARE SCARCE **Galloway, A.W.E.**	IMPACTS OF OVERFISHING ON CROWN-OF-THORNS STARFISH (COTS) PREDATORS: EFFECTS ON REEF HEALTH, ABUNDANCE, AND DIVERSITY OF COTS **†Schireson, I.L.; Wu, N.C.; Lyell, D.J.; White, C.**	EXPLORING MULTITROPHIC STABILITY IN MARINE ECOSYSTEMS **†Srednick, G.**

Contributed Speed Talks

† eligible for Best Student Paper Award

Saturday 13:30 - 15:00

Time	Session 14: Speed Talk General Session II
	Chair: Gretchen Hofmann
	Location: WINDJAMMER
13:30 - 13:35	THERMAL BREADTHS OF NATIVE VERSUS INTRODUCED SPECIES OF MARINE SNAILS **†Rivlin, N.D.**
13:35 - 13:40	USING LOCAL ECOLOGICAL KNOWLEDGE TO IDENTIFY CLIMATE CHANGE COPING STRATEGIES UTILIZED BY SMALL-SCALE FISHERS IN WESTERN NAYARIT **†Hori, A.**
13:40 - 13:45	UTILIZING FUNCTIONAL TRAITS TO UNDERSTAND FOUNDATION SPECIES FACILITATION ACROSS A BIOGEOGRAPHIC GRADIENT **†Heineke, M.R.**
13:45 - 13:50	Q&A PERIOD
13:50 - 13:55	EVALUATING SUCCESS OF EXPERIMENTAL BULL KELP RESTORATION IN PUGET SOUND **†Martinson, I.N.**
13:55 - 14:00	SUNFLOWER SEA STAR EFFECTS ON LOCALIZED GRAZER DENSITY IN SITKA SOUND, ALASKA **†Rough, M.E.**
14:00 - 14:05	TESTING FOR LOCAL ADAPTATION BETWEEN 2 POPULATIONS OF OLYMPIA OYSTERS IN CENTRAL CALIFORNIA **BuyanUrt, B.**
14:05 - 14:10	Q&A PERIOD
14:10 - 14:15	LONG TERM MONITORING ON NORTHEAST PACIFIC ROCKFISH, SEBASTES SPP., HOW LONG IS LONG ENOUGH TO TRACK SIGNIFICANT CHANGES IN ABUNDANCE AND DIVERSITY AFTER FISHERY RESTRICTIONS? **Larson, S.E.**
14:15 - 14:20	THE ROLE OF NATURE AND EQUITY IN PLANNING FOR A RESILIENT COAST **Wallingford, P.D.**
14:20 - 14:25	IT'S HOT ON THE BOTTOM TOO: MARINE HEATWAVES AND PHENOLOGY OF LIFE HISTORIES OF BENTHIC MARINE ORGANISMS **Hofmann, G.E.**
14:25 - 14:30	Q&A PERIOD
14:30 - 14:35	Q&A PERIOD
14:35 - 14:40	SUCCESSFUL PARTNERSHIPS REMOVING PURPLE URCHINS IN SONOMA COUNTY **Contolini, G.**
14:40 - 14:45	INVESTIGATING THE MECHANISMS THAT FACILITATE SPECIES INVASIONS IN A RECENTLY INTRODUCED SEA ANEMONE **†Monuki, K.**
14:45 - 14:50	Q&A PERIOD
14:50 - 14:55	Q&A PERIOD
14:55 - 15:00	Q&A PERIOD

Contributed Talks

† eligible for Best Student Paper Award

Saturday 15:30 - 17:30

Time	**Session 15: Special Session: Honoring Ted Grosholz** *Chair: Brian Cheng* Location: REGENCY 1-3	**Session 16: Special Session: Marine disease ecology in a changing world II** *Chair: Maya Groner* Location: REGENCY MAIN	**Session 17: Reproduction, Dispersal, and Recruitment** *Chair: Darren Johnson* Location: REGENCY 4-6	**Session 18: Special Session: Kelp Research and Restoration in Along the West Coast I** *Chair: Pike Spector* Location: SPYGLASS	**Session 19: Conservation and Restoration III** *Chair: Sara Worden* Location: BIG SUR	**Session 20: Community Ecology III** *Chair: Lia Domke* Location: CYPRESS	**Session 21: Intertidal Ecology I** *Chair: Maria Christina Vasquez* Location: WINDJAMMER
15:30 - 15:45	THE LONG AND THE SHORT OF IT: HONORING TED GROSHOLZ **Cheng, B.S.**	EPIDEMIOLOGY OF PROLIFERATIVE KIDNEY DISEASE IN AN OREGON SALMONID HATCHERY **†Das, N.**	USING GENETIC TOOLS TO ASSESS THE RELATIONSHIP BETWEEN MARINE PARASITE TRANSMISSION STRATEGY AND DISPERSAL CAPACITY **†Barton, R.L.**	TROPHIC CASCADES IN MARINE PROTECTED AREAS DRIVE DIFFERENCES IN KELP FOREST RESILIENCE TO MARINE HEATWAVES **†Kumagai, J.A.**	MARINE RESERVES ENHANCE RECOVERY OF SOME COMMERCIAL SPECIES FROM MARINE HEATWAVES **Olguín-Jacobson, C.**	CHEMICAL WARFARE ON TEMPERATE REEFS: REVEALING THE INHIBITORY EFFECTS OF TURF ALGAE ON KELP FOREST RECOVERY **†Farrell, S.**	AT A CLAM'S PACE: EXPLORING THE RECOVERY AND SPATIAL DISTRIBUTION OF PISMO CLAMS (TIVELA STULTORUM) ON PISMO BEACH, CALIFORNIA **†Bills, M.**
15:45 - 16:00	RENAISSANCE ECOLOGIST: THE RESEARCH CAREER AND INFLUENCE OF TED GROSHOLZ **Kimbro, D.L.**	METATRANSCRIPTOMICS REVEALS A VIRAL COMMUNITY SHIFT AND TUMORIGENESIS RESPONSE TO SCOMBRID AQUACULTURE DISEASE **†Leidholt, S.L.**	DECADAL VARIABILITY IN CORAL RECRUITMENT ON SETTLEMENT TILES ON PALMYRA ATOLL FROM 2011-2022 AND ITS RELATION TO THE NEARBY ENVIRONMENT **†Romero, S.L.**	COMMERICAL KELP HARVESTING IN CALIFORNIA **Flores Miller, R.E.**	CRYOPRESERVATION OF THE COLLECTOR URCHIN, TRIPNEUSTES GRATILLA **Westbrook, C.E.**	CORAL-SPONGE INTERACTIONS: BUILDING FENCES AND HAVING NEIGHBORS FOR LUNCH **†Schull, S.**	THE POPULATION IMPACTS OF TWO RANGE-EXPANDING PREDATORS ALONG THE NORTHEAST PACIFIC COAST **†Beshai, R.A.**
16:00 - 16:15	"YOUR SENSE OF SCALE HAS BEEN COMPLETELY BLOWN" AND OTHER OBSERVATIONS: A TED TALK ON A MENTOR'S INFLUENCE **Chang, A.L.**	HISTORIC OVERHARVEST OF MARINE DETRITIVORES MAY INCREASE CORAL DISEASE ON MODERN REEFS **Clements, C.S.**	IT'S ALL A BIG MISTAKE: LARVAL ERRORS AND THE FORMATION OF NEW AGGREGATIONS OF THE SERPULID ANNELID FICOPOMATUS ENIGMATICUS **Mendelson, A.**	KELP FOREST REFORESTATION PROGRAM IN BAJA CALIFORNIA **Beas-Luna, R.**	DEVELOPING AN INDIGENOUS-LED MONITORING AND RESPONSE PROGRAM FOR INVASIVE EUROPEAN GREEN CRAB ON HAIDA GWAII **Brown, A.**	INTERCONNECTEDNESS OF CORAL AND MICROBIOME ECOLOGICAL MEMORY DURING REPEATED MARINE HEATWAVES **†Vompe, A.D.**	SITE SPECIFIC OSMOTIC TOLERANCE OF THE MUSSEL MYTILUS GALLOPROVINCIALIS IN FLUCTUATING SALINITY ENVIRONMENTS **Vasquez, M.C.**

Time	**Session 15: Special Session: Honoring Ted Grosholz** *Chair: Brian Cheng* Location: REGENCY 1-3	**Session 16: Special Session: Marine disease ecology in a changing world II** *Chair: Maya Groner* Location: REGENCY MAIN	**Session 17: Reproduction, Dispersal, and Recruitment** *Chair: Darren Johnson* Location: REGENCY 4-6	**Session 18: Special Session: Kelp Research and Restoration in Along the West Coast I** *Chair: Pike Spector* Location: SPYGLASS	**Session 19: Conservation and Restoration III** *Chair: Sara Worden* Location: BIG SUR	**Session 20: Community Ecology III** *Chair: Lia Domke* Location: CYPRESS	**Session 21: Intertidal Ecology I** *Chair: Maria Christina Vasquez* Location: WINDJAMMER
16:15 - 16:30	CHELA & TED'S EXCELLENT ADVENTURE OR THE PORTFOLIO APPROACH: A WAY FORWARD FOR RESTORATION OF NATIVE OYSTERS IN A DYNAMIC, URBAN ESTUARY **Zabin, C.**	EFFECTS OF MICROBES ON HERBIVORY IN CORAL REEFS AND CONSEQUENCES FOR REGIME SHIFTS **Briggs, A.A.**	INTERACTIONS BETWEEN LIFE HISTORY TRAITS OF MARINE FISH RESULT IN AT LEAST ONE MODERATE MOVEMENT EXTENT ACROSS LIFE STAGES **†Rosenberg, E.J.**	SPORA: CHALLENGES AND OPPORTUNITIES FOR KELP RESTORATION IN BAJA CALIFORNIA, MEXICO **Paz-Lacavex, A.**	STOCKING THE BROOD STOCK: UTILIZING MICROBIOLOGY TO ENHANCE ASSISTED EVOLUTION RESTORATION TECHNIQUES **†Nixon, E.N.**	A TRAIT BASED APPROACH FOR SEAWEEDS MAY PROVIDE AN ALTERNATIVE METHOD FOR QUANTIFYING ANTHROPOGENIC STRESSORS ON TROPICAL REEFS **†Alexander, J.; Galindo-Salazar, Y.**	LIMPET IDENTIFICATION AND MISIDENTIFICATION IN THE INTERTIDAL ZONE OF HOPKINS MARINE STATION **†Passmore, M.R.M.**
16:30 - 16:45	HOW'S IT GOING ACE? BALANCING ACADEMIC SUCCESS AND PERSONAL GROWTH IN THE NEXT GENERATIONOF ECOLOGISTS **Wigginton, R.D.**	SYMBIOSIS PROVIDEDS RESILIENCE TO BACTERIAL PATHOGENESIS BY REDUCING OXIDATIVE STRESS WITH GLUCOSE METABOLISM IN SEA ANEMONE AIPTASIA **Grewelle, R.E.**	GERMLINE STEM CELL COMPETITION IN A MARINE TUNICATE: A REPRODUCTIVE MECHANISM HIGHLIGHTING NATURAL SELECTION AT THE CELLULAR SCALE **Levy, T.**	THE SPORE SOLUTION: ENHANCING KELP FOREST RECOVERY THROUGH MEIOSPORE TRANSLOCATION **Carpenter, E.G.**	INFORMING 3D PRINTING DESIGNS THROUGH DATA COLLECTION TO PROMOTE CORAL RECRUITMENT **†Muñoz-Maravilla, J.D.**	ARE DIVERSE BIOLOGICAL COMMUNITIES MORE RESISTANT TO INVASION? A CASE STUDY WITH MARINE INVERTEBRATE FOULING COMMUNITIES **†Bruntil, T.R.**	FIELD ACCLIMATIZATION OF ADULTS INFLUENCES OFFSPRING PERFORMANCE IN THE ROCKY INTERTIDAL MUSSEL, MYTILUS CALIFORNIANUS **†Chamorro, J.D.**
16:45 - 17:00	TRANSLATING TED'S WISDOM **Hollarsmith, J.**	WHAT DOESN'T KILL YOU MAKES YOU STRONGER? POTENTIAL FOR SELECTED WITHERING SYNDROME RESISTANCE IN ENDANGERED WHITE ABALONE **†Deutsch, A.A.**	DEVELOPING PURPLE HINGED ROCK SCALLOPS (CRASSEDOMA GIGANTEA) FOR AQUACULTURE BY OPTIMIZING AERATION AND FEED CONCENTRATION IN THE HATCHERY. **Kim, A.**	BIOMARKERS OF RECOVERY: A CASE STUDY OF HOW PRIMARY CONSUMERS ASSIMILATE AND PARTITION ENHANCED NUTRITION FOLLOWING KELP FOREST RESTORATION. **†SPINDEL, N.B.**	ENVIRONMENTAL JUSTICE IN ECOSYSTEM RESTORATION FRAMEWORKS **†Clemens, J.**	TRAIT-MEDIATED EFFECTS OF CLEANING MUTUALISMS ON CORAL REEF HERBIVORY **†Cryan, D.M.**	THE INTERACTION OF *PISASTER* PREDATORS AND ENVIRONMENTAL STRESSORS DRIVING PREY DISTRIBUTIONS IN A ROCKY INTERTIDAL BOULDER FIELD **†Rothman, B.; Dickens, J.; Garza, C.; Morgan, S.; Gravem, S.**
17:00 - 17:15	DIVERSE COLLABORATIONS, DIE-HARD MENTORSHIP, AND UNAPOLOGETIC ADVOCACY: HALLMARKS OF TED GROSHOLZ'S CAREER **Ridlon, A.D.**	Q&A PERIOD	COMPARISONS OVER SPACE AND TIME: HOW HAS 20 YEARS OF WARMING AFFECTED THE REPRODUCTION AND SETTLEMENT OF SEMIBALANUS BALANOIDES? **†Weinstock, J.B.**	THE ROLE OF DYNAMIC KELP FOREST-URCHIN TRANSITION ZONES FOLLOWING A DEFORESTATION EVENT **†Correa De Souza, V.B.**	HOW GRAZING AND HABITAT COMPLEXITY IMPACT BIODIVERSITY AND ECOSYSTEM FUNCTIONING ON SEAWALLS **†Knapp, C.L.**	SEASCAPE HETEROGENEITY INFLUENCES ALASKAN EELGRASS FISH COMMUNITIES **†Domke, L.K.**	WILL CLIMATE WARMING AMPLIFY THE COMPETITIVE AND PREDATORY EFFECTS OF A RANGE-EXPANDING MARINE GASTROPOD? **†McCann, B.N.**

Time	Session 15: Special Session: Honoring Ted Grosholz *Chair: Brian Cheng* Location: REGENCY 1-3	Session 16: Special Session: Marine disease ecology in a changing world II *Chair: Maya Groner* Location: REGENCY MAIN	Session 17: Reproduction, Dispersal, and Recruitment *Chair: Darren Johnson* Location: REGENCY 4-6	Session 18: Special Session: Kelp Research and Restoration in Along the West Coast I *Chair: Pike Spector* Location: SPYGLASS	Session 19: Conservation and Restoration III *Chair: Sara Worden* Location: BIG SUR	Session 20: Community Ecology III *Chair: Lia Domke* Location: CYPRESS	Session 21: Intertidal Ecology I *Chair: Maria Christina Vasquez* Location: WINDJAMMER
17:15 - 17:30	MANAGING A BENTHIC ECOLOGY LAB WITH TWENTY-FIVE YEARS OF SPINELESS LEADERSHIP **Grosholz, E.D.**	Q&A PERIOD	BORN LOSERS: ADAPTIVE INACCURACY AND THE TYPE III SURVIVORSHIP CURVE **Johnson, D.W.**	CHANGES IN PLANT DEMOGRAPHICS INFLUENCED BY DISTURBANCE DRIVE INTERANNUAL VARIABILITY IN GIANT KELP NET PRIMARY PRODUCTION **†Beckley, B.A.**	ADAPTIVE MANAGEMENT IN ACTION: RESULTS AND RECOMMENDATIONS FROM THE FIRST EVALUATION OF CALIFORNIA'S MARINE PROTECTED AREA NETWORK **Worden, S.E.**	EXPLORING THE MECHANISMS OF EMERGENT COMMUNITY SHIFTS ALONG A CO_2 GRADIENT **†Palmisciano, M.**	SPAWNED FROM THE INTERTIDAL: THE REPRODUCTIVE PATTERN OF PURPLE SEA URCHINS **†Martinez, C.; Haberman, I.; Haupt, A.J.**

Contributed Talks

† eligible for Best Student Paper Award

Sunday 09:00 - 10:30

Time	**Session 22: Behavioural Ecology I** *Chair: Aaron Ninokawa* Location: REGENCY 1-3	**Session 23: Special Session: Marine disease ecology in a changing world III** *Chair: Drew Harvell* Location: REGENCY MAIN	**Session 24: Special Session: Restorative Aquaculture** *Chair: Kevin Travis & Priya Shukla* Location: REGENCY 4-6	**Session 25: Special Session: Kelp Research and Restoration in Along the West Coast II** *Chair: Kristen Elsmore* Location: SPYGLASS	**Session 26: Conservation and Restoration IV** *Chair: Julia Kobelt* Location: BIG SUR	**Session 27: Community Ecology IV** *Chair: David Jacobs* Location: CYPRESS	**Session 28: Intertidal Ecology II** *Chair: Michael Dawson* Location: WINDJAMMER
09:00 - 09:15	SEASONAL MIGRATION OF JUVENILE WHITE SHARKS ACROSS THE CALIFORNIAS **†Castillo-Heredia, A.**	USING THE PAST AND PRESENT GENOMIC SEASCAPE OF SEA STARS TO CONTEXTUALIZE FUTURE IMPACTS IN A CHANGING WORLD **Schiebelhut, L.M.**	WHAT IS RESTORATIVE AQUACULTURE **Gardner, L.D.**	EFFECTS OF STOCKING DENSITY ON MORPHOMETRICS AND REPRODUCTIVITY OF AQUACULTURE GROWN *NEREOCYSTIS LUETKEANA* FOR SORAL PRODUCTION **†Bugbee, B.M.**	PHYSIOLOGICAL AND CRYOPRESERVATION RESEARCH AS A PATH TO ENHANCING WHITE ABALONE CAPTIVE PRODUCTION **Ashlock, L.W.**	TURBINARIA ORNATA, AN EMERGENT FOUNDATION SPECIES OF SOUTH PACIFIC CORAL REEFS, SHIFTS ECOLOGICAL STRATEGIES OF ASSOCIATED ALGAE. **†Hannibal, K.N.**	DISTRIBUTION CHANGES IN INTERTIDAL FOUNDATION SPECIES ARE DRIVEN BY INCREASED TEMPERATURES **†Hansen, R.L.G.**
09:15 - 09:30	BEHAVIORAL THERMOREGULATION UNDER CHRONIC AND ACUTE HEAT STRESS IN SOUTHERN CALIFORNIA INTERTIDAL NUDIBRANCHS **†Munoz, L.**	GENE EXPRESSION PROFILES IN PYCNOPODIA HELIANTHOIDES EXPOSED TO SEA STAR WASTING DISEASE **†Crandall, G.A.**	ROLE OF THE AQUACULTURE INDUSTRY IN THE RESTORATION OF CALIFORNIA KELP SYSTEMS **Graham, M.H.**	MULTIPLE RESTORATION TECHNIQUES YIELD GREATER RESTORATION SUCCESS OF BULL KELP (*NEREOCYSTIS LUETKEANA*) **Karm, R.H.**	LOCAL ECOLOGICAL KNOWLEDGE ENHANCES OUR CAPACITY TO DOCUMENT POTENTIAL CLIMATE SENTINELS **Early-Capistrán, M.M.**	RANDOM (KELP) FOREST: A TEMPORAL STUDY OF CHANGING COMMUNITIES ON CALIFORNIA'S NORTH COAST **Moitoza, F.D.; Craig, S.F.**	MICROBES: RAPID DEGRADER OR KEY CONSTITUENT OF PREDATOR RISK CUES? **†Vargas, J.R.**
09:30 - 09:45	ASSESSMENT OF THE IMPACTS OF HUMAN TRAMPLING ON THE BEHAVIOR OF AN ENDANGERED INTERTIDAL CRAB **Park, S.**	SMALL BUT MIGHTY: HOW CAPTIVE-BRED JUVENILES OF A TOP BENTHIC PREDATOR COULD ENHANCE KELP FOREST CLIMATE RESILIENCE **Hodin, J.**	FOULING ORGANISM OR SUPERFOOD? REIMAGINING THE POTENTIAL OF VOLUNTEER MACRO-ALGAE ON AN OYSTER FARM IN TOMALES BAY, CA. **Fleener, G.B.**	RACE TO RESTORE: UNDERSTANDING HOW SCIENTISTS ARE WORKING TO RESTORE CALIFORNIA'S KELP FORESTS **Chan, K.M.**	TESTING THE IMPACTS OF ACIDIFICATION ON PACIFIC LITTLENECK CLAMS: CAN SHELL HASH PROMOTE GROWTH BY ALTERING PORE WATER CHEMISTRY? **†Kempf, H.L.**	RAPID LATE HOLOCENE FORMATION AND DESTRUCTION OF REEF-TOP ISLANDS IMPACTED POLYNESIAN ECOLOGY AND HABITABILITY **Jacobs, I.R.**	THE IMPORTANCE OF INTERTIDAL URCHIN POPULATIONS FOR KELP FOREST CONSERVATION: DRIVERS OF INTERTIDAL URCHIN REPRODUCTIVE CAPACITY **†Haberman, I.**

Time	**Session 22: Behavioural Ecology I** *Chair: Aaron Ninokawa* Location: REGENCY 1-3	**Session 23: Special Session: Marine disease ecology in a changing world III** *Chair: Drew Harvell* Location: REGENCY MAIN	**Session 24: Special Session: Restorative Aquaculture** *Chair: Kevin Travis & Priya Shukla* Location: REGENCY 4-6	**Session 25: Special Session: Kelp Research and Restoration in Along the West Coast II** *Chair: Kristen Elsmore* Location: SPYGLASS	**Session 26: Conservation and Restoration IV** *Chair: Julia Kobelt* Location: BIG SUR	**Session 27: Community Ecology IV** *Chair: David Jacobs* Location: CYPRESS	**Session 28: Intertidal Ecology II** *Chair: Michael Dawson* Location: WINDJAMMER
09:45 - 10:00	PERSONALITY VARIATION IN A MARINE SNAIL: BEHAVIORAL REPEATABILITY AND SELECTION IN THE WILD **†Nguyen, B.M.**	NEW INSIGHTS ON SEA STAR WASTING DISEASE FROM 3 YEARS OF CONTROLLED EXPERIMENTS **Prentice, M.B.**	ANTICIPATING TRADE-OFFS AND PROMOTING SYNERGIES BETWEEN SMALL-SCALE FISHERIES AND AQUACULTURE TO IMPROVE OUTCOMES **Mansfield, E.J.**	EFFECTS OF CHANGING SALINITY AND TEMPERATURES ON INVASIVE UNDARIA PINNATIFIDA REPRODUCTION AT THE NORTHERN EDGE OF ITS RANGE IN NORTH AMERICA **Korabik, A.R.**	FUNCTIONS OF FEEDER BLUFFS IN THE SALISH SEA **Kobelt, J.N.**	ECOLOGICAL CONSEQUENCES OF KELP FOREST COLLAPSE FOR ROCKY REEF FISHES **†Yiu, D.S.**	EFFECTS OF OCEAN ACIDIFICATION AND OCEAN WARMING ON THE BEHAVIOR AND PHYSIOLOGY OF THE SEA STAR, EVASTERIAS TROSCHELII **†Penn, C.J.**
10:00 - 10:15	EVALUATING THE NONCONSUMPTIVE EFFECTS OF GIANT SEA BASS **†Reed, K.C.**	HEALING SEA STAR ILLNESS AND INJURY THROUGH ENVIRONMENTAL MANAGEMENT AND IMMUNE SUPPORT **Rudek, T.E.**	THE ROLE OF SEAWEED MICROBIOMES IN ENHANCING AQUACULTURE SUCCESS **Edwards, M.S.**	EFFECTS OF WARMING AND ACIDIFICATION ON DIFFERENT LIFE STAGES OF BULL KELP (NEREOCYSTIS LUETKEANA) **†Roethler, M.**	REINTRODUCTION OF THE ENDANGERED NORTHERN TIDEWATER GOBY TO MALIBU LAGOON **Spies, B.T.**	DECADAL-SCALE TIME SERIES HIGHLIGHT THE ROLE OF CHRONIC DISTURBANCES IN DRIVING ECOSYSTEM COLLAPSE IN THE ANTHROPOCENE **Edmunds, P.J.**	DOES LARVAL SUPPLY MATTER? MEROPLANKTON CONCENTRATIONS AS DRIVERS OF INTERTIDAL INVERTEBRATE ABUNDANCE IN THE GULF OF ALASKA **Traiger, S.B.**
10:15 - 10:30	CHARACTERIZING MALE DOMINANCE BEHAVIOR IN A POLYGNOUS BREEDER, THE NORTHERN ELEPHANT SEAL **Roth, J.D.; Dillon, H.E.**	FJORD OCEANOGRAPHIC CONDITIONS SUPPORT REMNANT POPULATIONS OF PYCNOPODIA HELIANTHOIDES FOLLOWING A DISEASE OUTBREAK **Gehman, A.L.M.**	PANEL DISCUSSION	DISTRIBUTION AND DIVERSITY OF KELPS AND ROCKWEEDS IN THE CALIFORNIA CURRENT ECOSYSTEM **Janousek, C.N.**	FRAMEWORK FOR ASSESSING AND MITIGATING THE IMPACTS OF OFFSHORE WIND ENERGY DEVELOPMENT ON MARINE BIRDS **†Ellis, A.A.**	SUBMARINE GROUNDWATER DISCHARGE DRIVES CHANGES IN REEF FISH COMMUNITY STRUCTURE AND FUNCTION **†Zeff, M.**	A DECADE OF DEATH AND OTHER DYNAMICS: A COMMUNITY PERSPECTIVE ON SEA STAR WASTING **Dawson, M.N.**

Contributed Talks

† eligible for Best Student Paper Award

Sunday 11:00 - 12:30

Time	**Session 29: Behavioural Ecology II** *Chair: Jack Barkowski* Location: REGENCY 1-3	**Session 30: Fisheries Ecology** *Chair: Alexandra Davis* Location: REGENCY MAIN	**Session 31: Evolutionary Biology** *Chair: Brendan Cornwell* Location: REGENCY 4-6	**Session 32: Special Session: Kelp Research and Restoration in Along the West Coast III** *Chair: Pike Spector* Location: SPYGLASS	**Session 33: Anthropogenic pollution in marine environments** *Chair: Nyssa Silbiger* Location: BIG SUR	**Session 34: Community Ecology V** *Chair: Sean Bignami* Location: CYPRESS	**Session 35: Intertidal Ecology III** *Chair: Racine Rangel* Location: WINDJAMMER
11:00 - 11:15	VERIFICATION OF GIANT SEA BASS (STEREOLEPIS GIGAS) SPAWNING: THROUGH PASSIVE ACOUSTIC MONITORING **†Burns, E.H.**	UNCOVERING PATTERNS AND MECHANISMS OF PARALYTIC SHELLFISH TOXICITY IN ALASKA'S GEODUCK CLAM FISHERY **†Hart, C.**	MICROBIOME COMPOSITION AND IMPACT OF ANTIBIOTICS ON THE REPRODUCTION OF EX-SITU BRED GIANT KELP GAMETOPHYTES. **†Piango, S.C.**	GEOGRAPHIC VARIABILITY OF FLOATING KELP RECOVERY AFTER A HEATWAVE EVENT IN THE SALISH SEA **Claar, D.C.**	CORALS IN A HOT PLASTIC OCEAN: HOW HEAT AND PHTHALATES SHIFT A MONTIPORA CAPITATA CORAL MICROBIOME **†Tanja, S.S.D.**	COMMUNITY ASSEMBLY PREDICTION BY ECOLOGICAL REGULATION (CAPER): MODELING CLIMATE-DRIVEN FOULING DYNAMICS IN THE SAN FRANCISCO BAY **†Chari, M.**	ALGAL RESILIENCE: HAVE ROCKY INTERTIDAL ALGAE COMMUNITIES IN THE MONTEREY PENINSULA BEEN IMPACTED BY RECENT STORMS **†Martinez, O.M.**
11:15 - 11:30	PATTERNS IN HUMPBACK WHALE SONG IN THREE U.S. WEST COAST NATIONAL MARINE SANCTUARIES **†Barkowski, J.**	THE BENEFITS AND DRAWBACKS OF INTEGRATING SPECIES INTERACTIONS INTO REBUILDING PLANS **†Odell, A.N.**	THE REGULATORY UNDERPINNINGS OF SEASONAL RUN-TIME VARIATION IN CHINOOK SALMON, ONCORHYNCHUS TSHAWYTSCHA **†Algayer, T.**	KELP FOREST CANOPIES: HABITAT STRUCTURE REVEALS UNIQUE BENTHIC COMMUNITIES **†Attridge, C.M.**	INCREASE IN SUBMARINE GROUNDWATER DISCHARGE MAY ADVERSELY AFFECT METABOLISM OF THE TROPICAL CORAL, *POCILLOPORA ACUTA* **†Merges, H.E.**	ALGAL TRAITS, NOT JUST SPECIES IDENTITY, INFLUENCE THE SELECTIVITY OF HERBIVOROUS AND DETRITIVOROUS FISHES **†Barber-Choi, N.; Brooks, M.; Martinez, B.; O'Rourke, B.M.**	FACTORIAL FIELD MANIPULATION REVEALS MULTI-STRESSOR EFFECTS ON A CRITICAL HABITAT-FORMING SHELLFISH **Rangel, R.E.**
11:30 - 11:45	SEASONAL AND MORPHOLOGICAL VARIATION IN CONTRACTION BEHAVIOURS OF THE TEMPERATE DEMOSPONGE *TETHYA CALIFORNIANA* **†Guillas, K.C.**	ROCKFISH SPECIES TRENDS IN PUGET SOUND, WASHINGTON, USA 2009-2023 **Shelledy, K.N.**	LIFE HISTORY AND DISTRIBUTION INFLUENCE HISTORICAL DEMOGRAPHY IN CORAL TRIANGLE FISHES **Reid, B.**	TOWARD CLIMATE-SMART NETWORKS OF TRANSBOUNDARY MARINE PROTECTED AREAS IN THE CALIFORNIA BIGHT **Arafeh-Dalmau, N.**	KELP FOREST RESTORATION IN NEW ZEALAND **Shears, N.**	PACIFIC COAST FEEDING GROUP GRAY WHALES LIKELY CONSUME LOW-QUANTITY & LOW-QUALITY PREY AT THE SOUTHERN EDGE OF THEIR FEEDING RANGE **†Norman, R.E.**	ASSESSING GREEN CRAB INFLUENCE ON PACIFIC COAST ECOSYSTEMS **†Nicol, S.J.**

Time	**Session 29: Behavioural Ecology II** *Chair: Jack Barkowski* Location: REGENCY 1-3	**Session 30: Fisheries Ecology** *Chair: Alexandra Davis* Location: REGENCY MAIN	**Session 31: Evolutionary Biology** *Chair: Brendan Cornwell* Location: REGENCY 4-6	**Session 32: Special Session: Kelp Research and Restoration in Along the West Coast III** *Chair: Pike Spector* Location: SPYGLASS	**Session 33: Anthropogenic pollution in marine environments** *Chair: Nyssa Silbiger* Location: BIG SUR	**Session 34: Community Ecology V** *Chair: Sean Bignami* Location: CYPRESS	**Session 35: Intertidal Ecology III** *Chair: Racine Rangel* Location: WINDJAMMER
11:45 - 12:00	ANALYZING ECOLOGICAL IMPLICATIONS OF MESOSCALE CLIMATIC IMPACTS ON JUVENILE WHITE SHARK HABITAT RANGE AND SEA OTTER INTERACTIONS **†Stepanov, F.**	LEVERAGING EMERGING TECHNOLOGY AND CITIZEN SCIENCE TO COLLECT FISHERY SIZE-STRUCTURE DATA **†Elstner, J.**	AN EXPERIMENTAL TEST OF ECO-EVOLUTIONARY DYNAMICS ON ROCKY SHORES **†Longman, E.K.**	EVIDENCE OF LOCAL ADAPTATION IN BULL KELP UNDER EXTREME WARMING **Dykman, L.N.**	EVALUATING THE IMPACTS OF NOISE POLLUTION ON A MARINE FISH, THE GARIBALDI (HYPSYPOPS RUBICUNDUS) **†Jones, R.C.**	IMPACTS OF A NONNATIVE BRYOZOAN ON BENTHIC COMMUNITY STRUCTURE DURING A MULTI-YEAR MARINE HEATWAVE **†Michaud, K.M.**	RACE AGAINST THE TIDES: GROW UP FAST OR FACE THE HEAT **†Litle, J.W.**
12:00 - 12:15	PYCNOSH: LABORATORY FEEDING RATES AND INVERTEBRATE PREY SIZE PREFERENCES OF THE SEA STAR *PYCNOPODIA HELIANTHOIDES* **†Taradash, A.C.**	FORECASTING PREDATOR-PREY OVERLAP FOR CLIMATE READY FISHERIES MANAGEMENT IN THE BERING SEA **†Goodman, M.C.**	COUPLED POPULATION GENOMIC PATTERNS IN THE CORAL ACROPORA HYACINTHUS AND THEIR SYMBIONTS PREDICT RESPONSES TO HEAT STRESS **Cornwell, B.H.**	KELPS ON DEMAND: CLOSED-SYSTEM PROTOCOLS FOR CULTURING LARGE BULL KELP SPOROPHYTES FOR RESEARCH AND RESTORATION **†Supratya, V.P.**	LONG-TERM MICROPARTICLE MONITORING AT THE SEATTLE AQUARIUM AND ITS IMPORTANCE FOR FISHERIES **Padula, V.**	SPATIAL DYNAMICS OF ANIMAL-MEDIATED NUTRIENTS IN TEMPERATE WATERS **†Lim, E.G.**	Q&A PERIOD
12:15 - 12:30	BEHAVIORAL ASSESSMENT OF PREDATORY FISH GUILDS TO PREY ODOR CUES BETWEEN TWO NEARSHORE HABITATS OFF SANTA CATALINA ISLAND **†McElfish, M.M.**	RELATIVE IMPORTANCE OF DYNAMIC AND STATIC REEF CHARACTERISTICS ON THE DISTRIBUTION OF CORAL REEF FISHES **Miller, S.D.**	EXPERIMENTAL TRANSCRIPTOMICS UNCOVERS CRYPTIC LOCAL ADAPTATION IN A HIGH GENE FLOW SYSTEM **†Lee, A.**	STAR TRACK: THE LANDSCAPE OF FEAR CREATED BY SUNFLOWER SEA STARS ROAMING AN URCHIN BARREN **Gravem, S.A.**	TRACKING HEAVY METALS DURING BLEACHING STRESS AND RECOVERY IN HAWAIIAN REEF-BUILDING CORALS **†Backstrom, C.H.**	STAR DUST: SUNFLOWER SEA STAR CHEMICAL CUES LOCALLY REDUCE RED URCHIN DENSITIES GRAZING AND BENEFIT KELP **†Hunter, N.; Mancuso, R.; Campbell, R.; Gravem, S.A.; Galloway, A.W.E.; Raimondi, P.**	Q&A PERIOD

Contributed Talks

Session 1: Applied Ecology I

* indicates presenting author, † indicates eligibility for Best Student Paper Award

QUANTIFYING CORAL LOSS AND COMMUNITY CHANGE FROM CORAL BLEACHING USING UNDERWATER PHOTOGRAMMETRY AND AI-ASSISTED IMAGE SEGMENTATION

† Kopecky, K.L.[1*]; Pavoni, G.[2]; Nocerino, E.[3]; Brooks, A.J.[1]; Corsini, M.[2]; Menna, F.[4]; Gallagher, J.P.[1]; Capra, A.[5]; Castagnetti, C.[5]; Rossi, P.[5]; Gruen, A.[6]; Neyer, F.[7]; Muntoni, A.[2]; Ponchio, F.[2]; Cignoni, P.[2]; Troyer, M.[8]; Holbrook, S.J.[1]; Schmitt, R.J.[1]

1- UC Santa Barbara 2- Visual Computing Lab ISTI-CNR 3- University of Sassari 4- Bruno Kessler Foundation 5- University of Modena and Reggio Emilia 6- ETH Zurich 7- Terradata AG 8- Microsoft Quantum

Detecting impacts of natural and anthropogenic disturbances that cause declines in organisms or changes in community composition has long been a focus of ecology, but a tradeoff often exists between the spatial extent over which relevant data can be collected, and the resolution of those data. Recent advances in underwater photogrammetry, as well as computer vision and machine learning tools that employ artificial intelligence (AI), offer a potential solution to resolve this tradeoff. Here, we coupled a rigorous photogrammetric survey method with novel AI-assisted image segmentation software to quantify the impact of a coral bleaching event on a tropical reef, both at an ecologically meaningful spatial scale and with high spatial resolution. In addition to outlining our workflow, we highlight three key results: 1) dramatic changes in the three-dimensional surface areas of live and dead coral, as well as the ratio of live to dead colonies before and after bleaching, 2) a size-dependent pattern of mortality in bleached corals, where the largest corals were disproportionately affected, and 3) a significantly greater decline in the surface area of live coral as revealed by our approximation of the 3D shape compared to the more standard planar area (2D) approach. Further, we are comparing trajectories of community reassembly after disturbances that either remove dead coral structures or leave these structures intact on the reef, finding divergent assembly patterns. Increasing the resolution, accuracy, spatial extent, and efficiency with which we can quantify effects of disturbances will improve our ability to understand the ecological consequences that cascade from small to large scales, as well as allow more informed decisions regarding mitigation of undesired impacts.

THE SMOKING BARNACLE – MARINE SCIENCE AS A FORENSIC TOOL IN SUBTIDAL CRIME SCENE INVESTIGATIONS

Morris, K.[*]

Ecomarine Consulting, LLC and Santa Ana College

On October 1, 2021, an oil spill originating from the ruptured Amplify Energy Pipeline created an 8,320 acre plume that spread from Huntington Beach to San Diego, CA. Upon inspection, it was determined that a traumatic impact occurred midway along the 17-mile concrete-reinforced steel pipeline, where it was dragged 30 m from its original subsea alignment. A forensics investigation was undertaken to establish a timeline of when the damage occurred using biological samples collected from the pipeline. Near the damage site, benthic infauna cores and epifauna scrapings were collected. Shannon diversity (H') in the drag zone was similar (H'=3.74, BRI=20) to that observed in the reference site (H'=3.73, BRI=19), suggesting that the assemblage in the disturbed benthos had ample time to recover. Epifauna samples taken from the unarmored pipeline where the protective concrete had torn free revealed a diverse community (H'=2.22) attached to the anticorrosive inner liner. While this assemblage differed slightly from that on the intact concrete, the fouling community included animals whose tubes required months to construct. Furthermore, red-stripe barnacles (*Paraconcavus pacificus*) collected from the unarmored pipeline were of a size known to require nine months to grow ($\bar{x}$=23.8mm, max=27.5mm), strongly suggesting that the pipeline was damaged in January 2021. Marine forensic science paired with shipping records allowed investigators to establish that the damage was caused by two cargo container ships (MSC Danit and M/V Beijing) that dragged anchor near the pipeline in severe winds.

CHARACTERIZING EXPOSURE OF CA MPAS TO PROJECTED MID AND END OF CENTURY CLIMATE CONDITIONS

† Sridhar, N.[*]; Fiechter, J.; Kroeker, K.J.

UC Santa Cruz

While many ecological principles and societal concerns informed the establishment of California's MPA network, little research was available on the geographic variability in exposure to climate stressors. The spatio-temporal landscape of the CA coast is highly variable, creating a mosaic of temperature, pH, and dissolved oxygen conditions. As warming, ocean acidification, and deoxygenation accelerate, MPAs will be exposed to unique stressor magnitudes and combinations. Understanding future patterns of warming and acidification will inform our expectations for geographic variation in MPA efficacy and resilience to environmental change. Here, we analyzed output of downscaled regional climate projections from a coupled physical-biogeochemical model under the RCP8.5 emissions scenario to a) characterize the severity, intensity, and duration of future anomalous events in CA MPAs and b) identify spatial patterns in biogeochemical conditions through the middle and end of the century. Results suggest the drivers of spatio-temporal variability in temperature, pH, and dissolved oxygen concentrations in CA MPAs are similar in historic and end of century time periods. By the end of the century, low pH events (defined by exposure to conditions below pH 7.8) are less frequent in MPAs in northern CA, more frequent in southern CA, but of longer duration in MPAs in all regions. Warming events are more frequent but shorter in MPAs in most regions by the end of the century. This work will inform management efforts by forecasting patterns of change before they occur to aid effective planning.

LINKS BETWEEN DEFINING OCEAN CLIMATE VARIABILITY AND THE RESILIENCE OF FISHED POPULATIONS ACROSS MULTIPLE TIME SCALES

White, J.W.[1*]; Kilduff, D.P.[2]; Hastings, A.[2]; Botsford, L.W.[2]

1- Oregon State University 2- UC Davis

Characterizing the ecological consequences of extreme ocean events is crucial for adaptive responses to climate change. A recent proposal defines marine heatwaves in two different ways; one being the occurrence of pulses of extreme temperatures relative to a historical climatology (useful for shorter time scales in the near future), and the other, on longer time scales moving into the future, as extremes relative to a shifting baseline that accounts for rising average temperatures. We describe how similar definitions have been used in ecology over the past 30 years to describe the 'resilience' of ecological populations. On short time scales ('engineering resilience'), the concern is response to individual pulse events, which depends on the magnitude of impact and the time required to recover. Over longer time scales, resilience ('ecological resilience') is measured either in terms of the buffering of variability around a steady state, or as the tendency to remain in one domain of attraction and not shift to a less desirable state. Those effects depend both on the long-term trend in conditions and in variability about that trend, because population dynamics filter environmental variability, amplifying some frequency bands and dampening others. We use models to show when those two definitions would or would not be similar, and how examining ecological responses in the frequency domain provides a way to link the two. Finally, on both time scales, harvesting is usually expected to reduce resilience, but protections from harvest in marine reserves have mixed benefits.

CONSEQUENCES OF JAPANESE EELGRASS ESTABLISHMENT FOR MANILA CLAMS IN PUGET SOUND, WASHINGTON

† Griffin, J.E.[1,2*]; Samhouri, J.F.[3]; Tolimieri, N.[3]; Sanderson, B.L.[3]; Kiffney, P.M.[3]; Hovel, K.A.[2]

1- UC Davis 2- San Diego State University 3- NOAA Fisheries

Japanese eelgrass (*Zostera japonica*) is a non-native marine plant which has become established in Puget Sound, Washington. Its interaction with local species such as native eelgrass (*Zostera marina*) and its effects on shellfish aquaculture, a major industry in Puget Sound, are not well understood. Previous studies suggest that eelgrass (native or non-native) may have positive or negative effects on populations of the Manila clam (*Ruditapes philippinarum*), an important aquaculture species. Our objective was to determine the effect of habitat type on Manila clam populations. We performed a three-month field experiment in Puget Sound, in which we outplanted Manila clams in three habitat types (native *Z. marina*, non-native *Z. japonica*, and mudflats), and determined clam survival, growth, reproductive status, and condition. Our experiment occurred at three field sites (Tramp Harbor, Dumas Bay, and Viewpoint Park) during two summers (2011 and 2012). We found inconsistent effects of habitat type on Manila clam survival, growth, reproductive status and condition among the three sites. Though habitat type affected clams within some sites, no one habitat type led to consistently different outcomes across sites and years. Our results indicate that *Z. japonica* does not have a consistent negative effect on clams compared to *Z. marina* and mudflats, and that site-specific factors may be more important for clam populations than habitat type. This suggests that increases in *Z. japonica* populations are not likely to negatively affect local Manila clam populations or aquaculture operations.

INVESTIGATING THE THERMAL RESPONSE OF PARASITIC DISEASE WITH ECTOTHERMIC INTERMEDIATE HOST IN THE ERA OF GLOBAL WARMING

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Schistosomiasis, a neglected tropical disease, holds significant global health importance, primarily affecting disadvantaged populations in low-resource regions, particularly sub-Saharan Africa. As the world grapples with the challenges of climate change, the impact on schistosomiasis transmission dynamics is becoming a growing concern. This concern arises due to the free-living parasitic stages and its ectothermic intermediate host snails, whose life history traits rely on temperature variations. In this study, we employ a temperature-dependent dynamic system to represent the life cycle of schistosomiasis. We simulate the thermal response of schistosomiasis using the Basic Reproduction Number and Mean Parasite Burden in the human body as metrics to measure the intensity of disease transmission. Additionally, we assess the impact of human water contact rates on the thermal response of transmission. Our findings reveal a higher optimal temperature for schistosomiasis transmission than previously reported. Furthermore, accounting for changes in human-water contact behavior as temperatures rise further shifts the optimal temperature for transmission. To validate our results, we compare them with data from the Global Neglected Tropical Disease (GNTD) database. Sophisticated models are essential tools for gaining deeper insights into disease transmission and the intersection between climate change and global health problems.

Session 2: Ecosystem Assessment

* indicates presenting author, † indicates eligibility for Best Student Paper Award

THE EFFECTS OF DEAD-IN-PLACE POCILLOPORA CORALS ON CORAL REEF COMMUNITY STRUCTURE

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CSU Northridge

Coral bleaching is increasing in severity, often resulting in high coral mortality. Detached dead colonies can propagate damage within reefs, forming bare patches suitable for coral settlement. Dead-in-place colonies give refuge for algae and invertebrates, delaying successional processes that lead to coral recovery. Bleaching in 2019 in Moorea, French Polynesia, reduced coral cover at 10 m depth from 69% to 13%, leaving many dead-in-place *Pocillopora* spp. colonies; these were rapidly encrusted by the alga, *Lobophora variegata*. We tested the hypotheses:

(1) dead-in-place corals surrounding live *Pocillopora* will dislodge to create open space for coral recruitment, and (2) dead *Lobophora*-encrusted *Pocillopora* provide greater habitat complexity, therefore the diversity and abundance of motile invertebrates will be higher. Invertebrate abundance was compared between live and dead colonies, photos of tagged corals were used to track dislodgement and *Lobophora* abundance, and a crush test was applied to branches testing dissolution. Dead colonies had 5-fold more invertebrates (mostly amphipods) than live corals and dissolution hollowed out 5% of branches; 3% of the affected colonies dislodged. These results suggest dead-in-place, algae-encrusted *Pocillopora* increase the abundance and richness of invertebrates. Dislodgement was limited, but a unique form of internal dissolution was discovered. While dead algae-encrusted corals provide habitat for invertebrates, their persistence may impede succession if dislodgement does not create space for coral recruitment.

EDNA FISH FAUNAL ANALYSIS OF ESTUARINE MARINE PROTECTED AREAS IN CALIFORNIA

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In order to evaluate the effectiveness of environmental DNA (eDNA) metabarcoding in monitoring fish communities in estuarine marine protected areas (EMPAs), we conducted an initial eDNA analysis of four lagoons (Ten Mile River, Pajaro River, Malibu Lagoon, Batiquitos Lagoon) along the coast of California during two seasons (spring and fall) as part of the EMPA Monitoring Project. We found that eDNA results were largely consistent with expected community assemblages and highlighted seasonal variation within sites. Results also reflected differences in latitude and mouth opening pattern between sites, with lower latitude lagoons having higher diversity and the perennially open Batiquitos Lagoon having the most marine taxa. We were also able to detect uncommon species not captured via other collection methods, as well as genetic variation in taxa like staghorn sculpin (*Leptocottus armatus*) and four species of salmonids. Challenges overcome include overlaps in taxonomic assignment in Cottidae and *Menidia*. Overall, this data suggests that eDNA metabarcoding is an effective inclusion in EMPA monitoring practices, and can be combined with additional metadata and collection data for even more in-depth investigation. Further analysis should permit us to determine which survey methods are most appropriate for monitoring fish communities in California estuaries and lagoons.

DISCONTIGUOUS REEF FEATURES MAY PROVIDE REFUGIA FOR GIANT KELP AMONG PURPLE URCHIN AGGREGATIONS

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The role of habitat fragmentation in limiting the diversity and stability of many subtidal ecological communities is well described. However, to-date, the majority of studies on habitat fragmentation examined its influence on community composition at large spatial scales (> 100 meters horizontal resolution). Here, we surveyed the benthic environment of Monastery Beach (southern Carmel Bay, California) to explore how habitat contiguity influenced *Strongylocentrotus purpuratus* (purple urchins), *Macrocystis pyrifera* (giant kelp), and other macroalgae densities. Habitat contiguity was measured as uninterrupted segments of homogenous habitat (substrate and relief) and used to quantify the magnitude of habitat fragmentation. Stereo diver-operated video (DOV) transects (10 m) were used to extract data on meter-scale habitat association data between purple urchins, giant kelp, and various macroalgae as substrate and relief structure varied. Results of linear mixed-effects modeling suggest all target species densities exhibited a negative relationship with substrate contiguity regardless of substrate type (p-value < 0.05). Contiguity was also examined as substrate and relief transitions, calculated over the length of the transect. Purple urchins were positively associated with substrate transitions but negatively associated with relief transitions. Macro algae and giant kelp stipe densities were positively associated with relief transitions (p-value < 0.05). These results may suggest heterogenous reef as refugia for macro algae among purple urchin aggregations.

EFFECTS OF THERMAL STRATIFICATION ON KELP FOREST PERSISTENCE AND THEIR COMMUNITIES ON CATALINA ISLAND

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CSU Northridge

Long-term climate change threatens kelp forest communities, which cannot withstand temperature extremes. Thermal stratification (temperature differences between shallower and deeper water) can disrupt the flow of nutrients that kelp rely on, but how stratification affects kelp is not well understood. We are investigating how stratification influences kelp forest persistence at Santa Catalina Island, California. We are monitoring temperature, kelp density, as well as fish and invertebrate community composition at the benthic, midwater, and canopy regions of the water column in kelp forests that vary in kelp persistence. Additionally, we are using publicly available kelp-canopy satellite data to verify kelp persistence at the study sites and evaluate how temperature stratification affects kelp persistence. Preliminary results suggest a trend between time spent under the thermal threshold for kelp (15.5°C) and degree of persistence. There may also be a trend between species richness in the kelp forest and kelp presence, which will continue to be monitored throughout the following seasons. This study can help predict how shifts in abiotic conditions may impact kelp forest and rocky reef communities as the thermal environment continues to change.

REMOTELY OPERATED VEHICLES (ROVS) IN BULL KELP FORESTS - AN OPEN-SOURCE BENTHIC SURVEY METHODOLOGY WITH AN EYE TOWARDS AUTONOMOUS OPERATIONS

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Seattle Aquarium

Shallow subtidal ecosystems such as kelp forests are logistically challenging to survey, limiting the data collection necessary to guide conservation, restoration, and management. Recent advancements in Remotely Operated Vehicle (ROV) technology are increasingly enabling natural resource managers to harness relatively low-cost, small, and highly customizable ROVs. In partnership with the Port of Seattle and other entities throughout the state of Washington, we have customized two BlueROV2's manufactured by Blue Robotics to conduct benthic video surveys within kelp forests. In addition to implementing a ROV-based kelp forest monitoring program in Elliott Bay, Seattle, we have refined our positioning methodology to enable precise spatial tracking of the ROV across the seafloor—crucial for future spatial modeling efforts.

Furthermore, in partnership with software developer and co-author Clyde McQueen, we are pursuing custom software to enable autonomous operations, such as via *surftrak*, an open-source, terrain-following addition to ArduSub that will enable our ROV to maintain a consistent altitude while flying above variable terrain. In parallel, we are helping other entities in Washington develop similar low-cost ROV programs, with the ultimate objective of increasing our collective capacity to gather data and conserve coastal ecosystems and resources.

ROLE OF HERBIVOROUS REEF FISHES IN RESILIENCE-BASED MANAGEMENT

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Resilience-based management is an approach to maintain or increase the resistance and/or recovery capacity of reefs to local and global stressors. Given that both local and global stressors are increasing in intensity and frequency on reefs worldwide, this approach to local management has recently gained traction. The potential for herbivorous fishes to play an outsized role in reef resilience has led to herbivore fisheries management to arise as a key tool in resilience-based management. Yet, the evidence for managing herbivore populations for this ecosystem-based objective is largely lacking at scales relevant to management. Meanwhile, herbivore catch can be a large component of overall reef fisheries, especially for Pacific islands such as Hawai'i. I will share how we have worked collaboratively across agencies and institutions to compile evidence related to the implementation of herbivore-based management in Hawai'i. With 20,242 fish transects compiled from multiple sources alongside data on 27 biophysical and human drivers we have analyzed how multiple drivers explain spatial gradients in herbivore populations and herbivory processes. We have also uncovered evidence that herbivores have played a role in explaining disparate trajectories across reefs following a major heatwave in 2015. I will conclude with discussing how these lines of evidence have contributed to decision making related to nearshore fisheries management as part of the Holomua Marine Initiative.

Session 3: Population Biology and Ecology I

* indicates presenting author, † indicates eligibility for Best Student Paper Award

TURNING UP THE HEAT ON MARINE TURTLE POPULATION DYNAMICS

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Marine turtles have temperature-dependent sex determination, such that sex is determined in the egg stage by the nest temperature during the middle third of incubation. Warmer nests produce more females, and cooler nests produce more males. As climate change progresses, nesting beaches are warming and producing increasingly more females and fewer males. Most population surveys and research on marine turtles in the past have focused on females and hatchlings, which are more easily accessible during the nesting and hatching season. As a result, the role of males in marine turtle population dynamics is not well understood. Specifically, the relationship between the breeding sex ratio and reproductive success (known as the 'mating function'), is unknown. We are collecting demographic and genetic information to better understand how many males are contributing to the population of green turtles that nest on Praia do Leão (Lion Beach) on Fernando de Noronha, Brazil. Using the data collected from three and a half field seasons with this subpopulation, I have constructed an age based computational population dynamics model to explore the survival probabilities of this population three generations into the future, under different temperature change scenarios and different mating functions.

POPULATION GENETICS OF THE MUSSEL *MYTILUS CALIFORNIANUS* IN BAJA CALIFORNIA, MEXICO

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The mussel *Mytilus californianus* is distributed across rocky intertidal communities from southern Alaska, USA to Baja California, Mexico. Previous studies in the northern distribution have concluded this species is genetically homogeneous, probably due to its long pelagic larval phase and associated potential for dispersal. However, there are numerous reasons to expect lower genetic diversity and higher population structure at the edge of a species' range, including smaller population sizes, greater distances between suitable habitat, and local adaptation. We explored the genetic diversity of *M. californianus* throughout seven sites in Baja California using the mitochondrial gene cytochrome oxidase subunit I (COI). Mantle and gill tissue was collected of 169 total individuals, and a 553 bp fragment was PCR amplified and sequenced using standard primers. The AMOVA confirmed that *M. californianus* in Baja California is genetically homogeneous since no structure was found among sites (FST= 0.00084). In addition, we found high haplotype (h=0.837-0.997) and low nucleotide diversity values (π=0.0003-0.0008). These results, along with a high number of unique haplotypes and negative Tajima's D values indicate *M. californianus* population is expanding. The present work shows connectivity of *M. californianus* in the peninsula is high, and genetic diversity has not been affected by recent environmental changes in the region. However, we suggest keeping monitoring this species at the southern limit, where it is most vulnerable.

MODELING THE EFFECTS OF DISPERSAL AND SCALE ON TICK-BORNE PATHOGEN RISK IN HETEROGENEOUS ENVIRONMENTS

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In light of the increasing number of Lyme disease cases reported in the western US, it is becoming crucial to understand the relationships between biodiversity, tick-borne diseases, and transmission risk to humans. Furthermore, the ever-increasing encroachment of humans into natural habitats requires knowledge of how landscapes with heterogeneous distributions of tick host species will alter these relationships. However, experiments using exclosures to keep out large mammal hosts have found conflicting results regarding the effects of host biodiversity on tick-borne pathogen transmission risk. We developed a theoretical, spatially explicit model of Lyme disease transmission incorporating the

movement of large and small mammal hosts to reconcile the contradicting outcomes from these experiments. We found that the spatial scale of the exclosure relative to the hosts' dispersal rates are critical determinants of whether transmission risk to humans inside the exclosure is lower or greater than background risk. Our findings help to interpret otherwise conflicting results of past exclosure experiments, and will be useful to inform future land use policies in Lyme-prevalent areas.

PARASITE PIONEERS: A LOTERÍA GAME PROVIDING PARASITE EDUCATION TO CHILDREN

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The "Parasite Pioneers" project aims to promote parasite education to elementary and secondary school students in an interactive and gamified way. The initiative involved researching rare and common parasites and compiling information on their life cycles, habitats, and host interactions. Inspired by a traditional Mexican lotería game, we created a final lottery sheet with 54 human, animal, and environmental parasites with their corresponding host information. We balanced simplicity with key and necessary details on parasites' life cycle, and used a colorful graphical format geared towards children of all ages. We included parasites across a range of domains and spanning a variety of different transmission pathways, and we are in the process of generating location-specific sheets for the regions of Africa, Asia, and North America. In addition to the lotería cards and accompanying pin buttons for interactive gameplay, we also compiled flashcards, guidelines, and fact sheets for school instructors to facilitate the administration of the game in the classrooms also when teachers don't have any specific background in parasite ecology. By demonstrating an innovative approach to science communication, this game aims to engage children in a manner that will broaden their academic horizons and help them to gain a deeper understanding on an often-neglected component of biodiversity with a significant conservation, veterinary and public health impact.

EVALUATING OFFSHORE WIND FARMS AS OTHER EFFECTIVE CONSERVATION MEASURES AND THEIR IMPLICATIONS FOR FISHERIES MANAGEMENT

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Offshore wind farms (OWFs) are increasingly being developed on U.S. coastlines, particularly on the U.S. Pacific Coast. This development raises concerns about their impact on fisheries and fisheries management due to displaced effort and loss of fishery-independent survey data collection on the continental shelf. Additionally, the U.S. is actively expanding its network of protected areas as part of the 30x30 initiative and OWF areas could potentially contribute as "Other Effective area-based Conservation Measures" (OECMs), though their value as protected areas is debatable because they are not planned to protect specific habitats or species. Previous research involving OWFs being placed along the Pacific Coast has examined impacts on endangered species (e.g., marine mammal entanglement), but it has not comprehensively assessed fisheries impacts or potential conservation benefits. We used a spatially explicit population model to investigate the effect on fishery effort and fishery management responses to potential OWF implementation, focusing on five groundfish species. Our findings indicate that the loss of fishery-independent survey data in OWFs causes information loss and reduced yield due to increased uncertainty in estimates of stock biomass. Moreover, positioning the OWF in better habitat areas produces the best conservation outcomes, but also the greatest loss of fishery yield. Overall, our research underscores the intricate challenges and trade-offs involved in balancing OWF expansion with sustainable fisheries management and conservation efforts in U.S. coastal regions.

CHAOS IS NOT RARE IN NATURAL ECOSYSTEMS

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Chaotic dynamics are thought to be rare in natural populations, but this may be due to methodological and data limitations, rather than the inherent stability of ecosystems. Following extensive simulation testing, we applied multiple chaos detection methods to a global database of 172 population time series and found evidence for chaos in >30%. In contrast, fitting traditional one-dimensional models identified <10% as chaotic. Chaos was most prevalent among plankton and insects and least among birds and mammals. Lyapunov exponents declined with generation time and scaled as the -1/6 power of body mass among chaotic populations. These results demonstrate that chaos is not rare in natural populations, indicating that there may be intrinsic limits to ecological forecasting and cautioning against the use of steady-state approaches to conservation and management.

Session 4: Physiological Ecology I

* indicates presenting author, † indicates eligibility for Best Student Paper Award

EFFECTS OF DAILY TEMPERATURE RANGE (DTR) AND THERMAL PRIMING ON ACQUIRED THERMAL RESISTANCE IN TROPICAL REEF CORALS

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Tropical Pacific islands provide model systems to study the effects of nuanced thermal effects on the biological responses of corals to climate change. One key effect is the ability of thermal history created by the DTR to "prime" corals to modulate their resistance to warming. This study tests the effects of contrasting DTR on the response of corals to elevated temperature on the backreef of Moorea, French Polynesia. Two sites along the North shore provided an annual DTR contrast of 0.625ºC vs 1.040ºC. An initial reciprocal transplant experiment between these sites with *Porites rus* showed no effect of origin on photophysiology or growth, suggesting a lack of intrinsic site effects in determining phenotype. In

April/May 2023, *P. rus* fragments from these two sites were incubated at 28.74ºC vs 31.80°C, with the outcome showing that maximum dark adapted quantum yield (F_v/F_m) was depressed by 19.7% for corals from the high DTR site, although growth was unaffected. To test for temporal and taxonomic generality of this result, fragments of *P. rus* and massive *Porites* spp. from these sites were incubated at 26.71ºC vs 29.93ºC in August 2023. Overall, the effect of DTR in mediating protection to high temperature was small: F_v/F_m was unaffected by temperature in massive *Porites* from the high DTR site but was depressed 5% in low DTR corals. In *P. rus*, high temperature reduced F_v/F_m by 8% in high DTR *P. rus*, but 5% in low DTR *P. rus*. The overall small effect sizes suggest the magnitude of DTR regimes observed in Moorea are unlikely to protective corals exposed to high temperature.

PACIFIC OYSTER PERFORMANCE UNDER MULTIPLE INTERACTING CLIMATE CHANGE STRESSORS

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It is important to understand how marine organisms respond to environmental stressors to predict, plan for, and mitigate the impacts of climate change on marine ecosystems and communities that depend on them. Bivalves support essential ecosystem functions and are a key taxon in the global aquaculture industry. Coastal ecosystems, where most bivalves are found, are particularly impacted by both global and local stressors making it essential we understand how these species respond to stress. Here, we examined how multiple interacting climate change stressors (temperature, pH, hypoxia) impact Pacific oyster (*Crassostrea gigas*) performance throughout Puget Sound, Washington. We outplanted diploid and triploid (individuals with an additional set of chromosomes) oysters at four shellfish farms, monitored their performance (mortality, growth, respiration), and collected environmental information (temperature, oxygen, pH) in summer 2023. We observed a pulse of high mortality at only one site, with the timing of this mortality coinciding with a drop in oxygen levels. No other differences in mortality were observed between sites. Spatial differences in oxygen consumption existed, however differences did not correlate with variation in environmental conditions. Results indicate oyster performance varies between sites with no clear impact of a single stressor on oyster performance or survival. This highlights the need to consider variation in multiple interacting stressors over small spatial scales to develop strategies to manage the impacts of climate change in coastal ecosystems.

EFFECTS OF MARINE HEAT WAVE CONDITIONS AND FOOD AVAILABILITY ON PURPLE SEA URCHINS

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A series of recent marine heat waves brought prolonged, record-breaking temperatures to California's coastline, resulting in the loss of over 90% kelp forest habitat in northern California. This event coincided with a subsequent increase in purple urchins (*Strongylocentrotus purpuratus*) in northern California and declines in southern California. Despite the critical role purple urchins play in the persistence of kelp forests, the influence of temperature and food availability on gonadal investment in S. purpuratus remains poorly understood, even though these factors may dictate interannual reproductive potential. To address this gap, we experimentally investigated the influence of temperature (10-20C) and food on reproduction and respiration rate in Sonoma (northern) and Santa Barbara (south central) urchins. In both populations, when food was limiting, we found gonad size decreased with increasing temperature, whereas when ample food was provided, gonad size increased with increasing temperature. In Santa Barbara urchins, metabolic rates increased stepwise with temperature, with rates suppressed under low food conditions. In Sonoma urchins cultured under high food conditions, metabolic rates were similar between 10-18C, but markedly increased at 20C. A comparable (albeit suppressed) trend was observed when food was limiting. These results highlight warm temperatures drive increasing reproductive potential when food is plentiful, but when food is limiting, the opposite trend is observed, yielding a variety of potential consequences for kelp forests in a warming world.

EFFECTS OF NUTRIENT AVAILABILITY ON THE THERMAL OPTIMA AND SENSITIVITIES OF GALÁPAGOS SEAWEEDS

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Thermal sensitivity in ectothermic organisms is highly context-dependent and may explain the varied responses to climate change among species and with ambient environmental conditions. As such, there is renewed interest to examine the potential combined effects of local factors (i.e., nutrients) and global temperature on thermal biology. This study was conducted to determine whether nutrients influence the thermal optima and sensitivities (estimated as the T_{opt}, and slope activation and deactivation energies *E* and *Eh*, respectively) of four genera of Galápagos seaweeds (*Padina* spp., *Caulerpa racemosa*, *Ulva* spp., and *Ochtodes* spp.) through estimating thermal performance curves for respiration (R) and net photosynthesis (NP). It was hypothesized that nutrient enrichment would increase thermal optima and decrease sensitivities (i.e., via eliminating potential nutrient limitation effects) across genera based on the significance of nitrogen (nitrate) in regulating physiological processes, including responses to heat and oxygen stress, as well as photosynthetic efficiency. The thermal optimum varied substantially across taxa (27.6-36 °C) and was enhanced ~2 °C under nutrient additions in *Padina* spp. and *Caulerpa racemosa*, although the later revealed heightened sensitivity to temperature. In contrast, *Ulva* spp. displayed reduced sensitivity to higher temperatures under enrichment. Lastly, NP across taxa showed lower optimal temperatures than R, suggesting further warming could reduce primary productivity, with potentially far-reaching implications for marine food webs.

THERMAL PLASTICITY HAS HIGHER FITNESS COSTS IN MORE THERMALLY TOLERANT FAMILIES OF TIGRIOPUS CALIFORNICUS

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1- UC Santa Cruz 2- UC Santa Barbara 3- Woods Hole Oceanographic Inst.

As heatwaves become more frequent and severe, ectotherms may experience selective pressures to increase their upper thermal limits and the phenotypic plasticity of those limits. However, ectotherm populations with high thermal tolerance often possess reduced thermal plasticity, suggesting a tradeoff. The fitness tradeoff hypothesis is often invoked to explain this pattern. It states that investments toward thermal tolerance and its plasticity consume common resources resulting in greater fitness costs of plasticity among tolerant genotypes, but remains untested. Studying the intertidal copepod *Tigriopous californicus*, we tested whether fitness tradeoffs drive negative correlations between ectotherm thermal tolerance and plasticity. We collected copepods from four populations distributed across 4 °N of latitude and reared lines from each population under a laboratory common garden for two generations before conditioning a third generation of full-sibling families (sibships) to high and low temperature. We measured sibships' fecundity (a fitness corollary) and upper thermal tolerance in each temperature before modeling fecundity as a function of thermal tolerance, the plasticity of thermal tolerance across temperature, and an interaction between basal tolerance and plasticity. Populations and families with high thermal tolerance exhibited reduced thermal plasticity. The fitness effects of thermal tolerance and thermal plasticity interacted such that plasticity incurred larger reproductive costs in families with high basal tolerance, consistent with a fitness tradeoff.

MAKING SENSE OF THE ARMS RACE: INTEGRATED ANALYSIS OF PHENOTYPIC PLASTICITY DURING ECHINOID LARVAL DEVELOPMENT

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CSU Long Beach

Feeding echinoid larvae exhibit food-induced morphological plasticity in arm length. If food is scarce, larvae grow long arms to increase algal food capture rate. If food is abundant, larvae grow shorter arms and direct energy toward faster development. Recent studies from our lab have sought to define the comprehensive nature of arm-length plasticity in larvae of the Pacific sand dollar, *Dendraster excentricus*. Higher dimensional analyses (surface area and volume) indicate that beyond having longer arms, low-fed larvae also have a significant expansion of surface area compared to high-fed larvae. This enables low-fed larvae to have increased access to another source of nutrition: dissolved organic molecules in seawater. Rates of amino acid transport were more than 2-times greater in low-fed larvae than high-fed larvae. When long-armed, low-fed larvae were switched to high-food conditions at 10-, 20-, and 30-days post fertilization, all treatments exhibited a rapid decrease in arm length, indicating that plasticity capacity is maintained throughout the larval period and that long arms incur a significant energetic cost to maintain. Physiological analysis of food switched larvae revealed a surprising similarity in the total energetic cost of development despite large differences in planktonic larval duration (> 21 days). These results reveal a novel suite of adaptive responses to low-food conditions that involve more than arm length. This information is critical for modeling recruitment success in feeding larval stages facing climate-induced variation in food availability.

Session 5: Conservation and Restoration I

* indicates presenting author, † indicates eligibility for Best Student Paper Award

FRIEND OF FOE? EFFECT OF EELGRASS ON FILTER FEEDER BIOMASS AND CONDITION INDEX IN A MULTI-HABITAT LIVING SHORELINE

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Over the past decades, estuarine ecosystems have suffered significant habitat loss. Multi-habitat living shorelines (MHLS) implementation can restore lost habitat function. Researchers constructed MHLS in 2016-2017 in Newport Bay, CA by restoring eelgrass and oyster beds together and in isolation at each of four sites. I hypothesized that eelgrass would increase sedimentation rates onto adjacent oyster beds, causing declines in oyster and other filter feeder biomass and per capita condition indices (CI). One year (2018) and four years (2021) post-restoration, I excavated filter feeders from replicate quadrats on oyster beds, identified them by species, weighed them to determine wet and dry tissue and shell weight, and quantified CI. I quantified sedimentation by measuring mud deposition on oyster beds using a periodontal probe and quantified eelgrass densities using quadrat surveys. Mud deposition was not affected by eelgrass presence or density, except in 2018 at one of three sites, where deposition was higher when oyster beds were restored without eelgrass. After one year, eelgrass presence decreased native oyster and non-native mussel biomass and increased native and non-native mussel condition indices. Eelgrass density had no effect on filter feeder biomass or CI at one and four years post-restoration. Increasing understanding of the relationship filter feeders share with eelgrass will inform future management decisions about whether to restore MHLS together or in isolation.

CLIMATE CHANGE REDUCES LONG-TERM POPULATION BENEFITS FROM MARINE PROTECTED AREAS THROUGH SELECTIVE PRESSURES ON SPECIES MOVEMENT

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1- UC Santa Barbara 2- The Nature Conservancy

Marine protected areas (MPAs) are important conservation tools that confer ecosystem benefits by removing fishing within their borders. Fishing mortality outside of a traditionally fixed MPA can exert selective pressure for low movement alleles, resulting in enhanced protection. Moving less, however, could be detrimental in the face of climate change. Here, we build a model to assess the impact of movement evolution in and around static MPAs resulting from both fishing mortality and temperature-dependent mortality across five climate scenarios. While movement evolution allows MPA populations to survive longer, we find that long-term, climate change degrades the benefits by selecting for higher movement

genotypes. Resulting population decline within MPAs is faster than expected based on climate mortality alone, leading to population extinction sooner, even within the largest MPAs. Our findings suggest that while static MPAs may conserve species for a time, other strategies may be employed in conjunction to conserve species into the future.

EXPLORATIONS OF PLACE THROUGH MARINE SCIENCE, LITERATURE, HISTORY, AND ART ABOARD THE HISTORIC *WESTERN FLYER*

Mostow, R.S.*; Thomas, K.N.

Western Flyer Foundation

The Western Flyer Foundation is a marine science research and education nonprofit inspired by the cross-disciplinary friendship of ecologist Ed Ricketts and author John Steinbeck. In 1940, Ricketts and Steinbeck chartered the *Western Flyer*, a wooden sardine purse-seiner, for a six-week exploration of Mexico's Gulf of California. The following year they published *Sea of Cortez* (and later *Log from the Sea of Cortez*), a work of creative nonfiction that blends marine science, philosophy, and natural history. The Western Flyer Foundation acts as steward of the recently restored *Western Flyer* and is preparing for the next phase of this iconic vessel's story: as a platform for marine research and education. Through our education programs, teachers, scientists, and students conduct field research in marine and coastal ecosystems of Monterey Bay, CA while immersing themselves in the rich literary and historical traditions of the *Western Flyer*. Our programs integrate the arts and the sciences and are hands-on and skills-based. These programs are free for participating schools and are aimed at engaging students from our local community with backgrounds or identities currently underrepresented in ocean sciences. Here we will describe example education programs run by the Western Flyer Foundation, insights into the integration of art and science from our pilot programs, and opportunities for future connections and collaborations.

REFRESHING MITIGATION: GUIDANCE FOR IMPROVING FUTURE OUT-OF-KIND RESTORATION ACROSS CALIFORNIA'S COASTAL ZONE

Anderson, S.S.[1*]; Ambrose, R.F.[2]; Spies, B.T.[1,3]

1- CSU Channel Islands 2- UC Los Angeles 3- Cabrillo Marine Aquarium

Coastal stressors are growing in intensity and magnitude thanks to development pressures and our unfolding biodiversity and climate crises. As we draw closer to exhausting remnant nearby candidate mitigation locations (e.g., potential coastal salt marsh restoration sites) and evermore chronic disturbance pushes systems toward alternative stable states (e.g., beachless coastlines at high tide), most official mitigation guidance remains focused on replicating historic conditions. As a consequence, when regulators are faced with increasingly common situations where in-kind mitigation is impractical or impossible, they are left without clear guidelines for out-of-kind mitigation. We propose a new approach to address this management gap by using ecological structure, ecological function, and ecosystem services metrics when considering potential out-of-kind mitigation projects and when assessing their subsequent performance. Our framework provides flexibility for developing out-of-kind mitigation projects while ensuring that lost resources are fully compensated for.

COMPARISON OF FISH RECRUITMENT ON AN ARTIFICIAL REEF AND ADJACENT NATURAL REEFS

† Huang, J.L.*; Steele, M.A.; Nickols, K.J.

CSU Northridge

Artificial reefs provide new hard-bottom substrate, which can increase the availability of suitable habitat for many benthic species. With intentional design and material choice, it's hoped that they can replicate characteristics of natural habitat to mitigate losses from anthropogenic disturbances or climate change. In 1999, an artificial reef was constructed near the San Onofre Nuclear Generating Station (SONGS) in Southern California to mitigate loss of kelp forest habitat caused by discharge from the power plant water cooling system. This artificial reef and two nearby natural reefs have been monitored annually via scuba surveys. To understand the efficacy of the artificial reef in providing comparable habitat function for larval recruitment, we analyzed the SONGS Mitigation Monitoring data to determine the recruitment patterns of three abundant fish species: California sheephead (*Bodianus pulcher*), kelp bass (*Paralabrax clathratus*), and señorita (*Oxyjulis californica*); and evaluated for environmental variables (e.g. MOCI, SST, MEI, PDO, BEUTI, NPGO) driving recruitment. Recruitment of kelp bass and señorita was similar on the artificial reef and natural reefs; but recruitment of California sheephead differed among the three reefs. Interannual variation in recruitment was substantial for all three species, but no single environmental parameter significantly predicted any of this variation. A deeper understanding of the environmental drivers of variation in recruitment could help to understand how changes in environment could affect the functionality of artificial reefs.

RECENT HEATWAVE SHIFTS CORAL REEF COMMUNITIES IN UNEXPECTED WAYS

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University of Florida

Florida Keys coral reefs are among the most degraded coral reefs on earth. Decades of overexploitation, diseases, extreme temperatures, and hurricanes have resulted in communities dominated by more hydrocorals and octocorals than stony corals. In the summer of 2023, a marine heatwave in the Florida Keys broke records and made headlines with striking images of bleached stony corals. To understand community-level impacts of the heatwave, we returned to sites surveyed in 2022 and assessed benthic communities post-heatwave. Our short time series reveals that Florida Keys stony corals suffered high levels of bleaching and mortality, in a scene all too common around the world. However, we also observed signs of bleaching and mass mortality in other sessile benthic organisms including zoanthids, hydrocorals, and octocorals. Looking across sites, we found benthic communities that were once distinct converged on a simpler community structure. Our preliminary findings suggest that reefs may be changing more quickly and in different ways than previously thought, with no clear winners as reefs catapult into the Anthropocene.

Session 6: Community Ecology I

* indicates presenting author, † indicates eligibility for Best Student Paper Award

DOES URBANIZATION ALTER VERTEBRATE SCAVENGING ASSEMBLAGES AND ECOSYSTEM FUNCTIONS ON CALIFORNIA BEACHES?

† Gerraty, F.D.*; Gobei-Bacaylan, A.; Diel, K.

UC Santa Cruz

Urbanization is rapidly transforming coastal landscapes around the world, altering the structure, function, and connectivity of marine and terrestrial ecosystems. In this study, we explore the impact of urbanization on the structure of vertebrate scavenging assemblages and the ecosystem functions they provide in sandy beach ecosystems in central California, USA. We sampled vertebrate scavenging assemblages using baited camera traps on 17 beaches spanning a 40km gradient of coastal urbanization and documented 1,231 scavenging events by 12 vertebrate species, including several species rarely considered important consumers in sandy beach habitats. We identified pronounced urbanization-associated shifts in the composition of vertebrate scavenger guilds, but found that these differences did not lead to subsequent changes in ecosystem functions performed by shoreline scavengers. Rates of carrion processing did not differ across the urbanization gradient, with urban-adapted and invasive species compensating for the absence of the predominate native scavengers documented in rural areas. Our results underscore the pervasive and nuanced effects of urbanization on the dynamics of land-sea connectivity and demonstrate that urban ecosystems can sometimes sustain critical ecosystem functions in the face of landscape transformation.

SPATIOTEMPORAL DRIVERS OF PARROTFISH DISTRIBUTION AND THEIR IMPLICATIONS ON DYNAMIC HABITAT SHIFTS AROUND MOOREA, FRENCH POLYNESIA

Castañeda, N.*; Adam, T.; Caselle, J.; Burkepile, D.

UC Santa Barbara

Parrotfishes play an important role in benthic dynamics on coral reefs by impacting the prevalence of algae and facilitating corals. Adult parrotfishes are often positively correlated with algal productivity suggesting food availability strongly influences their distribution. However, the temporal and spatial responses of parrotfishes to available resources can be dynamic. We examined the spatiotemporal patterns of parrotfish abundance around the island of Moorea, French Polynesia to understand the drivers of ontogenetic habitat shifts of scarids. First, we used surveys of fish communities across ~200 reef sites around Moorea to identify the current spatial correlates of parrotfish stage structure in lagoon habitats. Then, we used a time series of fish communities spanning a seventeen-year time period (2005 – 2022) across 18 sites to explore the relationship between the abundance of parrotfishes of different life stages and benthic communities over time. The current spatial distribution of parrotfish is highly variable across the reefs of Moorea, with the abundance of juveniles positively associated with habitat availability and the abundance of adults/subadults positively associated with algal resources. Using our time series, we found a significant increase in the average size of parrotfish found in the lagoons over time, which corresponded to increased algal resources, suggesting there is retention of adult parrotfish in lagoons/nursery habitats as algal availability increases. Using both long-term and fine-scale data of parrotfish distribution, we can make inferences about how shifts toward algal-dominated reefs may alter ontogenetic habitat shifts and redirect movement of parrotfishes across reef habitats.

NON-CONCURRENT CLIMATE INDUCED RANGE MOVEMENT IN HERBIVORE AND PRIMARY PRODUCER

† Cortese, M.R.*; Freestone, A.L.

Temple University

Species range movement due to changing ocean conditions is occurring around the world. As species move, they build new interaction networks as they shift from or into new ecological communities. Typically, species ranges are modeled individually, but biotic interactions have been shown to be important to creating more realistic modeling outputs for species. To understand the importance of consumer interactions in Eastern Pacific kelp forest species distributions, we used a Maxent framework to model a key foundation species, giant kelp (*Macrocystis pyrifera*), and a dominant herbivore, purple sea urchins (*Strongylocentrotus purpuratus*). We found evidence for giant kelp expansion in the northern section of its range, with no projected contraction at the southern range edge. Despite its known co-occurrence with giant kelp, models of purple urchin showed a non-concurrent southern range contraction and a co-occurring northern range expansion. While the co-occurring movement may lead to increased spatial competition for suitable substrate, this non-concurrent contraction could result in community wide impacts such as herbivore release, tropicalization, or ecosystem restructuring.

OH SHT! I FORGOT TO MEASURE THAT! COPING WITH OMITTED VARIABLE BIAS FOR THE CAUSAL ANALYSIS OF OBSERVATIONAL DATA**

Byrnes, J.E.K.[1*]; Dee, L.E.[2]

1- University of Massachusetts Boston 2- University of Colorado Boulder

As ecology tackles progressively larger problems, we have begun to move beyond the scale at which we can conduct experiments to derive causal inferences. Experiments have long been seen as the gold standard for quantifying causal effects in ecological systems. Large-scale observational data, in contrast, has largely been seen to either provide a place to explore ideas derived from experiments or a source of interesting patterns to inspire randomized controlled experiments This avoidance of using observational data for causal conclusions arises from the valid fear of results of unmeasured confounding variables in observational analyses. Unmeasured confounders that influence both the causal variable of interest and effect can bias conclusions - a problem known as Omitted Variable Bias. This phenomenon is what leads to the old saying, “Correlation is not causation.” Many other scientific disciplines, however, cannot do experiments for reasons of ethics or feasibility; they have developed robust approaches for causal inference from observational data. Here we show how these approaches can be used in ecology

for causal inferences from observational data. We use a motivating example of assessing the effects of warming on intertidal snails to discuss how ecologists currently handle observational survey data and inference - often incorrectly. We then present alternative statistical design, discuss how they work using the language of causal path diagrams, demonstrate how easily they can be applied to common ecological datasets, and finally how well they are able to overcome problems of unmeasured confounding variables. We present these tools in the hopes that others will pick them up and begin to apply them to their own science as an important complement to experiments for generating meaningful insights into the future of our oceans.

THE INFLUENCE OF MARINE PROTECTED AREAS ON THE DIETARY NICHES OF CALIFORNIA REEF FISHES

† Gutterman, M.E.*; Steele, M.A.

CSU Northridge

A species' diet is an indication of the role it plays in a community and the extent of its interactions with other species. However, it is not always clear to what degree these roles change at different locations and how much of the variation is tied directly to human activities degrading marine ecosystems. Marine protected areas (MPAs) have been shown to increase the population numbers and body size of harvested species, however, little is known about how these changes within MPAs influence the diets of species within them. This study looked at how MPAs influence prey availability, diet composition, and trophic position in California reef fishes. The diets of two fish species, Embiotoca jacksoni and Bodianus pulcher, were assessed inside and outside of MPAs. Preliminary data suggest that the diets of B. pulcher inside MPAs contain species from more taxonomic categories than those of B. pulcher from non-MPA study sites. In contrast, E. jacksoni shows the opposite pattern, with the fewer taxonomic groups found in the stomach contents of fish from MPAs. These differences inside vs. outside of MPAs may reflect a shift in the dietary niche of these fishes within MPAs to accommodate increased competition due to higher population biomass within MPAs. Although many studies have documented enhanced densities and biomass of harvested species inside marine protected areas, this study supports the hypothesis that these larger populations result in tangible changes in dietary niche and trophic ecology.

REDUCTION OF TOP-DOWN CONTROL RESULTS IN DISSIMILARITY IN COMMUNITY COMPOSITION AND ALTERNATIVE PATHS LEADING TO CORAL- OR ALGAL-DOMINANCE ON A CORAL REEF

Speare, K.E.[1*]; Adam, T.C.[2]; Goodman, A.[2]; Vega Thurber, R.[3]; Burkepile, D.E.[2]

1- Arizona State University 2- UC Santa Barbara 3- Oregon State University

Top-down (e.g. herbivory and predation) and bottom-up (e.g. nutrients) processes both structure ecological communities, but their relative importance in driving community assembly after severe disturbances is debated. Many marine ecosystems are also experiencing human-induced changes to top-down and bottom-up forcing through fisheries and nutrient pollution, thus, making community re-assembly after disturbance unpredictable. We experimentally tested the relative importance of top-down and bottom-up processes in driving community development after a simulated disturbance on a coral reef using an experiment that manipulated herbivory and nutrient enrichment for four years. We conducted our experiment on a coral reef in Moorea, French Polynesia starting in 2018. Our experiment had eight plots in which we removed all live corals and fleshy macroalgae to mimic the effects of a severe cyclone. Within each plot, we nested 4 herbivore exclosures (~1 m2 each) that allowed different size fishes access to the benthos, creating four levels of herbivory. Each plot was then assigned to either ambient or enriched nutrient conditions. Overall, herbivory strongly affected community development, whereas nutrients had a weaker effect. After four years, herbivory was inversely related to beta-diversity, where plots with low herbivory had high beta-diversity relative to plots with high herbivory. This dissimilarity in community composition at low levels of herbivory was the result of plots becoming rapidly colonized by either coral or macroalgae. In contrast, community development in plots with higher levels of herbivory was slow but predictable, with all plots slowly increasing in coral cover and remaining relatively free of macroalgae. This result suggests that reduced top-down control can result in alternate community paths that lead to either coral- or algal- dominance. We conclude that herbivory strongly influences both the rate and predictability of community development in these ecosystems.

Session 7: Speed Talk General Session I

* indicates presenting author, † indicates eligibility for Best Student Paper Award

WASHINGTON STATE ACIDIFICATION NEARSHORE MONITORING NETWORK (ANEMONE): COMMUNITY SCIENCE, EDUCATION, AND WORKFORCE DEVELOPMENT

Anderson, K.N.*; Allen, K.S.; Donoghue, C.; Catton, C.A.

Washington Dept. of Natural Resources

The Acidification Nearshore Monitoring Network (ANeMoNe) is a community science, education, and workforce development program that started in 2015 as a targeted research project to investigate the ameliorative effects of eelgrass habitats on local pH conditions. Since then, the program has expanded to 12 locations statewide to monitor climate change and acidification in nearshore environments and to test practical management options to reduce negative impacts of changing ocean conditions. Each year volunteer ANeMoNe Site Guardians monitor eelgrass beds and maintain sensor arrays during the spring and summer low tide series. Environmental sensors continuously measure water temperature, pH, dissolved oxygen, salinity, and water levels both inside and outside of eelgrass beds at each of the sites. Biological data, including eelgrass density, bird behavior, and bivalve recruitment are also collected to explore the ecological effects of climate change in the nearshore environment. Leveraging the activities of the Community Science program, we have also developed K-12 curricula focused on climate resilience and local ecology, and we have established youth internships with our tribal partners to engage young climate leaders, particularly from communities most vulnerable to climate change. Through collaboration, education, and mentorship, the ANeMoNe program contributes to a deeper understanding of climate change effects in the nearshore and informs collaborative solutions that benefit both local communities and the global environment.

MOVEMENT OF WEANED NORTHERN ELEPHANT SEAL PUPS DURING THEIR FIRST AT-SEA FORAGING MIGRATION

† Saenger, K.[1*]; Bean, W.T.[1]; Harris, H.S.[2]; Campbell, L.[2]; Eby, E.[2]; Riordan, K.[1]; Murphy, M.[1]; Kolluru, G.R.[1]; Liwanag, H.E.M.[1]

1- Cal Poly, San Luis Obispo 2- The Marine Mammal Center

The northern elephant seal (*Mirounga angustirostris*, NES) is a well-studied marine mammal known for engaging in long foraging migrations at sea. Adult male NES follow pathways along the coast towards Alaska and adult female NES follow pathways to open ocean. However, there is little to no information about newly weaned NES pup foraging behavior. This lack of knowledge is significant because NES have a mortality rate of ~50% in the first year. This project aims to better understand the migratory pathways of NES during this critical life stage. We deployed satellite tags on newly weaned NES pups at Vandenberg Space Force Base (VSFB, est. 2016, n=10) and San Nicolas Island (SNI, est. 1949, n=5). We hypothesized that weaned NES pups would [1] prioritize near-site foraging areas and thus migrate shorter distances compared to adults, [2] exhibit no sexual divergence in their pathways, and [3] have pathways that differ between the two breeding sites. We have found a high degree of individual variation in migration distance, with one seal venturing over 3000 km to the Gulf of Alaska, and another remaining near the Channel Islands of California. Examining these migratory pathways and comparing them between rookeries and years provides insight into important foraging grounds for this life stage, differences between breeding sites, and environmental influences on migration, which will inform the conservation and management of this species.

STORYTELLING AND ETHICS IN SCIENCE: LESSONS FROM LIVING AND LEARNING IN FORT BRAGG, CA

† Blundell, M.Z.[*]

UC Davis

In marine systems, the effects of global change on natural resource-dependent coastal communities offer both opportunities and challenges for science communication. For example, the loss of kelp forests in Northern California has spurred public enthusiasm and concerns about restoration. Through an immersive engagement project, I worked in collaboration with the City of Fort Bragg, a rural coastal community, for several months to develop a mini-curriculum entitled “Coding the Coast” about local kelp forest ecology and computer coding, which I taught for three weeks in local second-grade classrooms. In this talk, I share some lessons regarding science communication and ethics that stood out from this public engagement experience. This presentation explores the practical application of storytelling in science communication. I demonstrate how storytelling can bridge the gap between technical and public understanding by sharing examples that highlight its effectiveness in various contexts. I also emphasize the ethical importance of research as service, i.e., as information to serve and not merely as information to collect. In an era of global change, applied research that engages collaborators and audiences outside of academia is increasingly important. Storytelling can be a unifying tool that fosters inclusivity and excitement about the scientific process.

WHEN THEY GO LOW, WE GO HIGH: A TIDAL HEIGHT COMPARISON OF OYSTER CARDIAC AND GAPE ACTIVITY

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San Diego State University

High intertidal species occupy a unique habitat niche where water depth, temperature, oxygen availability, and other factors cycle from high and low every day. A field monitoring experiment in San Diego Bay was designed to measure the heart rate and gape activity of Pacific oysters, *Crassostrea gigas* , at two tidal heights. Oysters in the low shore group displayed diel heart rate cycling in accordance with the day-night fluctuation of water quality parameters like dissolved oxygen, temperature, and pH. Heart rate of oysters in the high shore group cycled over both a twelve hour and a twenty four hour cycle, suggesting a stronger influence of the mixed tidal cycle on cardiac activity of oysters that settle at higher elevations. Gaping behavior at both tidal heights was strongly associated with tidal exposure. While the high shore group gaped during submersion throughout the study period, the low shore group occasionally closed their valves during submersion. The reason for closed valves during submersion is unclear, but it may indicate that the food and oxygen demands of the low shore group were sufficiently met.

UTILIZING CORALNET FOR UNDERSTORY KELP SPECIES AND SUBSTRATE TYPE DETECTION IN ELLIOTT BAY, WA: A CLASSIFIER TRAINING APPROACH

Williams, M.[*]; Bogdanova, E.; Larson, S.; Randell, Z.

affiliation not listed

Kelp forests play a vital role in the health and biodiversity of marine ecosystems, making their accurate monitoring and assessment imperative for ecosystem management. In this study, we explore the application of CoralNet, a collaborative image annotation platform, to efficiently and accurately detect understory kelp species and substrate type. We leverage benthic imagery, utilizing supervised classification techniques to accurately categorize individual species and their percentage coverages. By establishing an open-source repository of annotated kelp forest imagery, we seek to synergize the global research efforts for more comprehensive meta-analyses of these underwater forests. This approach not only enhances our understanding of the Elliott Bay ecosystem but also provides valuable tools for ecological research and conservation efforts. By harnessing the power of CoralNet and machine learning, this study presents a scalable and adaptable solution for monitoring kelp forests throughout Puget Sound.

USING HYDROACOUSTICS TO EXAMINE THE RELATIONSHIP BETWEEN THE VERTICAL DISTRIBUTION OF FISH AND ENVIRONMENTAL FACTORS

† Diaz, L.C.[1,2*]; Bolser, D.G.[1,3]; Egerton, J.P.[1,4]; Erisman, B.E.[1,3]

1- UT Austin 2- CSU Northridge 3- NOAA Fisheries 4- Echology Ltd, UK

In the U.S. Gulf of Mexico, ship channels are an interface between bays, estuaries, and the open ocean. Despite being the heart of many fish activities, little is known about fish behavior in these crucial habitats. This study determined the relationship between the vertical distribution of fishes and fluctuating environmental variables. To understand this relationship, 32 hydroacoustic surveys in the Aransas Ship Channel (Port Aransas, TX) were conducted and paired with measurements of temperature, salinity, dissolved oxygen (DO), and barometric pressure. Pelagic fishes were tracked through successive 'pings' of the echosounder and their mean height off the bottom (HOB) was recorded. Temperature, salinity, and DO had small, but significant effects on fish HOB ($R2 = 0.20$, 0.38, and 0.12 respectively; p-value < 0.05 for each), while changes in barometric pressure did not have a significant effect ($R2 = -0.028$, p-value > 0.05). Species composition in the study area changes seasonally, and since summer conditions (low DO, high salinity, and warmer temperatures) had the biggest influence on fish HOB, trends might be indicative of shifting community composition rather than behavior of resident fishes. Future work will examine changes in HOB in response to episodic disturbances (e.g., cold fronts) over shorter time scales to separate the effect of species composition from behavioral responses. Findings may have implications for planning development activities for the ship channel in the near future (e.g., dredging, installation of a desalination plant and crude oil terminal).

THERMAL REFUGIA ARE BEING LOST AS CONTROL OF INTERTIDAL ZONATION SHIFTS FROM EMERSION TIME TO THERMAL STRESS

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University of British Columbia, Canada

The vertical upper limits of intertidal species may be determined by factors ranging from thermal stress, desiccation tolerance, and food supply, and the relative importance of these factors may vary in space and time. Surveys conducted in Washington State in the year 2000 indicated that the upper limits of barnacles (*Balanus glandula*) and mussels (*Mytilus californianus*) were determined by emersion time, not thermal stress, at wave exposed coastal sites (e.g., Tatoosh Island). However, upper limits shifted to thermal control as one moved east towards warmer sites in the Strait of Juan de Fuca and San Juan Islands. Resurveys at the same locations on Tatoosh Island in 2010 and 2023 indicate that thermal control of upper limits became important at this site after 2010. The upper limits of both barnacles and mussels remained similar from 2000 to 2010, but have shifted significantly downshore between 2010 and 2023. For barnacles, this shift was significantly greater on south-facing surfaces compared to north-facing surfaces. The lower limit of the mussel bed has also shifted downshore since 2010, likely as a consequence of reduced *Pisaster ochraceus* densities associated with sea star wasting disease. These results suggest that sites that formerly served as refugia from high temperatures may now be vulnerable to thermal stress. The impacts of further warming, coupled with the recovery of intertidal predators, may result in a squeeze effect that reduces the distributional extent of important habitat-forming species like barnacles and mussels.

EFFECTS OF TEMPERATURE ON THE GROWTH RATE AND SETTLEMENT OF OLYMPIA OYSTER (OSTREA LURIDA) LARVAE

† Rodman, C.C.[1*]; Johnson, K.M.[1,2]

1- Cal Poly, San Luis Obispo 2- California Sea Grant

The Olympia Oyster (*Ostrea lurida*) is the only native oyster species on the west coast of North America. Since the early 20th century their populations have been overexploited and reduced from factors including pollution and overharvesting. As a bivalve species that lives in estuarine, intertidal, and subtidal environments they contribute to healthy, biodiverse ecosystems along our coasts by providing structure to the shoreline, filtering water, and acting as a food source. It is important that we understand the environmental conditions that this species thrives in so that restoration efforts can be as effective as possible. Aquaculture is a growing industry that provides many services; restoration is one potential service provided when cultivating native species. In order to have flourishing Olympia populations in the wild, restorative aquaculture techniques can be used to increase populations alongside commercial operations. The conditions used during early hatchery stages can have long-lasting impacts on juvenile growth and survival. As such, the questions I sought to answer were 1) How does temperature affect the growth rate of Olympia oyster larvae, 2) How does temperature affect the amount of larvae that settle on a given substrate, 3) When using shells as the substrate, how does the species of shell affect the amount of larvae that settle, and 4) How does the shell side effect the amount of larvae that settle on them. Together this work can help guide future restorative aquaculture practices to meet both commercial and restoration goals for this species.

WHY ARE COCONUT CRABS (BIRGUS LATRO L.) SMALLER AND RARER IN COCONUT PLANTATIONS ON A PACIFIC ATOLL?

† Burnett, M.W.[1*]; White, T.D.[2]; Braman, C.A.[1]; Kerrigan, A.[1]; Young, H.S.[1]

1- UC Santa Barbara 2- Stanford University

Coconut crabs (*Birgus latro* L.) are the world's largest terrestrial arthropods and support critical ecological processes on tropical atolls. We surveyed unharvested *B. latro* populations on several islets of Palmyra Atoll, a wildlife refuge in the central Pacific, to investigate the impacts of forest composition on crab sizes, density, and behavior. Perhaps counterintuitively, mark-recapture surveys revealed that dense coconut (*Cocos nucifera* L.) plantations like those found throughout the tropical Pacific support 64% fewer coconut crabs than the broadleaf forests they replaced. Timed visual surveys corroborated this finding, with over seven times more coconut crabs detected in broadleaf forests than in coconut monocrops. Coconut plantations featured a greater proportion of small crabs and very few crabs of terminal size. While coconut palms provide an abundant food resource for coconut crabs, behavioral observations suggest that monospecific palm understories fail to provide as many sheltering and burrowing sites as broadleaf trees with complex root systems—over half of all crabs observed sheltering had selected broadleaf tree structures for the purpose, even in mixed and coconut-dominated forest stands. We hypothesize that the scarcity of such structures limits the survival of large crabs in coconut monocrops. These findings indicate that restoration of diverse atoll forests would benefit the charismatic and widely overharvested coconut crab, which was recently listed as a vulnerable species by the IUCN.

HEAT STRESS: CHANGING DISTRIBUTION OF FUCUS EVANESCENS & FUCUS GARDNERI IN THE ALASKAN INTERTIDAL

† Bower, E.H.*; Valladares, S.*

UC Santa Cruz

Fucus *gardneri* and Fucus *evanescens* are genetically distinct seaweed species found in the nonpolar regions of the Alaskan rocky intertidal. Fucus provides habitat, shelter, and food for a variety of invertebrates and serves as a key substrate for herring spawning and opibionts. Ester Serao discovered genetic differences in Stika, Alaska, between the two species, but little research had studied their morphological, physiological, or ecological differences. This study characterizes the morphology of the two species and the mechanisms driving their distribution along the intertidal elevational gradient. We conducted field surveys in Sitka, Alaska and found that F. *gardneri* is more abundant in lower intertidal zones whereas F. *evanescent* is more abundant in higher intertidal zones. To assess the factors driving the difference in distribution, we measured the thermal performance, conducted desiccation experiments, and did field transplants. Our results show that F. *evanescent* had a lower maximum photosynthetic rate than F. *gardneri* when subjected to desiccation and warm temperatures. However, F. *evanescent* was able to retain more water and recover faster than F. *gardneri* under similar conditions. Preliminary results indicate that F. *evanescent* experienced more herbivory which suggests an explanation for a higher zonation pattern in F. *evanescent*. These results suggest an interplay between physiological stress and herbivory govern their distributions and may affect the zonation pattern of these species under conditions of increasing temperature resulting from climate change.

INVESTIGATING IMPACTS OF MARINE HEATWAVES ON A PRIMARY DRIVER OF KELP FOREST RECOVERY AND DECLINE: STRONGYLOCENTROTUS PURPURATUS

† McDonald, A.M.*; Hofmann, G.E.

UC Santa Barbara

Kelp restoration has become a major goal for California agencies, but ocean climate change and the interaction with over-grazing by sea urchins makes decision-making complex. It is clear that kelp forests are deteriorating due to ocean warming, but how is one of their main predators, the purple sea urchin, expected to respond to changes in environmental conditions? To provide information on the impacts of serial marine heatwave (MHW) events on *S. purpuratus* offspring physiology and thus exploring potential for future kelp forest restoration, adult urchins were acclimated to a MHW and a non-MHW condition. Following the two-month long acclimation period, adults were spawned and offspring from each parental condition were reared at 15°C. We assessed transgenerational effects via morphometrics, biochemical indices, and temperature tolerance of the progeny. Results showed that serial MHW events affected life history traits of *S. purpuratus*. For the adults, MHW-acclimated sea urchins had lower survival probability at MHW temperatures but their eggs were larger. For the progeny, gastrula-stage embryos from MHW-acclimated females were more thermally tolerant and had higher developmental success at elevated temperatures as compared to progeny from non-MHW-acclimated females. Overall, we found various outcomes for different life stages with adults faring worse but survivors produced thermally hardy progeny, possibly contributing to the success of urchins in declining kelp forests.

NORTHERN SEA OTTER (ENHYDRA LUTRIS KENYONI) POPULATION AND FORAGING ANALYSIS IN WASHINGTON STATE

Olsen, A.Y.*; Larson, S.

Seattle Aquarium

Northern sea otters (*Enhydra lutris kenyoni*) were translocated from Alaska to Washington in 1969/1970 to repopulate a previously occupied area within their range. The native otters had been extirpated during the Pacific maritime fur trade, and the last Washington sea otter was shot in 1911. Fifty nine animals were translocated from Amchitka Island, Alaska to the outer coast of Washington, where the population has now grown to over 3,000 individuals. An annual population census occurs in June with collaboration from the U.S. Fish and Wildlife Service, U.S. Geological Survey, and Washington Department of Fish and Wildlife. The Seattle Aquarium (and other groups) participate by conducting ground surveys to ground truth photos of rafts taken by small plane. To access sea otter population growth impacts to the nearshore, foraging data is also collected by the Seattle Aquarium on a monthly basis from various locations in Washington between Neah bay and Kalaloch. Here, we present a preliminary analysis of population growth and diet using a Bayesian model, Sea Otter Foraging Analysis (SOFA).

USE OF A CALIFORNIA WETLAND: HARBOR SEAL (PHOCA VITULINA) HAUL-OUT PATTERNS IN ELKHORN SLOUGH

† Nicholson, E.H.[1*]; Eby, R.[2]; McDonald, B.I.[2]

1- Moss Landing Marine Labs 2- affiliation not listed

This project investigates the small-scale habitat use patterns in a nonmigratory marine species, the harbor seal (*Phoca vitulina*). The goals are to provide an updated overview of the harbor seal population in Elkhorn Slough, CA, identify haul-out areas that are seasonally relevant for pupping and molting, and analyze environmental factors that may influence the harbor seals' abundance and distribution in the slough. Seal count data were collected by researchers at the Elkhorn Slough National Estuarine Research Reserve (ESNERR) during bi-monthly surveys at 14 sites throughout the slough. Additional survey data at the 5 most populated haul-out areas were collected by volunteers from Moss Landing Marine Laboratories (MLML). Results indicate that there are differences in the abundance of harbor seals observed in the slough across seasons with more seals being present during the molting season. There is also a difference in how they are distributed within the slough. During the pupping season, the number of seals increases at the Seal Bend and East Wildlife locations while decreasing at other locations. During the molting season, the number of seals increases at the Avila location while decreasing at other locations. The primary environmental factor influencing harbor seal abundance is tide height. The knowledge gained in this study is important for future research and conservation decisions and could inform the design of seal population surveys to make them more accurate and effective.

Session 8: Applied Ecology II

* indicates presenting author, † indicates eligibility for Best Student Paper Award

BRINGING MARINE HEATWAVES INTO THE LAB: HOW TO ENGINEER HEATING EVENTS IN AN EXPERIMENTAL SETTING

† Ritger, A.L.*; Hofmann, G.E.

UC Santa Barbara

Marine heatwaves have generated growing interest among scientists and the public as heating events increase in frequency, intensity, and duration due to anthropogenic climate change. Anomalously warm water events often have devastating impacts on marine ecosystems and the human societies that rely upon them by disrupting ecological, social, and economic systems. Experimental studies are a critical component of research programs aimed at broadening our understanding of the ecological effects of marine heatwaves; however, traditional experimental methods often do not accurately reflect the complexity of marine heatwaves as they occur in our oceans. In this presentation, I describe how to use a Raspberry Pi as a temperature controller to generate marine heatwaves that match the dynamic nature of real-world heatwave events in the lab. This experimental set-up allows for full customization, allowing researchers to re-create marine heatwaves that have happened in the past or produce entirely new heatwave scenarios based on future projections. By adopting this more realistic experimental approach, scientists can design marine heatwaves studies that are more generalizable and useful in a world where marine heatwaves are the new norm.

MOLECULES IN PREDATOR URINE ENHANCE SURVIVAL OF A KEY ECOSYSTEM ENGINEER

Belgrad, B.[1*]; Russell, C.[1]; Cannon, R.[1]; Lunt, J.[1]; Roney, S.[2]; Cepeda, M.[2]; Jaco, B.[2]; Weissburg, M.[2]; Kubanek, J.[2]; Smee, L.[1]

1- Dauphin Island Sea Lab 2- Georgia Inst. of Technology

Many prey species adjust their behavior or morphology to reduce predation risk in response to predator chemical cues. These kairomones structure numerous ecological interactions and may be utilized to improve the survival of cultivated species or enhance restoration efforts. However, these molecules remain largely unidentified. We performed a series of bioassays with a model foundation species, oysters, to identify the chemical cues predators release that stimulate oysters to grow stronger shells and determine their consistency across different predator species. We placed juvenile oysters into jars and exposed them to exudates from either predatory fish, snails, or crabs as well as to eight different concentrations of urine extracted from blue crabs and two candidate molecules known to affect mud crabs. Oysters were held under these conditions for two months before measuring individual growth and shell strength. Oyster shell strength significantly increased by ~20 – 30% in response to urine from every fish and crab species, but did not change in response to oyster drill mantle fluid. Blue crab urine produced a standard dose response curve in oysters with urine concentration causing shell strength to peak at ~0.19 mL urine/L seawater. Additionally, both candidate molecules significantly increased oyster shell strength with the greatest response observed when the molecules were applied together. These findings suggest there are common (perhaps ubiquitous) molecules governing prey fear responses and their identification opens opportunities to manipulate species interactions.

EFFECTS OF OYSTER AQUACULTURE ON ELASMOBRANCH ABUNDANCE AND HABITAT USE IN A LARGE COASTAL ESTUARY

† Harman, R.M.*; Marin, J.J.R.; Bourdeau, P.E.

Cal Poly, Humboldt

Habitat modification from aquaculture can have large effects on natural communities, with increasing habitat complexity positively influencing benthic invertebrate and small fish abundance. However, the effects of aquaculture on elasmobranchs (i.e., sharks and rays), which use nearshore habitat to forage and provide top-down control of these ecosystems, is largely unknown. Over two years, I deployed baited remote underwater video systems (BRUVS) to examine the effects of oyster aquaculture on the presence and abundance of elasmobranchs and their main benthic prey (crabs) in mudflat and eelgrass habitats in Humboldt Bay, which yields ~70% of California's oysters, and provides critical habitat for elasmobranchs and crabs. I found positive effects of aquaculture presence on the likelihood of observing elasmobranchs (mainly bat rays and leopard sharks) in both mudflat and eelgrass habitats. In contrast, I found no effect of aquaculture presence on the abundance of the elasmobranch's main prey (rock crabs and Dungeness crabs). Elasmobranchs may be attracted to aquaculture for increased feeding opportunities, refuge from larger predators, or other stimuli associated with the aquaculture operation. Increased elasmobranch presence in and around aquaculture could intensify their top-down effects in these modified habitats, which may explain the unexpected lack of increased crab abundance in habitats with aquaculture. Future field manipulation could directly test the hypothesis of increased elasmobranch predation on crabs in aquaculture-modified habitats.

TOP-DOWN CONTROL OF INVASIVE EUROPEAN GREEN CRABS BY SOUTHERN SEA OTTERS IN CENTRAL CALIFORNIA

Jeppesen, R.[1*]; Grosholz, E.[2]; de Rivera, C.[3]; Tinker, M.T.[4]; Hughes, B.[5]; Eby, R.[1]; Wasson, K.[1]

1- Elkhorn Slough National Estuarine Research Reserve 2- UC Davis 3- Portland State University 4- UC Santa Cruz 5- Sonoma State University

Can recovering populations of native apex predators increase the resistance of coastal ecosystems to invasions by non-native species? Elkhorn Slough estuary in central California is habitat for several keystone species including the Southern sea otter (*Enhydra lutris nereis*) and several invasive invertebrates including the European green crab (*Carcinus maenas*). We investigated whether predation by sea otters has suppressed abundance of green crabs in Elkhorn Slough. We analyzed monitoring data tracking both otter and green crab abundances since the early 2000s. We found that as sea otters have steadily increased over the past decade, green crabs have declined. Sea otters consume a variety of prey including green crabs, which we quantified with field observations. Our analysis showed increasing sea otter density resulted in a significant reduction of relative green crab abundance at multiple sites. However, tidally restricted sites that impeded access by sea otters maintained higher densities of green crabs, highlighting the importance of restoring natural hydrology. We also compared green crab population trends across California estuaries and found green crabs have remained consistently low only in Elkhorn Slough over the past decade. We suggest that focusing efforts to maintain populations of native apex predators can have similar effects on invaders elsewhere.

COMPOSITION AND DISTRIBUTION OF FISH ASSEMBLAGES IN CAP DE CREUS NATURAL PARK IN RELATION TO DEPTH AND LEVELS OF MARINE PROTECTION

† Cieri, K.P.[*]; Starr, R.M.

Moss Landing Marine Labs

To preserve fish stocks and fishing interests, marine protected areas (MPAs) were established in parts of the Mediterranean Sea in the late 1970s. Enforced no-take areas have resulted in greater abundance, body size, biomass, and diversity of harvested fish species. The Cap de Creus Natural Park in Girona, Spain was established in 1998 and is divided into three management zones: a park zone, a partial reserve, and an integral reserve. The aim of this project was to improve our understanding of the distribution, abundance, and size composition of fishes in the park. I predicted that relative abundance, average length of conspecifics, community composition, and species richness and diversity would vary with depth according to species. I also hypothesized that relative abundance of fished species, especially those at higher trophic levels, would be greater inside reserve areas. To test these hypotheses, I surveyed 11 sites across the 3 zones in the park in 2018 using 3 video survey methods; a baited lander (BRUV), diver-operated video (SCUBA), and unbaited landers (Landers). I found that fish community composition, richness, and diversity differed above and below 25 meters. Additionally, highly vulnerable species were almost entirely confined to reserve areas that prohibited spearfishing. SCUBA surveys did not detect differences in the abundance of moderately vulnerable species between reserve and open areas. Further investigation is required to determine species-specific differences among tool types and long-term monitoring is needed to elucidate the effects of this MPA.

ECOLOGICAL IMPACTS OF THE INVASIVE EUROPEAN GREEN CRAB (CARCINUS MAENAS) IN WASHINGTON

Rubinoff, B.[1,2*]; Adams, J.[1]; Fisher, M.[2]; Grason, E.[1]; Litle, K.[1]; McDonald, P.S.[2]; Stote, A.[1]; Watkins, L.[1]

1- Washington Sea Grant 2- University of Washington

The European green crab (EGC) was first detected in Washington, USA in 1998, and since then, has expanded in numbers and spatial extent across coastal and inland waters. Ecological impacts of EGC have not yet been recorded at this early stage of invasion, but as populations continue to grow, they are likely to become increasingly detectable/apparent. We analyzed Washington Sea Grant's Crab Team monitoring data to determine how EGC populations vary over space and time and to identify species showing negative population correlations with green crab abundance. Native hairy shore crab (*Hemigrapsus oregonensis*) showed the strongest negative relationship with green crab abundance, aligning with documented impacts in other locations. We then conducted a tethering experiment during the summer of 2023 to investigate whether green crab abundance across multiple invaded sites show a positive correlation with the number of tethered hairy shore crab consumed. In this talk, we will present the results of our tethering experiment and discuss how they align with documented impacts of EGC in other locations. We will conclude by suggesting how our monitoring and experimental results can best be utilized by managers in coastal Washington.

Session 9: Special Session: Marine disease ecology in a changing world I

* indicates presenting author, † indicates eligibility for Best Student Paper Award

MARINE HERBIVORES FACILITATE TRANSMISSION OF A SEAGRASS PATHOGEN

Graham, O.J.[1*]; Aoki, L.R.[1]; Burge, C.A.[2]; Harvell, C.D.[1]

1- Cornell University 2- University of Maryland, Baltimore County

Herbivores commonly vector terrestrial plant pathogens, though their role in transmitting marine plant pathogens remains unknown. Here we show that amphipods (*Ampithoe lactertosa*) consumed more eelgrass (*Zostera marina*) infected with the protist *Labyrinthula zosterae* (Lz), the causative agent of seagrass wasting disease, than asymptomatic control leaves. Isopods (*Pentidoea wosnesenskii*) and snails (*Lacuna* spp.) grazed more asymptomatic leaves. We isolated Lz from herbivore feces, indicating that herbivores that eat diseased eelgrass can pass the live pathogen; qPCR detected Lz in herbivores. Experiments demonstrated isopods and snails indirectly facilitated pathogen transmission by creating grazing scars that increased disease, but did not directly transmit Lz from diseased to asymptomatic eelgrass. Field surveys demonstrated a close association between disease and herbivore grazing scars. Disease risk increased by 29% on grazed leaves. This is the first report of herbivores facilitating the spread—and magnifying the impacts—of a marine plant pathogen.

CONTRIBUTION OF THE MICROBIOME TO EELGRASS WASTING DISEASE

Maher, R.L.[1*]; Graham, O.J.[1]; Adamczyk, E.M.[2]; Schenk, S.[2]; Vinton, A.[1]; Crandall, G.[3]; Parfrey, L.W.[2]; Harvell, D.[1]

1- Cornell University 2- University of British Columbia, Canada 3- University of Washington

Across marine systems, host-associated microbiomes perform essential roles in host immunity and health. Integrating the microbiome into disease ecology studies may enhance our understanding of the dynamic interactions between host, pathogen, and environment. We are interested in understanding the contribution of the microbiome to disease susceptibility and outcomes of *Labyrinthula zosterae*, an opportunistic pathogen that causes eelgrass (*Zostera marina*) wasting disease (EWD). Eelgrass is a critical foundation species in coastal habitats, and worldwide outbreaks of EWD jeopardize its ecological value. In three separate laboratory experiments, we applied three different microbiome disruption treatments to eelgrass from the Salish Sea, WA, then inoculated plants with *L. zosterae* and measured disease following an incubation period. Eelgrass with microbiomes disrupted by antibiotics and dilute bleach had significantly lower disease severity (proportion infected leaf area) compared to eelgrass with native microbiomes (Graham et al, in review). In contrast, microbiome disruption with betadine did not significantly influence disease metrics. Experimental inoculation consistently resulted in 100% disease prevalence for eelgrass with no

microbiome disruption, highlighting the inability of the native eelgrass microbiome to provide defense against the pathogen in a lab setting. While microbiomes are often considered a critical first line of defense against pathogens, this work presents surprising experimental evidence that the eelgrass microbiome may sometimes facilitate disease.

DO OYSTERS REDUCE OR INCREASE TRANSMISSION OF EELGRASS WASTING DISEASE?

Alma, L.[1*]; Field, G.[2]; Burge, C.B.[1,3]

1- UC Davis, Bodega Marine Lab 2- University of Maryland, Baltimore County 3- California Dept. of Fish and Wildlife

Eelgrass (Zostera marina) is ecologically and economically important in coastal waters where it provides vertical habitat for organisms, prevents erosion, and serves as a carbon sink. Eelgrass meadows are rapidly disappearing globally for a variety of factors including eutrophication, sedimentation, temperature increases, and disease. An opportunistic pathogen Labyrinthula zosterae (Lz), causes eelgrass wasting disease (EWD), characterized by dark lesions which eventually lead to partial then full mortality of tissue. Eelgrass meadows and oyster beds frequently coexist in nature, however not much is known about their biotic relationship and if bivalves assist in propagule removal or exacerbate the disease. It is known that bivalves have the ability to dampen transmission of EWD through filtration, but they may also vector the disease on their shells or inside their tissues, which may be of concern when transferring aquaculture products. To investigate this theory, we conducted a lab-based experiment in Friday Harbor, WA, where we exposed either live oysters (Crassostrea gigas) or empty oyster shells to Lz. Subsequently we treated oysters and shells with one of three common sanitization methods: 6.25 ppm bleach, 10 ppt saline bath, or 24-hour depuration. Treated oysters were added to tanks with eelgrass and monitored for signs of EWD. We measured lesion severity and collected samples to analyze intensity of infection using qPCR as a proxy from water, oyster tissue, grass blades, and shells. Additionally, we have preserved oyster tissue for histological analysis to determine whether Lz can be found infecting oyster tissues. By conducting a carefully controlled experiment and implementing molecular analysis, we can improve our mechanistic understating of disease transmission to inform future management strategies to reduce the risk of EWD.

SCALED MODELS OF EELGRASS WASTING DISEASE: FROM LEAVES TO MEADOWS

Hofmann, E.E.[1*]; Klinck, J.M.[1]; Groner, M.L.[2*]; Harvell, C.D.[3]; Burge, C.A.[4]; Graham, O.J.[3]

1- Old Dominion University 2- Bigelow Lab for Ocean Sciences 3- Cornell University 4- UC Davis, Bodega Marine Lab

Eelgrass wasting disease, caused by the marine protist *Labyrinthula zosterae*, is distributed across the northern range of eelgrass (*Zostera marina*). Endemic infections are common and severe outbreaks occur less frequently. The environmental and biological interactions that mediate the epidemiology of wasting disease were investigated using a hierarchy of models that extend from within the leaf to the plant to across an eelgrass meadow. The leaf model simulates the time-dependent development of lesions that result from interactions of transmission, pathogen spread, host growth, light availability (water depth), salinity, and temperature. Parameterizations of model processes are based on extensive field and laboratory measurements of disease infection and progression in the northeast Pacific. The simulated lesion development compromises leaf growth, consistent with experimental observations. Additional simulations show the effect of differing virulence of pathogen strains, microbiome composition, and host damage from herbivore grazing on pathogen transmission and progression. The time-dependent individual plant model is based on individual leaves that emerge and grow at different times during the summer growing season. Simulations with this model highlight the importance of the rate of leaf growth rate and leaf turnover relative to infection intensity and pathogen growth in determining disease progression. Scaling up to create meadows from collections of individual plant models allows simulations of meadow health that can be validated against field observations. This hierarchy of models allows extension of individual leaf processes to understand wasting disease progression and its impact on the health and viability of seagrass meadows.

EELGRASS WASTING DISEASE MAPPING USING UAVS: A SEASCAPE-SCALE PREDICTIVE APPROACH

Yang, B.[1*]; Hawthorne, T.L.[2]; Aoki, L.[3]; Beatty, D.S.[4]; Domke, L.K.[5]; Eckert, G.L.[5]; Graham, O.J.[6]; Harvell, C.D.[6]; and Hovel, K.A.[7]; Hessing-Lewis, M.[8]; Mueller, R.[9]; Rappazzo, B.[6]; Reshitnyk, L.[8]; Stachowicz, J.J.[4]; Tomas, F.[9]; Duffy, J.M.[10,11]

1- San Jose State University 2- University of Central Florida 3- University of Oregon 4- UC Davis 5- University of Alaska Fairbanks 6- Cornell University 7- San Diego State University 8- Hakai Inst., Canada 9- Oregon State University 10- MarineGEO Program 11- Smithsonian Environmental Research Center

Declines in eelgrass, a vital coastal habitat, are linked to wasting disease in both historical Atlantic outbreaks and recent Pacific coast incidents. Our study introduces a pioneering method to map and forecast eelgrass wasting disease using Unoccupied Aerial Vehicles (UAVs) with low-altitude autonomous imaging, surpassing the traditional labor-intensive manual field sampling with limited spatial coverage. We mapped intertidal eelgrass beds using UAVs across sites from Alaska (USA) to California (USA), spanning 18 degrees of latitude. The UAV imagery-derived Green leaf area index (G-LAI) was a significant predictor of the disease's spatial distribution and intensity, particularly in highly infected areas. This approach offers an efficient, reliable, and scalable technique to study seagrass diseases across varied geographies and conditions. As marine organism diseases rise globally, swift and effective monitoring becomes crucial to grasp disease dynamics and inform timely management. In our groundbreaking study, we harnessed high-resolution UAV imagery from 12 sites across the NE Pacific, achieving 1.5 cm spatial resolution. This novel method detects wasting disease in eelgrass beds on a seascape scale through object-oriented image segmentation and classification. In situ sampling validated the predictions, accounting for 58% of the variance in disease severity.

FIRST RARE, THEN EVERYWHERE: UNCOVERING THE DIVERSITY AND ECOLOGICAL ROLE OF SEAGRASS-ASSOCIATED PHYTOMYXID PARASITES

† Kolátková, V.[1*]; Elliott, J.[2]; Vohník, M.[3]; Gawryluk, R.[1]

1- University of Victoria, Canada 2- University of Puget Sound 3- Inst. of Botany, Czech Academy of Sciences

Phytomyxids (Rhizaria: Endomyxa: Phytomyxea) are a monophyletic group of obligately biotrophic intracellular parasites infecting various plants, algae and oomycetes, and dreaded pathogens of numerous crops of great economic importance. Despite their infamy in agriculture, the diversity and ecological significance of phytomyxids in natural (and specifically marine) environments remain largely understudied. Historically, phytomyxids were believed to be scarce in coastal ecosystems, but through our systematic sampling surveys and an analysis of a global amplicon sequencing dataset, we recently revealed that phytomyxids parasitizing the eelgrass *Zostera marina* – an important foundation species in coastal areas and estuaries of the Northern hemisphere – are in fact one of the most predominant eukaryotes associated with these underwater meadows, and can be found in the roots of >99% of examined plants. Furthermore, the diversity of marine phytomyxids appears to be much greater than previously anticipated, with our preliminary findings suggesting that they infect at least 5/11 currently recognized seagrass genera. Molecular analyses of the rRNA phylogenetic markers show that seagrass-associated taxa form distinct novel clades within Phytomyxea and indicate long coevolutionary host-parasite relationships resulting in high host-specificity. Given the ongoing large-scale losses of seagrass meadows worldwide, further research on phytomyxid parasites and their pathogenic potential is needed to better understand to what extent they affect seagrass health and their environmental stress threshold.

Session 10: Population Biology and Ecology II

* indicates presenting author, † indicates eligibility for Best Student Paper Award

LOCAL ADAPTATION OF THERMAL SENSITIVITY IN POPULATIONS OF CALIFORNIA GRUNION. IMPLICATIONS FOR RESILIENCE IN A WARMING OCEAN

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CSU Long Beach

Ocean warming poses an ongoing threat to many species, but to anticipate how populations will respond over multiple generations, we need to understand both the sources and patterns of genetic variation in thermal sensitivity. One potential source of such variation is local adaptation to environmental conditions. For example, if individuals inhabiting cooler waters tend to have cold-tolerant genotypes and individuals inhabiting warmer waters have warm-tolerant genotypes, then local adaptation could promote genetic variation in the population as a whole. We tested for local adaptation of thermal sensitivity in populations of California Grunion. We collected the gametes of northern and southern populations of Grunion and reared their embryos and larvae in a common laboratory environment. Larvae were reared across temperatures reflecting their natural range and we measured growth and mortality. Southern populations were much more sensitive to temperature and had a higher capacity for growth under higher temperatures. Mortality was lowest at intermediate temperatures and northern and southern populations did not show a strong difference in thermal sensitivity of mortality. When examining the effects of temperature on biomass production (combination of survival and growth), we found that southern populations indeed have a higher thermal optimum than northern populations. Grunion experience gene flow at large spatial scales and our results suggest that adaptation to local temperature conditions can increase overall level of genetic variation in thermal sensitivity by 25 to 75%.

SIGNS OF RESILIENCE: SURVIVORSHIP AND GROWTH OF CORALS IN HAWAIʻI TWO YEARS POST-BLEACHING

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1- Arizona State University 2- Cooperative Institute for Marine and Atmospheric Research, University of Hawaiʻi 3- Pacific Islands Fisheries Science Center, National Marine Fisheries Service 4- Scripps Institute of Oceanography

Coral bleaching driven by marine heatwaves is increasing in frequency and severity worldwide. The persistence of coral reefs is contingent upon resilience in the face of rising human and climate stressors. Varying vulnerability can lead to the loss of susceptible species post-bleaching, giving rise to community restructuring or even ecosystem collapse. We used structure-from-motion photogrammetry to track 2,150 coral colonies of four common species (*Montipora capitata, M. patula, Porites lobata, Pocillopora meandrina*) across the Main Hawaiian Islands, during the peak of the 2019 bleaching event and again in 2021. We examined variability in species' survivorship, and tested for significant predictors. We also explored how bleaching impacted species' short-term growth and size structures. Overall, coral exhibited high survivorship; the lowest rates of mortality were detected for *P. lobata* (7.7%) and the highest for *P. meandrina* (21.5%). Survivorship of all species was significantly predicted by size, with mortality higher for smaller colonies. Bleaching extent, prior heat stress, and depth were also correlated with survivorship for some species. For surviving colonies, bleaching did not significantly affect the probability of growth from 2019 to 2021. Except for *P. lobata*, species' size structures did not change significantly between years. Investigating the fate of corals post bleaching is critical for identifying resilient populations and understanding how corals may withstand future heatwave events, which hold high value for developing informed management plans in Hawaiʻi.

IS IT A SIMPLE NORTHWARD MARCH WITH CLIMATE CHANGE? EVIDENCE FOR MULTIPLE LONG-DISTANCE COLONIZATION EVENTS OF KELLET'S WHELK BEYOND THE HISTORIC RANGE

López, C.[1*]; Daniels, B.[2]; Lee, A.[3]; Freel, E.B.[1]; White, C.[2]; Christie, M.R.[3]; Davidson, J.M.[2]; Anderson, P.[2]; Toonen, R.[1]

1- Hawaiʻi Inst. of Marine Biology, Univ. of Hawaiʻi at Mānoa, Moku o Loʻe, Kāneʻohe 2- Cal Poly, San Luis Obispo 3- Purdue University

Rising ocean temperature is modifying marine species distribution, abundances, and phenology according to their thermal tolerance and ability to adapt. Warmer temperature regimens combined with changes in major ocean currents are enabling poleward transport and range expansions of many species. In this context, it is essential to understand processes underlying the climate change-driven reorganization of species composition for establishing effective conservation and management strategies. Here we report population genetic structure of the gastropod Kelletiia kelletii, a key species in kelp forest ecosystems and one of the most valuable invertebrate fisheries in California, whose populations have recently undergone a substantial northward range expansion. We genotyped 768 adults from 13 locations across its historical and expanded range

(~1600km) using reduced representation genomic sequencing (RAD-seq). Analyses of 30,717 SNPs is inconsistent with a simple expansion of northern populations following a warming ocean. Instead, our data show evidence for long distance larval dispersal of K. kelletii larvae from a central historical range site (Point Loma) hundreds of km into the expanded northern range (Big Creek). Consistent with previous analyses, there is minimal population structure throughout much of the K. kelletii range, but we find comparatively higher population genetic structure across much smaller geographic distances within the expanded range. The two most genetically similar populations (Big Creek & Point Loma) seem most likely to result from transport during an El Niño Southern Oscillation (ENSO) event rather than from consistent on-going gene flow. Despite smaller geographic distances, the genetic divergence of expanded range populations exceeds that of the historical range sampled in this study, indicating multiple origins of these range expanded populations. Such northern range expansions could become more frequent because the magnitude and frequency of ENSO events are predicted to increase under climate change. Furthermore, populations successfully settled in the expanded range could act as a source of larvae for continued future northern expansions. Understanding the factors driving changes in populations connectivity is crucial for establishing management measurements to ensure the persistence of this and other economically and ecologically important species in the context of climate change.

WE'RE HAVING A HEATWAVE! TURNING UP THE HEAT TURNS DOWN THE CALORIES IN CRANGON SHRIMP

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Oregon State University

Brown shrimp, *Crangon* spp. are important prey for many ecologically and economically important fish species, but little is known about their population dynamics in the NE Pacific. The objective of this study was to assess the caloric content of *Crangon alaskensis* from central Oregon before, during, and after the 2014-2015 marine heatwave. We hypothesized the caloric densities of the samples would be lowest during the years of the marine heatwave compared to other years because of the coupled effects of the warm temperatures and the toxic phytoplankton bloom Oregon coastlines experienced. A total of 198 samples were collected from depths of 30 to 60 m with a beam trawl, dried, and processed using bomb calorimetry. Preliminary analysis suggests a substantial effect of the marine heatwave on summer caloric content: caloric densities increased from June to August (when upwelling is normally strongest) in years before and after the marine heatwave. In 2015, caloric density decreased from June to August. The strongest correlation of caloric density with environmental factors was found with a one-month delay of the BEUTI upwelling index. Other significant factors were in situ dissolved oxygen and temperature. The PDO index was marginally significant. Overall, caloric density of *Crangon* shrimp is influenced by environmental factors and future heatwaves will likely negatively impact their population.

ECOLOGICAL SUCCESS OF NO-TAKE MARINE PROTECTED AREAS: A GLOBAL META-ANALYSIS INFORMED BY POPULATION DYNAMICS THEORY

Hopf, J.[1*]; Barcelo, C.[2]; Caltabellotta, F.[3]; Farnsworth Hayroyan, S.[4]; Garcia, D.[1]; McLeod, M.[3]; Lester, S.[5]; Nickols, K.[4]; Quennessen, V.[1]; Ridgeway, J.[6]; Yeager, M.[7]; White, J.W.[1]

1- Oregon State University 2- University of Washington Puget Sound Inst. 3- Washington Dept. of Fish and Wildlife 4- CSU Monterey Bay 5- Florida State University, Tallahassee 6- University of Illinois Urbana-Champaign 7- NOAA Fisheries

Adaptively managing current marine protected areas (MPAs), and planning for future MPAs, requires accurately assessing whether established MPAs are achieving their goals of conserving biomass and rebuilding harvested populations. Ecological assessments of MPAs are commonly based on comparing inside the MPA to a reference point outside and/or before implementation (i.e., measuring 'response ratios'). This approach, however, is based on the concept of detecting ecological impacts, such as the effects of a habitat disturbance. MPAs are not simple ecological experiments; by design, they have effects outside their boundaries, and population dynamic responses can be nonlinear. This complicates assessment interpretations. In this study, we used a two-population model to explore how MPA response ratios for fish populations (inside-outside, before-after, and before-after-control impact [BACI]) behave under different conditions, such as whether the population is receiving a sustainable larval supply or if it is declining despite no-take protection. Using these model insights as a comparative framework, we then evaluated MPA effects based on data collected from 82 published studies on 264 no-take MPAs from around the world in the past decade. We demonstrate that not all response ratios are equal: for example, inside-outside and BACI comparisons can fail to detect population decline within MPAs and before-after comparisons are required. Considering this, we found that MPAs globally are providing positive outcomes, although those benefits may be smaller than previously reported.

GENOMIC PATTERNS OF POPULATION STRUCTURE IN OCHRE SEA STARS CHALLENGE PREVIOUS REPORTS OF RANGE-WIDE PANMIXIA

† Duffin, P.J.[1*]; Schiebelhut, L.M.[2]; Dawson, M.N.[2]; Wares, J.P.[1]

1- University of Georgia, Athens 2- UC Merced

Seascape genomics is an exciting emergent field that attempts to relate geographic and ecological features to evolutionary patterns that act on natural populations. In the past decade, whole-genome sequencing (WGS) analyses have yielded fascinating insights into non-model marine organisms' demographic history, population connectivity, and local adaptation. Yet, these efforts have been disproportionately concentrated on commercially important species, and species of ecological value remain understudied within the framework of seascape genomics. The keystone predator *Pisaster ochraceus* (ochre sea star) once dominated rocky intertidal ecosystems, but populations have recently suffered mass mortality due to an elusive wasting disease. Here, we aim to characterize the genomic architecture of *P. ochraceus* using WGS data from 65 individuals belonging to five regions spread throughout their broad native range (Alaska to Baja California). While previous work on subsets of the ochre star genome found an overall lack of genetic structure across populations, our analyses on 11.7 million SNPs reveal pronounced genomic divergence

between stars collected in open coastal sites compared to those residing in sheltered bay locations of the Salish Sea. By exploring neutral and adaptive genetic diversity in this threatened marine organism, we add valuable context to how we should protect and manage their populations in a changing world.

Session 11: Physiological Ecology II

* indicates presenting author, † indicates eligibility for Best Student Paper Award

CHARACTERIZING THE EFFECTS OF MULTIPLE STRESSORS ON THE PHYSIOLOGY OF BERING SEA SNOW CRAB

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1- University of Alaska Fairbanks 2- NOAA Fisheries

As carbon dioxide (CO_2) concentrations in our atmosphere continue to rise, the oceanic uptake of CO_2 is expected to further reduce seawater pH by 0.3-0.4 units by the year 2100, a process termed ocean acidification (OA). In addition to OA, ocean warming (OW) is also anticipated to occur in the North Pacific, as marine heat waves are already evident in the region. Considering the oceans will both acidify and warm concurrently, multiple-stressor manipulative experimentation is an emergent area of study that aims to examine the individual and interactive effects of these factors on marine organisms. Here, I determined the individual and interactive effects of elevated pCO_2 and elevated temperature on juvenile *Chionoecetes opilio* and *Chionoecetes bairdi* using an integrative approach across levels of biological organization, from cellular to population level. This work addresses critical knowledge gaps about how *C. opilio* and *C. bairdi* and its fishery will respond to ocean change by 1) conducting the first ocean change multiple-stressor experiments on *C. opilio* and *C. bairdi* 2) determining the potential species-specificphysiological adaptive traits in response to these stressors, and 3) incorporating the experimental data into a dynamic bioclimate envelope model. With the recent closure of the Bering Sea snow crab fishery, the first closure of this fishery in its existence, this research comes at a time critical for the effective managementand longevity of this Alaskan fishery.

UPTAKE AND EXPORT OF NITROGEN BY MACROSYSTIS HOLDFASTS

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Moss Landing Marine Labs

Giant kelp (*Macrocystis pyrifera*) productivity drives the ecology and function of its ecologically and societally valuable associated ecosystem. Its growing medium, seawater, constantly bathes kelp, but macronutrient availability is inconsistent, and oligotrophy can limit growth and maintenance. Small-scale macronutrient inputs may be critical to persistence during such periods. I propose a novel biological interaction that can mitigate the scarcity of nitrogen (N), an essential and seasonally-limited macronutrient: infauna-holdfast symbiosis. I hypothesize that holdfast infauna acquire forms of N that giant kelp cannot use and process them into ammonium, a preferred source of N by giant kelp. I tested the physiological capability of giant kelp to uptake N through its holdfasts and export it to other thallus regions, implying a mechanism to overcome source-sink imbalances. Aquacultured sporophytes were placed in plastic, 2L bags to isolate water surrounding holdfast surfaces from the remainder of the thallus. Filtered seawater was added to the bags, and [$^{15}NH_4^+$] increased to either 17.4 ± 0.4 µM or left unmanipulated (1.1 ± 0.2 µM). Percent ^{15}N-at increased significantly in both holdfast and stipe tissues of (+) $^{15}NH_4^+$ treatments, though the effect was much stronger in holdfasts. Percent ^{15}N-at increased significantly over time in holdfasts, allowing uptake rates to be determined. This is the first confirmation of nitrogen uptake and export through giant kelp holdfasts and supports continued exploration of how holdfast symbioses support nitrogen acquisition in giant kelp.

STUNTED GROWTH IN JUVENILE DUNGENESS CRABS EXPOSED TO RAPID, INTENSE UPWELLING EVENTS

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Coastal habitats along the California Current regularly experience periods of low pH and low dissolved oxygen (DO) due to upwelling. The severity of these conditions will continue to increase with global environmental change. Moreover, organismal exposure to low pH and low DO conditions is often episodic in upwelling systems. Experiments with static environmental conditions allow scientists to study the relationship between treatment intensity and the magnitude of organismal response; whereas, temporally variable (e.g., fluctuating) treatments more accurately represent in-situ conditions. In 2022, we subjected juvenile Dungeness crabs (*Metacarcinus magister*) to six levels of static, simulated upwelling conditions of coupled low temperature, pH, and DO. After five weeks, only crabs in the most intense treatment exhibited reductions in growth. Crabs in the five less severe treatments maintained growth, suggesting a threshold response. The following year, we subjected juvenile Dungeness crabs to static, frequent (five-day cycle), or long (twenty-day cycle) upwelling events within present (control) or future (severe) upwelling conditions. The mean conditions were the same among variability and static treatments for each scenario. Crabs in the “severe long” upwelling cycles maintained normal growth, whereas crabs in the “severe static” and “severe frequent” upwelling cycles experienced stunted growth. These findings suggest the duration of relaxed conditions is more important than the duration of upwelled conditions for juvenile Dungeness crab growth during upwelling season.

COMPARATIVE GENOMICS AND TRANSCRIPTOMICS OF MARINE INTERTIDAL (FAMILY STICHAEIDAE) PRICKLEBACKS TO BETTER UNDERSTAND DIETARY DIVERSITY

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Marine intertidal pricklebacks (family Stichaeidae) are best known for dietary diversity, ontogenetic dietary shifts, convergent evolution of herbivory, and multiple invasions into intertidal habitats. There have been multiple studies that provide insight into digestive physiological properties within pricklebacks such as the variation in gut length across species, enzymatic activity, microbial fermentation in the gut, and the sequenced genome of *Cebidichthys violaceus*. Here, we contribute to the understanding of dietary diversity in pricklebacks by sequencing the pyloric caeca and middle intestine transcriptomes of four intertidal prickleback species: *Anoplarchus purpurescens* (carnivores, no shift), *Xiphister atropurpureus* (ontogenetic shift from carnivory to omnivory), *Xiphister mucosus* and *C. violaceus*, (both exhibit ontogenetic shifts from carnivory to herbivory). From the transcriptomes of the pyloric caeca and middle intestine, we detected orthologous gene sequences across the four species, annotated the orthologs, and estimated selection with bioinformatics programs. With bioinformatics tools, we detected signatures of adaptive evolution by estimating nonsynonymous and synonymous substitution rates from orthologous gene clusters. We identified candidate genes under positive Darwinian selection with the following gene ontology terms: carbohydrate metabolism, proteolysis, phospholipid, and lipid catabolic processes. Overall, we characterized gut tissues and identified candidate genes under positive Darwinian selection to better understand dietary specializations within marine intertidal fishes.

MITIGATING OCEAN ACIDIFICATION IN SHELLFISH-AQUACULTURE: THE STORY OF AN ABALONE AND SEAWEED CO-CULTURE

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Climate change is negatively impacting shellfish aquaculture operations worldwide. Ocean acidification (OA) increases shell dissolution rates and decreases calcification rates, which ultimately negatively affects overall growth and development. This study addressed the negative impacts of OA on juvenile red abalone (Haliotis rufescens) and the ability of the red seaweed dulse (Devaleraea mollis) to reduce these effects.Specifically, we tested the hypothesis that Integrated Multi-Trophic Aquaculture (IMTA), where abalone and seaweed are grown together, can raise seawater pH through photosynthesis to yield more favorable conditions for abalone growth and shell construction. A 5-month experiment was conducted to determine the benefits of IMTA on abalone growth, shell composition, and morphology. Abalone were raised in high (~8.3), ambient (~8.0), medium (~7.9), and low pH (~7.6), the pH being regulated by CO2 gas input or seaweed buffering. After 5 months of experiencing these treatments, abalone raised in high and ambient pH treatments showed increased shell length and density and demonstrated less variation than those raised in medium and low pH treatments. Preliminary analyses of shell structure and function suggest that these growth differences may translate to differences in physical and chemical shell properties. The dulse from the lower pH treatment grew faster than the high pH treatments, suggesting that elevated pCO2 levels may also increase seaweed production. Overall, seaweed buffering of acidified water may allow abalone aquaculture to persist in the face of OA and shepherd abalone through the juvenile stage, which is more vulnerable to OA, providing the opportunity to outplant resilient abalone in kelp forest communities.

BENTHIC MARINE INVERTEBRATE HERBIVORES DIVERSIFY THEIR ALGAL DIETS IN WINTER WHEN KELPS ARE SCARCE

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Organisms in high latitude ecosystems are adapted to live with significant seasonal variation in environmental conditions, which can affect basal production by seaweeds. Herbivores in these systems may deal with depleted food availability in the winter by reducing food consumption, or by changing diet composition or basal metabolism. We used a combined trophic tracer approach to investigate the seasonal differences between winter and summer of the fatty acid composition and isotopic values of six of the dominant macroalgae and the six most common invertebrate herbivores in Sitka Sound, Alaska. All taxa differed in their multivariate fatty acid profiles by season, and all herbivores had significantly enriched monounsaturated fatty acid composition in winter, similar to the algae, suggesting that the algal fatty acids patterns were transferring to the consumers. The isotopic values of the producers were consistently enriched in 15N and depleted in 13C in the winter. Meanwhile, consumers' d15N values did not differ by season, but their d13C values were lower in the summer, closer to the year-round d13C values of red algae. Taken together, the tracers suggest that in winter, when the dominant kelp standing stock in this system is depleted, consumers are sustained by incorporating more of the less abundant and less preferred red macroalgae and do not generally increase the use of omnivory. Benthic herbivorous invertebrates from diverse lineages use diet diversification as a strategy for dealing with reduced availability of their preferred kelp prey in winter.

Session 12: Conservation and Restoration II

* indicates presenting author, † indicates eligibility for Best Student Paper Award

DRIVERS OF MACROALGAE RESILIENCE AND REASSEMBLY IN NEARSHORE CORAL REEFS

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Coral reefs globally are being degraded by a suit of local and global stressors. Many reefs have experienced shifts from coral to algae dominated assemblages that show strong persistence in the face of disturbance or restoration efforts. While much effort has been made to understand the factors controlling the resilience of coral communities, less is known about the drivers of macroalgae resilience. Here I present results from a 2 year macroalgae removal experiment performed across a natural gradient of nutrient enrichment and herbivory to assess the relative strength of these drivers in controlling recovery. I also investigated how these suspected drivers affect the benthic community reassembly following a disturbance, and the extent to which fish communities respond to changes in benthic composition. While many sites demonstrated full recovery to pre-disturbed cover in just 1 year, there was substantial variation in macroalgae resilience. Much of this variation is explained by a time-integrated nutrient metric and functional measures of herbivory, with the best simple model explaining 81% of the variation in recovery.

Community reassembly also varied significantly among sites, with some returning to monocultures of the highly unpalatable macroalgae *Turbinaria ornata*, while others shifted to palatable algae assemblages or reefs characterized by coral-invasible turfing algae and encrusting corals. This project lends valuable insights into the drivers of macroalgae resilience that can inform management and restoration of these unwanted assemblages.

LIMITED GENOMIC EVIDENCE FOR POPULATION COLLAPSE IN THE CRITICALLY ENDANGERED BLACK ABALONE (HALIOTIS CRACHERODII)

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The black abalone, Haliotis cracherodii, is a large, long-lived marine mollusc inhabiting the rocky intertidal coast of California and Mexico. In 1985 populations were impacted by a fatal bacterial disease known as Withering Syndrome, wiping out an estimated 99% of individuals and resulting in the species' designation as critically endangered in 2003. Current conservation strategies propose restoring depauperate populations with translocated individuals from rare healthy populations. However, population collapse on this scale may have dramatically lowered genetic diversity and strengthened geographic differentiation, making translocation-based recovery a contentious strategy. To address these uncertainties, we sequenced the genomes of 133 black abalone individuals from across the range. We observe almost no population structure with the exception of a single chromosomal inversion that segregates by latitude. Genetic divergence between populations is minimal, and we find no relationship between the extent of divergence and geographic distance or environmental similarity. Additionally, genetic diversity within populations is high and diversity appears uniform across the range. Nevertheless, demographic inference confirms a severe population bottleneck beginning around the time of Withering Syndrome onset, suggesting that there may be a "time-lag" between a population's collapse and significant effects on genetic structure and diversity. Finally, we find that the bacterial agent of Withering Syndrome is present in all individuals, and its prevalence shows no relationship with geography. Altogether, these results highlight the surprising lack of genomic evidence for this species' near extinction, and provide hope that translocation of individuals from distant parts of the range can aid in recovery.

CAN CORALLINE ALGAE HABITAT BOLSTER THE CLIMATE RESILIENCE OF WASHINGTON'S ENDANGERED PINTO ABALONE?

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Since 1994, Washington State has seen a 97% drop in the native pinto abalone population. Restoration aquaculture efforts have been underway since 2007 to return the wild population to a self-sustaining density. Restoration groups spawn pinto abalone in hatcheries and rear them for 1-2 years before releasing them to subtidal sites. The success of abalone not only depends on restoration efforts but also on the capacity of abalone to survive and reproduce as threats of ocean acidification and warming increase. Crustose coralline algae can play an important role in the success of restoration efforts by serving as a natural settlement inducer and creating a pH refuge for juvenile abalone. In this study we examined settlement of pinto abalone under different environmental conditions (7.95pH, 14°C (control); 7.95pH, 18°C; 7.6pH 14°C; and 7.6pH, 18°C) using two substrates: clean fiberglass with GABA (a neurotransmitter typically used to induce larval settlement) and CCA covered fiberglass. If presence of CCA can improve settlement and mitigate effects of ocean acidification on larval and juvenile abalone, we may be able to improve the efficacy of abalone restoration efforts in Washington. We tracked settlement rate and then survival, growth, and substrate microbial composition for the first three months of juvenile growth. Our findings will unblock bottlenecks in the hatchery rearing process and provide insights into ideal wild abalone habitat as climate change continues.

LONG-TERM MONITORING FROM THE *WESTERN FLYER*, A RESTORED FISHING VESSEL WITH A LITERARY PAST

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1- Western Flyer Foundation 2- Oregon State University 3- Stanford University 4- Naval Postgraduate School

In 1940, author John Steinbeck and marine ecologist Ed Ricketts chartered the fishing vessel *Western Flyer* for a six-week exploration of Mexico's Gulf of California, resulting in the groundbreaking works *Sea of Cortez* (1941) and later *The Log From the Sea of Cortez* (1951). This historic vessel has been carefully restored by the Western Flyer Foundation, and will soon embark on its next chapter as a marine research vessel and at-sea education platform based in Monterey Bay. Through our research program, we aim to continue and build upon Steinbeck and Ricketts's work of careful observation and documentation of patterns in marine environments to improve our understanding of how coastal systems change over time and how marine ecosystems function and impact human communities. Through strategic partnerships and collaboration, our work will fill important data gaps in Monterey Bay, the Gulf of California, and elsewhere along the North American west coast, taking advantage of the unique nearshore research capabilities offered by the *Western Flyer*'s quiet, electric-diesel hybrid engine. A suite of science instrumentation includes a conductivity -temperature-depth (CTD) profiler, flow-through system for surface temperature, salinity, and pH, custom meteorological array, scientific echosounder, and ROV. Our research will be deeply integrated with our education program, with students collecting high-quality data and scientists mentoring and learning from students. Here, we discuss our research plans and opportunities for collaboration in Monterey Bay and across the Pacific coast from Alaska to Baja California.

WAVE, LIGHT, AND DISSOLVED OXYGEN EXPOSURES DRIVE NOVEL COASTAL EELGRASS (ZOSTERA PACIFICA) TRANSPLANT PERFORMANCE

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The high ecological and economic value of seagrass is recognized, with these foundational habitats providing myriad ecosystem services. Yet through cumulative anthropogenic impacts, seagrasses are exhibiting extensive declines globally. The US West Coast has suffered seagrass habitat loss, catalyzing decades of seagrass protection and restoration efforts. Yet, mitigation transplanting efforts have prioritized *Zostera marina* (narrow-leaved eelgrass) in shallow, protected environments, while a dearth of information is available on species inhabiting offshore islands and exposed mainland coasts. In this study, we conducted a novel transplant of *Zostera pacifica*, a wide-bladed species found in depths of 10 – 20 m on the mainland coast, at three geographically distinct sites in Santa Monica Bay, coupled with continuous in situ biophysical data to provide insight into physical drivers impacting *Z. pacifica*. Utilizing environmental thresholds, we performed exposure analyses to evaluate factors influencing *Z. pacifica* transplant performance. Wave exposure (H_{rms} > 0.59 m and U_{rms} > 0.1 m s^{-1}), photosynthetically active radiation (< 3 and > 5 mol m^{-2} day^{-1}) and dissolved oxygen (<3 mg O_2 L^{-1}) exposure impacted transplant success. These data represent the first holistic study of *Z. pacifica* transplanting on an exposed mainland coast, provide a view into the baseline environmental envelopes within existing *Z. pacifica* habitat, and further, may serve as a model for investigating scalable open-coast seagrass restoration in temperate regions.

IMPACTS OF OVERFISHING ON CROWN-OF-THORNS STARFISH (COTS) PREDATORS: EFFECTS ON REEF HEALTH, ABUNDANCE, AND DIVERSITY OF COTS

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1- Cal Poly, San Luis Obispo 2- University of Western Sydney 3- Stanford University

Introduction: Disturbances, such as the Crown-of-Thorns Starfish (CoTS), lead to coral reef degradation by significantly reducing hard coral cover. Certain predator species may help control CoTS populations. This study assesses how the abundance and diversity of CoTS predators in a green zone near Lizard Island affect the local CoTS health.Methods: Four sites near Lizard Island Research Station in far north Queensland, Australia, were surveyed. Predator abundance and diversity of 19 species were recorded using transects to analyze their relationship with CoTS abundance and health, with injured arms indicating a predation event and lower health. The study also considered the impact of substrate composition on CoTS and predator abundance. Transects were conducted at reef crests and reef flats to understand habitat degradation and reef composition complexity in relation to predators and CoTS. CoTS dissection data included diameter, arm count, number of short and missing arms, and sex.Results and Conclusion: Adult predator abundance correlated with CoTS health within green zones. Higher predator abundance and diversity correlated with increased CoTS injury proportions. CoTS diameter also correlated with predation, with smaller CoTS experiencing more predation events. Common resting and feeding substrates for CoTS were hard dead substrate and Acropora. Predator diversity linked to more frequent predation events, emphasizing the need for further CoTS predation research. Understanding and mitigating CoTS influence on habitat degradation, especially in open take zones, is crucial.

Session 13: Community Ecology II

* indicates presenting author, † indicates eligibility for Best Student Paper Award

AN ENERGY CRUNCH HYPOTHESIS TO EXPLAIN THE COLLAPSE OF MUSSEL BEDS IN THE SOUTHERN CALIFORNIA BIGHT

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1- CSU Los Angeles 2- University of Washington 3- Cal Poly, Pomona 4- NOAA Fisheries 5- CSU Monterey Bay

Prior analyses of sea surface temperatures (SST) indicate that the Southern California Bight (SCB) showed little influence of seasonal upwelling, but a clear signal of the wider ocean warming that began in the late-1970s. To investigate possible effects of rising SST on a shore community, we compiled historical photographs of mussel (*Mytilus californianus*) beds extending back to 1973-1983 at 3 locations. To assess changes in mussel bed communities as documented in photos, we used automated image analysis and GIS modeling. Over 4-5 decades, all beds showed deep declines in coverage, some disappearing. Prior studies elsewhere on the Pacific Coast showed that mussel bed losses occurred when the upper boundaries descended towards the lower boundaries. The descent was attributed to increasing exposure to lethal air temperatures (AT) during low tides. However, in the SCB, beds diminished not because the upper boundaries descended, but rather, because the fluctuating lower boundaries ascended, eventually converging on the comparatively stationary upper boundaries. We also note that on sites with photographic records detailed enough to provide a rough time series, the shore level of the lower boundary appeared to be sensitive to El Nino/La Nina variation with the greatest upward shifts coinciding with the former, and partial recovery coinciding with the latter. Longitudinal studies of mussel growth at two sites showed greater growth and survival during a La Nina event than the subsequent El Nino. Therefore, we propose that in the SCB rising SST has reduced ration, and rising AT and SST together elevated mussel metabolic costs, diminishing the mussels' ability to recoup losses to predation, itself possibly driven higher by rising SST. Thus, global warming, by altering predator-prey energetics, may produce gradual but pervasive effects that ramify through some coastal marine communities.

EXPLORING MOBILE PREDATOR DIETS AS A PATHWAY FOR REEF-PELAGIC CONNECTIVITY

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A growing number of studies have established that pelagic resources are crucial for coral reef function and resilience, however, our understanding of these trophic pathways and complex interactions remains limited. We used stable isotope (SI) analyses of plant and animal tissues collected across Palau's marine environs to estimate the relative contribution of reef vs. pelagic resources to mobile predatory fish diets as a proxy for connectivity. Using cluster analyses, SI niche analyses, and Bayesian SI mixing models, we investigated which species or trophic guilds rely on a mix of resources across habitats. Our results indicate that pelagic predators are primarily reliant on pelagic-derived prey, while reef predators exhibit a wide range of dietary mixing with an overall trend of greater proportions of pelagic dietary carbon correlating with foraging at higher trophic levels. We found that traits underlying dietary mixing, such as body size or mobility, vary between and within species populations. We

conclude that the causes of dietary mixing in predatory fish are complex, species-specific, and likely associated with ontogeny and/or species interactions. Elucidating the dynamics of predator-mediated habitat connectivity is critical for understanding ecosystem functioning, managing predatory fish populations in Palau's complex mosaic of management and fisheries zones, and for predicting the consequences of climate change and other anthropogenic stressors.

THE RELATIONSHIP BETWEEN HABITAT FRAGMENTATION AND CORAL DIVERSITY IN MOOREA, FRENCH POLYNESIA, AND ST. JOHN, US VIRGIN ISLANDS

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Coral reefs have become the poster child for ecosystem degradation, with fragmentation of habitats interpreted as an early sign of loss of ecosystem function. Contemporary work introduces nuance to this interpretation, posing the hypothesis that fragmentation may allow a system to remain in an un-degraded state. We describe patchy reefs in the backreef of Mo'orea, French Polynesia, and in St. John, US Virgin Islands, evaluating their potential to sustain high coral diversity as a fragmented habitat. In Mo'orea, at a spatial scale of 1-10 km, coral diversity was similar between reefs with high versus low habitat fragmentation, even where habitat area (i.e., summed among patches) was similar between areas of low and high fragmentation. In St. John, patches of reef are largely composed of *Orbicella annularis* and are occupied by numerous benthic invertebrates; the diversity of sessile invertebrates was unrelated to habitat fragmentation, as was detected at a scale of <1 km in Mo'orea. Together, these results suggest that the diversity of reef-associated invertebrates does not intrinsically decline with habitat fragmentation. The concordance in community diversity between this study, and outcomes hypothesized from contemporary understanding of habitat fragmentation, suggests there is a positive association between diversity and resilience, supported by fragmentation. The complex dynamics associated with fragmentation and habitat decline can expand conservation strategies to threatened coral ecosystems and further our understanding of ecosystem response to environmental change.

EXPLORING THE ROLE OF SEX-BASED DIFFERENCES IN TROPHIC INTERACTIONS: THE CASE OF KELP FORESTS

Gissi, E.[1*]; Goodman, M.C.[1]; Elahi, R.[1]; McDevitt-Irwin, J.[2]; Arnoldi, N.S.[1]; Arafeh Dalmau, N.[1]; Knight, K.J.[1]; Olguín Jacobson, C.[1]; Palmisciano, M.[1]; Tillman, C.M.[1]; Micheli, F.[1]

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In the face of escalating pressures from climate change, we need to properly understand how marine ecosystems are responding. A fundamental but often overlooked biological characteristic of organisms is sex. Living organisms exhibit a variety of sexes (male, female, hermaphrodite) and sex-based differences at individual, population, and species levels. Biological sex broadly affects the morphology, physiology, behavior, and distribution of organisms and populations across taxa, with evidence of sex-specific differences in survival to thermal stress, timing of biological mechanisms, and energetics. However, sex-based intraspecific differences are considered when conducting studies at organismal and population levels but generally overlooked in community ecology. Here we explore how sex-based differences influence trophic interactions. We draw on examples from the ecologically and economically important ecosystem, kelp forests, where previous research has demonstrated strong trophic interactions influencing their community structure and ecosystem function. We then discuss the future challenges and directions for community ecologists to integrate biological sex into their research. Filling the vast knowledge gap on the role of biological sex within ecological communities is essential against the risk of failing in representing environmental processes and ecological dynamics, and indeed in conservation management.

CHARACTERIZING THE IMPACT OF NUTRIENT ENRICHMENT ON ORGANIC MATTER EXUDATES OF REEF-BUILDING CORAL AND MACROALGAE

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1- UC San Diego, Scripps Inst. of Oceanography 2- University of Hawaii at Manoa 3- Royal Netherlands Inst. for Sea Research

Coral reefs exhibit high rates of gross primary production, a significant proportion of which is released into the water column by benthic producers as dissolved organic carbon. This exuded photosynthetic material, often referred to as exometabolites, is decomposed as a key source of nutrition by the heterotrophic microbial community. The goal of this study is to characterize how nutrient enrichment alters the chemical complexity and nutrient content of coral reef-derived exometabolites released by a variety of foundational coral and macroalgae species from Moorea, French Polynesia. The results indicate that each primary producer generates an exometabolite pool with a distinct profile of the essential nutrients: nitrogen (N) and phosphorus (P). The total amount of dissolved organic carbon (C), and fluorescent dissolved organic matter signal also varied across benthic functional groups. Additionally, nutrified coral treatments exhibit variable C, N and P stoichiometric ratios compared to corals from ambient non-nutrified sites. This suggests that changes in the reef benthic community structure and nutrient regime can modify both the concentration and composition of exometabolite pools released into the reef ecosystem. The changes in the organic matter pool that bathes the reef ecosystem may contribute to increased microbial loads and modifications in the natural seawater microbiome on reefs experiencing nutrient pollution.

EXPLORING MULTITROPHIC STABILITY IN MARINE ECOSYSTEMS

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Understanding the drivers and impacts of spatiotemporal variation in species abundance on community trajectories is key to understanding the factors contributing to ecosystem resilience. Despite decades of research on biodiversity-stability relationships, most studies are performed within a trophic level, overlooking the multitrophic complexity that structures natural communities. Here we investigate the patterns of multitrophic diversity, synchrony and stability broadly across global scale and finely within regional scale to understand the contribution of

competitive and consumptive species interactions on community stability. In systematic review we find heterogeneity in the relationships between species synchrony and multitrophic stability, which we examine further with long-term monitoring data to understand the mechanistic drivers of variation. We assess how protection and environmental heterogeneity within a California MPA network promotes temporal stability at community and metacommunity scales. Protection promoted stability through reductions in prey species synchrony at local scale but was insufficient to stabilize dynamics at regional scale. In contrast, variation in sea surface temperature directly enhanced stability at the regional scale, with indirect effects at the local scale, through reductions in competition and predation strength. In concert, these findings indicate that multitrophic assessments of species synchrony and community stability are under-represented but critical for understanding how biodiversity influences community stability in nature.

Session 14: Speed Talk General Session II

* indicates presenting author, † indicates eligibility for Best Student Paper Award

THERMAL BREADTHS OF NATIVE VERSUS INTRODUCED SPECIES OF MARINE SNAILS

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Extreme temperature events have the capacity to push organisms outside of their thermal limits of survival and trigger rapid population declines. These changes can have cascading effects on species interactions, food web connectedness, and the structure and functioning of ecological communities, which can degrade habitats and disrupt ecosystem services. More recently, extreme temperature events have emerged as agents promoting the spread and establishment of non-indigenous species (NIS) as NIS often have thermal tolerance limits that vary from those of native species given their different thermal evolutionary histories. Here, I compare the upper and lower thermal tolerance limits and supercooling points (SCPs) of two native and three introduced species of intertidal marine snails in the Strait of Georgia, British Columbia to assess whether extreme temperature events driven by climate change may alter invasion dynamics. Because many intertidal gastropod species in temperate regions produce egg capsules in the winter when food supply is more favorable, I also measure the lower thermal tolerance limits of encapsulated larvae from benthic egg masses of two native and one introduced snail species. Results show that thermal tolerance limits significantly differed between species, and that introduced species had both higher and lower upper and lower thermal tolerance limits, respectively, than native species. These results suggest that changes in extreme temperature events may favor the establishment of introduced species by disproportionately affecting the survival of native species relative to NIS.

USING LOCAL ECOLOGICAL KNOWLEDGE TO IDENTIFY CLIMATE CHANGE COPING STRATEGIES UTILIZED BY SMALL-SCALE FISHERS IN WESTERN NAYARIT

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University of Washington

As climate change and overfishing impacts continue to worsen, it becomes increasingly crucial to understand the profound impacts it has on small-scale fishers. The coast of Nayarit, Mexico is considered a climate change hotspot and the small-scale fishing communities that inhabit it are extremely vulnerable to climate change and overfishing impacts. Using local ecological knowledge documented from fishers in Nayarit, Mexico, this study aims to identify their response to climate changes over time from 1950 to 2020. We analyze the coping strategies fishers use to continue their livelihoods and traditional ways of life. These strategies include the diversification of fishers' target species caught and the relocation of fishing grounds. Fishers are increasingly diversifying the types of fish they target, recognizing that some previously abundant species may become scarcer. Additionally, overfishing has negatively impacted traditional fishing grounds, forcing fishers to explore new areas further from the coast. While some studies explore the transformative strategies fishers adopt, this study analyzes the adaptive measures fishers employ to sustain their participation in fisheries. By conducting a comprehensive analysis of these adaptive measures used by fishers and their impact, our study provides insights on the resilience of small-scale fishers ability to withstand the stressors of climate change and overfishing.

UTILIZING FUNCTIONAL TRAITS TO UNDERSTAND FOUNDATION SPECIES FACILITATION ACROSS A BIOGEOGRAPHIC GRADIENT

† Heineke, M.R.*; Kimbro, D.L.

Northeastern University

Positive interaction theory predicts that foundation species, such as coral reefs and rainforest trees, facilitate biodiversity by providing refugia for associated species, and assumes that the strength of facilitation increases as biological and environmental stress increases. *Ascophyllum nodosum* is an important intertidal foundation species in the northwest Atlantic that provides habitat for both marine and terrestrial species by buffering against desiccation and thermal stress during low tide. But results of this community influence vary widely: previous work suggests that the *A. nodosum* canopy can promote, is neutral, or negates barnacle recruitment within the GoM. A possible driver of this inconsistency is the lack of exploration into *A. nodosum* functional traits, previous work measures the canopy as either present or absent. To explore whether trait variation underlies this biogeographic inconsistency, I sampled 16 sites from Long Island, NY to Lubec, ME at two tidal elevations per site to ascertain functional trait and community composition differences. These pilot data revealed distinct morphological differences and barnacle composition between the two regions. Northern individuals are taller, older, and denser, but southern individuals are associated with higher barnacle densities. Despite higher desiccation stress in the south, there was no difference in thallus thickness between the two regions. These data suggest that *A. nodosum* functional traits may be a significant driver of understory community diversity and merit further investigation next summer, when I will expand the functional trait analyses and community surveys.

EVALUATING SUCCESS OF EXPERIMENTAL BULL KELP RESTORATION IN PUGET SOUND

† Martinson, I.N.[1*]; Hayford, H.A.[2]; Lowry, D.[3]

1- CSU Monterey Bay 2- Puget Sound Restoration Fund 3- NOAA Fisheries

Kelp forests are highly dynamic, critical nearshore ecosystems that provide many species with habitat and nursery grounds, cycle carbon, and have a culturally significant role in coastal communities. An exponential decline in bull kelp (*Nereocystis luetkeana*) has been observed in recent decades in Puget Sound, WA, particularly in Central and South Sound. Puget Sound Restoration Fund has partnered with NOAA Fisheries and community partners to develop scalable techniques for bull kelp restoration through enhancement outplants. Outplants occurred from 2020-23 at Jefferson Head, traditionally known as Doe-Kag-Wats, off the northeastern Kitsap Peninsula in Central Puget Sound. Each year, kelp was planted in March and reached the surface by June; however, observed recruitment was low and no outplant resulted in a self-sustaining bed the following year. Though growth was successful, the lack of significant secondary settlement suggests low fecundity, or bulk transport of propagules away from outplant sites. This study evaluated the success of the 2021 and 2022 enhancements by comparing growth, condition, and reproductive effort to a nearby, persistent kelp bed near Seattle, WA. Data suggest there may be a trade-off between growth rate and reproductive effort at the outplant site compared to the reference site. Understanding this trade-off will advance future bull kelp restoration efforts by informing strategies to maximize fecundity of reintroduced kelp, resulting in self-sustaining beds that enhance coastal resilience and contribute to ecological stability.

SUNFLOWER SEA STAR EFFECTS ON LOCALIZED GRAZER DENSITY IN SITKA SOUND, ALASKA

† Rough, M.E.[1*]; Kroeker, K.J.[2]; Galloway, A.W.[3]; Metzger, J.[2]; Gravem, S.[1]

1- Oregon State University 2- UC Santa Cruz 3- University of Oregon

Kelp forest ecosystems provide food, shelter, and nursery habitats for many species. Many kelp forests on the North American Pacific Coast are currently threatened by herbivorous sea urchins, whose populations have increased dramatically in recent years. A possible contributing cause of the sea urchin increase is the decline of their predator, the sunflower sea star *Pycnopodia helianthoides*, due to sea star wasting disease starting in 2013. Compared with other sea urchin predators, such as sea otters, there has been little research investigating the potentially important role that *Pycnopodia* have on kelp forest dynamics. To test if *Pycnopodia* affect the localized density of their grazer prey and create a 'landscape of fear', we quantified subtidal grazer densities within 4m of wild stars on benthic rocky reefs in Sitka Sound, Alaska. We found no effect of *Pycnopodia* on green sea urchin (*Strongylocentrotus droebachiensis*) or pinto abalone (*Haliotis kamtschatkana*) densities. However, we found that red sea urchin (*Mesocentrotus franciscanus*) densities were lower in a 1.5 meter radius around *Pycnopodia* in the field, and that active stars may cause stronger responses than inactive stars. This work suggests that sunflower sea stars affect localized sea urchin density in the wild, and helps us better understand whether *Pycnopodia* reintroductions may be a useful tool for restoring kelp forests and benefitting our coastal ecosystems, fishing industry, and recreational economies.

TESTING FOR LOCAL ADAPTATION BETWEEN 2 POPULATIONS OF OLYMPIA OYSTERS IN CENTRAL CALIFORNIA

BuyanUrt, B.[1*]; Hollister, L.[1]; Wasson, K.[2]; Gardner, L.[2]; Copeland-Baldwin, S.[1]; Johnson, K.M.[1,3]

1- Cal Poly, San Luis Obispo 2- Elkhorn Slough National Estuary Reserve 3- California Sea Grant

Olympia oysters (*Ostrea lurida*) are the only native oyster species to the Western Coast of California. Restoration and conservation efforts of these species are important to maintaining the ecological, economic, and cultural value of the California coast as well as mitigating the effects of climate change. Many populations of this species have declined throughout the species range as a result of overharvesting and habitat degradation. For estuaries with severely depleted population sizes, one proposed strategy to increase genetic diversity is to interbreed the populations. These approaches, however, risk reducing locally adapted genotypes to environmental stressors such as elevated temperature and hypoxia. In California, both Morro Bay and Elkhorn Slough have been identified as priority estuaries with depleted populations that may benefit from interbreeding. The objective of this study is to identify whether there are unique adaptations between two populations of hatchery-raised Olympia oysters, that come from these two estuaries with historically distinct local stress conditions. Upon completion of the multistressor exposure (i.e., anoxia and elevated temperature), we found that the Olympia oysters exhibited estuary specific differences in survival rates. Future analysis will look for differences in the transcriptomic profile and physiological response (measured as survival and immune response activation) between the two populations of Olympia oysters.

LONG TERM MONITORING ON NORTHEAST PACIFIC ROCKFISH, SEBASTES SPP., HOW LONG IS LONG ENOUGH TO TRACK SIGNIFICANT CHANGES IN ABUNDANCE AND DIVERSITY AFTER FISHERY RESTRICTIONS?

Larson, S.E.[1*]; Christiansen, J.[2]; Randell, Z.[1]; VanDamme, C.[2]; Shelledy, K.[1]; Williams, M.[1]; Olsen, A.Y.[1]; Lowry, D.[3]; Jasper, W.[4]

1- Seattle Aquarium 2- Seattle Aquarium-Retired 3- NOAA Fisheries 4- Makah Fisheries Management

Since the early 1980s, SCUBA divers from the Seattle Aquarium have been informally monitoring bottomfishes on rocky reefs west and east of Neah Bay, Washington, during specimen acquisition and scientific collections. These observations produced insight into the structure and complexity of these rocky reef ecosystems, and an informal record of bottomfish particularly rockfish, Sebastes spp., abundance and diversity. Based on increasing concern over the long-term stability of rockfish populations in Washington by state, federal, and tribal agencies, the Seattle Aquarium formalized monitoring of these systems starting in 2005 with diver-operated video (DOV) surveys to quantify bottomfish abundance and diversity over time. Divers performed 100-meter video transects, devised to be both non-invasive and repeatable, for assessing both relatively sessile bottomfishes and schooling, transitory rockfish species. Strip transects were conducted annually in August from 2005-2021 at five permanently marked sites. Species-specific relative abundance data for bottomfish were later acquired by biologists from archived video. Notably, over the 17-year study period there was community stability with a slight increase in bottomfish abundance over time at four of the sites with significant increases in four species: Canary, quillback, vermillion, and yelloweye rockfish. We documented just one significant young-of-the-year (YOY) recruitment event in 2016. This highlights the need for sustained and long-term monitoring for long-lived species with long generation times, like rockfish.

THE ROLE OF NATURE AND EQUITY IN PLANNING FOR A RESILIENT COAST

Wallingford, P.D.[1*]; Mann, A.[1]; Heady, W.N.[1]; Stanley, C.K.[1]; Won, O.[2]

1- The Nature Conservancy 2- UC Santa Cruz

California's coast harbors high numbers of endemic and rare species in a diverse array of habitats. However, 59% of coastal habitat area is vulnerable to five feet of sea level rise, with profound implications for ecological communities and biodiversity. Strategic migration and restoration of vulnerable coastal habitat can help mitigate these anticipated losses. Minimally developed coastal areas such as agricultural lands present prime opportunities for creating future coastal habitat and migration space as sea levels rise. By analyzing existing land use and development patterns we can identify where to target conservation and restoration efforts. To do this, we developed a framework that considers an area's vulnerability to sea level rise, its ecological importance for biodiversity and connectivity, regional acquisition and restoration economics, and the co-benefits of climate change mitigation and adaptation. We also identified opportunities to increase equitable access to the coast and to incorporate environmental justice and equity frameworks into conservation planning. As climate change continues and accelerates, migration and restoration of shorelines will be important for California to achieve its goal of conserving 30% of state lands and coastal waters by 2030. Considering how environmental benefits and burdens are currently distributed and incorporating equity into future habitat conservation planning can help prevent existing inequities from being perpetuated, while also protecting California's unique and biodiverse coastal habitats.

IT'S HOT ON THE BOTTOM TOO: MARINE HEATWAVES AND PHENOLOGY OF LIFE HISTORIES OF BENTHIC MARINE ORGANISMS

Hofmann, G.E.[*]

UC Santa Barbara

Marine heatwaves (MHWs) are of increasing concern due to the emerging ecological and socioeconomic impacts on coastal ecosystems. Leveraging temperature data of the Santa Barbara Coastal Long Term Ecological Research (SBC LTER) project, we analyzed the MHW events observed at kelp forest study sites in the Santa Barbara Channel. Not only were MHWs more frequently detected in the last 10 years, the events on average lasted longer and were more intense. MHWs were detected year-round, suggesting that marine organisms have exposure risks regardless of their phenology. Analysis of the temperature data revealed that anomalously high temperatures were also observed on the sea bottom, and these "hidden" MHWs did not necessarily have a concurrent signal at the sea surface and vice versa. Such spatial variation in MHWs has significance for processes such as interactions with the phenology of life history events of sessile benthic organisms, and further, may cause us to re-examine the existence of thermal refuges for mobile and non-mobile species. Finally, these observations highlight the importance of depth-stratified, long-term coastal monitoring to better understand our changing coastal ocean.

SUCCESSFUL PARTNERSHIPS REMOVING PURPLE URCHINS IN SONOMA COUNTY

Contolini, G.[*]; Hohman, R.; Gómez, J.; Mears, T.; Zepp, A.

Greater Farallones Association and Greater Farallones National Marine Sanctuary

Bull kelp, *Nereocystis luetkeana*, is the foundation species of kelp forest ecosystems in northern California and historically provided essential ecosystem services. Since 2014, bull kelp has declined dramatically—up to 90% in many areas. Many of these areas have also seen exponential increases in purple urchin densities, which could prevent long-term recovery of bull kelp. Therefore, one of the first steps of kelp restoration is to reduce purple urchin densities. Greater Farallones Association and NOAA's Greater Farallones National Marine Sanctuary have identified two priority sites to begin kelp restoration in northern California: Fort Ross Cove and Timber Cove in Sonoma County. However, preliminary surveys indicate we may need to remove over one million urchins to facilitate kelp recovery in our restoration areas, far exceeding the capacity of our team. To solve this problem, we tapped into the treasure trove of experience and enthusiasm in Sonoma and Mendocino County's commercial red sea urchin fishing industry. Since September 2023, five divers on three local vessels have landed over 9,000 lbs and 68,000 purple urchins (and counting) in 28 diver days from our two sites. We have also developed positive relationships with the fish processor who lands the urchins and the composting company who disposes of them, all of whose talents and skills are now an essential part of the project. We look forward to nurturing these partnerships as we continue urchin removals, kelp outplanting, and ecological, kelp canopy, and oceanographic monitoring for several more years.

INVESTIGATING THE MECHANISMS THAT FACILITATE SPECIES INVASIONS IN A RECENTLY INTRODUCED SEA ANEMONE

† Monuki, K.[*]; Bay. R., ; Sanford, E.

UC Davis

Global change is driving unprecedented alterations in species distributions. For example, human vectors can lead to range shifts through the introduction of species to new environments. The success of such species invasions will be determined by a species' ability to adapt via selection and/or acclimatize via plasticity to its introduced environment. However, the relative importance of standing genetic variation, selection, and plasticity in facilitating species invasions remains unclear. To address this question, we are studying an introduced anemone first reported in Tomales Bay, CA in June 2022. Our morphological and molecular analyses confirm this species is the Small Brown Sea Anemone *Anthopleura hermaphroditica*. This asexually-reproducing sea anemone is endemic to Chile, Australia, and New Zealand and, to our knowledge, this is the first record of this species in the Northern Hemisphere. Our surveys show high variability in the abundance and size distribution of *A. hermaphroditica* throughout Tomales Bay, with peak abundances and asexual reproduction in the middle of the bay. Additionally, preliminary results suggest *A. hermaphroditica* populations in Tomales Bay have low clonal diversity, highlighting the potentially important role of plasticity in population establishment and growth in its introduced range. Future work will investigate clonal diversity in the introduced and endemic ranges and will examine the role of phenotypic plasticity in facilitating the success of this introduction.

Session 15: Special Session: Honoring Ted Grosholz

* indicates presenting author, † indicates eligibility for Best Student Paper Award

THE LONG AND THE SHORT OF IT: HONORING TED GROSHOLZ

Cheng, B.S.*

Universityof Massachusetts Amherst

It is my pleasure to introduce this special session to honor the career of Ted Grosholz. Here, I will briefly review Ted's career highs and lows and his contributions to marine ecology, invasion biology, and the sacrifice of so many green crabs. Not only did Ted conduct impactful basic and applied science, in this session we argue that one of Ted's most important contributions to the field was to train and mentor the development of independent scientists that pursued our own interests. In support of this view, I use Ted's published work (89 publications with 12,207 citations) and apply bibliometric analytical methods in the form of co-word analysis to map the conceptual structure of his science. Models indicate three distinct conceptual clusters. The first is an early career but short lived fascination with competition, coexistence and host-parasite dynamics. Unsurprisingly, the second and largest conceptual cluster is defined by biological invasions, *Carcinus maenas*, and salt marshes. However, the third cluster is conceptually distinct and motivated by his mentees, focused on climate change, predation, recruitment, organismal responses, and impacts of environmental change. This highlights Ted's ability to foster independence in his mentees. Combined with Ted's propensity to always have our best interests in mind, our findings suggest that Ted was in fact, an excellent mentor. And for that, we are grateful.

RENAISSANCE ECOLOGIST: THE RESEARCH CAREER AND INFLUENCE OF TED GROSHOLZ

Kimbro, D.L.*

Northeastern University

The study of how organisms interact with each other and their environment to determine the distribution and abundance of species as well as the flux of energy and nutrients is studied at multiple scales of biological organization by ecologists spanning a huge spectrum of expertise. Over the last 40 years, one of the many fantastically unique attributes of Ted Grosholz has been his embraced multiple sub-disciplines and scales to not only maximize his capacity of understanding, but also to test the utility of that understanding for addressing environmental problems confronting society, all while developing new outreach methods for promoting societal understanding of environmental problems and solutions. In this talk, we will revisit some of Ted's key research accomplishments in basic and applied ecology, and we will close with a look at how those accomplishments have helped fuel the development of the next generation of ecologists operating at the intersection of basic and applied science, and public outreach.

"YOUR SENSE OF SCALE HAS BEEN COMPLETELY BLOWN" AND OTHER OBSERVATIONS: A TED TALK ON A MENTOR'S INFLUENCE

Chang, A.L.*

affiliation not listed

Over a thirty-plus year career, Ted Grosholz contributed immensely to the science of invasion biology and the conservation of estuarine ecosystems. Ted's mentoring and teaching efforts brought just as much to the field as his contributions to literature, policy, and management. His unique brand of direct, honest advice mingled with hard-won wisdom and an edge of seat-of-the-pants-ness (is that an adjective?) brought several generations of new scientists to the science and practice of conservation. Ted alternately inspired hopes and deflated pipe dreams in equal measure, sometimes with shockingly humorous takes. Here, I honor Ted with a few tales of how his advice and example have played a key role in shaping my work and life.

CHELA & TED'S EXCELLENT ADVENTURE OR THE PORTFOLIO APPROACH: A WAY FORWARD FOR RESTORATION OF NATIVE OYSTERS IN A DYNAMIC, URBAN ESTUARY

Zabin, C.[1*]; Margulies, A.[2]; Blumenthal, J.[1]; Grosholz, T.[3]

1- Smithsonian Environmental Research Center 2- San Francisco State University 3- UC Davis

Ted helped to kickstart my research on native Olympia oysters in San Francisco Bay (SFB) and has continued to be a valued mentor, friend, and collaborator on oyster research for over 18 years. Together, we helped to design, implement, and monitor the first mid-scale oyster restoration project in SFB, the SFB Living Shorelines Bay. With two locations that varied widely in terms of oyster stressors, we had widely contrasting outcomes. The oyster story became even more interesting over a 5- and then 10-year monitoring time frame, as the project weathered a historic drought, the wettest year on record, and 6 of the hottest years on record for SFB. With Ted's amazing ability to see a compelling storyline in less-than-thrilling results, we present our thoughts on the way forward for oyster restoration in this increasingly dynamic estuary.

HOW'S IT GOING ACE? BALANCING ACADEMIC SUCCESS AND PERSONAL GROWTH IN THE NEXT GENERATIONOF ECOLOGISTS

Wigginton, R.D.*

Sacramento-San Joaquin Delta Conservancy

During his successful and diverse career, Ted Grosholz has tested ecological theory and moved that theory into practice in meaningful ways, particularly in his study of invasive species and ecological restoration. This ability to balance the demands of the academy with practical application has been mirrored in his mentoring approach, which encouraged students to succeed academically while prioritizing an investment in their personal health and happiness. To demonstrate these points, this talk will highlight the work Ted has pursued with scientists outside the

academy, particularly his support and mentoring of invasive species managers in the Sacramento-San Joaquin Delta. I will also demonstrate how Ted has successfully fostered a sense of personal resilience in his mentees, allowing them to have long-term success in a demanding field of work.

TRANSLATING TED'S WISDOM
Hollarsmith, J.*

affiliation not listed

Ted Grosholz was a wonderful mentor to many of the early career researchers who have had the good fortune to work with him. However, he often delivered his words of advice rather bluntly. In this talk, I will be translating some of the comments that most stuck with me and ultimately had the greatest positive impacts on my career choices. Highlights include, "It could be a train wreck," "Juneau has three NPR stations," and "I was in Earth First!" My hope is that others will also be able to benefit from his wisdom. I will also include brief overviews of my current research efforts as the mariculture and macroalgae research lead for the Alaska Fisheries Science Center, highly influenced by my time in Ted's lab.

DIVERSE COLLABORATIONS, DIE-HARD MENTORSHIP, AND UNAPOLOGETIC ADVOCACY: HALLMARKS OF TED GROSHOLZ'S CAREER
Ridlon, A.D.*

affiliation not listed

Ted's role as a co-founder of the Native Olympia Oyster Collaborative (NOOC) has exemplified some of the values that thread their way through his entire career: diverse collaborations, often with unexpected partners, a steadfast commitment to marine conservation that extended far beyond his role in academia, and a natural affinity for uplifting the next generations of ecologists, restoration practitioners, and coastal advocates. I will introduce NOOC, and review some of the collaborative's recent projects and publications, highlighting Ted's role in each and how they relate to his broader career. I'll then speak to his mentorship throughout my own career - from being a technician in his lab nearly 15 years ago to his last postdoctoral scholar in 2022 - to highlight the kind of lifelong mentor Ted has been to so many.

MANAGING A BENTHIC ECOLOGY LAB WITH TWENTY-FIVE YEARS OF SPINELESS LEADERSHIP
Grosholz, E.D.*

UC Davis

I have been very lucky to mentor a long list of graduate students and postdocs in my lab over the past 25 years at UC Davis. I was inspired by my own Ph.D. mentor, Wayne Sousa (UC Berkeley), who not only showed me how to be field ecologist, but how to create a supportive and understanding environment for his lab. Over these 25 years, marine ecology has transitioned from small-scale studies of competition and predation to processes at multiple scales including coastal upwelling and nutrient dynamics and human impacts such as biological invasions and climate change. My lab has tested many of these paradigms in a broad range of systems from offshore kelps and coral reefs to coastal marshes and freshwater floodplains. We have used various methods including stable isotopes, and sediment biogeochemistry to analyze food webs and ecosystem processes, population genetics and trace elements to describe dispersal and phylogenies, drone and satellite images to analyze large scale patterns, and experiments and models to understand population processes and inform coastal management. Our lab has examined a diversity of organisms from (spineless) benthic invertebrates to shorebirds, fishes, halophytes, macroalgae, and phyto- and zooplankton. This diversity of our work was only possible through the collaborative community in my lab. I learned that you can't require collaboration and friendship, you can provide the environment to encourage this. I credit my success as a scientist to this collaborative community I have been lucky enough to have been a part of.

Session 16: Special Session: Marine disease ecology in a changing world II

* indicates presenting author, † indicates eligibility for Best Student Paper Award

EPIDEMIOLOGY OF PROLIFERATIVE KIDNEY DISEASE IN AN OREGON SALMONID HATCHERY
† Das, N.[1*]; Bjork, S.J.[2]; Atkinson, S.D.[1]; Reed, A.N.[2]; and Hallett, S.L.[1]

1- Oregon State University 2- Oregon Dept. of Fish and Wildlife

Proliferative Kidney Disease (PKD) is of great economic and ecological concern for cultured salmonids in Europe and North America. It is caused by the myxozoan parasite *Tetracapsuloides bryosalmonae* (*T. bryo*), which alternates between a freshwater bryozoan and salmonid host. Although the parasite is endemic in Oregon, only four instances of *T. bryo* infections have been recorded in the state fish hatcheries and occurred between 1994 and 2001. This sparce occurrence changed however in 2020, when a PKD outbreak caused severe mortality of juvenile Chinook salmon (*Oncorhynchus tshawytscha*) at Leaburg Hatchery (LBH) on the McKenzie River. In response, and given the parasite's unknown regional epidemiology, we commenced a multi-faceted monitoring program. Monthly from 2021 to 2023, water samples from the LBH inflow, raceways and outflow were collected and analyzed for waterborne parasite stages via qPCR, and fish kidney tissue was sampled for histology and PCR. Histology shows severe pathology of kidney tissues that have a temporal correspondence to parasite detection in the water samples via qPCR. This increased surveillance also reveals the onset of disease signs and mortality after 55 days of water temperatures over 15C after fish exposure to the parasite. Preliminary results indicate that the onset of infections occurs in the late summer, leading to 95% morbidity. These data now inform a) the parasite's spatiotemporal abundance and distribution in hatchery fishes, and b) how the density of waterborne parasite stages relates to the severity of PKD in fish.

METATRANSCRIPTOMICS REVEALS A VIRAL COMMUNITY SHIFT AND TUMORIGENESIS RESPONSE TO SCOMBRID AQUACULTURE DISEASE

† Leidholt, S.L.[1*]; Bistolas, K.I.[1]; Galvin, T.[1]; Miller, E.A.[2]; Dasenko, M.[1]; Van Houtan, K.S.[3,2]; Boustany, A.[2]; Vega Thurber, R.L.[1]

1- Oregon State University 2- Monterey Bay Aquarium 3- Duke Marine Lab

Aquaria and aquaculture facilities are powerful tools for conservation and sustainability for some of the world's most heavily harvested fish species. However, high densities among conspecifics lead to animal disease outbreaks in these settings. One long-standing disease, Puffy Snout Syndrome (PSS), causes localized, collagenous tissue growths on the head in Scombrid fishes (e.g., tuna, mackerel, and bonitos). To date, PSS has only been documented in captive-held fish populations and is associated with high mortality rates. Little is known about the causative agent(s) of PSS and the immune responses it elicits. Therefore, we leveraged 'Omics and culture-based methods to evaluate PSS infections in three groups of Pacific mackerel (*Scomber japonicus*) – symptomatic-captive, asymptomatic-captive, and healthy wild-caught. Our aims were to 1) analyze gene pathways active in the host immune response to PSS, 2) characterize the viral community, and 3) culture and sequence the causative viral pathogen. Host transcripts showed numerous tumorigenesis and stress-related genes overexpressed in captive-held animals. Viral transcripts showed the *herpesvirales* family as overrepresented in differential abundance analysis. Viral culture elicited cytopathic effect over three passages in cell lines, with prominent syncytia formation. Overall, our results provide evidence for a viral disease agent responsible for PSS and offer insight into disease mitigation for aquaria and aquaculture facilities holding these commercially important fish taxa.

HISTORIC OVERHARVEST OF MARINE DETRITIVORES MAY INCREASE CORAL DISEASE ON MODERN REEFS

Clements, C.S.[1*]; Pratte, Z.P.[2]; Stewart, F.J.[2]; Hay, M.E.[1]

1- Georgia Inst. of Technology 2- Montana State University

Coral reefs are in dramatic global decline, with outbreaks of coral diseases playing a significant and increasingly frequent role in recent decades. This is especially true for Acroporid corals that represent ~25% of all Pacific coral species, were once dominant in the Caribbean but are now endangered, and that generate much of the topographic complexity on which many other species depend. Coral diseases commonly appear sediment-associated and could be exacerbated by the overharvest of sediment-feeding detritivores. Using field manipulations in both French Polynesia and Palmyra Atoll, we found that sea cucumbers, which have been overharvested for decades, strongly suppress disease among corals directly contacting reef sediments. Sea cucumber removal increased tissue mortality of *Acropora pulchra* (+370%) and *Acropora nasuta* (+124%) corals and altered sediment microbiomes—with microbiomes in removal plots containing more microbes associated with coral diseases. Sea cucumbers may historically have played a key role suppressing pathogenic microbes, and their overharvest during the past 200+ years may facilitate infectious diseases that have decimated coral reefs. Restoring the essential cleaning services of these once-abundant detritivores may help suppress coral losses to disease in a changing ocean.

EFFECTS OF MICROBES ON HERBIVORY IN CORAL REEFS AND CONSEQUENCES FOR REGIME SHIFTS

Briggs, A.A.[1,2*]; Holland, W.C.[3]; Osenberg, C.[4]; Paul, V.J.[2]

1- UC Davis 2- Smithsonian Marine Station 3- NOAA Fisheries 4- University of Georgia

Top-down effects of consumers can strongly influence the structure and function of ecosystems, and microbes have recently been recognized to modify the strength of these effects. Previous research has primarily explored how pathogenic microbes alter consumer effects, such as inducing trophic cascades during disease outbreaks. However, non-pathogenic microbes can alter consumer behavior through a variety of mechanisms, with potential consequences for ecosystems. We investigated how toxin-producing microalgae that live as epiphytes on macroalgae in coral reefs influence herbivory, using laboratory experiments on the reef urchin, *Echinometra viridis*, an important grazer in Caribbean and Atlantic reefs, and four species of benthic dinoflagellates from the genus *Gambierdiscus*. *Gambierdiscus* spp. produce a bioaccumulating toxin that causes ciguatera poisoning in people who consume contaminated seafood. In feeding preference assays, urchins consumed relatively less of a palatable, macroalgae-based agar gel food when it contained *Gambierdiscus* cells compared to food without dinoflagellate cells. Using dynamical models to explore the effects that toxic micro-epiphytes like *Gambierdiscus* could have on alternative stable states and regime shifts in reefs from coral to algal dominance, we found that the likelihood of regime shifts increased with the effect of epiphytes on herbivores. Thus, reefs could be more vulnerable to experiencing regime shifts than previously expected, given changing conditions that are facilitating harmful microbes in many reefs globally.

SYMBIOSIS PROVIDEDS RESILIENCE TO BACTERIAL PATHOGENESIS BY REDUCING OXIDATIVE STRESS WITH GLUCOSE METABOLISM IN SEA ANEMONE AIPTASIA

Grewelle, R.E.[1*]; Krediet, C.[2]; Renicke, C.[1]; Pringle, J.R.[1]

1- Stanford University 2- Eckerd College

Reef-building corals derive much of their energy from photosynthates (most prominently glucose) provided by their intracellular dinoflagellate symbionts (family Symbiodiniaceae), which are horizontally transmitted in most species. Innate immune pathways have been proposed to serve dual roles in the regulation of both symbiosis and pathogenesis. How these pathways play one or more roles remains poorly understood. Coral disease epidemics and bleaching events often coincide with high ocean temperatures, and still little is known about the cellular processes driving these events. Using the anemone Aiptasia as an experimental model of cnidarian-dinoflagellate symbiosis, we investigated if and how symbiosis influences susceptibility to bacterial pathogenesis via glucose metabolism. We found that the cnidarian pathogen, *Serratia marcescens*, induced a cytotoxic immune response in Aiptasia via formation of reactive oxygen species (ROS). The effects of ROS were quenched by the activation of the glucose-dependent pentose phosphate pathway. Exogenous glucose enhanced survival of Aiptasia larvae and adults, and symbiosis also enhanced survival in adults. The impact of symbiosis on survival was dependent on the Aiptasia genotype and dinoflagellate species, which suggests host-symbiont interactions modulate glucose translocation rates and/or immune activity. Our results describe a mechanism of

pathogenesis in symbiotic cnidarians that depends on glucose provided by dinoflagellates, which could partially explain the vulnerability of bleaching coral reefs to disease. Further investigation of the roles of the innate immune system in symbiotic cnidarians could illuminate pathways to resilience for two of the greatest threats to coral reefs: bleaching and infectious diseases.

WHAT DOESN'T KILL YOU MAKES YOU STRONGER? POTENTIAL FOR SELECTED WITHERING SYNDROME RESISTANCE IN ENDANGERED WHITE ABALONE

† Deutsch, A.A.[1*]; Marshman, B.C.[2]; Souza, C.A.[1,2]; Moore, J.D.[2]; Aquilino, K.M.[1]; Frederick, A.R.[1]; Burge, C.A.[2]

1- UC Davis 2- California Dept. of Fish and Wildlife

Withering syndrome presents a challenge for recovery of endangered white abalone, *Haliotis sorenseni*. The disease, caused by the bacterium *Candidatus* Xenohaliotis californiensis (*Ca*.Xc), inhibits the animals' ability to digest food and causes animals to starve, digest their own tissue for energy, and eventually wither. Previous studies have shown that populations of captive and wild abalone can develop resistance to *Ca*.Xc after previous exposure, and heritable resistance has been selected for in farmed red abalone, *Haliotis rufescens*. To inform captive breeding for white abalone recovery efforts, we utilized a common garden experiment to determine whether resistance to withering syndrome can be selected for in white abalone. We exposed seven populations of white abalone to *Ca*.Xc in elevated seawater temperatures (17°C) reflective of what outplanted abalone may experience in Southern California. We monitored survival and measured bacterial loads, using qPCR tests of fecal samples and in selected tissue samples over time. Our preliminary results indicated that some populations of white abalone were less susceptible to *Ca*.Xc, suggesting that resistance may be heritable among our captive breeding lineages. Should we find that *Ca*.Xc resistance is heritable, this would allow for the selection of specific crosses to increase disease resistance in white abalone populations and, ultimately, lead to more effective captive breeding practices for this endangered species.

Session 17: Reproduction, Dispersal, and Recruitment

* indicates presenting author, † indicates eligibility for Best Student Paper Award

USING GENETIC TOOLS TO ASSESS THE RELATIONSHIP BETWEEN MARINE PARASITE TRANSMISSION STRATEGY AND DISPERSAL CAPACITY

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1- Moss Landing Marine Labs 2- UC San Diego 3- Scripps Inst. of Oceanography 4- University of Washington 5- CSU Monterey Bay

In marine and terrestrial systems, life history drives the distribution of organisms and informs the spatial scale of population connectivity. Nearly all bony reef fishes and invertebrates have a bipartite life cycle with a planktonic larval stage, which increases the organism's dispersal capacity, and concludes with a relatively non-dispersive adult phase. While many studies have identified the relevant spatial scale for studying population structure in fishes and invertebrates, few have donethe same for parasitic taxa, which have even more complex life histories with a higher diversity in the range of dispersal strategies they use. Parasite taxa differ in (1) life cycle complexity, (2) host specificity, and (3) the types of hosts they can infect. All variables are likely to have both independent and synergistic effects on dispersal capacity. This research investigates whether transmission strategy and life cycle characteristics are reflected in the dispersal capacity of three groups of marine parasites using genetic analysis of their populations across French Polynesia and the Pacific Line Islands. We examined FST at the mtDNA CO1 level of 196 adult trematodes, 53 larval trematodes, and 50 copepods - parasites that each vary in their life history. Each parasite group had varying levels of population differentiation across the Line Islands and French Polynesia.

DECADAL VARIABILITY IN CORAL RECRUITMENT ON SETTLEMENT TILES ON PALMYRA ATOLL FROM 2011-2022 AND ITS RELATION TO THE NEARBY ENVIRONMENT

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1- UC San Diego 2- Scripps Inst. of Oceanography

All species rely on the ability to reproduce to maintain their presence and their role in their ecological community. In the past decade, coral mortality has increased due to unprecedented human impacts. For the adult coral community to persist, reliance on successful asexual and sexual reproduction is paramount. However, degraded reefs are already experiencing the effects of global and local stressors, resulting in reduced coral recruitment. Here we use an 11- year time series (2011-2022) on a remote atoll, Palmyra Atoll to monitor coral recruitment over time. This time series also includes disturbance events such as El Niño in 2014-2016 and subsequent bleaching events that occurred on Palmyra Atoll. To monitor the spatial and temporal variability in coral recruitment, calcification accretion units (CAUs; n=5) were deployed annually at 8 sites spanning the shallow reef terrace and deeper forereef habitats around the atoll. In addition to exploring variability in coral recruitment across space and over time, we explored correlations between number of recruits and surrounding benthic reef community composition as well as community composition on the settlement tiles. Preliminary results show that coral recruitment is generally high on Palmyra's reefs but that there is significant site/habitat and annual variability. The shallow reef terrace had significantly higher coral recruitment rates compared to the deeper fore reef. During the thermal anomaly event associated with El Nino in 2014-2016, coral recruitment on Palmyra decreased. Following the thermal anomaly associated, coral recruitment rates peaked in 2018 on most sites on the atoll. Since coral recruitment is often used as a proxy for the resilience of a coral reef, this long-term monitoring study on a remote reef is valuable to provide a baseline against other locally impacted reefs. Until now, a long-term monitoring study of coral recruitment has not been studied to this extent despite its importance in response to disturbance due to global stressors.

IT'S ALL A BIG MISTAKE: LARVAL ERRORS AND THE FORMATION OF NEW AGGREGATIONS OF THE SERPULID ANNELID FICOPOMATUS ENIGMATICUS

Mendelson, A.[*]; Nuon, K.; Pernet, B.

CSU Long Beach

The euryhaline annelid *Ficopomatus enigmaticus* is found as a non-indigenous species in estuaries throughout the world. Adults can form massive, dense aggregations that have major effects on both planktonic and benthic communities. These aggregations are formed by larval settlement: cues associated with adults induce planktonic larvae to settle in contact with those adults. Formation of a new aggregation, however, requires a larva to settle in the absence of adult cues. Solitary settlement in similar species has been explained by at least three hypotheses: some larvae may make incorrect settlement decisions ("Larval Error"); larvae that do not encounter adult cue may eventually accept a wider array of settlement substrata ("Desperate Larva"); larvae are genetically polymorphic in substratum requirement, with some being founders (settling only on uninhabited substrata) and others being aggregators (settling only on adults) ("Founder/Aggregator"). We sought to distinguish among these hypotheses in laboratory experiments on *F. enigmaticus*. As larvae of six full-sibling families became competent to settle, we exposed individual larvae to either adult tube, field biofilm, or lab biofilm and recorded settlement daily for the next six days. Settlement started at the same time in each treatment, and overall settlement was highest on adult cue, intermediate on field biofilm, and low on lab biofilm. These patterns are inconsistent with the Desperate Larva or Founder/Aggregator hypotheses, but consistent with the Larval Error hypothesis.

INTERACTIONS BETWEEN LIFE HISTORY TRAITS OF MARINE FISH RESULT IN AT LEAST ONE MODERATE MOVEMENT EXTENT ACROSS LIFE STAGES

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UC Santa Barbara

Fish move in two life stages, adult and larval, that are influenced by myriad, diverse factors which determine the viability and structure of fish communities. While high or low movement extents at each life stage have known trade-offs, the drivers and relationships between life stages are largely unknown. Understanding these interactions is vital for fish conservation, geographic patterns, and adapting to climate change. Here, we created a Gaussian Mixture Model (GMM) to group 606 fish species into six distinct movement classes, using home range and pelagic larval duration (PLD). We assessed key traits (length, longevity, optimal temperature, and trophic level) as predictors of movement class differences. Our results showed no stark trade-offs in ontogenetic movement extents, with all species exhibiting at least one mid-range extent and extremes absent. Some traits had differing relationships with movement extents at each life stage; when assessed alone, length correlated positively with home range and had no relationship to PLD. Factoring in lifespan, home range increased with length for long-lived species but decreased for shorter-lived ones. Conversely, PLD showed a negative length effect in long-lived species but no effect in short-lived ones. Our findings highlight specific physiological and environmental contexts where different movement combinations arise, even within overlapping movement classes. Research and management focused on a single life stage, even while considering a trait effect, may overlook the role of more complex trait interactions in fish movement.

GERMLINE STEM CELL COMPETITION IN A MARINE TUNICATE: A REPRODUCTIVE MECHANISM HIGHLIGHTING NATURAL SELECTION AT THE CELLULAR SCALE

Levy, T.[1*]; Anselmi, C.[1]; Ishizuka, K.J.[1]; McGeever, E.[2]; Detweiler, A.[2]; Sinha, R.[1]; Ohene-Gambill, B.F.[1]; Huynh, S.[2]; Morri, M.[2]; Palmeri, K.J.[1]; Gordon, T.[1]; Rosental, B.[3]; Neff, N.[2]; Weissman, I.L.[1]; Voskoboynik, A.[1]

1- Stanford University 2- CZ Biohub 3- Ben-Gurion University of the Negev

Botryllus schlosseri is a marine tunicate whose colonies fuse blood vessels, form chimeras, and exchange germline stem cells (GSCs) which compete to create the gonads within a chimera and pass their genes to the next generation. However, while their existence had been previously noted, GSCs were never isolated and characterized in *Botryllus* before.To do so, testes were dissociated, cells were stained with non-species-specific stem cell markers and analyzed using flow cytometry. Cells were then index-sorted followed by single cell RNA sequencing. Analysis of the cell clusters revealed expression of homolog genes to germline cell markers, as also proved by *in-situ* hybridization of *PIWI* and *VASA* genes in *Botryllus* testes. Based on their transcriptomic fingerprint, candidate GSCs were sorted, stained with lipophilic dyes and transplanted into reproductive colonies. Three days post transplantation, the cells were traced *in-vivo* and found in the testes of the recipients. Seven days post transplantation, flow cytometry analysis showed that some transplanted cells seemed to differentiate into spermatids and sperm, suggesting that the transplanted cell population was GSC-enriched. With the current ability to isolate them, further analyses may pave the way to explore the controlling factors of germline stem cell competition - a mechanism that underscores the concept that natural selection operates not only at the organismal level, but also at the cellular level.

DEVELOPING PURPLE HINGED ROCK SCALLOPS (CRASSEDOMA GIGANTEA) FOR AQUACULTURE BY OPTIMIZING AERATION AND FEED CONCENTRATION IN THE HATCHERY.

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1- Moss Landing Marine Labs 2- California Sea Grant

Despite continued interest and efforts spanning decades, scallop aquaculture along the West Coast of the United States remains a largely nonexistent industry. With the United States being one of the largest net importers of wild and farmed scallops globally, there remains a need to develop scallop aquaculture to meet increasing domestic demand while reducing pressure on wild populations. Purple Hinged Rock Scallops (*Crassedoma gigantea*) are a native species with a number of traits justifying aquaculture development yet the few existing hatchery protocols for *C. gigantea* report sparse or conflicting details regarding optimal culture conditions. We conducted a series of range-finding experiments to investigate the effects of aeration and feeding rate on larval growth and survival with the goal of determining an optimal range for larviculture. Shell length increased significantly over time as a function of increasing airflow (0 – 3.2 LPM) and water movement in the tank . We did not detect an upper threshold for aeration within our tested range over the 42-day experiment. A second range-finding experiment was conducted in ten

135L conical bottom tanks to determine optimal microalgal feeding rates (0-90Kcells/mL). Larval growth and survival were significantly associated with feed density, with an optimal range found between 3-15Kcells/mL. These results indicate that hydrokinetic stresses may be less detrimental for larval scallops than previously thought and that larvae perform better at microalgal densities lower than other cultured bivalves.

COMPARISONS OVER SPACE AND TIME: HOW HAS 20 YEARS OF WARMING AFFECTED THE REPRODUCTION AND SETTLEMENT OF SEMIBALANUS BALANOIDES?

† Weinstock, J.B.[1*]; Genovese, S.[2]; Krumhansl, K.[3]; DiBacco, C.[3]; Starczak, V.R.[4]; Pineda, J.[4]

1- MIT-WHOI Joint Program 2- Boston University 3- Bedford Inst. of Oceanography 4- Woods Hole Oceanographic Inst.

Warming ocean temperatures may affect marine species reproduction timing and success, with consequences to larval dispersal and recruitment. Unfortunately, because of the long temporal scales, few studies are able to directly evaluate change through time, instead relying on natural gradients in temperature as a “space-for-time” approximation. Here, we compare this “space-for-time” approach to a true comparison through time, using measurements of reproduction and settlement in the acorn barnacle *Semibalanus balanoides.* Both reproductive development and settlement density were measured weekly from Rhode Island to Nova Scotia during 2002-04, as well as from Massachusetts to Nova Scotia during 2020-23. Nearshore surface water temperatures for each site and sampling year were aggregated to yield 2 values per site-year combination: average temperature during (1) reproduction and (2) larval dispersal. We found that reproduction and larval dispersal occurred over a wide range of temperatures, corresponding to variable reproductive timing and success over both space and time. Settlement also varied by several orders of magnitude across sites and years, likely reflecting dynamics in reproductive output as well as pelagic mortality. Our unique measurements offer a rare opportunity to test the validity of space-for-time approaches in predicting the impacts of climate change. With this improved understanding, we may better predict population dynamics in the contexts of marine protected areas, spread of invasive species, and biofouling.

BORN LOSERS: ADAPTIVE INACCURACY AND THE TYPE III SURVIVORSHIP CURVE

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Type III survivorship describes a pattern in which younger life stages have a higher rate of mortality than their older counterparts. Many marine invertebrates and fishes exhibit Type III survivorship and this pattern of mortality is usually attributed to extrinsic factors (e.g., differential predation on smaller life stages). In this study, we present evidence that an intrinsic driver – developmental inaccuracy and trait maladaptation – can be responsible for Type III survivorship. We examined variation in morphology of California Grunion larvae, and how larval morphology is related to survival during early life (up to 12 d post hatching). By examining selective morphology on a sample of 64 different cohorts, we were able to describe the fitness surface relating larval phenotype to survival across a wide range of phenotype values. We then compared the degree to which the phenotype distribution within a given cohort overlapped with regions of high or low fitness. This analysis produced a metric of developmental inaccuracy that is similar to the concept of genetic load. Our results suggest a high degree of maladaptation for this population. Even in the relatively benign environment of the laboratory, many offspring are born losers. Their phenotypes indicate a substantial degree of developmental instability and inaccuracy, and these offspring die very early in life (within 6 d post hatching). The purging of unfavorable phenotypes early in life is followed by a period of less intensive selection, thus resulting in Type III survivorship.

Session 18: Special Session: Kelp Research and Restoration in Along the West Coast I

* indicates presenting author, † indicates eligibility for Best Student Paper Award

TROPHIC CASCADES IN MARINE PROTECTED AREAS DRIVE DIFFERENCES IN KELP FOREST RESILIENCE TO MARINE HEATWAVES

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1- Stanford University 2- University of the Sunshine Coast, Australia 3- UC Los Angeles 4- The University of Queensland, Australia

The debate about whether marine protected areas (MPAs) buffer against climate change impacts needs more empirical evidence, specifically to understand under which conditions MPAs support resilience to climate change. We empirically assess whether kelp forests within fully and partially protected MPAs along Central and Southern California were more resilient to the 2014-2016 marine heatwave regime. Using a long term satellite derived dataset of kelp area, environmental variables, and subtidal kelp community transect data, we test for resistance to and recovery from the large marine heatwave within MPAs, and whether trophic cascades explain any emergent patterns. We find that kelp forest resistance and recovery metrics are significantly higher within fully protected areas in Southern California, but not in Central California. Additionally, urchin densities were significantly lower within MPAs during and after the heatwave, while urchin predator densities were higher within Southern California MPAs, but not for those in Central California. The regional discrepancies in response to the heatwaves may be partly explained by three-way trophic interactions. While MPAs confer a multitude of ecosystem services, their ability to enhance resilience to climate change may be limited by local ecological integrity and environmental conditions. Long-term monitoring is therefore vital to detect signals of increased resilience to climate change within MPAs.

COMMERICAL KELP HARVESTING IN CALIFORNIA

Flores Miller, R.E.[*]; Ramey, K.L.; Frimodig, A.J.; Elsmore, K.E.; Kawana, S.K.

California Dept. of Fish and Wildlife

Kelp and other marine algae are ecologically, culturally, and economically important in California, providing ecosystem services for use and enjoyment by the public. The California Department of Fish and Wildlife (CDFW) manages marine algae resources, which includes overseeing commercial and recreational harvesting activities, and monitoring, research, and restoration activities. Giant kelp, *Macrocystis pyrifera*, has been

commercially harvested in California since the early 1900's. More recently, several other kelp species have been targeted for commercial harvest including bull kelp, *Nereocystis luetkeana*, and sea palm, *Postelsia palmaeformis*. The California Fish and Game Commission (FGC) has recently implemented new commercial regulations including temporary amendments pertaining to bull kelp due to the species dramatic reduction in Sonoma and Mendocino counties. The temporary amendments have a three-year sunset date to allow for the development of a statewide Kelp Restoration and Management Plan for giant kelp and bull kelp. In addition, CDFW is researching regulation amendments for FGC consideration for commercial harvest of sea palm and other marine algae that are reflective of current practices and environmental conditions. CDFW continues to gather information on harvest methods, locations, and density monitoring data. This presentation will provide a brief overview of the history of commercial harvest in California, current status of harvest including current regulations, and highlight opportunities to inform the management of kelp and other marine algae.

KELP FOREST REFORESTATION PROGRAM IN BAJA CALIFORNIA

Beas-Luna, R.[1*]; Abadía-Cardoso, A.[1]; Bauer, J.[2]; Lorda, J.[1]; Malpica, L.[1]; Palleiro, J.[3]; Paz-Lacavex, A.[4]; Torres-Moye, G.[3]; Zepeda-Dominguez, J.A.[1]

1- UABC 2- CICESE 3- FPPBC 4- UC Santa Cruz

More than than 8 thousand people from the fishing communities in Baja California have been directly affected by the collapse of *Macrocystis pyrifera* forests during the last decade. The kelp decline had ecological effects on important fishery populations and the estimated socioeconomic loss is approximately $70,000,000.00 USD per year. Such loss motivated a group of fishers to convince the *Secretaria de Pesca y Acuacultura* of the State of Baja California to request support from academia to develop a pilot program towards the restoration of marine forests in the coasts of Baja California. In this work, we briefly describe this process and present positive results obtained from experimental reforestation strategies. However, these experiments have been conducted at very small scales and thus we discuss options on how to scale and multiply these efforts, to increase the productivity of our local forests and their resilience. We are facing enormous challenges due to the reduction of marine forests in Baja California, the present project supports the idea of building a program with the following 7 actions: 1) ecological monitoring, 2) developing low-cost culture systems, 3) environmental monitoring network, 4) Structured and standardized urchin removals, 5) urchin by-product development; 6) Building local capacity for empowerment and promote citizen participation; and 7) Institutionalization.

SPORA: CHALLENGES AND OPPORTUNITIES FOR KELP RESTORATION IN BAJA CALIFORNIA, MEXICO

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1- UC Santa Cruz 2- UABC 3- CICESE 4- FPPBC

Baja California's fishing communities rely heavily on kelp forests as a source of their livelihood. Kelp is in decline in many regions of the world caused by anthropogenic pressure. There is an imminent need for a suite of kelp restoration techniques that can be easily applied and most importantly transferred. SPORA program emerged in 2022 as one of the few pilots to address this issue in Baja California. However, implementing kelp restoration efforts encounters technical, practical, and regulatory challenges. Tailoring restoration methods to site-specific conditions is imperative. SPORA concentrates on the facilitation of knowledge transfer and collaborations. This includes establishing a kelp culturing facility and a field-testing initiative encompassing green gravel deployment, herbivore population management, and the systematic evaluation of natural recruitment. Through these localized efforts, the widespread issue of kelp loss has gained the attention of fishing communities and governmental agencies in Mexico with new pilots on their way.

THE SPORE SOLUTION: ENHANCING KELP FOREST RECOVERY THROUGH MEIOSPORE TRANSLOCATION

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1- FISHBIO 2- Monterey Bay Seaweeds

Most kelps are recognized as foundation species, and many regions have experienced dramatic declines in kelps over the last decade. As a result, kelp restoration has garnered international attention from researchers and managers because it has the potential to mitigate the loss of ecosystem services and resources due to kelp loss. Restoration strategies around the globe have resulted in mixed success due to regionally unique challenges and tailored kelp restoration management strategies are necessary to cater to regional ecosystem needs. The Spore Solution team has been investigating a novel technique to facilitate kelp recovery through the dispersal enhancement of kelp meiospores. This technique utilizes a simple translocation of kelp meiospores from a local persistent kelp bed onto a barren reef. "Reef dusting" can aid current restoration efforts by bolstering the supply of haploid gametophyte kelps on the reef cheaply and pragmatically, complementing existing restoration strategies. In 2022 and 2023, we utilized the "Reef Duster" to inoculate rocky reefs off Double Point in Drake's Bay and experimental substrates in Stillwater Cove in Carmel Bay. Preliminary results suggest that reef inoculation can result in spore settlement, yet water motion may play a role in spatial precision. We discuss the Spore Solution's regional applicability and potential for incorporation into commercial fishery practices.

BIOMARKERS OF RECOVERY: A CASE STUDY OF HOW PRIMARY CONSUMERS ASSIMILATE AND PARTITION ENHANCED NUTRITION FOLLOWING KELP FOREST RESTORATION.

† SPINDEL, N.B.[1*]; GALLOWAY, A.W.E.[2]; SCHRAM, J.B.[3]; MCNEILL, D.G.[4]; BELLIS, S.K.V.[4]; GUUJAAW, N.[5]; YAKGUJANAAS, J.[6]; THOMPSON, M.[7]; SAUNDERS, G.W.[8]; LEE, L.C.[5]; OKAMOTO, D.K.[1]

1- Florida State University 2- OIMB 3- University of Alaska Southeast 4- Haida Fisheries Program 5- Gwaii Haanas National Park Reserve, National Marine Conservation Area Reserve, and Haida Heritage Site 6- Council of the Haida Nation 7- Thalassia Environmental 8- University of New Brunswick

Coastal kelp forests provide tremendous productivity, critical habitat, and a wealth of services to nearshore ecosystems. These marine biomes increasingly face multiple overlapping threats under rapid global change. Stakeholders worldwide have responded with restoration efforts aiming to increase the abundance of foundation species like kelp in such systems, with mixed success. However, we lack a comprehensive

understanding of how such increases affect the nutritional landscape and subsequently, the fitness of resident consumer taxa. We bridge this knowledge gap with an empirical Before-After-Control-Impact (BACI) case study of kelp forest restoration via removal of herbivorous sea urchins from 2017 to present in British Columbia, Canada. Sea urchin removal resulted in 65-fold increases in kelp abundance from 2018 pre- to 2019 post-restoration at a depth of 5-10 m in habitat previously dominated by “barrens”, seascapes denuded of macroalgae by overgrazing sea urchins. Fatty acid (FA) profiles of cooccurring grazers, sea urchins and abalone, elucidated two key classes of FAs differentiating barren versus kelp forest habitats: biofilm (i.e., FAs originating in bacteria and diatoms) and kelp biomarkers, respectively. In alignment with resurgent kelp following restoration, both abalone and sea urchins exhibited increases in kelp biomarkers. In contrast, higher proportions of biofilm biomarkers in grazers was characteristic of barrens habitat. In general, the gonad FA profile of deep-dwelling sea urchins at the restoration site transformed from a type characteristic of barrens habitat into one resembling kelp forest habitat, with an 89% increase in gonad mass after restoration efforts. Additionally, abalone exhibited a consistent ontogenetic shift from biofilm to kelp. Our results demonstrate kelp restoration via sea urchin removal enhances the quantity and quality of food in previously degraded habitats, and subsequently enhances the amount and nutritional quality of roe (i.e., gonads) in sea urchins therein. Moreover, this nutritional enhancement in deep habitats may provide new refugia from diving predators such as sea birds and sea otters for species of concern such as the northern abalone.

THE ROLE OF DYNAMIC KELP FOREST-URCHIN TRANSITION ZONES FOLLOWING A DEFORESTATION EVENT

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Sonoma State University

As the number of climate driven events increase, the persistence of many marine ecosystems, such as kelp forests, become progressively more vulnerable. Additionally, population dynamics, larval production and demographic connectivity are likely to become more variable. In Northern California, a series of perturbations, including a record-breaking marine heatwave (MHW) has led to a catastrophic decline of iconic and historically stable bull kelp (*Nereocystis luetkeana*) forests. Although many kelp forests have shifted to sea urchin barrens, observational and survey data shows locations where kelp populations have persisted, forming dynamic transitional zones. However, the fundamental processes of these zones are not well understood. In this study, I analyzed how species diversity at the macroscopic level and recruitment at the microscopic level varied within transitional zones. To address this, two sites were surveyed monthly (June-September 2023) to quantify kelp cover and species richness while simultaneously sampling invertebrate recruitment. Preliminary results reveal distinct population dynamics within transitional zones and increased species richness within the kelp boundary. This increase at the macroscopic level reflected greater invertebrate recruitment, mainly driven by urchins (*Stronglyocentrotus spp*). Further analysis will compare species richness at transitional zones with the interior of remnant kelp patches. These results indicate the importance to understanding the role these zones may have on critical kelp forests processes and persistence.

CHANGES IN PLANT DEMOGRAPHICS INFLUENCED BY DISTURBANCE DRIVE INTERANNUAL VARIABILITY IN GIANT KELP NET PRIMARY PRODUCTION

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1- UC Santa Barbara 2- Florida State University 3- University of Virginia 4- University of Massachusetts, Boston

Net primary production (NPP) is essential to life on Earth, and it is influenced by abiotic and biotic factors affecting plant standing biomass and rates of recruitment, growth, and mortality. We investigated the sources of interannual variability in NPP of giant kelp, *Macrocystis pyrifera*, at two kelp forests in Southern California, USA, using structural equation modeling (SEM) applied to a 19-year time series of kelp NPP and relevant demographic variables and environmental drivers. We found that the interaction between plant density and plant size at the beginning of the growing season is the predominant driver of annual NPP. Disturbance from winter storms and urchin grazing dictates the number of plants present at the beginning of the growth season, and both plant density and plant size have a negative influence on annual recruitment. Annual recruitment also has a positive influence on NPP. Interestingly, kelp growth remained consistently high throughout the study period despite considerable environmental variability, and consequently did not contribute significantly to interannual variability in NPP. Our findings highlight the primary factors causing year-to-year fluctuations in giant kelp NPP and provide a basis for predicting how it may respond to environmental fluctuations associated with climate change.

Session 19: Conservation and Restoration III

* indicates presenting author, † indicates eligibility for Best Student Paper Award

MARINE RESERVES ENHANCE RECOVERY OF SOME COMMERCIAL SPECIES FROM MARINE HEATWAVES

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1- Hopkins Marine Station, Stanford University 2- The University of Queensland, Australia 3- Sociedad Cooperativa de Producción Pesquera Buzos y Pescadores de la Baja California 4- Comunidad y Biodiversidad A.C 5- University of Georgia

Marine protected areas (MPAs) reduce local stressors, which may support biodiversity recovery from climate change impacts. While extreme climatic events such as marine heatwaves (MHWs) are increasing in frequency and duration, it remains unclear whether MPAs enhance the recovery of species from MHWs and how recovery varies across species. We used 15 years of kelp forest monitoring data to evaluate the impact and recovery of two sedentary (turban snail and warty sea cucumber) and two mobile (California lobster and California sheephead) species from the 2014-2016 MHWs, inside and outside two marine reserves in Isla Natividad, Baja California Sur, Mexico. We hypothesized that 1. all species were significantly impacted during the MHWs, 2. that impacts were less severe inside reserves than control sites, and 3. that species required fewer years to recover to pre-heatwave abundances inside reserves than at control sites. Analyses supported that the MHWs significantly

impacted all species. Although the effect of the reserves was not always statistically significant, losses during the MHWs were less severe inside reserves for all species except sheephead. Consistent with predictions, sedentary species recovered to pre-heatwave abundances faster inside reserves. In contrast, lobster and sheephead never recovered to pre-MHW abundances inside or outside the reserves. Our analysis of long-term monitoring data shows that, while marine reserves alone cannot prevent adverse impacts from extreme climatic events, they may support and enhance species recovery.

CRYOPRESERVATION OF THE COLLECTOR URCHIN, TRIPNEUSTES GRATILLA

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This study seeks to develop a cryopreservation protocol for the collector urchin, *Tripneustes gratilla*. Urchins are invaluable members of coral reef communities. Grazing pressure exerted on the reef by collector urchins significantly reduces algal biomass and protects the diversity of the ecosystem by inhibiting phase shifts to degraded, algae dominated reefs. In Hawaii, management agencies use *T. gratilla* as a biocontrol agent to help mitigate the impacts of invasive algae. As participants of the herbivorous guild, these urchins contribute directly to reef resilience. Therefore, Conservation strategies should be developed to preserve this species and the role it performs for the ecosystem. Here we propose the development of a protocol that could be used to cryobank urchin reproductive material. To formulate a cryopreservation protocol for *T. gratilla*, several cryopotectant agents (dimethyl sulfoxide, propylene glycol, ethylene glycol, trehalose) were tested and various cooling rates (1°C/min, 5°C /min, 10°C/min and 15°C/min) were examined. The protocol was also assessed at various stages of ontogenetic development in order to establish if *T. gratilla* is more receptive to cryopreservation at any point. Cryopreservation of embryos produced survival rates of up to 85.5% and up to 50.8% maturation to the 4-arm echinopluteus stage, assessed three days after thawing. This artificial reproductive technique could be used to compliment aquaculture production as well as the conservation and supplementation of depleted or otherwise imperiled urchin communities on the reef.

DEVELOPING AN INDIGENOUS-LED MONITORING AND RESPONSE PROGRAM FOR INVASIVE EUROPEAN GREEN CRAB ON HAIDA GWAII

Crawford, S.; Brown, A.*; Braun, J.; Guujaaw, N.; Kampen, G.; Curle, L.

Council of the Haida Nation

1: Council of the Haida Nation, B.C. Canada Haida Gwaii is an archipelago in the Pacific Northwest with a rich marine environment that has historically supported large populations of Haida people; Haida knowledge of the land and ocean and stewardship practices has been key to ensuring the ecosystem's continued resilience to human-caused pressures. In July 2020, the first invasive European Green Crab (EGC) was detected on Haida Gwaii. EGC is incredibly destructive and its presence in Haida Gwaii waters threatens both cultural and ecological systems. Following initial detection, the Council of the Haida Nation (CHN) utilized existing government partnerships, Indigenous knowledge, and existing research to design and initiate a response program to understand and mitigate the impacts of the invasion. This early-intervention program includes both detection trapping to understand the geographic extent of the invasion and depletion trapping at priority sites for population suppression. The program also includes monitoring and mapping ecological features and variables likely to affect and be affected by EGC, such as bivalves, native shore crabs, and eelgrass. Data collected is being used to assess the effectiveness of depletion trapping, refine the response strategy, and inform local management decisions.

STOCKING THE BROOD STOCK: UTILIZING MICROBIOLOGY TO ENHANCE ASSISTED EVOLUTION RESTORATION TECHNIQUES

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Over the past two decades, microbial symbiosis has become a fundamental tenant of coral reef ecology. Coral animals themselves host a dense and diverse microbial community of endolithic fungi and algae, dinoflagellate algae, archaea, viruses, and bacteria. Deemed the coral "holobiont", this microbial consortium confers functional roles in coral fitness and resilience. While coral restoration efforts expand globally, few consider the role of the holobiont. Specifically, coral larval propagation practices employ maximal sterility, poignantly overlooking the role of microbes on early coral survivorship and development. Current larval propagation techniques have achieved success in high rates of embryo fertilization and larval settlement, though post-settlement survival remains low, typically facing 99% mortality in the first year. This study examines the capacity to influence early life history coral microbiome development and post-settlement survivorship by rearing coral larvae in coarsely filtered reef water compared to the low microbial density, 0.5 um filtered seawater traditionally used. Bacterial microbiome development was analyzed via 16S rRNA gene amplicon sequencing of larvae and post-settlement recruits of the Caribbean coral Colpophyllia natans<//i>. Results suggest that external rearing environment significantly influences microbiome development and may have the capacity to influence post-settlement survivorship.

INFORMING 3D PRINTING DESIGNS THROUGH DATA COLLECTION TO PROMOTE CORAL RECRUITMENT

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Global degradation of coral communities demands management to slow the declining population trajectories of reef corals. One approach is enhancing recruitment by engineering surfaces that resemble natural structural elements on the reef. Using the backreef of Moorea, French Polynesia, we tested the hypotheses: (1) the abundance of coral recruits is proportional to the availability of microhabitats, normalized to their planar area, and (2) naturally-forming microhabitats, larval density, and gregarious behavior, affect settlement and the survival of coral recruits on 3D printed tiles. Through surveys, recruitment in naturally forming microhabitats (mm-cm scale) was quantified in the shallow (<7 m depth) backreef. Microhabitats mimicking those found on natural surfaces were printed onto tiles (34 x 46 x 4 mm), and the settlement rates and

locations of coral recruits were measured following exposure to larvae from the common coral *Pocillopora acuta*. Microhabitats on natural surfaces that were categorized as pits and grooves contained 85% of coral recruits, which was more than predicted by chance alone. On printed tiles, a higher percentage of recruits settled in grooves and pits than to smooth surfaces, although their survival was similar between microhabitats regardless of whether recruits were singletons or aggregated. When larval density was elevated, settlement and the frequency of gregarious settlement increased. These results highlight opportunities to enhance recruitment through engineered tiles replicating structural features that enhance coral recruitment.

ENVIRONMENTAL JUSTICE IN ECOSYSTEM RESTORATION FRAMEWORKS

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Ecosystem restoration projects are being pursued globally, driven by an increase in awareness regarding the human benefits that healthy ecosystems provide. This restoration push has incentivized the development of restoration frameworks that aim to guide project development. These projects can play an important role in environmental justice and ameliorate the impacts of human actions on marginalized communities. Despite the large number of frameworks in existence, no analysis has been conducted to understand their efficacy or universal applicability. In particular, no previous study has analyzed the value of these frameworks for environmental justice. This is crucial, as these frameworks guide site selection and restoration protocols, which directly impact the potential benefits to vulnerable communities. Through a systematic global literature review of restoration frameworks, the different strategies can be explored and their strengths and weaknesses can be assessed. The results of this study reveal substantial shortcomings in current restoration frameworks and have implications for environmental justice and the expansion of ecosystem restoration work.

HOW GRAZING AND HABITAT COMPLEXITY IMPACT BIODIVERSITY AND ECOSYSTEM FUNCTIONING ON SEAWALLS

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Seawalls drastically modify and homogenize marine habitats. These often-smooth vertical surfaces lack the habitat complexity found in natural rocky shores and have been found to host different, simpler communities. Ecological engineering (eco-engineering) of seawalls aims to counteract this reduced biodiversity by adding microhabitats such as pits and crevices. The objective of this experiment was to measure the promising effect of increasing rugosity on seawalls to support more diverse urban coastal ecosystems. Concrete tiles of varying surface complexity were deployed in the high intertidal in San Francisco Bay to measure their effect on the colonizing community and associated ecosystem functioning. In addition to the effect of complexity, this study also used predator exclusion treatments to test the effect of mobile invertebrate grazers on community development and functioning. After 18 months, we found that increasing habitat complexity led to greater species richness and shifts in community composition. More complex tiles also hosted unique species, such as the native Olympia oyster (*Ostrea lurida*). We used infrared gas analysis to measure the change in carbon dioxide during emersion to estimate gross primary productivity as a metric for ecosystem functioning. We found the effect of habitat complexity and grazing invertebrate mollusks drove not only differences in community composition and species richness, but also contributed to differences in gross primary productivity. These results demonstrate that increasing habitat complexity on vertical surfaces can increase biodiversity and illustrate the role of invertebrate grazers and surface rugosity in driving marine invertebrate and algal community structure and functioning on intertidal eco-engineered surfaces.

ADAPTIVE MANAGEMENT IN ACTION: RESULTS AND RECOMMENDATIONS FROM THE FIRST EVALUATION OF CALIFORNIA'S MARINE PROTECTED AREA NETWORK

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In 2022, California reached a remarkable milestone in marine conservation with the publication of the first comprehensive ten-year evaluation of the Marine Protected Area (MPA) Network and Management Program. Led by the California Department of Fish and Wildlife (CDFW), the Decadal Management Review (Review) highlights results, accomplishments, challenges, and gaps in knowledge under the four pillars of the MPA Management Program: Research and Monitoring, Outreach and Education, Enforcement and Compliance, and Policy and Permitting. A broader performance evaluation revealed evidence that the state's MPA Network is showing signs of fulfilling, to some degree, the ecosystem-based goals of the Marine Life Protection Act, the 1999 law that mandated the creation of the Network. Many marine species are more diverse and abundant across some habitats inside MPAs; scientific, educational, and recreational opportunities in coastal habitats have been enhanced by MPAs; and there are early signs that the MPA Network may provide some resiliency of marine ecosystems to climate change. Informed by these results and the input from California Native American Tribes, research partners, many state and federal agencies, and the public, CDFW concluded the Review with a suite of recommendations and action items to help guide the next 10 years of adaptive management of the MPA Network.

Session 20: Community Ecology III

* indicates presenting author, † indicates eligibility for Best Student Paper Award

CHEMICAL WARFARE ON TEMPERATE REEFS: REVEALING THE INHIBITORY EFFECTS OF TURF ALGAE ON KELP FOREST RECOVERY

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Maine's kelp forests are threatened by ocean warming, marine heatwaves, and species invasions, which have already caused a collapse of kelp forests and a rapid shift to small red turf algae on Maine's southern reefs. It is unknown, however, how this ecosystem state shift affects the chemical environment of the reef and its receptivity to kelp forest recovery. In this study, we compared northern reefs (kelp forests) with southern reefs (now dominated by turfs) to document how the reef "chemoscape" varies by ecosystem state. Examining chemical extracts from reef water and algae via liquid chromatography-tandem mass spectrometry, we found that turf reefs and kelp forests have distinct exometabolomes. We then present data for a series of kelp spore settlement experiments, in which we tested the effects of turf reef exometabolomes and algal chemical extracts on kelp settlement behavior and survival. Together, our findings increase our understanding of the ecological functions of marine natural products and reveal their ability to perpetuate ecosystem state shifts on temperate reefs.

CORAL-SPONGE INTERACTIONS: BUILDING FENCES AND HAVING NEIGHBORS FOR LUNCH

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affiliation not listed

Coral-sponge interactions are often described as competitive with sponges as winners in a battle for space, but little is known about the mechanisms employed by these invertebrates to establish relationships with their neighbors nor how their interactions change with time. This study focuses on two main objectives: 1) to describe coral behavioral responses to initial contact interactions among 20 coral-sponge pairings 2) to compare attachment rates of sponges on coral tissue and exposed coral skeleton over 2 weeks. This study is the first to document coral release of digestive filaments on sponges, and to describe how this effects sponges and their attachment abilities. Further, in all coral-sponge pairings, sponges are more likely to attach to coral skeletons than live coral tissue regardless of the coral's ability to use digestive filaments. Thus, it is inappropriate to generalize coral-sponge interactions as competitive with sponges as obvious winners because corals may have the ability to accept or deny attachment by sponges and contact made between corals and sponges can be beneficial; in some cases, sponges may be a food source for corals.

INTERCONNECTEDNESS OF CORAL AND MICROBIOME ECOLOGICAL MEMORY DURING REPEATED MARINE HEATWAVES

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Microbiomes are essential features of holobionts, providing their hosts with key metabolic and functional traits like resistance to environmental disturbances and diseases. In scleractinian corals, questions remain about the microbiome's role in resistance and resilience to factors contributing to the ongoing global coral decline and whether microbes serve as a form of ecological memory for holobiont acclimatization or adaptation. To test if and how coral microbiomes affect host health outcomes during repeated disturbances, we conducted a large-scale (32 exclosures, 200 colonies, and 3 coral species sampled) and long-term (28 months, 2018-2020) manipulative experiment on the forereef of Mo'orea, French Polynesia. In 2019 and 2020, this reef experienced the two most severe marine heatwaves on record for the site. Our experiment and these events afforded us the opportunity to test the dynamics and roles of coral microbiomes in the background of host bleaching and mortality resulting from these successive and severe heatwaves. We report unique microbiome responses to repeated heatwaves in *Acropora retusa*, *Porites lobata*, and *Pocillopora* spp., which included: microbiome acclimatization in *A. retusa*, and both microbiome resilience to the first marine heatwave and microbiome resistance to the second marine heatwave in *Pocillopora* spp. Moreover, observed microbiome dynamics significantly predicted coral species-specific phenotypes. For example, bleaching and mortality in *A. retusa* both significantly increased with greater microbiome beta dispersion and greater Shannon Diversity, while mortality in *P. lobata* increased significantly during shifts in microbiome composition. Compositional microbiome changes were also reflected in ratios of differentially abundant putatively beneficial to putatively detrimental taxa to coral health outcomes during repeated heat stress. This study reveals evidence for variable microbial responses to repeated heatwaves within different coral species and, importantly, suggests that host-dependent microbiome dynamics may provide a form of holobiont ecological memory to repeated heat stress.

A TRAIT BASED APPROACH FOR SEAWEEDS MAY PROVIDE AN ALTERNATIVE METHOD FOR QUANTIFYING ANTHROPOGENIC STRESSORS ON TROPICAL REEFS

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Anthropogenic stressors on coral reefs (e.g. sedimentation, nutrient enrichment, overfishing) are driving ecosystem shifts from coral to macroalgal dominance. Managing these stressors requires quantification of magnitude and effect, which can be time consuming and costly. Trait-based ecological approaches in other systems have demonstrated how environmental conditions can shape plant community traits; we posit community traits can be leveraged as indicators of anthropogenic stressors in coral reef systems. To test this hypothesis, we compared algal community traits across sites with varying nutrient, sediment, and overfishing stress on five fringing reefs on Moorea, French Polynesia. We quantified the relative strength of these stressors with bioassays, showed significant differences among sites, and identified stressor 'hot spots'. We randomly collected 20-25 algal individuals from each site, measured seven functional traits, and used an ordination approach to delineate trait space, quantify occupancy across sites and species, and link these traits to environmental drivers. Results showed that sites varied significantly in their occupancy of trait space and loading plots indicated trait values shifted in response to environmental stressors. For example, algae responded to sediments by maximizing surface area:dry weight or height:dry weight, both traits likely aiding in acquisition of light. These results demonstrate algal community traits have a great potential as indicators of the intensity of anthropogenic stressors, and may prove a low cost, low tech alternative to current methods.

ARE DIVERSE BIOLOGICAL COMMUNITIES MORE RESISTANT TO INVASION? A CASE STUDY WITH MARINE INVERTEBRATE FOULING COMMUNITIES

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The theory of biotic resistance predicts that diverse communities should be less susceptible to invasive species. Multiple experimental studies in marine fouling communities have found that increased diversity can decrease invasion success, though one observational study has shown opposing patterns. In this study, I manipulated the initial species richness of 120 naturally occurring fouling communities on 10x10 cm settlement panels into three treatment groups: low-richness (one species), mid-richness (three species), and high-richness (five-species). I then placed half the panels at two separate locations at the Eureka Public Marina, in Humboldt, CA, and photographed them for 10 weeks to see how the diversity affected the recruitment of species not present on the panels initially (novel species). I found that while empty space remained consistently independent of treatment or location, less diverse panels ended up with a higher percent cover of novel species, likely due to the dominance of the ascidian *Diplosoma listerianum*. Further, all treatments seemed to converge in terms of diversity and species composition by the end of the experimental period in spite of environmental conditions differing at each experimental location. These results support the biotic resistance hypothesis, though this resistance may only slow the eventual dominance of incoming species for a short time. Further, these results suggest that environmental conditions may need to differ drastically to drive differences in invasion success.

TRAIT-MEDIATED EFFECTS OF CLEANING MUTUALISMS ON CORAL REEF HERBIVORY

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Cleaning mutualisms can influence the behavior and distribution of client fish, many of which play important roles in shaping coral reef ecosystems. Still, the overall consequences of these trait-mediated effects in shaping ecological processes remains largely unknown. We examined how cleaning mutualisms involving the cleaner wrasse, *Labroides dimidiatus* shape herbivory patterns on coral reefs by studying 30 patch reefs (half with cleaners, half without) in the lagoons of Moorea, French Polynesia. On each reef, we conducted macroalgae herbivory assays, fish and benthic community surveys, surgeonfish foraging observations, and cleaner behavioral observations. We found that macroalgal herbivory rates were higher around cleaning stations. Increased herbivory rates appear to be driven by higher fish abundance on reefs with cleaners, and not by any differences in fish community composition. Foraging rates for the surgeonfish *Ctenochaetus striatus* (the most common client of *L. dimidiatus*) were similar on reefs with and without cleaners, suggesting limited effects of cleaners on foraging behavior or time budgets. Benthic community composition was also similar on reefs with vs. without cleaners. Finally, cleaners interacted with a wide variety of client species and exhibited high rates of cheating behaviors, both of which could limit their indirect effects on herbivory. Thus, cleaners increase local herbivory rates, primarily by increasing the local density of fish, rather than altering fish behavior, and as a result may promote reef resilience and facilitate coral recovery.

SEASCAPE HETEROGENEITY INFLUENCES ALASKAN EELGRASS FISH COMMUNITIES

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Nearshore marine ecosystems are composed of dynamic and diverse habitats that provide important services including shelter and prey for juvenile, migratory, and residential species. Habitats are often intermixed, even though we often study them in isolation without considering surrounding influences. We examined how fish communities differ in Southeast Alaskan eelgrass meadows when the surrounding seascape included or did not include adjacent kelp habitat to test the role of spatial arrangement and composition of nearshore coastlines on associated fish assemblages. We characterized habitats using aerial imagery and field sampling and quantified eelgrass fish assemblages using beach seines. We found increased fish species richness and diversity in eelgrass habitat when it included adjacent kelp. The shift in community composition included greater prevalence of Lingcod, Whitespotted Greenling, sculpins, Pacific Sand Lance, and Pink Salmon. Some species, however, were more abundant within eelgrass habitat that was surrounded by more eelgrass, including Pacific Staghorn sculpin, Shiner Perch, and Three-spine Stickleback. While both Three-spine Sticklebacks and Shiner Perch were caught in both types of eelgrass habitats, juveniles were more abundant in eelgrass only seascapes highlighting its nursery importance. An appreciation of seascape complexity wherein nearshore habitats are contextualized is important for evaluating the role of these habitats when making trade-offs and decisions in nearshore habitat conservation and fisheries management.

EXPLORING THE MECHANISMS OF EMERGENT COMMUNITY SHIFTS ALONG A CO_2 GRADIENT

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Ocean acidification (OA) due to rising atmospheric CO_2 will lead to changes in community structure in marine systems. We explored the mechanisms of ecosystem shifts under OA at the volcanic CO_2 vents at the Castello Aragonese in Ischia, Italy. Venting at the Castello delineates three distinct pH zones including ambient (~8.0 pH), low (~7.7 pH), and extreme low pH (~6.6 pH). Previous work at this site described a loss of marine calcifiers and a more homogenized benthic community dominated by fleshy algae as pH decreases. In addition to the direct effects of pH on calcifiers, potential drivers of community shifts are decreased sea urchin abundance, changes to urchin behavior, and greater algal growth and nutritional quality under OA. To test the influence of these factors, we performed *in situ* experiments to measure grazing rates and righting response of purple sea urchins (*Paracentrotus lividus*) under acute OA exposure in each zone, transplanted from the ambient zone. We also measured growth rates and C:N ratios (a proxy for nutritional quality) for two algal species (*Dictyota* spp. and *Halopteris scoparia*) in each pH zone. We did not find evidence that urchin grazing rates, righting response, algal growth rates, or C:N ratios were affected by pH zone,

suggesting that decreases in urchin abundance may be a stronger driver of ecosystem level changes in this system. Further investigation into the complex effects of OA on key consumer-algae relationships will be essential for predicting ecosystem shifts and improving conservation responses to climate change driven stressors.

Session 21: Intertidal Ecology I

* indicates presenting author, † indicates eligibility for Best Student Paper Award

AT A CLAM'S PACE: EXPLORING THE RECOVERY AND SPATIAL DISTRIBUTION OF PISMO CLAMS (TIVELA STULTORUM) ON PISMO BEACH, CALIFORNIA

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Pismo clams (Tivela stultorum) supported a once abundant recreational fishery on the California Central Coast until their populations declined in the 1980s. Pismo clam abundance on Pismo Beach, the historic epicenter of this fishery, remained low until clams began reappearing in the intertidal zone in larger numbers in 2015. The population grew steadily for the next few years, and then increased dramatically in 2021. The recovery of this species has presented the opportunity to better explore their spatial ecology and habitat preferences and requirements, and how these influence their distribution and abundance. We analyzed clam abundance data at three sites along the length of Pismo Beach to determine how abundance and size structure differ over this range. At each of our three field sites we explored the spatial distribution of the clam bed, documenting how much of the beach the clams occupy and how this changes over time. We further explored how preference for location vertically varies by clam size class. Lastly we analyzed sediment grain size along the beach to explore how physical habitat may be used to predict clam presence and abundance. These data collectively build our understanding of the habitat requirements of Pismo clams and how they are distributed within their ideal habitat.

THE POPULATION IMPACTS OF TWO RANGE-EXPANDING PREDATORS ALONG THE NORTHEAST PACIFIC COAST

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Global change is causing widespread redistribution of species, which itself can have severe ecological consequences. As predators redistribute, they are expected to negatively impact prey populations in the novel, recipient communities. Invasion biology theory suggests that these impacts can be predicted by either the abundance of the novel predator in the recipient community or the impacts on prey in the predator's native range. These expectations, however, are largely untested in range-shifting species. We manipulated the abundances of two predators undergoing poleward redistributions, the whelks *Mexacanthina lugubris* and *Acanthinucella spirata*, in their respective native and novel ranges and assessed whether consumption of prey (acorn barnacles and mussels) was related to predator abundance and whether impacts on prey in novel communities mirrored those in the native communities. We found that impacts on prey were related to predator abundances overall, with *Mexcanthina* and *Acanthinucella* having stronger abundance-associated effects on mussels and barnacles, respectively. Additionally, for both species, we found that predation impacts experienced in the native range generally predicted the impacts in the expanded range. Our results therefore suggest that impacts on prey vary by prey species and that impacts in the predator's native range are indicators of impacts in novel communities.

SITE SPECIFIC OSMOTIC TOLERANCE OF THE MUSSEL MYTILUS GALLOPROVINCIALIS IN FLUCTUATING SALINITY ENVIRONMENTS

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The invasive mussel Mytilus galloprovincialis is known as a limited hyposaline tolerant species with evidence of cellular and proteomic changes under 29ppt seawater. However, in Los Angeles, CA, we have found discrete populations of M. galloprovincialis inhabiting areas with highly variable seawater salinities due to freshwater run-off. Thus, we sought to determine the osmotic tolerance of this population of mussels and characterize the possible mechanisms conferring hyposalinity tolerance. We collected mussels from Ballona Creek (BC) and Marina del Rey Harbor (MDR), CA and acclimated mussels in the lab to control conditions (17ºC, 34ppt) for two-weeks. Following acclimation, mussels were exposed to hypo- or hyper-salinity conditions (40, 35 [control], 30, 25, 20, 15, 10, 5ppt) for one week and then physiological measurements obtained including: metabolic rate (MR), clearance rate (CR), hemolymph osmolarity, antioxidant enzyme activity, and HSP70 protein expression. Initial findings, based on MDR mussels, suggest that MR is reduced by 95% under hyper- and hyposalinity compared to the control. CR steadily decreased with hyposalinity and was reduced by 50% under 5ppt compared to the control. Mussels remained nearly isosmotic above ~500 mOsm exposure but became hyperosmotic regulators below 500 mOsm. We anticipate finding site specific differences in hyposalinity tolerance with this reflected by the antioxidant activity and HSP70 expression that contributes to a greater hyposalinity tolerance of BC mussels compared to MDR congeners.

LIMPET IDENTIFICATION AND MISIDENTIFICATION IN THE INTERTIDAL ZONE OF HOPKINS MARINE STATION

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At Point Cabrillo, within the Lovers Point - Julia Plat State Marine Reserve in Monterey Bay California — Stanford University scientists have been morphologically surveying the intertidal zone of Hopkins Marine Station (HMS) since the 1930s along the Hewatt transect. Lottia, a genus of true limpets, can be hard to identify in the field using morphological features down to species. Misidentification can impact the validity of data

collected, leading to misunderstandings of temporal and spatial distribution patterns. Using paired morphological and molecular identification of 171 limpets collected in the intertidal zone of HMS, I determined that two species (*Lottia fenestrata, L. sp alaska*) were being overlooked by morphological methods. I found *L. fenestrata* was misidentified as *L. pelta* and *L. paradigitalis*. My results show that *L. fenestrata*, which has not been documented along the transect, is moderately abundant (10 of 72 limpets that could be sequenced), yet not captured using only morphology. Another *Lottia* species, referred to here as *L. sp alaska*, is a new, unnamed limpet species not documented previously besides one specimen sequenced in the 2018 Dutch Harbor Marine Invasive Species BioBlitz from Amaknak Island, Alaska. *Lottia sp alaska* appears abundant in the intertidal zone of Hopkins, despite not being a described species, found in 20 of 72 limpets sequenced. Based on morphology, *L. sp alaska* was misidentified as *L. paradigitalis, L. pelta*, and *L. digitalis/austrodigitalis*. Future work will try to establish field-based ID methods for both misidentified species.

FIELD ACCLIMATIZATION OF ADULTS INFLUENCES OFFSPRING PERFORMANCE IN THE ROCKY INTERTIDAL MUSSEL, MYTILUS CALIFORNIANUS

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As marine species are increasingly met with extreme climate warming events, understanding acclimatory mechanisms that have the potential to alleviate stress is critical to predicting species response to ongoing and future warming. In this field-to-laboratory experiment, we investigated transgenerational plasticity in nature by examining how parental exposure to differing thermal regimes that exist across tidal height and season impact offspring phenotype. Here, *Mytilus californianus* , were collected from mussel beds in the high and low zone of the rocky intertidal following the Summer and Fall/Winter season. Adults were spawned in the laboratory and sets of offspring then were reared at cool (16°C) and warm (20°C) temperatures. At the veliger stage, physiological performance of offspring was assessed. Results from this study show that seasonal acclimatization and larval developmental temperature had prevailing effects on offspring performance. Where larvae from high and low mussels collected following the Fall/Winter were generally larger, had higher thermal tolerance, and lower respiration rates than those collected following the Summer when reared at the same temperature. These results support the idea that parental acclimatization can impact offspring performance, however, differences in adult thermal exposure at the microhabitat scale may not be the main driver. While laboratory studies have increased our understanding of transgenerational acclimation processes, field studies such as this provide insight into how these processes function in natural populations.

THE INTERACTION OF *PISASTER* PREDATORS AND ENVIRONMENTAL STRESSORS DRIVING PREY DISTRIBUTIONS IN A ROCKY INTERTIDAL BOULDER FIELD

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As one of the most physiologically challenging ecosystems on the planet, the rocky intertidal zone along the eastern Pacific is characterized by resilient organisms. Extreme heat fluctuations, desiccation, and heavy wave action are all abiotic factors such organisms have evolved to withstand. We used a rocky intertidal boulder field as our study system to test how these factors and the keystone predator Pisaster ochraceous interact to influence the zonation and microhabitats of intertidal prey species (mussels *Mytilus californianus*, acorn barnacles *Balanus glandula*, and gooseneck barnacles *Pollicipies polymerus*). Around each boulder, the sun, prevailing wind, and incoming waves change, creating abiotic gradients in temperature, desiccation, and wave stress that vary with shore level, incline, and compass heading. We can capitalize on these gradients to ask how each stressor influences the biota surveyed in 730 quadrats around 24 boulders at various elevations. Further, *Pisaster* was removed semiweekly from half of the boulders for several years before the prey surveys, enabling us to test whether the environment alters their top-down role. We used ArcGIS to map abiotic and biotic patterns onto the 3-D boulder field and used linear and additive models to test how prey are influenced by environment and predation. So far, we found that *Pisaster* pushes mussels into warmer microhabitats in sun-exposed and higher locations. Understanding how the environment can influence ecological processes is imperative as average air temperatures increase with climate change.

WILL CLIMATE WARMING AMPLIFY THE COMPETITIVE AND PREDATORY EFFECTS OF A RANGE-EXPANDING MARINE GASTROPOD?

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The effects of climate warming on the distribution of range-expanding species are well documented, but the interactive effects of climate warming and range-expanding species on recipient communities remain understudied. For example, with climate warming, range-expanding species may become a threat to local biodiversity due to their relatively stronger competitive or predatory effects on potentially weakened, or less well-adapted recipient communities. Acanthinucella spirata is a predatory marine gastropod that has expanded its distribution north along the California coast since the Pleistocene via a poleward geographical range shift, tracking climatic warming. To assess whether A. spirata has stronger predatory effects in the recipient community and is better suited to the warming conditions than a local predatory snail, I used a combination of field and laboratory studies to examine the feeding activity of A. spirata and a? local predatory whelk Nucella lamellosa) on shared prey on Cape Mendocino under ambient and elevated conditions. From a series of field surveys, I concluded that A. spirata is a potential competitive threat to N. lamellosa, due to its high local abundance, overlapping habitat, and shared prey on Cape Mendocino. In the laboratory experiment, I observed that A. spirata was a more efficient consumer of barnacles than N. lamellosa overall and ate significantly more barnacles than N. lamellosa under warmer conditions. As climate change continues, environmental conditions will become more stressful for all species; however, range-expanding A. spirata populations may be at a competitive advantage relative to N. lamellosa, as they exhibit greater abundances and a higher feeding rate at warmer temperatures than the local whelk.

SPAWNED FROM THE INTERTIDAL: THE REPRODUCTIVE PATTERN OF PURPLE SEA URCHINS

† Martinez, C.*; Haberman, I.*; Haupt, A.J.*

CSU Monterey Bay

Understanding reproductive patterns is necessary to predict a species' population dynamics. Species like purple sea urchins have a stable seasonal reproductive cycle, so understanding potential temporal and spatial differences in reproductive cycles is necessary to predict how environmental changes will impact reproductive output and grazing pressures. Purple sea urchins are herbivorous echinoderms and are an important species to study as they can cause an ecosystem to shift from a biodiverse kelp forest to an urchin barren. Sea urchins could exhibit spatial and temporal variation in reproductive capacity due to stressors across sites and seasons. We seasonally surveyed nine sites along the Monterey Peninsula, quantified intertidal algal groups, urchin densities, and collected urchins for reproductive analysis. Urchins were measured and weighed, and then their gonads were extracted to measure their gonadosomatic index (GSI). GSI is the proportion of the urchin's body weight that is reproductive. My analysis suggests an annual reproductive cycle of GSI, with a peak in fall across the sites and a post-spawning low in that winter. Pt. Pinos had a relatively low GSI in the summer but was the most reproductive of our sites in the fall. Differences in seasonal food availability between sites could be a driving factor that causes observed inconsistencies in relative reproductive output. This study is critical because it will help us understand how intertidal urchin populations respond to differences in habitat within a reproductive cycle.

Session 22: Behavioural Ecology I

* indicates presenting author, † indicates eligibility for Best Student Paper Award

SEASONAL MIGRATION OF JUVENILE WHITE SHARKS ACROSS THE CALIFORNIAS

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Great white sharks (*Carcharodon carcharias*) are an essential predator in the Californias coastal waters; however, very little is known about juveniles' complex habitat use patterns. Two white shark nursery areas have been identified across the Californias—one in the Southern California Bight (SCB) and the other in Bahía Sebastian Vizcaino (BSV) in Southern Baja California. The coastal area in these sites has high rates of incidental catches of juvenile white sharks (JWS) reported in local fisheries. We used satellite tracking data from 26 sharks to characterize the spatio-temporal patterns and movements of juvenile white sharks across these two nursery areas. Our results suggest that JWS can be found throughout the Californias most months of the year. However, JWS are more likely to be located south of BSV during the spring months, and a general northward distribution in the SCB in late summer. Additionally, with this work, we characterized the movement persistence patterns, suggesting a degree of residency of JWS near both nursery areas. Interestingly, a single shark moved inside the Gulf of California, where low move persistence was displayed in front of the coasts of Sinaloa and Santa Rosalía and El Barril area. Understanding these patterns is necessary to improve the management and conservation of this protected species. JWS movements across the border displayed in this study spotlight the need for a robust bi-national collaboration on the protection of this highly mobile species.

BEHAVIORAL THERMOREGULATION UNDER CHRONIC AND ACUTE HEAT STRESS IN SOUTHERN CALIFORNIA INTERTIDAL NUDIBRANCHS

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1- Chapman University 2- UC San Diego 3- University de Perpignan 4- UC Davis

Scientists and amateur tidepoolers alike have noticed an anecdotal increase in nudibranch abundance and an expansion of their geographic distribution in California in recent warm years, but little is known about why and how nudibranchs are thriving in present conditions. Our previous work has shown that there is a physiological trade-off between heat tolerance and the ability to rapidly increase heat tolerance through acclimation. These species coexist in the same tidepools, which led us to ask: are there behavioral mechanisms at play in microhabitat use that distinguish nudibranch species' thermal tolerance (i.e., do some nudibranchs seek thermal refuge and other use biochemical strategies to mitigate heat stress)? We collected intertidal nudibranchs from sites across Southern California to characterize their thermoregulatory behavior in the context of climate change-induced warming and extreme heat days. Nudibranchs were acclimated to cool and warm temperatures for two weeks and subsequently placed in simulated hot and cold tidepools for two days, representing chronic and acute heat stress. Nudibranchs in the warmer chronic acclimation temperatures were more likely to engage in escape behaviors (i.e., floating on surface tension) but nudibranchs in the acutely hot tidepools were less active and less likely to float than in cool tidepools. Because nudibranchs are more abundant during warm periods, understanding the interplay between physiology and behavior for nudibranch species may serve as an indicator of intertidal community health under climate change scenarios.

ASSESSMENT OF THE IMPACTS OF HUMAN TRAMPLING ON THE BEHAVIOR OF AN ENDANGERED INTERTIDAL CRAB

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1- University of British Columbia, Canada 2- Inha University, South Korea 3- Pohang University of Science and Technology, South Korea

The fiddler crab, *Austruca lactea*, is currently endangered owing to exposure to anthropogenic activities, including trampling associated with recreational activities. To assess behavioral responses of fiddler crabs, we conducted two field experiments for three semilunar tidal cycles in a tidal flat on Yeongjong Island, South Korea. First, we compared the behaviors of a pair of crabs, one of whose burrow openings had undergone a trampling. Trampling delayed the reemergence time, reduced travel distance of crabs, and altered their behaviors from courting or feeding to vigilance and burrow repair. Second, we trampled for four and two weeks on subsets of the crab population. Daily trampling events decreased

the number of crabs active on the surface and altered male courtship indicators. After the manipulative trampling period ceased, courtships recovered in longer trampling treatment. These results imply that coastal visitation without any regulation might aggravate the decrease in the population of *A. lactea*.

PERSONALITY VARIATION IN A MARINE SNAIL: BEHAVIORAL REPEATABILITY AND SELECTION IN THE WILD

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CSU Long Beach

Animal 'personality' is defined by consistent behavioral differences among individuals. For example, some animals tend to be bolder, while others are shyer. Within most populations, an appreciable amount of the total variation in behavior is due to fixed differences among individuals. However, reasons for this variation are less clear. Personality variation may be linked to variation in fitness, but studies of natural selection on personality are rare. In this study, we measured repeatability of two behaviors of wavy turban snails: exploration and emergence. Each behavior was assayed three times per snail on a total of about 700 individuals. We found moderate repeatability in exploration (r = 0.201, 95% CI: [0.12, 0.288]) and emergence (r = 0.294, 95% CI: [0.256, 0.333]). Once assayed for behavioral tendencies, snails were released to one of two underwater reefs, and resurveyed monthly for growth and survival – two components of fitness. We found directional selection for lower exploratory behaviors (p=0.01) and stabilizing selection for intermediate emergence times (p=0.005), but these results were not consistent across sites. Our results suggest that spatial variation in selection can help maintain personality variation within the population at large.

EVALUATING THE NONCONSUMPTIVE EFFECTS OF GIANT SEA BASS

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CSU Northridge

On the nearshore rocky reefs of southern California, giant sea bass (GSB) fill a unique niche, being the only resident, teleost apex predator of the plentiful mesopredators. GSB, though once abundant, were fished to near extinction during the 20th century and have only started to recover recently. The goal of this study was to test how a mock GSB predator affects the behavior of smaller fishes; from this, it was found that fish were more tentative and less likely to feed when the mock GSB was present, but that tentative behaviors around the mock GSB were mitigated in areas where GSB are more commonly found. This study provides evidence that kelp forest fishes may be robust to the reestablishment of GSB in some ways: future work should continue to explore how fishes may be reacting to the reestablishment of GSB and other marine apex predators.

CHARACTERIZING MALE DOMINANCE BEHAVIOR IN A POLYGNOUS BREEDER, THE NORTHERN ELEPHANT SEAL

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Cal Poly, San Luis Obispo

Polygynous breeding is characterized by one male mating with many females, and the northern elephant seal (*Mirounga angustirostris*, NES) is a well-known polygynous species, with males defending harems including as many as 100 females. Male-male competition during the breeding season is well-documented in NES, but there is little to no information about this behavior at the Piedras Blancas rookery, the largest NES mainland breeding colony. This study aims to better understand the dominance relationships among male NES at the Piedras Blancas rookery and how these relationships affect mating and beach behavior. The goals of this study were to (1) establish dominance rankings for focal NES males based on their displacement interactions and (2) correlate aggressive behaviors and copulations with those different dominance rankings. To do this, we tracked individual males (n=114) throughout the breeding season, identified by a unique hair dye mark on their side, and observed their behavioral interactions via visual surveys twice per week during the 2021-2023 breeding seasons. For each observation, we recorded the specific dominance behaviors (e.g., vocalization, rearing up, chasing) of each individual in addition to factors such as the beach location, mating success, and age class. We found that aggressive behaviors and copulations were positively correlated with dominance ranking. Understanding behavioral dynamics during the breeding season will help us better understand how these animals use their breeding beaches.

Session 23: Special Session: Marine disease ecology in a changing world III

* indicates presenting author, † indicates eligibility for Best Student Paper Award

USING THE PAST AND PRESENT GENOMIC SEASCAPE OF SEA STARS TO CONTEXTUALIZE FUTURE IMPACTS IN A CHANGING WORLD

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1- Sunflower Star Lab 2- University of California, Merced

Massive demographic declines associated with anthropogenically-induced stressors are on the rise. The confluence of multiple stressors, along with the increased magnitude, duration, frequency, and scale of environmental perturbation events, threatens stability of marine populations in complex ways and can lead to increased disease outbreaks. Starting in 2013, the sunflower sea star (*Pycnopodia helianthoides*) experienced 88–100% mortality from all but the northernmost portion of its range during a sea star wasting (SSW) outbreak with elevated water temperatures. Other stars were affected too, though to a lesser extent. For example, the ochre star (*Pisaster ochraceus*) suffered high mortality, but with concurrent high recruitment experienced relatively rapid recovery in many places. The brooding 6-armed star (*Leptasterias aequalis*) suffered declines but persisted at many of its previously inhabited sites. The limited capacity of *L. aequalis* for broad dispersal has the potential to reshape the mosaic of clade distributions on the seascape as populations recover. We use mitochondrial and whole genome resequencing (WGS) analyses to describe contemporary population genetic structure contextualized with historical samples. This allows us to explore how these population declines and beginnings of recovery (or not) affect the distribution of genetic variation in these ecologically important sea stars, the implications of continued global change, and potential for conservation actions.

GENE EXPRESSION PROFILES IN PYCNOPODIA HELIANTHOIDES EXPOSED TO SEA STAR WASTING DISEASE

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Sea star wasting disease has been impacting sea stars along the North American West Coast for nearly a decade, and the causative agent for this disease has not been identified. One of the hardest-hit species is the Sunflower Sea Star, *Pycnopodia helianthoides*, though it is unknown why this species is particularly vulnerable. A means to assess vulnerability and potential candidates for causative agents is to fully characterize their immune response. Using transcriptomics, non-exposed grossly healthy and disease-exposed *Pycnopodia helianthoides* were compared to identify differentially expressed genes. Genes were functionally characterized, with specific immune response genes expressed at a higher level in sea stars exposed to disease and exhibiting disease signs. This work will identify genes associated with disease resilience, will aid in identifying populations for conservation efforts, and provide complementary information for identifying causative agent(s).

SMALL BUT MIGHTY: HOW CAPTIVE-BRED JUVENILES OF A TOP BENTHIC PREDATOR COULD ENHANCE KELP FOREST CLIMATE RESILIENCE

Hodin, J.[1*]; Anteau, F.P.[2]; Ashcraft, B.F.[1]; Brito, M.[3]; Curliss, F.[4]; Kalytiak-Davis, A.R.[5]; Kitaeff, P.[1]; Schwab, C.J.[1]; Ullmann, J.L.[1]; Valdez, V.V.[1]; Weertman, W.L.[1]

1- University of Washington, Friday Harbor Labs 2- Wageningen University & Research 3- The Exploratorium 4- University of Washington 5- Oregon State University

Ten years ago, an unprecedented seastar wasting event impacted numerous asteroid species along thousands of kilometers in the Northeast Pacific, from the shallows to deeper waters. The most severely affected was the sunflower star (*Pycnopodia helianthoides*), now listed as critically endangered by an international body, and newly proposed for listing under the US Endangered Species Act; both are firsts for any sea star. The resulting disappearances of sunflower stars, a key urchin predator, seems to have contributed to a dramatic phase shift in Northern California from healthy bull kelp forests (*Nereocystis luetkeana*) to purple urchin barrens (*Strongylocentrotus purpuratus*). In 2019 our team at Friday Harbor Labs in the Salish Sea began the first ever captive rearing program for sunflower stars. In this presentation, we will provide updates on our efforts, including completion of their full egg-to-egg life cycle in captivity, documentation of their climate resilience as larvae and juveniles, insights into their juvenile behavior and ecology, and a successful field experiment demonstrating the robustness of our lab-reared stars in the wild. In addition to developing protocols to inform potential large scale captive breeding efforts directed at the goal of eventual rewilding, our labs findings highlight the poorly-understood but potentially critically important ecological functions of cryptic juvenile life stages in ecosystem health and hence climate resilience.

NEW INSIGHTS ON SEA STAR WASTING DISEASE FROM 3 YEARS OF CONTROLLED EXPERIMENTS

Prentice, M.B.[1,2*]; Chan, A.M.[1]; Crandall, G.[3]; Davis, K.[4]; Harvell, C.D.[5,6]; Suttle, C.A.[1]; Gehman, A.L.M.[2,1]

1- University of British Columbia, Canada 2- Hakai Inst., Canada 3- University of Washington 4- Washington Dept. of Fish and Wildlife 5- University of Washington, Friday Harbor Labs 6- Cornell University

In the past decade sea star wasting disease (SSWD) has been responsible for the loss of billions of sea stars across 20 species, primarily along the Pacific Coast of North America. The result has been trophic cascades and the loss of ecosystems supporting diverse marine communities. While we increasingly understand its impacts, we still lack a clear understanding of the epidemiology of SSWD, including its cause. One critical challenge affecting research efforts is the difficulty in controlling exposure to a disease source that is widespread and uncharacterized. Here, we present novel insights gained from 21 experiments involving controlled exposure of SSWD to multiple species of sea star (primarily Pycnopodia helianthoides) over 3 years. We successfully transmitted disease to grossly normal individuals via tissue homogenate, coelomic fluid and water taken from within or around wasting sea stars, with no wasting observed in any controls across all 21 experiments. In contrast to previous research, we were unable to transmit disease using 0.22um-filtered inoculum made from raw tissue homogenate, coelomic fluid or water taken from wasting stars, supporting a non-viral causative agent. We found support for both water and cross-species transmission, and demonstrate varying levels of susceptibility among Pacific Coast sea star species. Among the species assessed, one (Dermasterias imbricata), did not show any evidence of wasting following exposure, suggesting resistance of some species to SSWD, and the potential for reservoir species.

HEALING SEA STAR ILLNESS AND INJURY THROUGH ENVIRONMENTAL MANAGEMENT AND IMMUNE SUPPORT

Rudek, T.E.[*]

Oregon Coast Aquarium

Managing sea star illness and injury in any setting has always been a challenge, since the causative factors are not always able to be determined. At the Oregon Coast Aquarium, the focus shifted from triage response for specific symptoms to the control of an overall environmental perspective within the animal and surrounding the animal. The treatment utilizes temperature control, invertebrate probiotics, sea water buffers and nutrient additives, hormone cue control, enhanced water flow, and an iodine based dip treatment to treat the affected individuals. With this, the exact causative agent of the animals' decline whether it be viral, bacterial, parasitic, fungal, injuries, or general stressors such as pH or temperature does not matter because all possible issues are addressed and corrected within the same protocol. This combination of factors allows the sea star to properly utilize its own immune system to focus on healing instead of expending excessive energy combatting other possible stressors. The stars are carefully monitored for behavioral signs that indicate healing status, and the treatment elements are adjusted according to the identified positive or negative behaviors. Since there is no use of any antibiotics or medications, this method allows treated individuals to remain candidates for wild release after recovery. This research has led to a dramatic increase in recovery rates of treated sea stars across 8 cold water species (including sunflower sea stars) for all causative factors.

FJORD OCEANOGRAPHIC CONDITIONS SUPPORT REMNANT POPULATIONS OF PYCNOPODIA HELIANTHOIDES FOLLOWING A DISEASE OUTBREAK

Gehman, A.L.M.[1,2*]; Pontier, O.[1]; Froese, T.[1]; Sadlier-Brown, G.[1]; Jackson, J.[3]

1- Hakai Inst., Canada 2- University of British Columbia, Canada 3- Fisheries and Oceans Canada

Disease outbreaks are a newly predominant driver of mass mortality events, which have increased in magnitude and frequency. Remnant populations, composed of individuals that have survived the mass mortality event, could provide insight into the ability for the species to recover. The sea star wasting syndrome (SSWS) epidemic led to the rapid decline of Pycnopodia helianthoides from Mexico to Alaska, and while functionally extirpated from their previous southern range, there remain remnant populations the northern parts of their range. In the central coast of BC, we conducted expert subtidal diver surveys paired with CTD casts in a range of shallow subtidal habitats from 2013-2022. We found declines associated with SSWS in 2015, and after wasting we found remnant populations with large adult P. helianthoides, associated with surveys conducted in Fjords. Remnant population biomass density was affected by the interaction between temperature and salinity, with low biomass density associated with high temperature and low salinity water conditions. These associations suggest that conditions within the Fjord habitats could be providing a disease refuge. Protecting remnant populations of P. helianthoides could be imperative for the recovery of this species.

Session 24: Special Session: Restorative Aquaculture

* indicates presenting author, † indicates eligibility for Best Student Paper Award

WHAT IS RESTORATIVE AQUACULTURE

Gardner, L.D.[*]

California Sea Grant

Restorative and conservation aquaculture is an emerging field and is increasingly being explored and utilized in the US and abroad in a variety of different modes. Terms of definitions for the topic are similarly varied and sometimes ambiguous among different stakeholders. Examples of restorative aquaculture can include all species of cultured organisms including, finfish, shellfish and algae and may concern the restoration of the species itself or the development of desired ecosystem service. Coming to a common understanding of the intent and possible effects of restorative aquaculture is needed to advance the field in terms of environmental impacts, social license and regulatory considerations.

ROLE OF THE AQUACULTURE INDUSTRY IN THE RESTORATION OF CALIFORNIA KELP SYSTEMS

Graham, M.H.[*]

Moss Landing Marine Labs

An exploding world population is putting unprecedented pressure on marine ecosystems through overexploitation, habitat destruction and anthropogenic climate change. In California, purple sea urchin overgrazing inhibits the recovery of bull and giant kelp populations from recent climate stressors. The ecological and economic consequences of long-term kelp absence along the coast have been conspicuous and stimulated a push from governmental and non-governmental agencies to develop solutions that will result in noticeable recovery at relevant spatial and temporal scales. Such recovery will require both a cessation of sea urchin overgrazing and the re-establishment of functional kelp populations and some associated fauna. Here I present examples of numerous public-private partnerships currently working to promote kelp forest restoration and resilience, leveraged on the expertise, infrastructure, and investment of California commercial aquaculture companies.

FOULING ORGANISM OR SUPERFOOD? REIMAGINING THE POTENTIAL OF VOLUNTEER MACRO-ALGAE ON AN OYSTER FARM IN TOMALES BAY, CA.

Fleener, G.B.[*]; Rintoul, M.; Berry, E.

Hog Island Oyster Co.

Shellfish gear serves as a foundational substrate for a wide range of “volunteer” marine organisms, including many types of edible macroalgae (seaweeds). Traditionally these seaweed recruits are viewed as fouling nuisances, since they can restrict flow though shellfish baskets (limiting food availability) and may release unwanted chemicals (such as hydrogen sulfide) when they decompose. In recent years however efforts are afoot to reimagine these “fouling organisms” as food. Some of these seaweeds are highly valued in culinary markets, and also show promise as agricultural amendments - potentially providing an additional source of revenue for shellfish growers. Additionally, the export of algal biomass away from the marine environment provides a form of beneficial carbon removal. There is also a recognized benefit to reducing the commercial harvest of some seaweeds in wild coastal habitats, turning instead to the abundance recruiting onto shellfish farms. At this time, however, there is no real guidance for how shellfish growers might do this effectively and efficiently. Two years ago Hog Island Oyster Co. (HIOC) amended its lease agreements to permit the harvest of seaweeds found recruiting on oyster gear in Tomales Bay, CA. In 2022 we began an exploratory phase of chemical testing and small scale “harvest to kitchen” experiments, removing artisanal quantities of seaweed from our gear, drying it in home dehydrators, and incorporating these seaweeds into recipes for our Bay Area oyster bars. We also began working with neighboring land-based farms to test agricultural uses of these seaweeds. This presentation will share the Hog Island story and offer and initial roadmap for increasing this type of “secondary harvest” at other shellfish farms.

ANTICIPATING TRADE-OFFS AND PROMOTING SYNERGIES BETWEEN SMALL-SCALE FISHERIES AND AQUACULTURE TO IMPROVE OUTCOMES

Mansfield, E.J.[1*]; Micheli, F.[2]; Fujita, R.[3]; Fulton, E.A.[4]; Gelcich, S.[5]; Battista, W.[3]; Bustamante, R.H.[6]; Cao, L.[7]; Daniels, B.N.[8]; Finkbeiner, E.M.[9,10]; Gaines, S.[11]; Peckham, H.[12]; Roche, K.[3]; Ruckelshaus, M.[13]; Salomon, A.K.[14]; Sumalia, U.R.[15]; White, C.[8]; Naylor, R.[13]

1- Florida State University 2- Hopkins Marine Station, Stanford University 3- Environmental Defense Fund 4- CSIRO, University of Tasmania 5- Pontificia University Católica de Chile 6- CSIRO 7- Xiamen University 8- Cal Poly, San Luis Obispo 9- Conservation International 10- UC Santa Cruz 11- UC Santa Barbara 12- Wildlife Conservation Society 13- Stanford University 14- Simon Fraser University, Canada 15- University of British Columbia, Canada

Blue food systems are crucial for meeting global social and environmental goals. Both small-scale marine fisheries (SSFs) and aquaculture contribute to these goals, with SSFs supporting hundreds of millions of people and aquaculture currently expanding in the marine environment. In this work, we examined the interactions between SSFs and aquaculture, and the possible combined benefits and trade-offs of these interactions, along three pathways: (1) resource access and rights allocation; (2) markets and supply chains; and (3) exposure to and management of risks. Utilizing expert-identified illustrative case studies we analyzed the outcomes of these interactions between the two sectors. Analysis of 46 diverse case studies showcased both positive and negative interaction outcomes, which were context-dependent and determined by multiple factors. Results of our approach underscore the need to anticipate and manage interactions between SSFs and aquaculture deliberately to avoid negative socio-economic and environmental outcomes, promote synergies to enhance food production and other benefits, and ensure equitable benefit distribution.

THE ROLE OF SEAWEED MICROBIOMES IN ENHANCING AQUACULTURE SUCCESS

Edwards, M.S.[1*]; Lima, L.[1]; Booher, L.[2]; Polizzi, T.[2]

1- San Diego State University 2- Sunken Seaweed

Seaweed farming is considered regenerative ocean agriculture with great potential to increase food security, energy production, habitat restoration, water quality, and carbon sequestration. This 10-billion-dollar global industry is projected to reach a 20-billion-dollar annual value by 2024. Improving the growth and tissue properties for which seaweeds are farmed (i.e., protein, carbohydrate, alginate content) will be essential to this task, and this can be achieved by harnessing the potential of beneficial seaweed microbiomes. Just like microbial inoculants increase the yield of agricultural crops in land farming, microbes affect seaweed morphogenesis and recruitment, disease prevention, and physiological resilience to environmental changes. They are also crucial to the normal develiopment of kelp microscopic stages and the production of the sporophytes. Here we discuss the how microbes influence kelp development and condition, elucidate which microbial taxa are present on farmed and natural kelps, and what their functions in seaweed metabolism are. We also discuss how the microbiomes differ between kelp species, and geographically across latitudes. Ultimately, we explore the role of the seaweed microbiome in growing the seaweed farming industry in the U.S.

Session 25: Special Session: Kelp Research and Restoration in Along the West Coast II

* indicates presenting author, † indicates eligibility for Best Student Paper Award

EFFECTS OF STOCKING DENSITY ON MORPHOMETRICS AND REPRODUCTIVITY OF AQUACULTURE GROWN *NEREOCYSTIS LUETKEANA* FOR SORAL PRODUCTION

† Bugbee, B.M.[*]

Moss Landing Marine Labs

Persisting inter-annual population declines for the annual kelp *Nereocystis luetkeana* have greatly reduced the incidence of natural recovery through population fragmentation, decreasing the metapopulation seed bank. Early results from multi-pronged restoration efforts have shown assisted seeding through soral bags to be an effective method for enhancing kelp recruitment in barren reef states. Utilizing novel restoration aquaculture techniques, we have reliably produced all bull kelp life history stages, most notably a living soral bank, independent of its natural life cycle. Through the year-round availability of reproductive material, we can alleviate stress on remnant populations and, more importantly, enable in-situ spore enhancement in areas devoid of natural reproductive individuals. To optimize aquaculture methodologies for producing bull kelp reproductive material, I ran a two-pronged study evaluating the effects of stocking density on bull kelp development. First, I examined whole juvenile sporophytes, comparing blade, pneumatocyst, and stipe growth rates for 7 weeks across 6 density treatments (5, 10, 20, 40, 80, 160 individuals). Next, I compared blade growth, blade splitting, and reproductivity of “crowned” sporophytes across 6 densities (1, 2, 4, 8, 26, 32). Blade growth rates significantly differed among density treatments and across time for whole and crowned sporophytes ($p<0.05$). Increasing stocking densities had increasingly variable sporophyte development while lower densities maintained high growth rates and reached 100% fertility quicker.

MULTIPLE RESTORATION TECHNIQUES YIELD GREATER RESTORATION SUCCESS OF BULL KELP (*NEREOCYSTIS LUETKEANA*)

Karm, R.H.[1*]; Dias, A.[1]; Souza, V.[1]; Velazquez, M.[1]; Hascall, E.[1]; Strock, S.[1]; Huckeba, J.[1]; Kim, A.[2]; Bugbee, B.[2]; Murphey-Cannella, M.[3]; Bauer-Civiella, A.[3]; Grime, B.[4]; Hamilton, S.L.[2]; Hughes, B.B.[1]; McHugh, T.A.[4]

1- Sonoma State University 2- Moss Landing Marine Labs 3- Reefcheck Foundation 4- The Nature Conservancy

In the past, ecosystem restoration has overwhelmingly focused on single solutions to restore vegetated habitats, often with varying levels of success and failure. Few restoration projects consider multiple active approaches, despite potentially yielding greater success. Kelp restoration, which is relatively new compared to other marine restoration targets, have relied on either removal of overabundant grazers or planting new individuals. Here, we test for single and multiple approaches to kelp forest restoration, utilizing bull kelp (*Nereocystis luetkeana*) in northern California, where restoration efforts are critical after a >90% loss of bull kelp forests in the region over the last few years due to unfavorable ocean stressors (i.e shift in trophic dynamics and increased sea surface temperatures). The goal of the study is to test two kelp enhancement techniques (soral bags and seeded twine lines) in an area where sea urchin populations have been reduced to understand the synergistic effects of kelp enhancement and grazer reduction at Albion Cove, Mendocino County. Preliminary results indicate that frequent urchin harvesting yielded

ideal urchin densities of <2 per m². Additionally lab inoculated seeded twine resulted in growth of canopy-forming sporophytes that developed reproductive sori. These novel results provide the first documented result of successful bull kelp restoration on California's North Coast, and will serve as a prime example of why researchers and managers should consider combining multiple restoration approaches to increase success.

RACE TO RESTORE: UNDERSTANDING HOW SCIENTISTS ARE WORKING TO RESTORE CALIFORNIA'S KELP FORESTS

Chan, K.M.*

UC San Diego, Scripps Inst. of Oceanography and California Sea Grant

The recent push to restore kelp forests in California has created a crowded and at times, confusing landscape. Most of the resources on kelp restoration efforts in the state, both past and present, take the form of formal reports or scientific publications. These types of documents can often limit the accessibility of information to the interested public and policymakers because these documents often rely heavily on technical terminology and are either not made available to the public or are locked behind publisher paywalls. Additionally, they often do not highlight the local perspectives and knowledge, interconnectivity, and collaborative nature that many of the projects have. The inaccessibility of these resources makes it difficult for many outside of the kelp restoration world to understand the intricacies of the kelp restoration landscape. To increase the accessibility of the information surrounding kelp restoration projects happening in California, we created an open-access, web-based multimedia resource geared toward the general public. Underlying this resource are nearly 12 hours of interviews and site visits with a variety of experts in the field, who were selected to encompass the various regions of the state and methodologies used. The result is an interactive StoryMap that uses photos, videos, audio and maps to allow users to learn directly from experts on the issues, methodologies, and outcomes underlying kelp restoration in California.

EFFECTS OF CHANGING SALINITY AND TEMPERATURES ON INVASIVE UNDARIA PINNATIFIDA REPRODUCTION AT THE NORTHERN EDGE OF ITS RANGE IN NORTH AMERICA

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Increasing mean sea-surface temperatures (SST), marine heatwaves, and variation in salinity due to changing precipitation patterns are affecting many kelp species globally. The effects of these stresses on the microscopic kelp life stage (gametophyte) are much less understood, and could impact the ability of invasive kelps to survive and spread in new environments. We sought to answer the question: how do increased temperatures and low salinities affect the microscopic stages of the globally invasive kelp Wakame (*Undaria pinnatifida*) at the northern edge of its range in North America? We cultured gametophytes of *Undaria* from the San Francisco Small Boat Harbor at the UC Davis Bodega Marine Laboratory, where we exposed them to five salinity conditions ranging from low to ambient salinity (10, 15, 20, 25, and 33 psu) and two temperatures (15°C and 20°C) representing pre-2013 average maximum temperature in San Francisco and maximum increased temperatures experienced under the 2014-2016 marine heatwave. After six weeks in culture, we found that microscopic stages of *Undaria* were unable to survive at 10 and 15 psu, but exhibited relatively equal survival and sporeling production rates at 20, 25, and 33 psu. Additionally, *Undaria* had significantly higher survival and reproduction under 20°C than 15°C. Our results indicate that under predicted higher temperatures and reduced annual rainfall and higher salinity in drought years, future northward expansion of *Undaria* populations in California may be possible.

EFFECTS OF WARMING AND ACIDIFICATION ON DIFFERENT LIFE STAGES OF BULL KELP (NEREOCYSTIS LUETKEANA)

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Kelp forests along the West Coast are under threat from climate change. While the effect of ocean warming on kelps is well-documented, the effects of ocean acidification are less well understood. We examined the effects of warming and acidification, both separately and concurrently, on bull kelp (*Nereocystis luetkeana*) from two populations in Puget Sound, WA. Bull kelp is the primary canopy-forming kelp species in Puget Sound, and some areas of the Sound have lost over two-thirds of their canopy cover. Our collection sites differed in the overall temperature, urbanization level, and state of the kelp forest. Last summer, we performed brief exposure experiments on blade sections from adult sporophytes and measured photosynthetic and fluorescence parameters. This summer, we performed a 5-week exposure experiment on gametophytes and measured survival, growth, development, and reproductive success from spore settlement through the juvenile sporophyte stage. We also used a Mini-PAM fluorometer to simultaneously measure photosynthesis and respiration of gametophytes. We found that temperatures above 18-20C had a substantial negative impact on photosynthetic health in adult sporophytes. In gametophytes, growth increased but reproductive success decreased at these temperatures. Both sporophytes and gametophytes exposed to elevated temperature and pCO_2 had slightly higher photosynthetic and fluorescence parameters than those exposed to elevated temperature alone.

DISTRIBUTION AND DIVERSITY OF KELPS AND ROCKWEEDS IN THE CALIFORNIA CURRENT ECOSYSTEM

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In near-shore marine ecosystems, large brown algae such as kelps (Laminariales) and rockweeds (Fucales) have important ecological roles including the provision of biotic habitat structure and productivity fueling coastal food webs. Kelps in particular are species rich in the North Pacific and are an integral component of coastlines with abundant rocky substrates. The persistence of brown algal-dominated ecosystems such as intertidal kelp beds and subtidal forests is threatened by changing ocean conditions including heat waves. In this study, I investigated distributions of large brown algae in the California Current ecosystem to determine biogeographic patterns of relative abundance, species composition, and diversity. I used a rapid survey method to assess relative abundance as well as substrate characteristics at about 100 intertidal sites in California, Oregon, and Washington. Distribution data indicate only a small number of species with very widespread occurrence, a large group of taxa with moderate to infrequent occurrence, and an additional set of species with very limited occurrence or geographic distribution.

Analysis by latitude shows contrasting patterns of kelp and rockweed richness with the former reaching maximum diversity in the Pacific Northwest and the latter having maximum richness in southern and central California. Baseline natural history observations at broad scales such as these can help identify regions or taxa of high conservation interest and support regional monitoring efforts to assess coastal change such as the impacts of marine heat waves.

Session 26: Conservation and Restoration IV

* indicates presenting author, † indicates eligibility for Best Student Paper Award

PHYSIOLOGICAL AND CRYOPRESERVATION RESEARCH AS A PATH TO ENHANCING WHITE ABALONE CAPTIVE PRODUCTION

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After rapid declines of up to 99% in their population sizes, largely due to overfishing, white abalone were added to the Endangered Species List. Remaining individuals are too few and diffuse for successful wild reproduction, necessitating development of a captive production program for species restoration. Despite dramatic advances in production levels over the last decade, The White Abalone Captive Breeding Program (WACBP) still falls short by an order of magnitude of the amount of production required to save the species. Research at UC Davis' Bodega Marine Lab is therefore focused on dismantling barriers to increasing captive production through sperm cryopreservation research and the development of better reproductive conditioning methods through physiological experiments. Sperm cryopreservation provides the program with gametes on demand that can be available to enhance crosses and ensure the success of spawning events. In partnership with the CDFW Fisheries Genetics Lab, we successfully cryopreserved white abalone sperm while retaining nearly 50% motility, a breakthrough for the WACBP. Our reproductive conditioning work examines the role of diet and temperature in the growth of red abalone broodstock, and the links between diet and gametogenesis. Diet and temperature influenced red abalone growth, however they did not impact gross gonad development. Analysis of the finer-scale reproductive impacts of diet and temperature (such as hormone production) is currently underway and will inform the design of diet and gametogenesis experiments in endangered white abalone.

LOCAL ECOLOGICAL KNOWLEDGE ENHANCES OUR CAPACITY TO DOCUMENT POTENTIAL CLIMATE SENTINELS

Early-Capistrán, M.M.[1*]; Crane, N.L.[2]; Crowder, L.B.[1]; Garibay-Melo, G.[3]; Seminoff, J.A.[4]; Johnston, D.[5]

1- Stanford University 2- Society for Conservation Biology 3- Independent Researcher 4- NOAA 5- Kayak Santa Cruz

Climate change is inducing rapid transformations in marine ecosystems, with a pronounced effect on top predators like loggerhead sea turtles (*Caretta caretta*). Loggerheads' responsiveness to temperature fluctuations underscores their significance as a climate sentinel species. We present the first record of a loggerhead sea turtle in Monterey Bay, California, USA, documented through Local Ecological Knowledge (LEK) and community or citizen science, highlighting the pivotal role of these approaches in documenting species occurrences beyond anticipated habitats during climatic anomalies. In rapidly changing conditions, rigorously documented community science and LEK offer a crucial complement to conventional scientific methods, providing high-quality data with extensive coverage—especially for elusive species—and yielding insights into emerging phenomena.

TESTING THE IMPACTS OF ACIDIFICATION ON PACIFIC LITTLENECK CLAMS: CAN SHELL HASH PROMOTE GROWTH BY ALTERING PORE WATER CHEMISTRY?

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Marine calcifiers are at high risk from ocean acidification, and adaptation strategies are necessary to keep coastal populations healthy. Adding pulverized shells (shell hash) to clam habitat, a practice that has been implemented by some eastern Pacific Indigenous peoples for millenia, may mitigate the negative effects of acidification by altering the chemistry of pore fluids. We tested the hypothesis that shell hash increases the pH, alkalinity, and aragonite saturation state of pore fluids, and enhances calcification in Pacific littleneck clams (Leukoma staminea) under acidified conditions. Juveniles (n = 130) were raised in four experimental conditions for 90 days: control (pH = 7.8), acidified (pH = 7.4), control with shell hash, and acidified with shell hash. Three times a week, we measured pore water pH, alkalinity, salinity, temperature, and dissolved oxygen. Shell weight, soft tissue weight, and new shell growth were measured at day 90. We found that shell hash significantly increased the pH, alkalinity, and saturation state of pore fluids, and increased average shell growth. This study suggests that adding shell hash to clam habitat buffers against acidic conditions that could deleteriously affect the growth of littleneck clams.

FUNCTIONS OF FEEDER BLUFFS IN THE SALISH SEA

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University of Washington

Actively eroding coastal bluffs, known as feeder bluffs, are important sources of sediment for beaches in the Salish Sea, WA, but prevalent artificial shoreline armor can disrupt sediment supply processes. We conducted field sampling at 20 feeder bluff-backed beaches identified by the ESRP Beach Strategies Project as the highest or lowest priority for beach protection (preventing armor installation at natural bluffs) or restoration (armor removal) based on their potential benefit to sediment supply processes. We sampled 32 total metrics of ecological and physical parameters spanning zones from the top of the bluff to the low shore, and calculated an average beach function score based on these metrics to develop a more fine-tuned "scale bar" of beach function and examine whether the prioritized sites have the highest realized functions, not just potential benefits. Unarmored beaches scored over twice as high for our beach function metrics as armored beaches. Beach function scores may be largely driven by strong responses of upper beach metrics including wrack, logs, and overhanging vegetation, while metrics for

geomorphology and lower beach and subtidal organisms were more variable, perhaps due to differences in geographical region and distance from the bluff. Our results suggest that beaches with natural bluffs have the highest level of ecological function regardless of potential sediment supply benefit predicted by Beach Strategies, and restoring sediment supply processes at beaches with armored bluffs could double their ecological functions.

REINTRODUCTION OF THE ENDANGERED NORTHERN TIDEWATER GOBY TO MALIBU LAGOON

Spies, B.T.*; Najera, M.; Gaines, J.; Loya, B.; Estrada, A.

CSU Channel Islands

Reintroduction of species to habitats within their indigenous range helps protect populations from natural and anthropogenic threats, restores trophic dynamics and ecosystem functions, and is critical to the management and recovery of threatened and endangered species. The federally endangered northern tidewater goby *(Eucyclogobius newberryi)* is a small annual fish species endemic to California. This species exhibits local genetic divergence at a finer geographic scale than any other Pacific coast vertebrate and may be predisposed to local extirpation due to its preference for seasonally variable coastal lagoonal settings. Each clade represents an ecologically distinct component of the species, and each sub-clade (management unit) exhibits independent metapopulation dynamics at ecological timescales. Due to their metapopulation process and subdivision, as well as unique habitat preference, the tidewater gobies are of exceptional scientific interest in studying conservation translocation methods and post-release monitoring. The northern tidewater goby population in Malibu Lagoon peaked in the late 1990's after 52 individuals were reintroduced from the Ventura River in 1991. Populations began to decline in Malibu Lagoon by 2005 and by the time restoration efforts began in 2012, only eight tidewater gobies were observed. The population in Malibu continued to be sparse post-restoration while the population in nearby Topanga Canyon Lagoon continued thrive. From 2019 – 2022, California State Parks funded a study to investigate what was driving population declines in Malibu Lagoon and population stability in Topanga Lagoon. Results from that study recommended translocation of northern tidewater gobies from Topanga back to Malibu which was implemented in September 2022 in coordination with USFWS and the RCDSMM.

FRAMEWORK FOR ASSESSING AND MITIGATING THE IMPACTS OF OFFSHORE WIND ENERGY DEVELOPMENT ON MARINE BIRDS

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UC Santa Cruz

Offshore wind energy development is rapidly expanding globally to meet sustainable energy needs. However, it poses risks to marine wildlife, particularly marine birds, due to their vulnerability to displacement and collisions with wind infrastructure. Here, I introduce a comprehensive framework to assess and mitigate the impacts of offshore wind energy development on marine birds. I review existing best practices to quantify impact via monitoring and modeling (e.g., collision risk models, population viability analysis), and present a robust impact mitigation framework encompassing avoidance, minimization, and compensatory measures. This framework addresses impacts within the context of multiple stressors across multiple wind energy developments. The importance of incorporating compensatory mitigation into regulatory frameworks is underscored, offering a means to offset unavoidable impacts and produce net positive impacts of renewable energy development for marine birds. This framework is intended as a globally relevant approach with immediate application as wind energy developments move forward in the Pacific Outer Continental Shelf region and forms an important first step towards the regional strategic planning necessary to effectively leverage renewable energy development to benefit wildlife populations.

Session 27: Community Ecology IV

* indicates presenting author, † indicates eligibility for Best Student Paper Award

TURBINARIA ORNATA, AN EMERGENT FOUNDATION SPECIES OF SOUTH PACIFIC CORAL REEFS, SHIFTS ECOLOGICAL STRATEGIES OF ASSOCIATED ALGAE.

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affiliation not listed

Coral reefs have been shifting to prevalent and sometimes persistent algal-dominated states for decades, making research on the dynamics of these emergent algal communities vital. In the South Pacific, these shifts are often toward an alternative stable state formed by *Turbinaria ornata*, a relatively large, physiologically-complex alga with functional traits that facilitate the formation of dense patches supporting diverse algal communities. We hypothesize, as a foundation species, *T. ornata* shifts the ecological strategies of species that comprise the associated algal communities. We utilized a trait-based ecological approach to compare trait distributions of 8 key traits of 5 common algal species that occurred both within and outside of *T. ornata* patches. We quantified traits related to the ecological strategies of resource acquisition, resistance to herbivory, and resistance to disturbance. We found that differences in traits were species specific and varied between individuals within and outside of *T. ornata* patches. For example, 2 different strategies for resource acquisition were utilized inside of patches, growing taller or forming larger surface areas to capture light or nutrients. These emergent strategies that develop when algae are protected from herbivory may represent a functional tradeoff facilitated by *T. ornata*. As reefs continue to shift to algal-dominated communities, determining how persistent communities modify ecological strategies is crucial to understanding what novel suite of ecosystem functions will emerge.

RANDOM (KELP) FOREST: A TEMPORAL STUDY OF CHANGING COMMUNITIES ON CALIFORNIA'S NORTH COAST

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Cal Poly, Humboldt

An unprecedented ecosystem shift has come to the kelp forests of northern California because of a rapid succession of catastrophic events. Rocky reef communities have shifted from kelp forests to large scale urchin barrens due to increased purple urchin recruitment, the demise of *Pycnopodia helianthoides*, and a series of marine heatwaves (MHW's). Here we examine the biodiversity of the benthic community over an 8-year time span (from 2014 to 2021) using annual SCUBA surveys to examine community structure and both inter and intra-specific relationships within reef biodiversity. Modeling results suggest that some species have benefitted from the newly provided space due to urchin grazing and hints that other species could be indicators of healthy biodiversity based on their presence. The existence of kelps other than *Nereocystis* might be more important when thinking of system resiliency. This study shows the benefits of continued long-term monitoring for informing kelp restoration efforts, management of recovered kelp forest communities, and increases our understanding of ecosystem phase shifts and dynamics within rocky reef communities along California's north coast.

RAPID LATE HOLOCENE FORMATION AND DESTRUCTION OF REEF-TOP ISLANDS IMPACTED POLYNESIAN ECOLOGY AND HABITABILITY

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1- UC Los Angeles 2- California State University 3- UC Davis 4- UC Santa Barbara 5- Maritime Archaeology Program, Flinders University

The loss of coral reef-top islands (motu) around the world is a major problem exacerbated by climate change. In this context, we studied the formation, history and erosional loss of motu in the Society Islands at multiple scales using field surveys, carbonate petrography, radiometric dating, wave energy reconstruction, and LiDAR based altimetry/bathymetry from Moorea, and combined with analyses of satellite images to extend our inferences across the archipelago. In samples of emergent carbonates collected in Moorea, we identified paleo-reef components and reconstructed their history, inferring that motu formed through the emergence of reef crests ~ 2.0 kya ago, followed by storm surge deposition of unconsolidated coral rubble from the forereef over the emerged reef crest, thereby forming motu. Larger waves from the south preferentially eroded motu, leaving relict motu primarily on north-facing barrier reefs of the Society Islands. This work infers how past sea-level change and directional wave energy contributed to the distribution of motu around the Society Islands. The rapid formation and erosion of motu over the last 2 millenia likely influenced the 11th Century CE human settlement of Polynesia, and sequentially altered seawater circulation and ecology of Polynesian lagoons. Increased awareness of these past processes can now enhance solution-oriented science focused on enhancing the resilience of island habitats challenged by rising seas.

ECOLOGICAL CONSEQUENCES OF KELP FOREST COLLAPSE FOR ROCKY REEF FISHES

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Kelp forests support productive fish communities across many temperate coastlines; however, ecological linkages between kelp forests and fishes in the North Atlantic have not been well established or quantified. Thus, as this region warms and its kelp forests collapse into red algal turf reefs, the consequences for reef-associated fishes remain unknown. Here we assess whether the dominant reef fishes in the Gulf of Maine utilize kelp-derived energy. By doing so across 250 km of Maine's coast that now harbors both healthy kelp forests and degraded turf reefs, we identify how energy flow changes as forests are lost. We first defined the ecological niches of pollock (*Pollachius virens*) and cunner (*Tautogolabrus adspersus*) using $\delta^{13}C$ and $\delta^{15}N$ of bulk muscle tissues. Comparing individuals from kelp forests and turf reefs revealed that forest-associated fishes occupy a wider overall niche space and show greater separation among species. We then used $\delta^{13}C$ of essential amino acids (EAA) to determine the importance of kelp as an energy source, since EAA $\delta^{13}C$ values of local kelps are distinct from those of local phytoplankton and red algae. Our EAA $\delta^{13}C$ data from the two fishes suggest that they utilize kelp-derived energy to a high degree. The loss of kelp forests may thus be driving niche simplification via a decline of a kelp-based energy channel. This study shows that even epibenthic canopy-forming kelps provide key energetic resources to fish communities, and reveals a mechanism by which kelp forest collapse alters energy flow through coastal food webs.

DECADAL-SCALE TIME SERIES HIGHLIGHT THE ROLE OF CHRONIC DISTURBANCES IN DRIVING ECOSYSTEM COLLAPSE IN THE ANTHROPOCENE

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CSU Northridge

Biome degradation characterizes the Anthropocene Epoch, and modern ecology is deeply involved with describing the changes underway. Many projects focus on acute disturbances causing conspicuous changes in ecosystem structure, which leads to an under appreciation of chronic disturbances. Coral reefs epitomize this trend, because the changes in community structure are profound, yet the data to quantify these effects are usually inadequate to evaluate the relative roles of different disturbance types. Here, four decades of surveys from the coral reefs (9–14 m depth) of St. John, US Virgin Islands, are used to quantify the roles of acute versus chronic events in driving changes in benthic communities. These reefs changed over 36 years, with coral death altering species assemblages to depress abundances of the ecologically important coral *Orbicella* spp. and elevating the coverage of macroalgae and crustose coralline algae/turf/bare space (CTB). Linear mixed models revealed the prominent role of chronic variation in temperature in driving changes in cover of corals, macroalgae, and CTB. Multivariate analyses revealed strong associations between community structure and temperature, but weaker associations with hurricanes, bleaching, and diseases. These results highlight the overwhelming importance of chronically increasing temperature in altering the benthic community structure of Caribbean reefs.

SUBMARINE GROUNDWATER DISCHARGE DRIVES CHANGES IN REEF FISH COMMUNITY STRUCTURE AND FUNCTION

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Submarine groundwater discharge (SGD) is a widespread phenomenon of nearshore coral reefs and a key driver of environmental change in these ecosystems. SGD is associated with unique shifts in temperature, salinity, and carbonate chemistry, yet there is little information on its role in reef dynamics and ecosystem functioning. This study characterized reef fish community composition and herbivory across a gradient of SGD in a tropical coral reef lagoon in Mo'orea, French Polynesia using paired camera surveys and herbivory assays. Proximity to SGD significantly altered fish community structure, where high SGD habitats were characterized by high diversity and distinct fish communities. Tidal-driven changes in groundwater significantly increased feeding frequency and shifted feeding regimes from predominantly benthic herbivory to planktivory, due to species turnover and the utilization of dietary plasticity in relevant species. Further, fishes consistently preferred algae collected near groundwater seeps compared to algae grown in ambient seawater conditions during herbivory assays. The observed increase in herbivory for SGD-associated algae relative to algae collected from ambient conditions may be due to the higher % tissue nitrogen content in the algae, likely improving algal palatability. Our results demonstrate that SGD plays a key role in the structure and function of reef fish communities, highlighting the effects of groundwater springs on coral reef processes.

Session 28: Intertidal Ecology II

* indicates presenting author, † indicates eligibility for Best Student Paper Award

DISTRIBUTION CHANGES IN INTERTIDAL FOUNDATION SPECIES ARE DRIVEN BY INCREASED TEMPERATURES

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Air temperatures are increasing in the coastal northeast Pacific, driven by anthropogenic climate change. This warming is expected to impact the distributions of intertidal organisms whose upper limits are set by thermotolerance. Downward shifts in species upper limits could trigger major changes to intertidal communities, especially if the species shifting are foundation species. To investigate changes in intertidal limits and their potential causes, we combined historical comparisons with observations along local thermal gradients and an experimental thermal manipulation. We found that the upper limits of important habitat-forming species including barnacles, mussels, and brown algae had shifted down since 1957 and 1958 and 2009 and 2010. We also found that lower temperatures due to location, substrate orientation and intertidal height increased the growth and survival of a dominant intertidal species *Hedophyllum sessile* at its upper limits. Similarly, growth and survival of *Hedophyllum* were higher when artificially shaded, suggesting this species could have persisted at higher intertidal heights under the cooler conditions of the past. Our results suggest that shifting upper species limits in Juan de Fuca Strait are the result of climactic warming. These shifts are likely to continue with climate change and could have important consequences for habitat provisioning and biodiversity in the temperate rocky intertidal.

MICROBES: RAPID DEGRADER OR KEY CONSTITUENT OF PREDATOR RISK CUES?

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In marine environments, water-borne chemical cues from predators are one of the most common ways by which prey assess and respond to predation risk. Understanding how prey adaptively adjust their behavior, morphology, and life history to predator chemical risk cues is therefore critical to understanding the total effects of predators on prey populations, and their indirect effects on communities. Despite the central importance of chemical cues in assessing predation risk, little is known about how the dispersal, persistence, or degradation of risk cues are affected by the environment. Using laboratory-based observations of a well-studied antipredator behavior by the marine gastropod *Tegula funebralis* in response to the predatory sea star *Pisaster ochraceus*, we found that *Tegula* exhibits a graded response to field-relevant *Pisaster* cue concentrations, indicating an adaptive response to risk cues. We also observed that cue activity, decreases rapidly over time, with responses reduced by >50% within 24h; suggesting that microbial activity contributes to cue degradation. Furthermore, cue activity was preserved for up to 72h by freezing cue water, which presumably slowed microbial degradation. Surprisingly, it appears that microbes themselves may also be a key component of *Pisaster* risk cue, as *Tegula* did not respond to cue water that was filtered to remove microbes and showed a reduced response to predator cue water that was treated with the antimicrobial tetracycline. Together, our results suggest that microbes play a critical role in mediating perceived predation risk.

THE IMPORTANCE OF INTERTIDAL URCHIN POPULATIONS FOR KELP FOREST CONSERVATION: DRIVERS OF INTERTIDAL URCHIN REPRODUCTIVE CAPACITY

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Kelp forests support biodiverse ecosystems and currently face severe declines due to urchin grazing and marine heat waves. Purple sea urchins (*Strongylocentrotus purpuratus*) are herbivores that live in kelp forests and can create urchin barrens via overgrazing. In subtidal systems, urchin reproductive capacity is negatively correlated with urchin density and food availability, but the drivers of intertidal urchin reproductive output are less understood. To understand what factors drive spatial variation in intertidal urchin reproductive capacity, we collected urchins from nine sites along the Monterey Peninsula in California as well as algal coverage and urchin population density. We dissected urchins to calculate gonadal-somatic indices (GSI) of urchins and explored correlations between GSI and urchin population density, algal consumption, intertidal algal coverage, wave exposure, and drift algae availability. We found there is significant spatial variation in urchin GSI, but intertidal algal coverage and urchin density alone are not reliable predictors of urchin GSI; this is in contrast to subtidal patterns. Other parameters, like drift algae availability, may contribute to our understanding of intertidal urchin GSI. Even at high densities, urchins in the intertidal can exhibit high reproductive capacity, since high urchin densities are not necessarily correlated with low food availability. This results in dense populations of healthy intertidal sea urchins whose populations may be connected to the persistence of urchin barrens via larval dispersal.

EFFECTS OF OCEAN ACIDIFICATION AND OCEAN WARMING ON THE BEHAVIOR AND PHYSIOLOGY OF THE SEA STAR, EVASTERIAS TROSCHELII

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1- UC Santa Barbara 2- NOAA Fisheries

The mottled sea star, Evasterias troschelii, is an ecologically-important, abundant predator in intertidal coastal systems from Alaska to California; however, its physiological response to increased temperatures (ocean warming) and decreased pH (ocean acidification) is currently unknown. In this study, the behavioral and physiological response of E. troschelii was explored in a 25-day experiment which fully crossed pH (ambient and pH 7.5) with temperature (8°C and 14°C). Growth, feeding rate, condition index, and righting time were measured. The 50% lethal temperature (LT50) was measured before and after exposure. Growth and feeding both increased with temperature and were not affected by pH. Condition index was unaffected by both temperature and pH. Righting time increased at low pH and decreased at increased temperature. The LT50 increased by about 2°C every 30 minutes from the beginning to the end of the experiment but was unaffected by either temperature or pH treatments. Simulating the effects of climate change on E. troschelii suggests they are well-adapted to a wide range of temperature and pH as they survived temperatures well within future projections and pH had a limited effect on physiological and behavioral responses.

DOES LARVAL SUPPLY MATTER? MEROPLANKTON CONCENTRATIONS AS DRIVERS OF INTERTIDAL INVERTEBRATE ABUNDANCE IN THE GULF OF ALASKA

Traiger, S.B.[1*]; Bodkin, J.[1]; Coletti, H.[2]; Esler, D.[1]; Holderied, K.[3]; Iken, K.[4]; Konar, B.[4]; McKinstry, C.[5]; Monson, D.[1]; Pretty, J.[6]; Renner, M.[3]; Robinson, B.[7]; Suryan, R.[3]; Weitzman, B.[8]

1- U.S. Geological Survey 2- National Park Service 3- NOAA Fisheries 4- University of Alaska Fairbanks 5- Native Village of Eyak 6- Prince William Sound Science Center 7- United States Marine Corps 8- U.S. Fish and Wildlife Service

Post-settlement processes that structure intertidal benthic invertebrate populations are well-documented, but supply-side dynamics also can be important. We used long-term monitoring data to investigate the importance of larval concentrations (Bivalvia veligers, Cirripedia nauplii, and Asteroidea bipinnaria) on post-settlement intertidal abundance of mussels (*Mytilus trossulus*), clams (Veneridae), barnacles (Cirripedia), and sea stars (Asteroidea), in Prince William Sound (PWS) and Kachemak Bay (KBAY). Benthic intertidal abundance was monitored annually or biannually at 5-6 sites in each region and meroplankton were monitored 4-9 times per year at 12 stations in PWS and 9 stations in KBAY. Additional variables such as temperature were also included in the analyses. The explanatory value of including meroplankton in models of benthic abundance varied by taxa and region. In both regions, veliger concentration was a more important driver of small mussel density than large mussel density. Variation in barnacle cover explained by nauplii concentration varied between intertidal strata and regions. Bipinnaria were uncommon and intertidal sea star densities were low, making assessment of the role of bipinnaria difficult. There was also large variation in benthic invertebrate abundance among sites. Temperature was included in the top models for most taxa. Overall, this study suggests that meroplankton concentrations can help explain variability in post-settlement abundance. However, species and site-specific meroplankton data may improve understanding of post-settlement abundance.

A DECADE OF DEATH AND OTHER DYNAMICS: A COMMUNITY PERSPECTIVE ON SEA STAR WASTING

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1- UC Merced 2- Sunflower Star Lab, Monterey 3- University of Georgia, Athens

Mass mortality events may provide insight into biological extremes and also ecological interactions more generally. The sea star wasting (SSW) epidemic that began in 2013 catalyzed research on a few species and exposed a dearth of information for many lesser known sea stars. We combined datasets for 65 species to ask what we might learn more broadly from the 2010s SSW outbreak. Much of what we found was familiar: the 2010s SSW outbreak clearly affected over a dozen species with instantaneous wasting prevalence rates of 5–80%; populations of some species collapsed within weeks; recovery has been heterogeneous. But looking at the community of sea stars also provided novel perspectives: SSW disproportionately affected intertidal and shallow subtidal taxa; environmental and species variation protracted the outbreak, which lasted 2-3 years from onset until declining to chronic background rates of ~2% SSW prevalence; recruitment began immediately in many species, and in general, sea star assemblages trended toward recovery; a marine heatwave in 2019 raised concerns that sea star assemblages may be ratcheted toward collapse. However, the biological, ecological, and environmental cause(s) and consequences of the SSW outbreak remain vague, unavoidably retrospective, and perhaps contextually adrift and always indeterminate. Nonetheless, our retrospective suggests applied and basic research ideas that may be intriguing to explore going forward.

Session 29: Behavioural Ecology II

* indicates presenting author, † indicates eligibility for Best Student Paper Award

VERIFICATION OF GIANT SEA BASS (STEREOLEPIS GIGAS) SPAWNING: THROUGH PASSIVE ACOUSTIC MONITORING

† Burns, E.H.[*]; Allen, L.G.; Franklin, M.P.

CSU Northridge

The Giant Sea Bass (GSB), Stereolepis gigas, is the largest marine bony fish off the coast of California. It is the apex predator of the California kelp forests and is currently classified as critically endangered by IUCN Red List. Despite its important role in our ecosystem a large part of its behaviors and reproductive processes are unknown. Previous studies have shown GSB capable of producing a variety of sounds (many sounding like a “boom”). Many of these GSB sounds have been observed to be closely associated with spawning aggregations. In the summer of 2019, there were multiple successful spawning events in captivity. These spawning events lead to the discovery that GSB have specific sounds

associated with spawning. Using the descriptions of spawning sounds of captive adults recorded in 2019, I examined continuously recorded audio samples gathered in the summers of 2014 and 2015 from giant sea bass aggregations at two sites off the coast of Santa Catalina Island, CA to document the presence, quantity, and timing of these spawning sounds in the wild. A band limited energy detector (BLED) was employed along with a visual and auditory quality check system to detect GSB spawning sounds. Over 1,600 hours of recordings were examined and over 1870 sounds were identified and documented. I found that significantly more short bursts, long bursts, and long bursts combinations occurred during the previously hypothesized spawning time of 19:00 to 21:00. These findings confirm previously hypothesized spawning times of GSB spawning at dusk in the wild. GSB spawning sounds, first recorded in captivity, can now be used to identify wild GSB spawning activities and locations. The confirmation and timing of these sounds is crucial to understanding the critically endangered GSB life history events, behaviors, and site usage.

PATTERNS IN HUMPBACK WHALE SONG IN THREE U.S. WEST COAST NATIONAL MARINE SANCTUARIES

† Barkowski, J.*

Moss Landing Marine Labs

Cetaceans have evolved to utilize their auditory system more than any other sensory system due to the unique physical properties of sound in water. Cetacean species use sound for social, foraging, and reproductive behaviors. One of the most well-known examples of cetacean vocalizations is humpback whale song – produced by humpback whale males typically on the breeding grounds. As more acoustic data is collected in migratory and breeding habitats, we have learned that these whales produce this song almost year-round. To better understand the function of song, we must first understand the extent to which song occurs and investigate environmental conditions that might correlate with song production. This study investigated seasonality in humpback whale song production through three years of passive acoustic monitoring data in three different national marine sanctuaries along the U.S. West Coast. The onset and peak presence of song was then compared to upwelling indices derived from the BEUTI model, which includes nitrate flux. Despite considerable variation in upwelling across the three years, song started and reached a peak in presence at roughly the same time of year in all latitudes. Contrary to what has been reported for blue whales, the onset of humpback whale song does not appear to be correlated to upwelling conditions. This could be the result of humpback whale's ability to forage on both fish and krill, while blue whales are obligate krill feeders.

SEASONAL AND MORPHOLOGICAL VARIATION IN CONTRACTION BEHAVIOURS OF THE TEMPERATE DEMOSPONGE *TETHYA CALIFORNIANA*

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Moss Landing Marine Labs

Many sponges (Phylum Porifera) alter their body shape by constricting and dilating their canals, incurrent (ostia), and excurrent (oscula) pores to control water flow or in response to external stimuli, such as a hard bump or sudden change in water pressure. This has been termed the "sneeze" response. However, many sponges also exhibit rhythmic local and global contractions in the absence of apparent external stimuli; these contractions may play a role in waste excretion and removal processes. The periodicity and amplitude of contraction cycles vary between and within species, but it is not known what factors affect them. We used the orange puffball sponge *Tethya californiana* (Class Demospongiae) as a model to assess the effects of intrinsic and extrinsic factors on contraction cycle periodicity and amplitude: body volume (i.e., amount of tissue available to contract) and season (month). Contraction cycles had periods of 4.73–6.30–8.43 hr (min–mean–max; n = 24). Changes to body volume most strongly correlated with lengthening of the active contraction period (R^2 = 0.12); expansion and static cycle phases were less affected. Contraction cycles and their relationship to body volume changed throughout the year, suggesting influence by a complex interaction of environmental variables. Future inclusion of environmental data and experiments examining the effects of water quality, food enrichment, and physical disturbance will parse out the factors affecting seasonal changes in contraction cycles. This work increases our knowledge of whole-body coordination in a group of early-diverging metazoans and will inform studies into the evolution of behaviour in animals.

ANALYZING ECOLOGICAL IMPLICATIONS OF MESOSCALE CLIMATIC IMPACTS ON JUVENILE WHITE SHARK HABITAT RANGE AND SEA OTTER INTERACTIONS

† Stepanov, F.[1*]; Tanaka, K.[2]

1- UC Berkeley 2- NOAA Fisheries

Recent studies have shown an increase in juvenile White Shark (*C.Carcharias*) presence further northward along the California coast during marine heatwaves. Current SST projections may narrow the band of thermal suitability for juvenile *C.Carcharias* along the California Coast, and more permanently shift their habitat northward along the California coast. Shifting thermal habitat of juvenile *C.Carcharias* may have ecological impacts on Southern Sea Otters *(Enhydra lutris nereis)* , a keystone species in the central California marine ecosystem, as they are often mistaken for prey. This study aims to address potential shifts in the future distribution of juvenile *C.Carcharias* and the resulting ecological effects on the *E.nereis* population. To achieve this, we utilized data from 14 PAT-tagged juvenile C.carcharias and constructed a thermal suitability model. Subsequently, we assessed potential climate-induced alterations in the habitat of future juvenile *C.Carcharias* by combining our thermal suitability model with projected SST conditions from the downscaled CMIP6 ensemble climate outputs. We then analyzed these projected changes in the juvenile *C.Carcharias* habitat to gain insight into the extent of overlap with known *E. nereis* habitats along the California coast. The resulting models depict increasing habitat overlap given projected suitable thermal areas for juvenile *C.Carcharias* and historical *E. Nereis* data.

PYCNOSH: LABORATORY FEEDING RATES AND INVERTEBRATE PREY SIZE PREFERENCES OF THE SEA STAR *PYCNOPODIA HELIANTHOIDES*

† Taradash, A.C.[1*]; Gravem, S.A.[2]; Kroeker K.J., [3]; Metzger, J.[3]; Galloway, A.W.E.[1]

1- OIMB 2- Oregon State University 3- UC Santa Cruz

Pycnopodia helianthoides is a large, predatory sea star native to the northeast Pacific coast. Once abundant along the west coast of North America, its populations were drastically reduced by the sea star wasting epidemic, resulting in the loss of an influential intertidal and subtidal predator. The contents of its opportunistic diet of benthic invertebrates are known through field observations and gut content analyses, but maximum feeding rates and size preferences of prey by *Pycnopodia* are largely unknown. We performed a five-week lab experiment to investigate predation rate, prey handling time, prey size preference, and growth of adult *Pycnopodia* (n=19, 115-117mm radius) fed an ad libitum diet of one of five prey species, with multiple prey sizes available at all times. We recorded the stars' feeding activity and egested prey sizes four times per day. Overall, the stars ate sea urchins (*Mesocentrotus franciscanus*, *Strongylocentrotus droebachiensis*) at a higher frequency than abalone (*Haliotis kamtschatkana*), clams (*Saxidomus sp.*), or snails (*Tegula pulligo*). However, *Pycnopodia* growth was highest on the abalone diet, suggesting they are high-quality prey. Three stars in the *Tegula* treatment did not successfully eat for 5 weeks. Handling times of the prey species did not differ. Overall, stars favored the smaller individuals of each species while generally ignoring large individuals. These results ultimately suggest that *Pycnopodia* could have an outsized impact on populations of smaller urchins.

BEHAVIORAL ASSESSMENT OF PREDATORY FISH GUILDS TO PREY ODOR CUES BETWEEN TWO NEARSHORE HABITATS OFF SANTA CATALINA ISLAND

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1- UC Santa Cruz 2- Eckerd College

Foraging is a sensory-mediated process, with predatory success dependent on both prey detection and location. Olfactory cues pervade aquatic environments, and many fish can use this information to locate food resources. However no known studies have attempted to survey the behavioral responses of predatory fish guilds to prey chemical stimuli, in situ and across multiple habitat types. Marine habitats around Santa Catalina Island boast high fish diversity and habitat complexity, yet sensory modalities used during foraging have not been reported for most fish in this system. We modified Baited Remote Underwater Video (BRUV) methodologies to assess olfactory-sensitive predators in rocky reef and sandy bottom habitats. BRUVS are often used to assess species richness but are deployed using environmentally unrealistic bait quantities to draw in the maximum diversity. As such, traditional BRUV methods may not give us a clear picture of predator detection abilities to prey odor cues. Here, we use two prey species (anchovy and squid) at ecologically relevant concentrations (prey items at 15g and 70g) and contrasted this with a traditionally used bait quantity (500g). We documented 28 species, with 8 species consistently present in over 40% of trials. There were species-specific responses to different odor cues/concentrations across habitats, with kelp bass (*Paralabrax clathratus*) being the most responsive to all odor cues. Knowing the sensory information used during foraging is critical for furthering our understanding of ecological interactions within this system.

Session 30: Fisheries Ecology

* indicates presenting author, † indicates eligibility for Best Student Paper Award

UNCOVERING PATTERNS AND MECHANISMS OF PARALYTIC SHELLFISH TOXICITY IN ALASKA'S GEODUCK CLAM FISHERY

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1- University of Alaska Fairbanks 2- Jamestown S'Klallam Tribe 3- University of Washington Tacoma 4- University of Alaska Southeast

This research explores the patterns and mechanisms of paralytic shellfish toxicity in commercially harvested geoduck clams from the toxin-producing dinoflagellate *Alexandrium catenella* in Southeast Alaska. Alaska's commercial fishery for geoduck clams (*Panopea generosa*) is a small but lucrative fishery, with annual ex-vessel values averaging US $3.9 million (2010-2022). In recent years, the presence of paralytic shellfish toxins (PSTs) in clam tissue resulted in declines in fishery openings and harvest. PSTs can bioaccumulate in the tissues of filter feeders when *A. catenella* blooms in the spring and summer seasons. However, high levels of toxicity in geoduck clams occur sporadically during the fishery in the fall and winter months long after toxic blooms have subsided. Levels of PSTs in geoduck clams vary substantially from week-to-week, and elevated PSTs are increasingly causing economic loss to the fishery through sampling costs from repeated testing and by delaying or closing harvests. In the past decade (2011-2021), about 60% of geoduck clams tested for PST failed regulatory screenings, up from a 36% failure rate in the decade prior (2001-2010). Knowledge about patterns and distributions of this harmful algal species and its toxins will help improve management of geoduck dive fisheries and provide information to reduce impacts of PSTs in this fishery. Patterns in geoduck clam paralytic shellfish toxicity from two decades of shellfish testing in southeast Alaska show that geoduck clams are increasingly failing biotoxin screening tests in some areas and these patterns are most closely correlated with regional air temperatures. We created the first maps for this region documenting *A. catenella* benthic cyst distribution, sediment characteristics, and geoduck clam toxicity and found that cyst counts declined over the three-year study but patterns in cyst distribution were not related to geoduck PST levels or sediment characteristics. Lastly, we examined how geoduck clam toxicity dynamics varied across harvest areas, time, age, and cyst gut content in Alaska's commercial fishery. We confirmed the ability for geoduck clams to ingest dormant *A. catenella* cysts but revealed that this process nor the age of a clam is directly related to patterns of paralytic shellfish toxicity in this clam species. All together, these findings lead to a better understanding of the variability of PSTs in geoduck clams and are informative to future fishery management as well as protecting human health.

THE BENEFITS AND DRAWBACKS OF INTEGRATING SPECIES INTERACTIONS INTO REBUILDING PLANS

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1- UC Davis 2- NOAA Fisheries

Considering ecosystem attributes, such as species interactions, can improve the biological and economic outcomes of fisheries management decisions. Efforts to incorporate species interactions into fisheries management has focused on harvest goals, but fisheries management contain many components. Species rebuilding plans, another facet of fisheries management, generally remain strict and single-species in nature, often

limiting or prohibiting harvest of productive species occupying shared habitats. Yet, considering species interactions has the potential to minimize tradeoffs between harvest and rebuilding goals. For example, harvest of a predator may reduce predation pressure on and promote recovery of a rebuilding species, given low enough bycatch mortality, supporting both harvest of a predator and recovery of their prey. Here, we investigate the biological and management outcomes of considering predator-prey interactions within rebuilding plans, using the U.S. West Coast Groundfish Fishery as a relevant case study. We constructed age-structured population models for yelloweye rockfish and their lingcod predator and analyzed the outcomes of lingcod fishing scenarios on the long-term population structure and rebuilding time of yelloweye rockfish. We find that the benefits of a lingcod fishery depend on the extent of prey selectivity and that the biological and management outcomes conflict with each other. Specifically, yelloweye rockfish experience positive (negative) biological and negative (positive) management outcomes at low (high) prey selectivity. The results of this work highlight types of circumstances where the addition of ecosystem complexity might resolve conflicting goals in marine fisheries management.

ROCKFISH SPECIES TRENDS IN PUGET SOUND, WASHINGTON, USA 2009-2023

Shelledy, K.N.[1*]; Olsen, A.Y.[1]; Tanz, A.[1]; Williams, M.H.[1]; Christiansen, J.[2]; Wilken, H.[3]; Van Damme, C.[2]; and Larson, S.[1]

1- Seattle Aquarium 2- Seattle Aquarium - retired 3- Point Defiance Zoo & Aquarium

Rockfishes (*Sebastes* spp.) are a long-lived, understudied, multi-species fish assemblage in inland Washington (USA) waters. Driven by large-scale fishery removals in the 1970s, their numbers declined and have yet to recover, perhaps due to slow maturation and rare recruitment success. Since then, rockfish fishing restrictions have increased within Puget Sound, culminating in a 2010 total ban. Here, we analyze rockfish community trends (abundance and Shannon Diversity) within Puget Sound from 2009-2023. Our dataset includes 157 recorded dive transects from nine rocky reef habitats at depth 5-24m throughout four Puget Sound basins: Admiralty Inlet (2 sites), Central Puget Sound (4 sites), Hood Canal (2 sites), and South Puget Sound (1 site). Significant differences in community species composition between basins were observed; we noted more Black (*S. melanops*), Yellowtail (*S. flavidus*), and Puget Sound (*S. emphaeus*) rockfish and fewer Brown rockfish (*S. auriculatus*) at sites in Admiralty Inlet vs. Central Puget Sound. Adult rockfish counts and Shannon Diversity varied seasonally, with higher rockfish counts and diversity indices in summer/autumn vs. winter/spring. Notably, we observed a significant negative trend in total adult rockfish count per survey over time, driven in part by declining Copper rockfish (*S. caurinus*) counts in Hood Canal. We recommend continued monitoring and additional investigation into what factors besides fishing may be driving the trends reported here.

LEVERAGING EMERGING TECHNOLOGY AND CITIZEN SCIENCE TO COLLECT FISHERY SIZE-STRUCTURE DATA

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1- UC San Diego, Scripps Inst. of Oceanography 2- The Nature Conservancy 3- UC Santa Barbara

The ubiquity of data-limited, data-absent, and unmanaged fisheries around the world illustrates a significant need for enhanced monitoring of living marine resources beyond conventional agency-led programs. While quantitative stock assessments represent the gold standard for fisheries management, simple length-based datasets alone can provide important insights into fishery status and can be collected by citizen and community scientists. Here, we demonstrate the performance of a web-based platform that uses computer vision software and digital edge detection to measure harvested catch from pictures submitted by users (e.g., fishers, scientists, fisheries managers). Specifically, we demonstrate consistent measurement precision and bias (relative to hand measurement) across disparate taxa, users and fisheries through a collaboration with local fishing communities. Our results demonstrate that tools using computer vision and machine learning can produce consistent size estimates that are generally comparable in quality to conventional hand measurements. At present, we are also developing novel depth cameras and associated AI tools to facilitate efficient underwater collection of multi-species size and abundance data at low cost. Our efforts in this space have the potential to directly improve fisheries management frameworks and facilitate citizen science contributions, particularly in small-scale, data-limited fisheries.

FORECASTING PREDATOR-PREY OVERLAP FOR CLIMATE READY FISHERIES MANAGEMENT IN THE BERING SEA

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1- Stanford University 2- NOAA Fisheries 3- Oregon State University 4- University of Washington

Studies using species distribution models to forecast range shifts under future climate scenarios are ubiquitous, but the implications of shifting species distributions for ecosystems, fisheries, and conservation remain poorly understood. In the eastern Bering Sea - a culturally and economically important large marine ecosystem - recent warming has resulted in shrinking sea ice extent, with extensive changes propagating through the water column and altering the annual distributions of groundfish and crabs along the shelf. Using a rich dataset of biomass and abundance for various fish and crabs surveyed annually in more than 300 locations along the Bering Sea shelf, we use generalized additive mixed models to characterize the distribution of eight species at both juvenile and adult size classes, and project the distributions of these species forward under multiple climate models and scenarios. We then use these projections to forecast changes in spatial overlap between predator and prey couplets, propagating model uncertainty into uncertainty in predator-prey overlap metrics. Combining data from stomach contents samples with abundance data collected for a subset of these groundfish, we derive empirical relationships between predation rates and various metrics of spatial predator-prey overlap, finding that overlap is a good predictor of predator-prey interaction strength for some but not all species. We examine the ecological implications of projected species distributions and overlap in the context of these results.

RELATIVE IMPORTANCE OF DYNAMIC AND STATIC REEF CHARACTERISTICS ON THE DISTRIBUTION OF CORAL REEF FISHES

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1- UC Santa Barbara 2- Florida State University

The distribution of coral reef fishes is affected by numerous environmental factors. Fishes may be influenced by variables that are relatively dynamic (e.g., coral versus macroalgae cover) or that are more static (e.g., location in seascape, amount of habitat). We utilized a novel survey approach to simultaneously conduct paired, georeferenced fish and benthic surveys in the lagoons of Moorea, French Polynesia. This approach allowed us to cover large spatial extents while altering spatial resolution. We modeled the biomass of different herbivorous fish groups and species important in the fishery at different spatial scales to determine the ideal scale for predictability and the relative importance of dynamic versus static variables in describing their distribution. We found that most groups were relatively more associated with static compared to dynamic variables, with the exception being detritivores. Fish biomass tended to be highest in areas further offshore, closer to reef passes, and with more physical structure. These results suggest that most groups may be somewhat resilient to changes in the benthic state over small timescales.

Session 31: Evolutionary Biology

* indicates presenting author, † indicates eligibility for Best Student Paper Award

MICROBIOME COMPOSITION AND IMPACT OF ANTIBIOTICS ON THE REPRODUCTION OF EX-SITU BRED GIANT KELP GAMETOPHYTES.

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1- University of Wisconsin-Milwaukee 2- Hortimare

The algal microbiome is crucial for regulating algal populations in various environments through the synthesis of compounds essential for growth, germination, morphogenesis, and pathogen resistance. However, there is a lack of knowledge regarding how these bacteria change with time in perpetual ex-situ preservation conditions (germplasm). Algae-associated microbiota management is gaining attention for its role in health, nutrition, and resilience in industrial breeding programs for efficient production. Germplasm conditions, however, may affect algae's ability to recruit beneficial microbiota and regulate life cycle transitions. This study applied an antibiotic cocktail (ciprofloxacin, ampicillin, streptomycin and kanamycin) to giant kelp gametophytes from germplasm to investigate the impact of bacterial overgrowth on gametophyte fertility. The 16S rRNA gene from gametophyte tissue under differing treatments of antibiotics and environmental samples was sequenced to assess microbial diversity and to determine how community composition changes during active growth conditions. Results revealed high bacterial diversity dominated by Proteobacteria and Bacteroidetes. These bacteria play important roles in seaweed metabolism and morphogenesis and seem to be the most abundant groups regardless of the environment. Antibiotic treatment did not significantly alter bacterial composition, and gametophyte fertility improved over time in active growth, suggesting that this axenic treatment can be used in ex-situ protocols to reduce contamination without impacting fertility.

THE REGULATORY UNDERPINNINGS OF SEASONAL RUN-TIME VARIATION IN CHINOOK SALMON, ONCORHYNCHUS TSHAWYTSCHA

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1- Washington State University 2- UC Santa Cruz

Pacific salmon are an ecologically, economically, and culturally valuable clade of fish that are well-known for their long migrations from the ocean to their freshwater spawning grounds. Unlike other Pacific salmon species, Chinook salmon display substantial variation in the time at which they begin their migration, resulting in seasonal run-time groups known as fall- and spring-run salmon. Seasonal run-time has been found to be highly correlated with variants in a ~140 kb gene region containing two protein-coding genes: GREB1L and ROCK1. Several co-inherited genetic variants exist in protein-coding and regulatory regions of GREB1L and ROCK1, making it unclear if run-time variation results from protein structural variation, regulatory evolution, or both. The expression profiles of these genes remain unexplored in Chinook salmon. Regulatory elements – such as enhancers – in the GREB1L/ROCK1 gene region also remain unidentified. In this study, we share the tissue-specific and life-history-stage-specific expression profiles of GREB1L and ROCK1 in Chinook salmon as well as expression differences between fall- and spring-run salmon. Lastly, we share predicted enhancer regions in the GREB1L/ROCK1 gene region and their target genes that may play a role in mediating seasonal run-time. The results from our study provide insight on physiological triggers of migratory timing in Chinook salmon as well as the regulatory underpinnings of run-time variation mediated by the GREB1L/ ROCK1 gene region.

LIFE HISTORY AND DISTRIBUTION INFLUENCE HISTORICAL DEMOGRAPHY IN CORAL TRIANGLE FISHES

Reid, B.[1*]; Fink, A.[2]; Ethridge, A.[3]; Molino, E.[4]; Garcia, E.[5]; Clark, R.[6]; Whalen, J.[3]; Baldisimo, J.[3]; Roberts, R.[1]; Jablonski, C.[3]; Malabag, M.[2]; Bucol, A.[7]; Bird, C.[5]; Carpenter, K.[3]; Pinsky, M.[1]

1- UC Santa Cruz 2- Rutgers University 3- Old Dominion University 4- Arizona State University 5- Texas A&M Corpus Christi 6- Drexel University 7- Silliman University

The Coral Triangle represents the apex of marine species diversity. Characterizing the demographic history of species inhabiting this region can illuminate the processes that have generated and maintained this treasure trove of diversity as well as inform ongoing efforts to manage and preserve tropical marine species diversity. We generated shotgun whole-genome sequencing data for over twenty Philippine fish exhibiting a variety of habitat preferences, range sizes, and reproductive modes. We used a de novo genome assembly method (SPAdes) to produce draft genomes for a single individual of each species, and we used a pairwise sequentially Markovian coalescence (PSMC) methodology to infer the past population trajectory for each species. PSMC identified a variety of demographic modes, including long-term stability, expansion, and cycles of expansion and decline. Despite this diversity in individual trajectories, a few key life history traits (including fecundity) and range size predicted components of these trajectories across species. These results provide useful baselines for data-poor tropical fish species and lay the foundation for identifying recent demographic trends using temporal genomic data.

AN EXPERIMENTAL TEST OF ECO-EVOLUTIONARY DYNAMICS ON ROCKY SHORES

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A growing body of theoretical studies and laboratory experiments has focused attention on reciprocal feedbacks between ecological and evolutionary processes. However, evaluating the importance of eco-evolutionary feedbacks in natural communities requires field experiments that test whether selection on phenotypic variation within populations leads to contemporaneous effects on community dynamics. We tested the hypothesis that selection on consumer traits in a population of drilling snails (*Nucella canaliculata*) can drive eco-evolutionary dynamics in a rocky shore community. We conducted a laboratory selection experiment, raising newly-hatched snails on four diet treatments encompassing a range of prey species and shell thicknesses. Adult snails were then tested on their capacity to drill thick-shelled mussels. Snails from these treatments were outplanted to field cages for one year to test whether groups differed in their effects on mussel bed succession. Counter to our hypothesis, successional patterns differed minimally based on the early life diet of the snails. Thus, although our laboratory results suggest that prey can impose selection that leads to rapid adaptation and divergent consumer traits, these feedbacks were not strong enough to result in clear community effects. We propose that a limited range of variation in functional traits within populations, moderate strengths of selection, and a background of substantial natural variation may all act to dampen the potential for strong eco-evolutionary dynamics in many natural communities.

COUPLED POPULATION GENOMIC PATTERNS IN THE CORAL ACROPORA HYACINTHUS AND THEIR SYMBIONTS PREDICT RESPONSES TO HEAT STRESS

Cornwell, B.H.*; Palumbi, S.R.

Hopkins Marine Station, Stanford University

Partner quality in coral-dinoflagellate endosymbioses impacts the performance of the holobiont, shaping ecologically important phenotypes such as local adaptation and stress-induced bleaching. Here we investigate population genomic patterns in *Cladocopium* spp. and the coral *Acropora hyacinthus* in ~200 coral colonies across Palau and examine how these patterns correspond to bleaching. This coral species shows little genome-wide genetic structure across the study range and interacts with generalist symbionts, yet we found significant associations between ca. 30000 pairs of host and symbiont SNPs, showing that a small subset of alleles across the host genome are associated with a small subset of alleles in the symbiont genome. These associations suggest coevolution or interactions between coral and symbiont variants. To assess possible functional importance of these allele matches we conducted an experimental warming assay where we found that individuals which show more coral-symbiont matching at these loci show higher symbiont densities in ambient conditions, and an even stronger pattern of increased symbiont density after stressful heated conditions. These data suggest a constellation of genetic interactions between corals and symbionts tunes the nature of their interactions. Such genetic correlations within and between species have implications for the establishment of symbiosis, the breakdown of the partnership when temperatures rise, and the consequences of symbionts interacting with multiple host species across generations.

EXPERIMENTAL TRANSCRIPTOMICS UNCOVERS CRYPTIC LOCAL ADAPTATION IN A HIGH GENE FLOW SYSTEM

† Lee, A.[1*]; Daniles, B.N.[2]; Hemstrom, W.B.[1]; López, C.[3]; Anderson, P.[2]; Davidson, J.[2]; Toonen, R.J.[3]; White, C.[2]; Christie, M.R.[1]

1- Purdue University 2- Cal Poly, San Luis Obispo 3- HIMB

Given that local adaptation can be attenuated or quickly eroded in high gene-flow systems, understanding how and when local adaptation occurs in the ocean has been a long-standing question in marine ecology. Differentiation in putatively adaptive loci (*i.e.*, loci under strong divergent selection) may occur in the face of high gene flow even if populations appear homogenous at neutral loci. We studied populations of Kellet's whelks (*Kelletia kelletia*) in its historical and recently expanded (1970s) ranges by combining a common garden experimental design with RNA-Seq. Because the offspring were raised in aquaria with identical conditions, differences in gene expression in their offspring can be attributed to genetic effects, heritable epigenetic effects, or parental effects and may uncover loci underlying cryptic local adaptation. We first identified 2,770 differentially expressed genes between historic and range-expanded offspring reared in a common environment. Next, using SNPs called from differentially expressed genes, we recovered parental population structure using clustering and phylogenetic analyses. We also identified highly divergent regions of the genome associated with the novel conditions in the whelk's expanded range. The most differentiated SNP between the expanded and historical range occurs on the gene triosephosphate isomerase (*TPI*), which is upregulated in Monterey. *TPI* is an essential and highly efficient enzyme involved in glycolysis and glucose genesis. Additionally, *TPI* may play an important role in general stress and cold stress response. Our findings help us better understand how marine organisms are responding to their rapidly changing environment. More broadly, our findings help us further understand how local adaptation can occur in high gene flow systems.

Session 32: Special Session: Kelp Research and Restoration in Along the West Coast III

* indicates presenting author, † indicates eligibility for Best Student Paper Award

GEOGRAPHIC VARIABILITY OF FLOATING KELP RECOVERY AFTER A HEATWAVE EVENT IN THE SALISH SEA

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Washington Dept. of Natural Resources

Marine heatwaves can cause catastrophic losses to floating kelp canopies, threatening the resilience potential of these vital ecosystems. However, how baseline thermal regimes and warming trajectories interact to drive kelp recovery timelines across geography is not known. We utilized a >30-year floating kelp canopy data set derived from low-tide aerial photography collected by the WA Department of Natural Resources

to disentangle patterns of floating kelp abundance over a region with distinct thermal regimes. This study provides evidence of variable kelp canopy decline and subsequent recovery across a geographic gradient. Floating kelp canopy extent decreased by half at sites along the open coast in 2014, then recovered rapidly (one year). Sites near to ocean influence (western Strait of Juan de Fuca) responded similarly. In contrast, sites located within the inland sea experienced slower recovery (2-3 years) even though all sites experienced coincident initial declines. Recovery timelines were associated with thermal trajectories, emphasizing the need to look beyond maximum summer temperature when predicting kelp resilience in the context of climate change. This study directly informs conservation and management efforts in Washington State, including the Kelp Forest and Eelgrass Meadow Health and Conservation Plan, and the Puget Sound Floating Kelp Canopy Vital Sign Indicator.

KELP FOREST CANOPIES: HABITAT STRUCTURE REVEALS UNIQUE BENTHIC COMMUNITIES

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The physical structure of canopy kelps plays a key role in supporting diverse assemblages of marine species. As such, the degradation of kelp forests by extreme climate events could redefine the organization of kelp-associated communities. To explore the relationships between kelp forest structure and the composition of associated biological communities, we surveyed 23 sites with canopy kelps (*Macrocystis pyrifera*, *Nereocystis luetkeana*) across Barkley Sound, British Columbia, a coastal fjord that experienced a marine heatwave and kelp forest extirpations in the past decade. We quantified structural attributes of kelp forests (density, height, biomass, area) and abundances of associated species (fish and macroinvertebrates), and collated environmental data. We found that the composition of benthic but not pelagic communities differed significantly between canopy kelps. In addition, the composition of macroinvertebrate assemblages was more strongly linked to kelp forest structure than the benthic fish community. Specifically, a greater macroinvertebrate species richness was associated with deeper forests of *M. pyrifera* with greater canopy height. In contrast, red urchins (*Mesocentrotus franciscanus*) disproportionately dominated the shallower forests of dense *N. luetkeana*. Our findings underscore the importance of differentiating among canopy species and faunal groups when assessing kelp-community relationships. By doing so, we can improve our ability to predict the emerging species assemblages that will characterize future coastlines.

TOWARDS CLIMATE-SMART NETWORKS OF TRANSBOUNDARY MARINE PROTECTED AREAS IN THE CALIFORNIA BIGHT

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Climate change poses an urgent threat to biodiversity that demands societal responses in the form of adaptive management and conservation. The magnitude of this challenge is reflected in recent international commitments to protect 30% of the planet by 2030 while adapting to climate change. However, because climate change is global in nature, interventions must transcend political boundaries. Here, we provide 21 biophysical guidelines for designing climate-smart transboundary marine protected area (MPA) networks and conduct analyses to inform their application in the California Bight, shared between Mexico and the USA. We found that future climates and marine heatwaves could decrease ecological connectivity by 50% and hinder the recovery of vulnerable taxa in MPAs. To buffer the impacts of climate change, planners should expand the coverage of MPAs, focusing on protecting critical nodes for the network as stepping stone MPAs and climate refugia, where the impacts of climate change might be less severe. For shared ecoregions, these actions require international coordination. Our work provides the first comprehensive framework for integrating climate resilience for MPAs in transboundary ecoregions, which will support the planning of MPAs in the California Bight and for other ecoregions.

EVIDENCE OF LOCAL ADAPTATION IN BULL KELP UNDER EXTREME WARMING

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Kelp forests are critical coastal ecosystems, yet the extent of canopy-forming kelp has drastically decreased in some areas due to climate change and recent marine heatwaves. Restoration is a potential strategy to assist kelp recovery and persistence after extreme climate events. In regions experiencing extreme warming, kelp restoration will likely require reforesting with thermally tolerant strains. To identify population-level differences in thermal performance, the offspring of bull kelp (*Nereocystis luetkeana*) sourced from five populations along a thermal gradient (230 km, ~6°C difference) in the Strait of Georgia, BC, Canada were outplanted in a common garden experiment at a warm site along the range (Hornby Island) where bull kelp has recently been extirpated by ocean warming. We monitored average length over time, as well as blade growth and condition at the warmest point in the summer. Blade growth and condition during thermal stress correlated strongly with distance from the outplant site but did not correlate as strongly with temperature at the source population. During the warmest month of summer, kelp from the closest site, Oyster River (55km away), had 0.67cm/d blade growth and the healthiest blade tissue, while kelp from the farthest site, Victoria (150km away), showed 0.16cm/d blade growth and intense bryozoan fouling ($p < 0.001$). These results indicate that population-level genetic differences determine bull kelp performance under thermal stress yet factors other than temperature contribute to adaptation to local environments.

KELPS ON DEMAND: CLOSED-SYSTEM PROTOCOLS FOR CULTURING LARGE BULL KELP SPOROPHYTES FOR RESEARCH AND RESTORATION

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In recent years, the ecologically important bull kelp *Nereocystis luetkeana* has suffered extensive declines associated with anthropogenic warming. These declines have received widespread attention and prompted numerous research and conservation initiatives, which often involve the cultivation and outplanting of kelp. However, research- and restoration-oriented cultivation techniques are still an area of active research, without well-established and widespread solutions. Commercial ocean-based methods often are not applicable for research and restoration, which may require the cultivation of kelp inland, under controlled conditions, under close monitoring, or with limited resources. We have developed techniques to cultivate bull kelp in land-based, closed (i.e., not flow-through) culture systems, which are highlighting the potential of closed systems to create new opportunities in research and restoration. We produced bull kelp in programmable, high-tech flumes, as well as in simple and low-cost tumble culture tanks. Careful control of stocking density, water motion, and nutrients was necessary for survival in absence of flow-through seawater. Closed-system techniques have permitted the cultivation of bull kelp in a lab that lacks direct ocean access and have facilitated novel observations of kelp morphogenesis and ecophysiology. Our techniques have contributed to a local kelp restoration effort by supplying young kelp for outplanting and conducting strain selection trials to identify and propagate warm-tolerant phenotypes.

STAR TRACK: THE LANDSCAPE OF FEAR CREATED BY SUNFLOWER SEA STARS ROAMING AN URCHIN BARREN

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The outbreak of sea star wasting disease in 2013 caused severe declines in sunflower sea stars (*Pycnopodia helianthoides*), and is potentially linked to the overabundance of sea urchins, and collapses in kelp forests. Sunflower stars not only eat sea urchins, they cause 'urchin stampedes' that may locally reduce grazer density and temporarily suppress grazing. However, it is not known how far away from sunflower stars this escape behavior may occur, nor how long-lasting it may be. To test these unknowns, we released 18 stars in 20 minute trials into urchin barrens in Sitka Sound, Alaska. We recorded densities of red and green urchins, pinto abalone, and dusky turban snails in quadrats radiating from 0-4m away from each star track (plus 5 control tracks) before, just after, and 1, 2, and 3 days after release. Within 1 hour, we found clear reductions in grazer density up 4m away from sea stars for both urchin species and up to 3m away for abalone, but no clear spatial response by snails. These flee distances correspond to a 157m2 and 89m2 landscape-area effect of a roving star on urchins and abalone, respectively. This localized density reduction was maintained for up to 72 hours for green urchins and 24 hours for red urchins and abalone, and we will discuss whether this may be caused by lingering sea star chemical cues. Together, these findings suggest that sunflower sea stars create a 'landscape of fear' that may last days, and that reintroducing these stars in urchin barrens may be a useful tool in aiding kelp forest recovery.

Session 33: Anthropogenic pollution in marine environments

* indicates presenting author, † indicates eligibility for Best Student Paper Award

CORALS IN A HOT PLASTIC OCEAN: HOW HEAT AND PHTHALATES SHIFT A MONTIPORA CAPITATA CORAL MICROBIOME

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Corals survive in nutrient poor waters by relying on the complex relationship with their diverse and abundant endosymbionts and microbiomes. Through their symbiotic partnerships, they sustain 25% of the world's marine biodiversity and are vital to economic and food security for hundreds of millions of people. Unfortunately, coral reefs are in ecological crisis. Climate change and ocean plastic pollution threaten reef-building corals and the global services worth $2.7 trillion USD they provide. Even under an ambitious emissions reduction scenario, 100% of coral reefs are projected to experience annual severe bleaching by 2045; and every year, 4.8 to 12.7 million tons of plastic waste enters the oceans. In this study, we examine the effects of thermal stress and plastic-additives known as phthalates on the *Montipora capitata* microbiome. Phthalates are known for reproductive and acute aquatic toxicity even at low concentrations. Previous research shows that phthalate-exposed plants, bacteria, and algae display impaired growth, reduced photosynthesis, and disturbed microbial community function. In corals, very little is known about the effects of phthalates on the microbiome. Using a multiple stressor experiment, this study provides new insight on the impacts of phthalate pollution on coral microbial communities in the context of ocean warming. Managing coral reefs for resilience to thermal stress and reducing pollution is paramount to their conservation, and microbial communities are a key part of coral resilience.

INCREASE IN SUBMARINE GROUNDWATER DISCHARGE MAY ADVERSELY AFFECT METABOLISM OF THE TROPICAL CORAL, *POCILLOPORA ACUTA*

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Submarine groundwater discharge (SGD) is an understudied environmental disturbance that may impact the health of corals in nearshore environments. SGD is the process of fresh or brackish water moving from terrestrial environments through the marginal seabed into coastal zones leading to altered biogeochemistry. Our research investigated how SGD may affect the respiration, photosynthetic, and calcification rates of a tropical coral, *Pocillopora acuta*, that is commonly found within the fringing reefs of Mo'orea, French Polynesia. We analyzed metabolism rates of *P. acuta fragments* (n=8 putative colonies per site) in response to a range of ecologically relevant SGD concentrations (0 - 4% SGD by volume across 9 dilutions) at two sites with different sources of groundwater. Metabolic rates were compared to environmental parameters such as salinity, pH, nitrate, phosphate, silicate, and total alkalinity (TA) that are known to change with the presence of SGD. Our results indicate that SGD-driven changes in pH significantly increased dark respiration, but the relationship varied by site. This is the first mechanistic study to assess

the physiological responses of a range of SGD concentrations on adult corals. For virtually all coastal communities, but particularly in Mo'orea, the fringing reef holds a strong cultural and ecological significance. This is particularly important because as global climate change trends continue to intensify, the flux and concentration of SGD in coastal waters will subsequently increase.

EVALUATING THE IMPACTS OF NOISE POLLUTION ON A MARINE FISH, THE GARIBALDI (HYPSYPOPS RUBICUNDUS)

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CSU Northridge

Human activities are increasing ocean sound beyond natural levels, and little is known about how anthropogenic noise pollution can impact fish in a sound-filled environment. Many fishes communicate through sound, including the garibaldi (*Hypsypops rubicundus*), a damselfish common on shallow rocky reefs in California and Mexico. This study evaluates how garibaldi respond to boating noise. Several rocky reefs around Santa Catalina Island that vary in exposure to anthropogenic (boating) noises were studied, recording noise levels, reproductive output and mating behaviors of garibaldi. Behavior of nest-guarding garibaldi towards a model garibaldi were recorded with GoPro cameras with and without a boat operating above (producing noise). I tested the hypothesis that garibaldi that are more exposed to boat noise would have lower reproductive output and exhibit more territorial behaviors. By studying the impacts of boating noise on a fish like the garibaldi, my research may highlight impacts of anthropogenic noise on marine fishes.

LONG-TERM MICROPARTICLE MONITORING AT THE SEATTLE AQUARIUM AND ITS IMPORTANCE FOR FISHERIES

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As awareness and concern over microplastic pollution and its impacts on global fisheries and fish consumption have grown over the last decade, so has the need for ongoing monitoring programs that can track microparticles in water bodies to better understand sources, distribution patterns and environmental factors that influence these patterns. This is especially true for Puget Sound, whose geographic diversity ranges from heavily populated urban areas to dense wilderness, but whose overall ecosystem health is intensely impacted by human activity and waste input. The Seattle Aquarium maintains a water monitoring program in which the water that is incoming into the Aquarium from Elliott Bay is monitored for the presence of microparticles such as microplastics and microfibers. Our microparticle monitoring program has been active since 2019, and an analysis of our data from 2019 and 2020 found a sharp decline in microparticle concentration in April 2020, a timeframe approximately coinciding with the start of Covid-19 restrictions, including stay at home orders and limited travel. While we initially believed seasonal fluctuations in environmental factors such as precipitation, river discharge and sewage overflow would most heavily influence patterns of microparticle concentrations in the data, Covid-19 restrictions played the most influential role in the drop in microparticle concentration in 2020. Since that time, we have continued our microparticle monitoring efforts, capturing not only the start of the Covid-19 pandemic but the gradual lifting of restrictions since that time. Preliminary data analysis suggests high variability in microparticle concentrations following April 2020, with several high spikes throughout the sampling period, which may be related to human activity such as the lifting of Covid-19 restrictions and construction around the Seattle Aquarium.

TRACKING HEAVY METALS DURING BLEACHING STRESS AND RECOVERY IN HAWAIIAN REEF-BUILDING CORALS

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Ocean warming has increased rates of coral bleaching, causing corals to expel their algal symbionts, stunting growth and reproduction. Bleached corals can feed on zooplankton/detritus for energy. However, these food sources could also cause bleached corals to bioaccumulate heavy metals, which can be essential nutrients but can become toxic in elevated concentrations. It is not known how concentrations of heavy metals fluctuate in bleached corals, change during recovery, and/or affect coral gametes after colonies bleach. In a controlled experiment, we thermally stressed *Montipora capitata* colonies in Kāne'ohe Bay, Hawai'i and sampled colonies during recovery after bleaching. We also quantified metals in egg-sperm bundles spawned the year following bleaching. After bleaching, metals including arsenic, cadmium, manganese, and vanadium decreased by 25-57% in coral tissues, possibly through symbiont loss. Symbiont acquisition coincided with increases in depleted metals to pre-bleaching levels, suggesting these metals are acquired through the presence of symbionts, and not by increased heterotrophy. Concentrations of metals in egg-sperm bundles were at least ten times lower than in parent tissue and did not differ between bleached and non-bleached colonies. However, arsenic in bundles was exceptionally high (up to 70% of concentrations in parent tissue). Arsenic could be preferentially stored in coral gametes due to its high lipid affinity.

Session 34: Community Ecology V

* indicates presenting author, † indicates eligibility for Best Student Paper Award

COMMUNITY ASSEMBLY PREDICTION BY ECOLOGICAL REGULATION (CAPER): MODELING CLIMATE-DRIVEN FOULING DYNAMICS IN THE SAN FRANCISCO BAY

† Chari, M.*; De Jesus, J.; Chang, A.

SERC

Fouling communities in the San Francisco Bay are highly sensitive to local climate-driven changes. The unique geography of the Bay makes invertebrate communities particularly susceptible to frequent fluctuations in salinity, which in turn has been correlated with distinct community assembly patterns. Many marine invertebrates have optimal salinity requirements for survivorship and larval production, and variability in winter outflow of the Sacramento-San Joaquin River system into the Bay has been shown to alter the recruitment patterns of some of these organisms.

The purpose of this model is to establish a deterministic link between the winter salinity gradient and the fouling communities established during a 3-month panel deployment the following summer. The unique structure emphasizes the effect of salinity on priority effects rather than as a forcer of competitive dynamics. This model was deployed using historic data from fouling surveys conducted at the Richmond Marina. Results indicate that this variability in settlement time alone can cause dramatic changes in community dynamics. Later relative settlement of solitary tunicates and branching bryozoans in “wet year” simulations predict coexistence between colonial tunicates and bryozoans, while early relative settlement patterns of solitary tunicates in the “dry years” produce solitary tunicate dominance. These results are corroborated with past point-count data from 2000 to 2023, and provide a basis for modeling community impacts of widely predicted changes in frequency and severity of extreme events.

ALGAL TRAITS, NOT JUST SPECIES IDENTITY, INFLUENCE THE SELECTIVITY OF HERBIVOROUS AND DETRITIVOROUS FISHES

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Herbivorous fishes are critical in promoting reef health and resilience by mediating the outcome of competition between coral and algae. Studies show that this outcome is determined by the functional diversity of fishes and differences in algal palatability, yet it is unknown how the functional traits of algal species may govern their palatability. To address this question, we measured functional traits of algae and then tested their palatability to herbivorous/detritivorous fishes through herbivory choice experiments on a patch reef of Moorea, French Polynesia. We measured 7 functional traits of 6 algal species with known differences in palatability, assembled and videoed field-based behavioral choice assays (n=28), and then. quantified herbivory pressure by quantifying biomass loss and measuring selectivity of fish species as # bites/fish species/hour. Results of PERMANOVA revealed significant differences in traits across algal species, and that herbivore selectivity varied among fish species. For example, a common detritivore *(Ctenochaetus striatus)* that ‘combs’ sediment preferred an algal species that collects sediment on its broad, filament-covered blades while certain herbivorous fish consistently chose algae lacking anti-herbivory defenses. Results demonstrate that algal traits may be useful in predicting overall palatability to diverse consumers. More broadly, our novel use of a trait-based approach to assess the functional ecology of macroalgae may prove critical in the future as reefs increasingly shift to algal domination in the Anthropocene.

PACIFIC COAST FEEDING GROUP GRAY WHALES LIKELY CONSUME LOW-QUANTITY & LOW-QUALITY PREY AT THE SOUTHERN EDGE OF THEIR FEEDING RANGE

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As opportunistic foragers, the Eastern North Pacific population (~20,000) of gray whales *(Eschrichtius robustus)*, feed on diverse benthic and planktonic invertebrates as they undertake one of the largest yearly migrations of any mammal. While most of the population travels to summer foraging grounds in Alaska, a sub-group of whales (~250) called the Pacific Coast Feeding Group (PCFG) summer between SE Alaska and northern California. The diet of PCFG whales north of California typically includes abundant and/or high-caloric prey items like euphausiids, mysids, and diverse species of amphipods, yet the few studies reported from northern California show evidence of a different invertebrate prey community. We assessed gray whale prey diversity and abundance using 83 systematically collected plankton tow and 60 benthic grab samples from May-Dec 2022 across 4 foraging ‘hotspots’ for PCFG whales in northern California. Results indicate a relatively low abundance of planktonic larval crustaceans and a high abundance of low-calorie benthic cumaceans *(Diastylopsis dawsoni)* in northern California. These findings suggest both low quality and low abundance of resources for PCFG whales at the southern edge of their range. Comparisons of abundance and caloric values of prey species found at our study sites to those in other foraging areas may explain why northern California represents the edge of their summer foraging range.

IMPACTS OF A NONNATIVE BRYOZOAN ON BENTHIC COMMUNITY STRUCTURE DURING A MULTI-YEAR MARINE HEATWAVE

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Invasive species pose significant economic and ecological threats to global biodiversity; however, nonnative species differ in their effects on local communities. A recent bryozoan invader in the Santa Barbara Channel, *Watersipora subatra*, can significantly reduce diversity and cover of invertebrate competitors in fouling habitats, while disturbance has been shown to facilitate its colonization. To evaluate the effects of its establishment on natural rocky reefs, we placed recruitment plates at a local kelp forest beginning in June of 2014 and removed *Watersipora* colonies monthly from half of the plates. Concurrently, the effects of the “Blob” marine heatwave began in the Santa Barbara Channel, allowing us to evaluate how both the presence of *Watersipora* and a major ecological disturbance influenced benthic community structure. We show that *Watersipora* was the most abundant species on control plates over time and was a significant driver of community dissimilarity between treatments. Communities with high cover of *Watersipora* had lower richness and diversity, though removal treatment was not a significant predictor of richness or diversity over the 32 months of sampling. *Watersipora* was susceptible to warming-induced declines in invertebrate cover during the peak of the heatwave, suggesting that the effects of this nonnative species must be considered in the context of more frequent marine heatwaves.

SPATIAL DYNAMICS OF ANIMAL-MEDIATED NUTRIENTS IN TEMPERATE WATERS

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Consumer-mediated nutrient cycling (CNC), which is the fertilization of primary producers by animals’ metabolic waste products, is known to drive variability in nutrient availability and thus primary productivity and community functioning in tropical waters. Yet, CNC may be an unappreciated contributor of variability in temperate systems. Therefore, we aimed to quantify and explain spatial variation in CNC by surveying

fish and macroinvertebrates via Reef Life Survey methods and measuring their ammonium excretions at 27 rocky reefs (3 years) and 17 kelp forests of varying density (1 year) in Barkley Sound, British Columbia. Ammonium concentrations varied from 0.009 to 2.5 uM across rocky reefs, and the relationship between animal biomass and ammonium varied with tidal exchange–weakly positive at slack and ebb tides, but weakly negative at flood tide. Ammonium was significantly higher within than near kelp forests, a difference that increased with kelp forest biomass. Ammonium variation between kelp forests was described by complex interactions between animal biomass, kelp density, and tide exchange. We also explored fine-scale ammonium variability and found nutrient enrichment on a scale of meters was possible, but only under low flow conditions. Our results suggest CNC-driven variability acts on scales ranging from a few meters to entire reefs, contributing to finer-scale variability in nutrient availability than allochthonous nutrient sources such as upwelling. CNC may therefore play a larger role than assumed in structuring temperate marine ecosystems from the bottom up.

STAR DUST: SUNFLOWER SEA STAR CHEMICAL CUES LOCALLY REDUCE RED URCHIN DENSITIES GRAZING AND BENEFIT KELP

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The loss of sunflower sea stars, *Pycnopodia helianthoides*, due to sea star wasting disease and the subsequent loss of kelp across large regions of its range raised important questions about their role in kelp forest transitions. Predators such as *P. helianthoides* can affect kelp biomass by consuming herbivorous urchins (consumptive effects) and creating a landscape of fear (behavioral effects) such that urchins graze less kelp when a sunflower star is present. While there is ample anecdotal evidence that *P. helianthoides* can elicit a significant flee response among sea urchins, many questions remain regarding sea urchins' behavioral responses to sunflower stars in the field. These questions include: at what distances and for how long do urchins avoid a sunflower sea star, and does the behavioral response influence community-level grazing pressure? To address these questions, we conducted a subtidal experiment in Sitka, AK, where we deployed pre-weighed kelp blades at discrete distances from a caged adult *P. helianthoides* and control cages in urchin barrens for 24 hours. We demonstrate an immediate reduction in the density of red sea urchins *Mesocentrotus franciscanus* nearest the sunflower star, but we did not detect an effect on green sea urchins *Strongylocentrotus droebachiensis*. Over 24-hours, this resulted in reduced community-level grazing rates within an approximate 2m radius from a sedentary *P .helianthodes*. Our results suggest that effects of *P. helianthoides* on sea urchin behavior may be an important consideration for kelp recovery.

Session 35: Intertidal Ecology III

* indicates presenting author, † indicates eligibility for Best Student Paper Award

ALGAL RESILIENCE: HAVE ROCKY INTERTIDAL ALGAE COMMUNITIES IN THE MONTEREY PENINSULA BEEN IMPACTED BY RECENT STORMS

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Disturbances affect ecosystems by creating substrate availability, often leading to increased diversity. Wave exposure is a chronic disturbance that drives diversity and patterns in community assemblages in the rocky intertidal. Organisms there have evolved to tolerate certain levels of disturbance, but acute disturbances, like storms, can bring heavier wave action. A series of storms between December 2022 to January 2023 brought intense disturbances to the coast of California outside the range the rocky intertidal can tolerate. Immediate impacts have been observed, but little is known about longer-lasting impacts on rocky intertidal communities. Macroalgae communities offer themselves as a model system to assess possible impacts as they are susceptible to environmental changes, diverse, and fast growers. Using a functional group identification approach, multivariate similarity compares the percent coverage of several macroalgae functional groups between the Summers of 2021, 2022, and 2023 in rocky intertidal sites around the Monterey Peninsula. Survey protocols from previous summers are replicated for consistency. While several sites around the peninsula show dissimilarity in composition in 2023 compared to previous years, there is no discernible pattern across sites. Further studies are required for how wave action interacts with the differing placement of each site around the peninsula. As prominent carbon sequesters along the California coast, it is essential to assess how these communities react to acute disturbance events facilitated by climate change.

FACTORIAL FIELD MANIPULATION REVEALS MULTI-STRESSOR EFFECTS ON A CRITICAL HABITAT-FORMING SHELLFISH

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Ocean acidification and warming are expected to have negative impacts on marine organisms, and particularly on shell-building species. Acidification and warming may operate independently or interactively, amplifying or mitigating impacts on individuals. Previous results have primarily come from lab studies of single species, yet these climate stressors are occurring within naturally dynamic systems with high abiotic and biotic variability. As a result, the impacts of these stressors in situ remain poorly understood. We conducted a 6-month field manipulation to determine the effects of ocean acidification and warming on a habitat-forming shellfish, the Pacific blue mussel (*Mytilus trossulus*), in a dynamic coastal system. Twenty tide pools were factorially manipulated, including unmanipulated control, CO_2 added, warmed, and combined CO_2 added and warmed treatments. We measured mussel shell thickness, strength, and corrosion at 0, 3, and 6 months of exposure to treatment conditions. CO_2 addition led to a decrease in shell thickness and strength and an increase in shell corrosion. However, we also detected an increase in shell strength for mussels exposed to both CO_2 addition and warming. These findings indicate that ocean acidification negatively impacted shell structure and function in situ and that these effects might be mitigated when exposed concurrently to moderate warming, leading to an interactive effect of acidification and warming on this critical habitat-forming shellfish.

ASSESSING GREEN CRAB INFLUENCE ON PACIFIC COAST ECOSYSTEMS

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The invasive European green crab (*Carcinus maenas*), a recent invader of British Columbia, Canada, is a voracious predator of molluscs and has the potential to damage native populations, alter natural ecosystems, and jeopardize fisheries. In separate in-lab predator-prey experiments, we compared the abilities of green crabs and the larger native red rock crab (*Cancer productus*) preying upon the native littleneck clam (*Leukoma staminea*). Crabs and bivalves were collected from Bamfield Inlet, Barkley Sound and the bivalves separated into 4 size categories: 11-18cm^3, 18-22cm^3, 22-28cm^3, and 28-38cm^3. Experiments were performed in a circular sea table 125.7cm in diameter and 68.6cm deep in the dark under red light with no water flow. In each trial, four bivalves (one from each size category) were placed in a clump and presented to one crab; the trial continued for 30 minutes or until the crab successfully killed a bivalve. There were 16 red rock and 15 green crab trials in which crabs attempted to take a bivalve. With one exception, all red rock crabs were able to crush a bivalve successfully, regardless of bivalve size, whereas none of the green crabs were able to fracture a bivalve. Green crabs overlapping in chelae size with red rock crabs were still unable to break into the bivalves. Green crabs are not able to prey on healthy adult *L. staminea* >11cm^3. Future research should investigate the potential impact of green crabs on younger, smaller, and injured *L. staminea*.

RACE AGAINST THE TIDES: GROW UP FAST OR FACE THE HEAT

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Accurate predictions of climate change impacts on ectotherms will rely on understanding how thermal environment influences the ability of sensitive early life stages to move on in their life cycles. Early life stages must grow, develop, and survive in thermal environments that vary on multiple timescales, yet little is known about which life processes limit success across these timescales in nature. We integrate environmental data with thermotolerance assays for embryos of the intertidal gastropod *Haminoea vesicula* to predict limiting fitness components across timescales of temperature variation. We show that survival has a lower thermal optimum than growth or development. As a result, survival and growth trade off depending on seasonal shifts in the temperatures embryos experience. Spring -deposited embryos experience cooler temperatures on average than summer-deposited embryos, but because spring-deposited embryos grow slowly and have long developmental periods, they tend to encounter the ~biweekly return of lethally hot temperatures caused by tidal forcing. By contrast, summer-deposited embryos experience temperatures that exceed the thermal optimum for survival more frequently, but compensate with high growth rates and short developmental times that allow them to avoid exposure to periodic extreme temperatures. Overall, we show that the fitness effect of trading off survival for growth or vice versa depends on how long development time is relative to tidally-forced periods of thermal variation.

Poster Sessions

Poster Session I

* indicates presenting author, † indicates eligibility for Best Student Paper Award

1 - QUALITY CONTROL: FLOW RATE HAS NO IMPACT ON MUSSEL BYSSAL THREAD PLAQUE ATTACHMENT

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Water flow often dictates the speed and efficiency of physiological processes in sessile intertidal organisms, who rely on consistent flushing for oxygen and food delivery. In *Mytilus* mussel species, which anchor themselves to substrate with collagenous fibers called byssal threads to avoid dislodgement by strong waves and currents, flow is known to affect the strength of attachment to substrate by causing mussels to increase or decrease thread number. However, little is known about whether flow affects the composition of the thread itself, which could also affect attachment strength. We hypothesized that mussels would produce weaker byssal threads in low flow due to resource-limitation and in high flow due to biomechanical constraints (with high flow preventing the mussel from conforming its foot properly to make a byssal thread). We placed *Mytilus californianus* under three different flows (1.5, 5.0 and 18.5 cm/s) and measured the attachment force, plaque area (substrate attachment area), and strength of the byssal threads produced. Plaque area increased linearly with attachment force ($R2 = 0.4$, $p < 0.001$), but flow did not affect thread attachment force, strength, or plaque area. However, there was a trend towards an effect of flow on byssal thread strength. The lack of an observed effect of flow on byssal thread quality may reflect limited statistical power (N=5-9 mussels per flow level) or that the range of flows tested were not extreme enough to induce resource or biomechanical limitations on the thread production process.

2 - TEMPORAL DYNAMICS OF COASTAL VERTEBRATE SCAVENGING ACTIVITY ON CALIFORNIA BEACHES

† Gobei-Bacaylan, A.K.*; Gerraty, F.D.

UC Santa Cruz

Scavengers are crucial to ecosystem function in sandy beach environments, which have little *in situ* productivity and therefore depend on spatial subsidies—often in the form of macroalgal wrack and marine animal carrion—as an organic matter resource base. However, vertebrate scavenging assemblages and patterns of scavenging activity are largely uncharacterized in sandy beach ecosystems along the California coast. In this study, we investigated the temporal dynamics of vertebrate scavenging activity at seventeen beaches in Santa Cruz County using motion-triggered game cameras baited with fish carcasses. We placed carcasses at both sunrise and sunset, allowing us to compare scavenging assemblages and rates of carrion processing during daytime vs. nighttime deployments. Each vertebrate scavenger species exhibited distinct

temporal trends in scavenging activity, but rates of carrion processing did not differ between diurnal vs nocturnal carcass deployments. These results broaden our understanding of vertebrate scavenging activity on California's sandy beaches and the ecosystem functions that these scavengers perform, with implications for coastal shoreline management strategies such as beach grooming and urban development.

3 - IMPACTS OF HARMFUL ALGAL BLOOMS ON ABALONE AQUACULTURE

Brown, I.T.*

CSU Monterey Bay

Abalone is a staple organism on the west coast both for ecological and commercial purposes. Native red abalone (Haliotis rufescens) was once a highly productive commercial fishery in California until its closure in 1997 due to overexploitation and disease. In response to a growing demand for domestically farmed seafood, aquaculture efforts have helped this species persist as a niche delicacy in the CA mariculture market.Abalone in aquaculture can be negatively affected by harmful algal blooms (HABs). These impacts could impact growth and survival during the seed/juvenile stage and at the adult stage. Monterey Bay is an ideal place to study these impacts because blooms of multiple phytoplankton species have been observed belonging to several genera known to be harmful: Alexandrium, Dinophysis, Pseudo-nitzschia, Cochlodinium, Akashiwo. We can leverage natural HABs in situ combined with cultured HABs in a lab environment to monitor the effects on abalone aquaculture growth and survival. These algal blooms are a growing concern, and understanding how they negatively affect farmed abalone is important. Understanding these impacts and how we can ameliorate them is a key need for aquaculture of abalone and other species. Past work with mussels has shown that food quality and availability can mitigate impacts of stressors such as ocean acidification. Understanding the impact of diet on the ability of abalone to withstand stressors related to HABs will be key to increasing efficiency of aquaculture of this important native species.

4 - SHIFTS IN THE PHENOLOGY OF NEARSHORE LARVAL GARIBALDI, HYPSYPOPS RUBICUNDUS, AT KING HARBOR IN SOUTHERN CALIFORNIA FROM 1982-2022

† Ramirez, D.F.*

Cal Poly, Pomona

Variability in climate cycles and regional oceanographic conditions have the potential to alter early life history and phenological patterns in teleost fish. The timing in the appearance of the planktonic larval phase is indicative of both adult spawning patterns, and pelagic larval distribution and survival. Preference to specific thermal regimes is a driving mechanism that triggers adult reproductive behaviors (e.g., nest building, migrations, courtship) and physiology (e.g., hormone production, oocyte development). Ocean temperature also influences larval growth, metabolism, and pelagic larval duration. As mean sea surface temperature in the Southern California Bight has risen in recent decades, offshore studies have shown patterns in peak larval abundance of fishes temporally shifting earlier or later in the year depending on the species. King Harbor in Redondo Beach, California has been the site of continuous nearshore ichthyofauna monitoring by Vantuna Research Group at Occidental College since 1974. Monthly ichthyoplankton tows have largely gone uninterrupted over a period of global climate change, multiple oceanographic decadal cycles, and more acute temperature events such as El Niño. This study is investigating patterns of phenological change in nearshore annual peak larval abundance of Garibaldi, *Hypsypops rubicundus*. Garibaldi are an abundant nearshore species with a distinctive spawning season and representative of many demersal life history traits. Detected temporal shifts will be correlated with interannual and decadal climate cycles such as El Niño Southern Oscillation and the Pacific Decadal Oscillation to measure climatic sensitivities for change in phenology. In addition, local oceanic variables such as zooplankton volume and upwelling intensity will be correlated with temporal shifts to determine if larval occurrence has trended with maximum plankton productivity. I will also examine whether temporal shifts and larval abundance is related to temporal patterns in adult Garibaldi abundance in King Harbor. Results of this study may provide insight into the potential mechanisms for population level effects of nearshore demersal fish due to long term climate change and more acute temperature events.

5 - VARIABILITY IN TEMPERATURE OF PAJARO RIVER WITH MAX DIFFERENCES IN FLOW REGIME

† Charleton, E.*; Yokomizo, L.; Olson, J.

CSU Monterey Bay

Water temperature is one important parameter that can differentiate tributaries both within and among drainage systems. Temperature affects the growth, metabolism, reproduction, emergence, and distribution of aquatic insects. (See Hynes 1970; Precht et al. 1973). Dissolved oxygen saturation is dependent on temperature and affects the macroinvertebrates and fish of rivers. To study this we measured temperature at 5 locations over time all with variable depth, flow, and sunlight. We see there is the same pattern among the locations with slightly higher daily highs in locations with full sun exposure. This study will be expanded upon with increased flow in the winter.

6 - DIVERSITY OF NON-GENICULATE CRUSTOSE CORALLINE ALGAE ON SAN JUAN ISLAND, WASHINGTON

† Gonzalez, J.[1*]; Jackson, G.[2]; Lichter, A.[3]

1- University of North Carolina, Wilmington 2- University of Guam 3- University of Washington

In the Northeastern Pacific Ocean, Corallinophycidae (Rhodophyta) includes two orders: Corallinales and Hapalidiales. This study focused on DNA-based identification of non-geniculate coralline algae on the rocky intertidal from San Juan Island, Washington. Here we recognized seven different species (Boreolithothamnion phymatodeum, Chamberlainium tumidum, Lithophyllum impressum, Bossiella frondescens, Bossiella mayae, Bossiella exarticulata, and Corallina vancouveriensis). Another was identified to the genus level (Lithophyllum sp. 1) and four to the ordinal level (Hapalidiales sp. 1, Hapalidiales sp. 2, Hapalidiales sp. 3, and Hapalidiales sp. 4). The result of this study shows that limited data is known about the diversity of coralline flora in San Juan Island despite their significant ecological role and abundant coverage in the rocky intertidal. This study is a demonstration of the benefit of DNA-based identification in surveying coralline diversity. This is also the start to better understanding this dominant, ecologically significant, and overlooked group of ecosystem engineers.

7 - PROJECT SALINE

Nather, A.[1]; Wauhob, A.[2]; Hunt, V.[3*]

1- University of Washington 2- Highline College MaST Center Aquarium 3- Central Washington University

Project SALINE (Salish Aquatic Learning & Insights Network Ecology) is a working prototype for a multimodal learning experience serving formal (13-16 yr/old) and informal (public) learners.SALINE is a networked learning platform consisting of an audio-visual communication system, an online learning management system, and a customized learning curriculum. As a flexible, modular framework, the SALINE platform is easily adaptable to facilitate connection between any combination of institutions and the outside world to enhance learning outcomes for educators and learners, regardless of location.The ChallengeSources of information, knowledge, and learning are everywhere. Rich content created by aquariums, schools, libraries, community centers, museums, and subject matter experts is increasingly available online.Due to many constraints, educators can struggle to connect and leverage this rich universe of available resources to foster the learning potential of their students, especially in communities with unevenly distributed technology and funding. Learning in isolation can be a challenge for students in becoming future scientists and technologists in a world that is becoming hyper-connected.A Solution: The SALINE PrototypeFunded by foundry10 and sponsored by the University of Washington, the Project SALINE prototype delivers a new educational and outreach program. The first version enhances the best of the MaST Center Aquarium's content delivered using MaST Aquarium's Hyflex classroom standards, Russel Wilson's Why Not You Academy classroom setting and instruction, and the SR3 (Sealife Response, Rehab, and Research) lab environment and experts.

8 - MONITORING ULVA BLOOMS USING UNMANNED AIRCRAFT SYSTEM (UAS) APPLICATIONS IN ELKHORN SLOUGH, CA

† Hernandez, M.[*]

Moss Landing Marine Labs

The primary productivity of *Ulva* is an important ecological function. However, *Ulva*blooms can harm the surrounding ecosystem when left unchecked. The purpose of this study was to monitor temporal variability in *Ulva* biomass at a shallow coastal lagoon in central California. Drones were used to monitor the cover of an *Ulva* bloom over time and aerial imagery of the bloom event was co-located with core samples to create an algorithm to estimate the *Ulva* floating mat biomass. Sampling was conducted at least once a month during a bloom event along with GPS point data of *Ulva* "cores" and water depth. Samples were triple-rinsed and then desiccated to record dry biomass. Aerial imagery was collected using a DJI Phantom model 4 UAS with a 3-band camera and Real-Time Kinematics (RTK) with a reference base station at California State University Monterey Bay. Images were run through Agisoft Metashape software to generate a Digital Elevation Model (DEM) and Orthomosaic (Ortho). By mapping the area and calculating the red, green, and blue bands, the Excessive Green (ExG) Index was used to identify healthy patches of *Ulva*. The mat of *Ulva* floating on the surface was extracted to calculate the raster layer's thickness and volume using geoprocessing tools in ArcGIS. Dry biomass was then correlated with the biomass index and water quality parameters. The overall average *Ulva* biomass was found to correlate better with the remote-sensed estimates, than the individual monthly point estimates.

9 - 17 YEARS OF COLONIZATION ON A LOST SHIPPING CONTAINER IN THE DEEP SEA

† McDermott, S.E.[1*]; DeVogelaere, A.[2]; Kahn, A.S.[1]; Barry, J.P.[3]

1- Moss Landing Marine Labs 2- Monterey Bay National Marine Sanctuary 3- Monterey Bay Aquarium Research Inst.

Cargo ships and shipping containers make up the majority of global trade by volume. Shipping containers can be lost at sea due to storms, fires, or human error. Once they sink, these containers bring new hard substrate to the seafloor that can be colonized by benthic invertebrates. We monitored community formation and succession on one lost container discovered in 2004 in deep water (1300 m) in the Monterey Bay National Marine Sanctuary. Video surveys collected by remotely operated vehicles in 2011, 2013, 2014, and 2021 were used to identify the species present on the container over time. Taxa richness on the container increased over time, with new taxa appearing such as glass sponges in 2021. The presence and dominance of species shifted over time, from a community comprised of mostly annelid worms to one dominated by scallops and reproductive *Neptunea* snails. Other than the presence of bacterial mats along the door frame, the breakdown of the container's internal contents (rubber tires) did not influence the community on the exterior of the container, something that may not be true of containers with toxic contents. Overall, with few key exceptions, the community on the container was similar to that of communities found on naturally occurring hard substrates at similar depths within the sanctuary. However, as global populations and shipping demands increase, the growing footprint of hard substrate in the deep sea caused by lost shipping containers may have additional downstream impacts.

10 - HIDDEN CURRENTS: A NOVEL FLOW SENSOR FOR MEASURING WATER VELOCITIES WITHIN BIOLOGICAL ASSEMBLAGES

† Maring, C.T.[*]; Nishizaki, M.T.

Carleton College

In aquatic systems, water motion is an important driver of mixing processes that affect the mass transfer of important gases, food particles/nutrients, and gametes between organisms and their fluid environment. Additionally, hydrodynamic flows can impart mechanical stresses that increase the risk of detachment for benthic organisms. Many foundational species, like marine mussels, form dense aggregations that potentially affect patterns of water flow. Quantifying flows inside the complex shapes associated with mussel beds has proven difficult as many techniques require a clear line of sight (e.g., acoustic doppler velocimetry; particle image velocimetry). Others are inappropriate for use in the small interstitial spaces between mussels (e.g., Plaster of Paris; electromagnetic current meters, tilt sensors). Presently, there is need to accurately quantify flows within aggregations of benthic marine organisms. Here, we present a field-deployable flow sensor based on 3D-printed mussels fitted with pressure sensors. Lab testing demonstrated that the sensors are accurate over a range of ecologically-relevant velocities. We also report results of a field-deployment that characterized natural flows present inside a *Mytilus californianus* mussel bed.

11 - TRACKING THE RECOVERY OF *PISASTER ORCHAROUS* THROUGH SPATIAL VARIATION IN ABUNDANCE OF ACROSS THE MONTEREY PENINSULA POST SEA STAR WASTING

Staton, M.*; Siegel, P.; Haupt, A.

CSU Monterey Bay

The Ochre Sea Star (*Pisaster Orchraceus*) is an important keystone species in the rocky intertidal that controls invertebrate populations including barnacles, snails, lipids, chitons, urchins, and mussels.Starting in 2013, Sea Star Wasting Disease (SSWD) decimated sea star populations along the west coast of North America Ochre Sea Star populations in Monterey Bay have begun to recover slowly with high spatial variation in recovery. We assessed spatial variation in abundance of sea stars across the Monterey Peninsula post SSWD to understand population recovery and variation in recovery. To measure abundance, we conducted timed searches, measuring size and recording health, at select sites along the Monterey Peninsula including: Point Pinos, Canary Row, Hopkins Marine Lab, China Rock, Pescadero, Carmel Point, Point Lobos, and Soberanes. There was a significant difference in the amount of *Pisaster Ochraceus* found per hour around the Monterey Peninsula. Sites Cannery Row and Soberaneas had significantly more than any other site. There was also a significant difference in *Pisaster Ochraceus* found per hour in areas of low human visitation and high human visitation, with low human visitation sites having much higher numbers of *Pisaster Orchraceus* per hour.

12 - DOES SWIM BLADDER MORPHOLOGY REFLECT THE RESPONSES OF NEARSHORE ROCKFISHES TO BAROTRAUMA?

† Alvino, M.K.*; Starr, R.M.; Hamilton, S.L.

Moss Landing Marine Labs

All rockfishes (*Sebastes* spp.) have physoclistous (closed) swim bladders that quickly expand with rapid changes in pressure, which occurs when fish are caught and reeled to the surface. Interestingly, some species of rockfish are more sensitive to pressure-related injuries (barotrauma) than others. Despite observable differences in barotrauma among rockfishes, the causes of these variations are not well known. We evaluated the importance of habitat occupied (benthic vs. semi-pelagic water column) and total body length as causes for the interspecific variation in barotrauma. We used hook and line fishing techniques and placed captured fish in portable hyperbaric chambers, then created a standardized recompression and decompression process for four nearshore rockfishes. After fish equilibrated to surface pressure, we measured the membrane thickness, tearing threshold, venous properties, and tensile stress of their swim bladders. Swim bladders of benthic Vermilion rockfish had significantly higher tearing thresholds and membrane thicknesses; swim bladder from semi-pelagic Blue rockfish displayed significantly lower tensile stress than the other species. These results suggest that semi-pelagic species, which suffer fewer barotraumatic injuries, are more efficient at off-gassing and therefore more resilient to changes in pressure than benthic rockfishes. By connecting swim bladder morphology and pressure-related injuries, my research will aid fishery management by more accurately predicting mortality rates related to barotrauma, potentially enhancing rockfish conservation.

13 - SUBMARINE GROUNDWATER DISCHARGE NUTRIENT DELIVERY EFFECTS ON COASTAL PRIMARY PRODUCTIVITY ON CORAL REEFS IN MAUNALUA BAY, HAWAI'I

Zummo, S.G.*; La Valle, F.F.

Pepperdine University

Maunalua Bay (O'ahu, HI) has experienced dramatic development and population increase in the last 100 years, affecting the water quality in the near shore coral reefs of the bay. The main source of land-based inorganic nutrients in Maunalua Bay is submarine groundwater discharge (SGD) which is a chronic freshwater vector. The goal of this project was to characterize the nearshore localized nutrient inputs via SGD both spatially and temporally in areas of special biological significance and understand how the delivery of these nutrients across the water column and benthos affects these systems. Benthic chamber experiments (n=12) were conducted in June, 2022 to quantify *in situ* C-uptake of three algal species (*Acanthophora spicifera, Bryopsis pennata, Pterocladiella* sp.) and phytoplankton on an algal-dominated reef with SGD. Our understanding of the role of invasive macroalgae on this reef in terms of contribution to productivity and proliferation was furthered from this study. *Pterocladiella*, the only native species, had the smallest C-uptake rate (mean C-uptake rate = 0.00105 mg C g dw $^{-1}$ h ^{1}) while *Bryopsis* had the largest C-uptake rate (mean C-uptake rate = 0.00771 mg C g dw^{-1} h ^{1}). *Acanthophora* had a mean C-uptake rate of 0.00428 mg C g dw^{-1} h ^{1}. Our results show that there is a trade-off between nutrient availability and salinity tolerance for reef primary producers. We believe this creates an environment that is advantageous for invasive algae. This work can be expanded to other tropical and high island coastal regions with SGD input into their nearshore ecosystems.

14 - DOES MICROHABITAT ELEVATION PLAY A ROLE IN EMBRYONIC STRESS RESPONSE IN THE PORCELAIN CRAB PETROLISTHES CINCTIPES?

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San Francisco State University

Climate change is increasing the frequency of heat waves and environmental stress for marine ectotherms. Previous studies have demonstrated significant variation in physiological responses to stress in broods of embryos of the porcelain crab *Petrolisthes cinctipes*. *P. cinctipes* live underneath rocks in the middle-upper intertidal zone. Crabs living higher on the shore experience greater thermal fluctuations and higher extreme temperatures during heat waves. I hypothesized that the elevation at which embryos are reared will influence their thermal stress tolerance. I predicted that embryos reared at higher elevations are more tolerant of heat stress given the higher thermal extremes experienced at higher elevations. I tested my hypothesis by subjecting n=12 embryos from each of n=8 mothers from higher or lower elevations to heat shock (1h @ 30°C). Control groups were kept at a constant 15°C. Yolk consumption, respiration rates, survival, and hatching success were measured as stress response variables. Embryos were imaged by microscopy and respiration rates were measured using OxNano fluorescence. Heat shocked

groups displayed 1.1 to 2% higher median and maximum yolk consumption rates compared to control groups. Unexpectedly, higher elevation embryos displayed more variation in yolk consumption rates than lower elevation embryos in response to heat shock. Understanding the source of thermal tolerance in certain broods of *P. cinctipes* will enhance our knowledge of an organism's capacity to overcome ever increasing thermal stress induced by climate change and heat waves.

15 - A MORPHOMETRIC ANALYSIS AND AGE CLASS ESTIMATION OF CALIFORNIA SEA LIONS (ZALOPHUS CALIFORNIANUS)

† Perez, S.A.[*]; Gurrola, D.M.; Hernandez-Gomez, O.

Dominican University of California

Skull morphometry of 427 California sea lion (Zalophus californianus) skulls from California Academy of Sciences (CAS) Ray Bandar's collection were examined. Four cranial measurements of each skull were obtained utilizing calipers. These four measurements included lateral total length (LTL), mandible length (ML), maximum width (MW), and total height (TH). Due to the difficulty of aging decomposing animals, several missing or unknown parameters were found during data collection. Limited skeletal remains, exposure to the elements, and lack of reference or stranding data may have also caused skull or total body length estimations to be missing or inaccurate. The purpose of this study was to correlate total body length to the four individual skull measurements. These measurements can then be used to create an age categorization chart to estimate age classes, similar to using total body length (Laake et al., 2016). In order to go about creating an age categorization table, we used Principal Component Analysis, (PCA), which reduces the dimensionality of large datasets. A linear regression model was used to correlate sex to total body length, in doing so we found that PC1 is different between males and females; it changes in relation to body length and is statistically significant ($p < 0.05$). It was concluded that LTL, ML, MW, and TH were also different between males and females; they change in relation to body length ($p < 0.05$). Since a positive correlation was found between individual skull measurements and total body length, it can be concluded that the chart created using PCA can be used to classify most age classes.

16 - AN ASSESSMENT AND CLASSIFICATION OF MATING SCARS ON FEMALE WHITE SHARKS IN THE NORTHEASTERN PACIFIC

Walter, A.[1*]; Yee, K.[2]; Anderson, S.D.[3]; Andrzejaczek, S.[4]; Block, B.A.[4]; Chapple, T.K.[4,5]; DiGiacomo, A.[4]; Kanive, P.E.[3,6]; Jorgensen, S.[1]

1- CSU Monterey Bay 2- CSU San Jose 3- California White Shark Project 4- Hopkins Marine Station, Stanford University 5- Oregon State University 6- Montana State University

White sharks (*Carcharodon carcharias*) are one of the most studied shark species, yet their elusive mating behavior has long perplexed researchers. Valuable insights into white shark mating habits can be gained from courtship-induced mating scars, which have yet to be properly classified in published literature. This project aims to quantify and define white shark mating scars, and infer where mating events may be occuring. Scar classifications were determined by an extensive literature review, shark encounter video data, and expert consultation. Video data has been collected by a consortium of researchers in central California since 2006 from Point Reyes, Ano Nuevo Island, the greater Farallon Islands, and Monterey Bay. Video clips were analyzed by multiple students to score scar types, color, and body locations. To overcome uncertainty in scar classification, we used Python and sql to create a database and to tally votes and confidence measures from multiple students resulting in consensus scar scores. This form of 'crowdsourcing' increases accuracy of classifications by non-expert researchers.

17 - VIDEO PROTOCOL APPLYING THE GREEN GRAVEL TECHNIQUE FOR GIANT KELP RESTORATION

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1- UC Irvine 2- UC Santa Cruz 3- University Autónoma de Baja California 4- The Nature Conservancy

Canopy-forming kelps are foundational species that support biodiversity and provide ecosystem services valued at over USD$500 billion per year. Forests of giant kelp, *Macrocystis pyrifera*, are facing unprecedented loss due to climate and anthropogenic stressors, necessitating the development of cost-effective, innovative, and accessible restoration strategies. Here, we present a video protocol illustrating the 'green gravel' approach to giant kelp restoration, including the collection, sporulation, inoculation, rearing, and maintenance of giant kelp. In this three-step approach, (1) reproductive adult kelps are collected from the field and used to create a spore solution; (2) kelp are reared on a substrate such as gravel under laboratory conditions; (3) gravel with visible sporophyte growth are deployed in the area to be restored. The presented protocol simplifies, centralizes, and democratizes existing practices in this field of restoration to facilitate conservation objectives for underwater kelp forests by researchers, managers and stakeholders.

18 - GIANT SEA BASS, STEREOLEPIS GIGAS, POPULATION TRENDS ALONG SOUTHERN CALIFORNIA

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The giant sea bass, *Stereolepis gigas*, is the largest marine teleost found along the California coast and is an important apex predator in kelp forest and rocky reef ecosystems. Due to their slow growing nature and annual aggregative predictability, they were nearly fished to extinction throughout their entire range: Humboldt Bay to Baja California, Mexico. Now listed as critically endangered by the International Union for the Conservation of Nature (IUCN) and protected by a fishing moratorium in California, it is believed the giant sea bass (GSB) population is recovering. However, there has been no direct population assessment of their numbers in California. Through collecting community-sourced photos of GSB via the Spotting Giant Sea Bass Project (https://spottinggiantseabass.msi.ucsb.edu/ (https://spottinggiantseabass.msi.ucsb.edu/)), we have been able to identify unique individuals through their spot pattern using machine learning algorithms, as GSB have idiosyncratic markings on their flanks. To date, we have identified 560 left side individuals and 529 right side individuals out of 1543 verified GSB encounters from 110 community scientists. Through capture- mark-recapture population models, the GSB population is

exhibiting signs of recovery in Southern California. Assessing GSB population trends allows for implemented more informed conservation management strategies. These efforts may further help the recovery of GSB thus increasing population resiliency, ecosystem function, and improving local ecotourism as GSB are valued at $2.3 million to recreational divers annually.

19 - THE RESPONSE OF *ANTHOPLEURA* ANEMONES TO EXTREME HEAT STRESS

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As the frequency and severity of extreme weather events increases due to global climate change, the ability to predict which organisms can withstand unprecedented environmental variability is critical to our understanding of global biodiversity loss. The intertidal zone is a highly variable environment where organisms experience both terrestrial and marine stressors, including fluctuating temperature, light, and humidity levels. Understanding which intertidal organisms are sensitive to environmental extremes and variability allows us to predict the “winners” and “losers” of climate change and how our shorelines will change as global climate warming progresses. Following the heat dome of 2021 that ravaged the Pacific Northwest and killed more than one billion marine animals, some surviving organisms showed novel or previously undescribed responses; this includes a cluster of aggregating anemones (sp. *Anthopleura elegantissima*), normally a dark green colour, that had turned orange with internal tissue extruding from the oral disk. As aggregating anemones are abundant in the intertidal zone and host symbiotic algae that contribute significantly to primary productivity, investigating this species’ response to heat stress improves our understanding of temperate cnidarians and how both host and symbiont might resist rising temperatures.This study establishes the upper thermal limit of aggregating anemones to better understand their response to extreme weather events. Using a LT50 survival experiment combined with two desiccation treatments, we determined whether desiccation acts as a buffer against or a secondary stressor in combination with extreme temperature. We also tracked the internal body temperature of anemones throughout each treatment to assess how they might buffer against changes in environmental temperature.

20 - INVESTIGATING MUTUAL INTERACTIONS IN CORAL-SEAWEED COCULTURES

† Hernandez, C.[1]; CSU Monterey Bay)[*,1*]; Roberson, L.[2]

1- affiliation not listed 2- Woods Hole Oceanographic Inst.

Coral reefs are facing significant threats from bleaching and climate change, highlighting the urgent need for research focused on their resilience. Algae, particularly red seaweed, have been identified as potential allies in supporting coral health and mitigating stressors such as excess nutrients and acidification. This research project aims to investigate the influence of co-cultivation on the growth and health of corals, specifically *Astrangia poculata* and *Acropora yongei*, in conjunction with red seaweeds *Eucheuma isiforme* and *Gracilaria mammillaris* . The experimental approach entails quantifying the growth rates of both corals and algae while closely monitoring water quality parameters. Additionally, photosynthetic efficiency will be assessed using pulse amplitude modulation (PAM) measurements. By studying the dynamics of coral-seaweed interactions, valuable insights were gained, potentially uncovering synergistic effects that can support the coral health. The findings from this study are anticipated to contribute not only to co-culture systems but also to a broader understanding of coral biology and ecological dynamics. Moreover, this research aims to enhance the resilience and sustainability of coral reef ecosystems by providing innovative approaches for promoting coral health and productivity.

21 - EXPANDING AN INTERNATIONAL FUNCTIONAL TRAIT DATABASE (“TRAITABASE”) FOR INTERTIDAL SEAWEEDS

Hall, H.[1*]; Griffin, J.[2]; Arenas, F.[3]; Mauffery, A.[2]; Cappelatti, L.[2]; Dolbeth, M.[3]; Fairchild, T.[2]; Fales, R.J.[1]; Parks, M.[2]; Martins, M.[3]; Zawadzka, M.[2]; Bracken, M.E.S.[1]

1- UC Irvine 2- Swansea University, UK 3- CIIMAR

An ecosystem containing multiple populations that play similar ecological roles may be better equipped to withstand disturbances. This link between functional redundancy and community resilience has been long established. However, this relationship has been comparatively understudied in nearshore marine ecosystems. Our goal is to use a functional trait framework to begin filling this knowledge gap, particularly in the context of intertidal seaweeds which play a crucial role in habitat formation. We are completing an in-depth functional trait analysis on intertidal seaweed communities spanning oceans and environmental gradients throughout California (USA), southern United Kingdom, and northern Portugal. The trait screening includes structural and compositional measurements related to competitive ability and resource capture. Structural measurements include thallus dry matter content, frond thickness, and carbon internal tissue content. Traits associated with resource acquisition include pneumatocyst presence, mass-specific surface area, and the surface-area-to-volume ratio. We are quantifying light absorption competition and space use by measuring maximum length and aspect ratio. Additionally, we are assessing resource retention by quantifying the surface-area-to-perimeter ratio and branching order, as these traits relate to breakage and resistance to water movement and herbivory. Once complete, we will compile our data into a single trait database (i.e., “traitabase”) which will be made available to the scientific community for use in future ecological research.

22 - DON’T FORGET THE SCIENTIFIC COLLECTING PERMIT

Slatoff, L.[*]

California Dept. of Fish and Wildlife

Every year, a wide range of fascinating scientific projects occur in California’s coastal marine waters. Projects include innovative alternative energy research, species behavior, climate change impacts on ecosystems, and more. As the trustee agency for California’s natural resources, the California Department of Fish and Wildlife (CDFW) aims to balance such projects with conservation of marine resources. This is accomplished with a scientific collecting permit (SCP) issued by CDFW to allow take and/or possession of live and dead wildlife for education, research, or propagation purposes. Applying for, and the issuance of these permits, helps both researchers and CDFW responsibly monitor and protect

California's marine resources. An average of 183 applications are submitted each year. Statewide 98% of permits are approved but the process towards getting a permit approved can be confusing for applicants. This poster will provide a cursory explanation of the review process which will help new and former applicants develop a better understanding of the need and purpose of SCPs. Knowing what CDFW looks for during the review process can help people know what information is needed and minimize the turnaround time. Researchers and students will walk away from the poster with the information needed to submit a successful SCP application.

23 - KELP VS SURFGRASS: WHO'S UNDER THE CANOPY? COMPARING INVERTEBRATE COMMUNITIES

Green, J.T.*; Zuelow, A.N.; Henkel, S.K.

Oregon State University

Kelps and seagrasses are foundation species that form overhead canopies in the intertidal, alleviating the stressors of low tide exposure such as UV, desiccation, and high temperatures for understory communities. *Phyllospadix* sp. (Surf Grass) and *Egregia menziesii* (Feather Boa Kelp), are co-occurring canopy formers on the U.S. west coast. Long term data from MARINe/PISCO show these two species have inverse trends in abundance at some Oregon sites. The objective of our research is to examine the impact each of these macrophyte species has on the invertebrate understory community. We established long term observation plots at four sites along the Oregon coast based on their high cover of both *Phyllospadix* and *Egregia*. At each site, 18-36 (0.25 m^2) plots were placed across 2-3 transects depending on availability of the target species. Percent cover/counts of all algae and invertebrate species were recorded in *Egregia*-only, *Phyllospadix*-only and Mixed plots. We hypothesized that *Phyllospadix* would accommodate lower species richness than *Egregia* due to its attenuated canopy structure. Preliminary data suggest there are no significant differences between *Egregia*, *Phyllospadix* or Mixed plots of the sessile and mobile invertebrate understory communities. One of our sites, Boiler Bay, had substantially more mobile invertebrates than any of the other sites making Site a significant factor for the community measurements. A subset of plots in this study have been manipulated by shearing or clearing so future data collection will provide more insight into the relationships between invertebrates and canopy-forming macrophytes.

24 - COASTAL CONNECTIVITY AND CALIFORNIA'S COYOTES

† Zilz, Z.L.*; Copeland, S.; Braman, C.A.; Lewin, G.B.; Young, H.S.

UC Santa Barbara

On the coast of California, coyotes are frequent visitors to the intertidal zone, consuming a wide range of marine-derived food items. However, human infrastructure and activity may disrupt coyote's ability and willingness to access coastal habitats and resources, fracturing a potentially important resource subsidy. Project ECOTONE (Energetic Connectivity of Terrestrial and Oceanic Nearshore Ecosystems) was developed to understand the role of anthropogenic disturbance in the movement of marine-to-terrestrial resource subsidies on the California coast, with emphasis on mammalian mesocarnivores. Camera trap footage from remote coastal habitats on the Nature Conservancy's Jack and Laura Dangermond Preserve and Vandenberg Space Force Base indicate that coastal coyotes could contribute significant subsidies to nearshore coastal sage scrub habitat due to their consistent foraging on marine food items (e.g. mollusks, crustaceans, fish, and pinnipeds). We present a basic habitat connectivity model for the remote southern California coast, as well as coyote foraging data (scat and camera trap images) collected thus far. We intend for this data to contribute to an expanding repertoire of research on habitat connectivity in the hopes that we can promote the conservation of the last remaining intact coastal habitat in Southern California.

25 - A GRAPH-THEORETIC ANALYSIS OF ECOSYSTEM DYNAMICS DURING SARDINE VS. ANCHOVY REGIMES

† Miron, L.R.*; Palacios, S.L.

CSU Monterey Bay

Graph theory- a field of mathematics dedicated to studying abstract representations of relationships between things- offers a versatile approach to ecological modeling. The Pacific Decadal Oscillation (PDO) describes the variability of ocean and atmospheric conditions that occur across the North Pacific Ocean basin. Each "warm" and "cool" phase of the PDO corresponds with ecosystem restructuring, characterized as the "sardine regime" and "anchovy regime." Our objectives are to use a novel application of graph theory to better understand potential drivers of PDO regime shifts, and also to determine the relevance of our methods to other complex systems. To create our graph models, we visually translate the interactions between North Pacific biophysical ecosystem components into analyzable networks. We hope to identify key points of ecosystem connectivity by evaluating the structures of each graph, and to assess similarities in ecosystem dynamics by conducting structural comparisons between graphs. Results of these analyses can inform how to further investigate the phenomenon, and our graph models can provide a basis to support future research; the adaptability of graph theory allows many options for incorporating additional properties and parameters into graphs. Our current progress on this project includes drafted models of the California Current Ecosystem during each PDO phase. We are refining our techniques before constructing comparable models of other regions.

26 - COMPARISON OF EELGRASS POPULATION ORIGIN AND GENOMIC VARIATION USING 3RAD.

† Paguio, K.*; Pantiga, T.; Chu, A.; Cohen, C.S.

San Francisco State University

Eelgrass, *Zostera marina*, is a coastal foundation species that provides environmental benefits such as blue carbon storage and wave attenuation. Conservation initiatives for these ecologically important species could benefit by understanding genetic diversity, structure, and connectivity between urbanized/anthropogenically influenced sites, such as those from San Francisco Bay, and those less impacted, such as those from Point Reyes National Seashore (PRNS). We used genome-wide triple restriction-enzyme associated DNA (3RAD) sequencing to compare samples from central California within San Francisco Bay (3 sites), outside the bay in PRNS (2 sites), and two outlier locations in Washington state. We extracted DNA using a liquid nitrogen and CTAB protocol, then quantified and evaluated the quality of the DNA using gel electrophoresis and Qubit measures. Next, samples were normalized via DNA precipitation to a concentration of 20ng/uL. Finally, we performed

the 3RAD protocol to create individual libraries to be sequenced. This was done in a genetics workshop, RADCamp2023, at Columbia University, New York, where participants did additional benchwork as well as bioinformatic analysis of RAD data. This process selectively sequenced the genomes of our samples and we compared genetic diversity across sites. We found that samples from geographically distant beds showed greater genetic differentiation with distance. Distinction across regions is evident, while individual sites within a region show mixing. We infer that genetic distance increases with geographic distance at the regional scale due to limited gene flow.

27 - HOW ARE HAPLOTYPE, SYMBIONT COMMUNITY, AND GENE EXPRESSION PROFILES RELATED TO GALÁPAGOS POCILLOPORID HEAT AND COLD TOLERANCES?

† Giamberton, K.R.[1,2*]; Brandt, M.[3]; Logan, C.A.[1]

1- CSU Monterey Bay 2- Moss Landing Marine Labs 3- University San Francisco de Quito

Mass coral bleaching and mortality events jeopardize the persistence of coral reefs worldwide. Galápagos corals experience a wide range of temperatures and inhabit marginal conditions compared to other tropical reefs. The stress tolerance of corals remaining after recent warm- and cold-water bleaching events in the archipelago may be the product of adaptation and acclimatization. In the spring of 2019, we investigated thermal tolerance differences in *Pocillopora* sp., a widespread reef-building coral in the Indo-Pacific found throughout the Galápagos. We unexpectedly found that corals from northern sites–which experience warmer and less variable annual average temperatures–were more resilient than those from central and southern sites, having both greater heat and cold tolerances. In this study, we sequenced the mitochondrial open reading frame (ORF) to determine *Pocillopora* haplotype, amplified actin using quantitative PCR to determine symbiont type, and used Tag-Seq to explore gene expression patterns in our samples. We aim to understand how these variables correlate with heat and cold tolerance. Preliminary results suggest that the thermally tolerant symbiont *Durisdinium* is absent from most central and southern sites, and a thermally tolerant Pocillopora ORF haplotype (type 1) exists in far northern and most central southeastern communities, possibly explaining differences in thermal tolerance across regions. Our results can provide insight into the adaptive potential of reefs worldwide as they endure warm and cold stress events.

28 - LONG-TERM INTERTIDAL COMMUNITY CHANGE FOLLOWING MASS MORTALITY OF A KEYSTONE MARINE PREDATOR

Chapuis, M.[1*]; McDevitt-Irwin, J.M.[1,2]; Palmisciano, M.[1]; Detrait, A.[3]; Gorum, O.[4]; Vogel, C.[5]; Elahi, R.[1]; Haupt, A.[6]; Micheli, F.[1]

1- Stanford University 2- UC Santa Barbara 3- Ecole Polytechnique 4- University of Southern California 5- University of Virginia 6- CSU Monterey Bay

Habitat-forming species (e.g. corals, plants, mussels) play important roles ecologically, economically, and culturally by structuring biodiversity and overall ecosystem function. However, especially in marine coastal ecosystems, they are threatened by a variety of local and global stressors (e.g., global climate change, fishing pressure, pollution). We evaluated the relative roles and combined effects of biotic (predation, i.e., whelk and seastar density) and abiotic drivers (i.e., temperature, wave height) on the long-term dynamics of habitat-forming mussel beds at the rocky intertidal sites in Monterey Bay (Hopkins Marine Station), California. We found that *Mytilus californianus* mussel cover has been increasing since 2014, following a seastar mass mortality event in 2013 from Seastar Wasting Disease, and that the lower limit of mussel beds has been shifting to lower tidal heights, supporting the hypothesized mussel expansion from decreased predation. However, long-term monitoring of the *Pisaster ochraceus* population shows that seastar abundance has been declining since long before 2013. It is thus likely that changes in mussel abundance and distribution are driven by a combination of factors, such as recruitment variability and extreme events in addition to decreased predation pressure. As more mass mortality and extreme weather events are expected under warming conditions in the coming decades, research addressing the impact of multiple stressors on intertidal communities can inform predictions about how these communities, and their functioning and services, will change.

29 - MONITORING WASTEWATER CONTAMINATION IN THE MARINE ENVIRONMENT: FROM TISSUE TO ECOSYSTEM

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UC Irvine

Wastewater is a pervasive contaminant of coastal ecosystems that threatens marine and human health. The dynamic constituents of wastewater complicate *in situ* monitoring. Wastewater contamination is commonly measured using bacteria of the genus *Enterococcus*, although several studies indicate levels may not necessarily correlate with environmentally relevant contaminants. Here, we conducted an analysis of publications examining long-term wastewater monitoring in marine environments, beginning with a literature search returning over 53,000 articles related to wastewater in the marine environment. We present a framework for considering ecologically-relevant indicators of wastewater contamination in the marine environment. We consider the biological, methodological, and societal relevance of indicators at each ecological level from tissue to ecosystem. We emphasize the importance of minimally disruptive methods such as count surveys and tissue analyses of invasive species in the evaluation of wastewater contamination over a period of time. Novel methods, for example behavioral changes in native species, can additionally provide insights into wastewater contamination, though these tend to be delayed indicators. We suggest that researchers examining wastewater pollution in the marine environment prioritize relevant, minimally damaging indicators at the appropriate ecological level.

30 - FISH ASSEMBLAGES ON SOUTHERN CALIFORNIA ARTIFICIAL REEFS QUANTIFIED USING REMOTELY OPERATED VEHICLE STEREO VIDEO

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Cal Poly, Pomona

Artificial reefs (ARs) have been used for thousands of years for economic and fishing benefits. In southern California ARs were historically constructed to increase recreational fishing opportunities, and more recently as habitat restoration and mitigation solutions. Marine infrastructure from harbor construction (e.g., breakwaters) and offshore energy development (e.g., offshore oil platforms, offshore wind) can also change the

distribution and abundance of local marine habitats and species via the introduction of artificial hard substrate. Decision makers must therefore understand how to evaluate and manage projects that add significant amounts of hard substrate into the marine environment, and how to potentially incorporate them into an artificial reef management program. We will assess how construction material and habitat characteristics (e.g., vertical relief, BPI, rugosity) affect the associated fish assemblages across the Bolsa Chica AR complex. Bolsa Chica reef modules vary greatly in size, complexity, and material type. The physical characteristics of the reef complex were quantified by analyzing geophysical (bathymetry and acoustic backscatter) data collected by the Vantuna Research Group at Occidental College with a Multi-Phase Echo Sounder. Fish assemblages will be quantified by a remotely operated vehicle (ROV) with a stereo video camera system. Video data will be processed using EventMeasure software. The results will be used to improve decision making related to marine infrastructure and artificial reefs, support an environmental review, and contribute to The California Department of Fish and Wildlife's process of developing and updating their AR assessment and management plan.

31 - UNDERSTANDING VARIABILITY OF MICROPLASTIC ABUNDANCE IN RELATION TO EELGRASS (*ZOSTERA MARINA*) HABITATS IN MORRO BAY

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Cal Poly, San Luis Obispo

Microplastics (fragments or fibers of plastic that are smaller than 5mm) are an emerging environmental threat. Understanding the distribution of microplastics in the environment is an important issue due to the damage they inflict to marine organisms and humans. Adams Lab at Cal Poly San Luis Obispo has identified microplastics in the sediments of Morro Bay, CA. Zhao et al. (2022) observed that epiphytic bacteria on the surface of eelgrass increased the sedimentation process of microplastics. In recent years, eelgrass (*Zostera pacifica*) has been on the rebound in Morro Bay and could have an impact on the retention of microplastic in the Bay. Therefore, we examined whether there is a difference in the concentration of microplastics in sediments between open beach and eelgrass bed habitats to determine whether eelgrass influences microplastic sedimentation in Morro Bay. We collected sediment samples from September 2022 through February 2023. We processed these samples in lab to extract the microplastics using KOH and density separation. We counted microplastics by staining samples to differentiate organic material from plastics. There was no significant difference in microplastic concentrations between the habitats of open beach (0.045±0.031) and eelgrass (0.044±v0.039)($p=0.545$). We speculate that this is due to the proximity of these habitats and the closed nature of Morro Bay. However, there was a significant difference ($p<0.0001$) in the overall concentration of microplastics among months, perhaps due to the intense storms in California during the winter 2023 season.

32 - LIVER GLYCOGEN AS A SENSITIVE INDICATOR OF FOOD LIMITATION IN DELTA SMELT

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1- UC Davis 2- CSU Northridge 3- U.S. Fish and Wildlife Services 4- California Dept. of Fish and Wildlife

Assessing habitat quality is a major goal of conservationists and restoration practitioners, but to associate habitat quality with biomarkers of vagile animals, the biomarkers must respond rapidly. Here we identified a biomarker capable of rapidly detecting food limitation in the imperiled Delta Smelt (*Hypomesus transpacificus*), a pelagic fish endemic to the San Francisco Estuary (SFE). We conducted an experiment with fed and unfed treatments of hatchery-raised, sub-adult Delta Smelt that were sampled at 12 time points: 0, 1, 2, 3, 4, 5, 6, 7, 9, 11, 14, and 21 days. We then compared four biomarkers using Day 21 fish: RNA/DNA in liver, triglycerides in liver, glycogen in liver, and glycogen in muscle. Of the liver endpoints, glycogen had the largest difference between treatments at Day 21, so we compared it to muscle glycogen across all time points. Liver glycogen declined by 60% after one day of fasting and remained depressed in the fasting treatment across all subsequent time points. Muscle glycogen also responded rapidly, taking only two days to decline by 39% in the fasting treatment, but the difference was inconsistent across subsequent time points. When applied to hatchery-released Delta Smelt collected from the SFE, liver glycogen concentrations were less than half that of the fed hatchery fish, consistent with the hypothesis of food limitation in the wild, but also several other potential causes. This study highlights the utility of liver glycogen as an indicator of recent foraging success in Delta Smelt.

33 - WHO'S KNOCKING? GRAY WHALE ACOUSTIC DETECTION ALONG CALIFORNIA'S CENTRAL COAST

† Short, S.M.[*]; Wilkin, A.; Orlando, I.; Nosbisch, L.; Schroth-Glanz, M.; Liwanag, H.

Cal Poly, San Luis Obispo

Passive acoustic monitoring (PAM) efforts are essential to marine mammal conservation. Bioacoustic techniques can be preferred as visual surveys are time intensive, costly, and limiting. California's coastline is a biodiversity hotspot and a known migration corridor of multiple cetacean species, including gray whales, according to stock assessments provided by NOAA. Certain studies have indicated that gray whales vocalize during migration which can help confirm cetacean presence throughout the year.Off the coast of San Luis Obispo, California in an area that overlaps with the gray whale's southern migration, our team detected an unidentified knocking noise. Although gray whale vocalizations can be difficult to confirm, we believe these knocks are produced by this transient species. In order to determine the source of these knocking sounds, the goals of this project are to (1) classify the repetitive noise as biotic or abiotic, (2) perform a comparative analysis of various species to narrow down possible biotic candidates, (3) utilize records from local whale watching companies for more accurate evidence of species presence at the time of our deployment, and (4) examine temporal variation in the occurrence of this knocking sound. Acoustic monitoring provides information about migration of gray whales necessary for conservation efforts.

34 - EXTENT OF SEDIMENT BURIAL IN NATIVE, OSTREA LURIDA, AND NON-NATIVE, MAGALLANA GIGAS, OYSTER POPULATIONS IN SOUTHERN CALIFORNIA, USA

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1- CSU Fullerton 2- Santiago Canyon College

The Olympia oyster (*Ostrea lurida*) is the only oyster native to North America's west coast but it lives alongside the Pacific oyster (*Magallana gigas*) which is native to Japan but was introduced and has increased in population density in Southern California over the past decade. Oyster reef persistence relies on oyster growth, which must outpace reef degradation and oyster burial due to sediment deposition. Exact tolerances to burial and the extent of oyster burial in soft sediment habitats are unknown for both oyster species. To build an understanding of the extent of sediment burial, we completed surveys at Pacific Coast Highway (PCH), Newport Bay, and Kellogg Beach, San Diego Bay, CA. At each site, random quadrats (0.5m x 0.5m) were surveyed for both oyster species; we recorded the extent of burial of each individual oyster and analyzed the effects of species and site on the % of each population that were buried and the average extent of burial per individual shell using 2-way ANOVA. More oysters were buried at Kellogg Beach (23-27% of the population) compared to PCH (3-13%). Among buried individuals, *O. lurida* was buried more deeply than *M. gigas* at Kellogg Beach (65% of shell length buried compared to 41%) and compared to O. lurida (38%) at PCH. This investigation provides a conceptual framework about the extent of sedimentation in native and non-native oyster populations and improves the likelihood of success in restoring native oyster populations.

35 - USING A MICROPLATE RESPIROMETRY SYSTEM TO IDENTIFY THE TRIGGER TO CORAL BLEACHING IN POCILLOPORA DAMICORNIS

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1- CSU Monterey Bay 2- Hopkins Marine Station, Stanford University

Thermal stress from marine heat waves cause a disturbance in the mutualistic symbiosis of cnidarian species and their photosynthetic symbionts, including reduction in oxygen production. This heat disturbance also results in the loss of symbionts from the host tissue in coral reefs, which is known as coral bleaching. Yet, little is known on the relationship between oxygen production and coral bleaching. The purpose of our study is to examine the oxygen production rates and bleaching scores of the scleractinian coral, Pocillopora damicornis, under elevated temperatures as a means to identify symbiosis failure. We hypothesize that oxygen production stops and coral bleaching occurs under the same conditions of temperature for P. damicornis. Corals were exposed to a single 4 hr pulse of elevated temperatures and were monitored for oxygen production immediately after stress was relaxed with a microplate respirometry system. Monitoring continued over a span of 5 days. Bleaching was scored on a visual coral bleaching scale of 1 (normally pigmented) to 5 (bleached). Our data show that photosynthesis rate declines after an exposure to 34 to 38 ˚C, and virtually halts at temperatures of 36˚C. Yet at 36°C, bleaching did not occur, and pigmentation was still present 5 days later. Thus, a heat-induced collapse in photosynthesis by itself does not immediately cause bleaching. Knowing the trigger to symbiosis failure can help researchers know how to prevent and treat affected corals from bleaching, which will enhance our understanding on the coral-algal symbiosis relationship.

36 - INTRASPECIFIC COMPETITION AS AN AGENT OF MORPHOLOGICAL SELECTION IN A LIKELY METAPOPULATION

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Towson University

Understanding mechanisms that shape diversity within species is a major goal of evolutionary biology. High levels of variation are often found within species, even for traits which appear to be under strong selection. For example, hermit-crab encrusting Hydractiniid hydroids on the US Atlantic Coast maintain a range of colony forms (e.g., runner-like or sheet-like) despite observational and experimental evidence that runner-like colonies are better intraspecific competitors. We expect the spatial structuring of populations, which allows for populations to evolve semi-independently, is an important factor in maintaining intraspecific diversity. However, the spatial scale at which populations are genetically isolated and the interplay between regional geneflow and local selection remain unclear in Hydractinia species. To address this gap, we used H. symbiolongicarpus that occur in the complex marsh and barrier island system on the Eastern Shore of Virginia to retest the hypothesis that site-level population density is correlated with a shift toward runner-like morphotypes. Our ten study sites varied in population density, but also occurred across a gradient of expected gene flow allowing us to test the contribution of both factors to the distribution of colony morphology. Preliminary analyses supported a correlation between morphology and local density, but we found variation within and among regions that was not explained by either population density or site proximity. Thus, we may need additional factors to explain morphological diversity in this species.

37 - EXAMINING HEALTH IN VALLEY GARTER SNAKES (THAMNOPHIS SIRTALIS FITCHI) ON STATEN ISLAND, CALIFORNIA

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UC Santa Cruz

As semi-aquatic predators, valley garter snakes (Thamnophis sirtalis fitchi) play a pivotal role in regulating prey populations and bridging the gap between terrestrial and aquatic food webs. Their importance in maintaining the ecological balance as both predator and prey warrants study on the health of these obligate carnivores. Situated within the Sacramento-San Joaquin River Delta, Staten Island California offers a unique opportunity to assess their health in an ecologically and economically important ecosystem. Through fieldwork utilizing modified minnow traps and rigorous examinations, we identified cysts and nasal crusting in a subset of captured snakes, symptoms reminiscent of Snake Fungal Disease. We conducted an analysis of the prevalence and implications of cysts. Employing figures that illustrate symptom prevalence and factors that may affect symptom prevalence, we hope to shed light on potential links between infected individuals and a potential cause. Comparisons with parasitic, fungal, viral, and bacterial diseases affecting the Thamnophis genus were undertaken to discern the specific nature of observed symptoms. The study underscores the need for comprehensive testing, diagnostic assessments, and pathological examinations. Moreover, our results emphasize the necessity of ongoing surveillance and conservation efforts, especially since many garter snake species are federally threatened or endangered. This study hopes to provide crucial insights for managing the delicate balance of snake populations and the broader ecosystem in California's diverse habitats.

38 - DISTRIBUTION OF PATTERNS AMONG TYPES OF SUBSTRATE FOR PATIRIA MINIATA AND PISASTER ORCHRACEUS; A SEA STAR DRAMA

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CSU Monterey Bay

Sea stars are an important keystone species in rocky intertidal ecosystems and can increase species diversity by controlling prey populations. Sea Star Wasting Disease (SSWD) has spread in sea star species on North America's West Coast, causing tissue disintegration, fragmentation, and death. Some species were heavily impacted by SSWD, decimating specific populations. Bat stars, *Patiria miniata*, suffered lower mortality while ochre stars, *Pisaster ochraceus* experienced a major decline. Observed recovery has been spatially variable, which could be driven by differences in habitat. Rocky intertidal sites in Monterey Bay comprise various substrates such as rock, boulder, cobble, and sand. In this study, we compared the densities of bat and ochre stars across different substrate types. Rocky intertidal sites included Cannery Row, Hopkins, Point Pinos, China Rock, Pescadero, Carmel Point, Point Lobos, and Soberanes. Additionally, we incorporated sea star wasting disease observations and timelines from the Multi Agency Rocky Intertidal Network (MARINe). Results show a significant separation between the two species; bat stars are common at sites with boulders and ochre stars are common at sites with more rock. Potential mechanisms could be that mussels require continuous rock for development, which ochre stars primarily consume. Bat stars typically feed on algae and small invertebrates, which reside in intertidal pools surrounded by boulders. Understanding the role of habitat and food preferences for sea star recovery can help make predictions about future populations.

39 - ONE FISH, TWO FISH? MORPHOLOGICAL ANALYSIS AND ASSESSMENT OF CRYPTIC SPECIES IN SEBASTES SAXICOLA ALONG THE NORTHEASTERN PACIFIC

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CSU Los Angeles

Cataloging biodiversity and analyzing the evolutionary history of life on Earth are two goals of biological research. This research is important for species that benefit from effective conservation and management, such as those of commercial or recreational value, and threatened or endangered species. Differentiating species within recently evolved taxa can be challenging, especially those which have experienced rapid speciation. Although genetic analysis allows us to establish phylogenies and classify species, morphological analysis is necessary to develop species descriptions, diagnostic characteristics, and identify novel species. We are examining two populations of stripetail rockfish, *Sebastes saxicola* (Gilbert, 1889) to determine if those found north of Point Conception, California are morphologically distinct from those found south of Point Conception. Preliminary genetic analysis suggests that there may be two distinct lineages with Point Conception as a biogeographic breakpoint. I am conducting a morphological analysis of 40 *S. saxicola* individuals each from north and south of Point Conception using preserved specimens from several institutions, as well as recently collected specimens. Principal component analysis (PCA) and a multivariate analysis of variation (MANOVA) of the data will determine whether there are significant morphological differences between the two populations. This work will either provide morphological characteristics with which to differentiate between the two lineages or indicate cryptic species in *S. saxicola*.

40 - DIFFERENCES IN DENTAL ABRASION IN AGE AND SEX OF CALIFORNIA SEA LIONS (ZALOPHUS CALIFORNIANUS)

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1- Dominican University of California 2- University of California

Dental abrasion is apparent across different sexes and age groups within pinniped species, specifically California sea lions (Zalophus californianus), underscoring the need for comprehensive investigations into the underlying factors and potential implications for their oral health and overall well-being. A total of 427 skulls were examined from California Academy of Sciences (CAS) Ray Bandar's collection. The specimens, 78.9% male, 20.9% female, and 0.002% unknown, were from strandings along Northern California from 1959 to 2009 ranging in age from pup to adult. For examination, 93.5% of teeth were accessible. Artificial absence accounted for 5.3%, 0.9% were classified as missing due to acquired tooth loss and 0.2% were congenitally absent. A total of 157 skulls (36.7%) recorded abrasion, differing from previous research that recorded 65.5% dental abrasion (Sinai 2014). Abrasion varied among age groups and between sex. Although males experienced a higher rate of abrasion (31.6%) than females (5.1%), there was not a significant difference (p=0.1335). Frequency of dental wear heightened with advancing age, however, the difference is not statistically significant (P=0.990). Discrepancies in abrasion rates may stem from variations in dietary habits or aggressive behaviors. Our sample heavily accounted for male and immature specimens, affecting our findings and ultimately countering the previous research that has been conducted.

41 - POPULATION GENOMIC ANALYSIS OF LATITUDINAL AND INTERTIDAL GRADIENTS IN THE CALIFORNIA RIBBED MUSSEL, MYTILUS CALIFORNIANUS

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1- UC Merced 2- Radford University

The California ribbed mussel, *Mytilus californianus*, is an ecosystem engineer distributed across the heterogeneous intertidal zones of the western coast of North America. Previous studies using allozymes, scDNA, transcriptomics, and DNA barcoding have indicated little population genetic structure in *M. californianus*. The present study aims to address the genetic structure of *M. californianus* using whole genome sequencing data. We collected animals from 20 sites along California and sequenced 6 individuals per site. Preliminary analyses used individuals sampled along the high and low limits of intertidal sites across four counties (La Jolla, Ventura, Humboldt, and Del Norte) for sequencing and bioinformatic analyses were performed on high performance computers and R packages. Sequences were sequenced at 10X coverage and length of

sequences ranged from 391 megabases to 20.5 megabases. This working study will explore the population genetics across sites as well as within to get an idea of the pattern latitudinally and by sites. It will also deepen our understanding of ecosystem dynamics that will help with future conservation work along the coast of California.

42 - THE EFFECT OF SEASONAL VARIATION ON EARLY DEVELOPMENT AND SUSCEPTIBILITY TO STRESS IN THE INTERTIDAL PORCELAIN CRAB PETROLISTHES CINCTIPES

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As climate change worsens, the intensity and duration of heat waves is increasing. Intertidal organisms are facing stressful conditions being exposed to daily immersion and emersion events where heat stress acts as a strong selective pressure. Porcelain crabs, an abundant rocky intertidal filter feeder, are currently experiencing temperatures close to their thermal maxima in nature. This is especially intense in the summer months where temperatures reach higher maxima while also being more thermally variable. Prior studies have shown porcelain crab embryo broods respond to environmental stress in variable ways. I hypothesize that the variations in brood response are induced by environmental conditions during oogenesis. I am examining whether seasonality in thermal variation plays an important role, as warm summer months are more thermally variable than the cooler, more stable winter months. Broods of embryos from summer months are expected to be more tolerant of thermal stress than those from winter months. I collected embryos from 8 moms in July and will be collecting again in December. Embryos were split into a heat shock (1hr @ 30C) or control (15C ambient) group. Respiration rates, yolk consumption, hatching success, and survival were measured. The preliminary data hints at greater respiration rates in heat shock treatments compared to control, with heat shock respiration rates being on average 120% higher across all broods. Results have shown considerable variation and increased metabolic demand throughout development in our ongoing analysis.

43 - UNVEILING THE INTRICACIES OF DEEP-SEA CARNIVOROUS SPONGES: TAXONOMIC INSIGHTS AND ECOLOGICAL SIGNIFICANCE

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Research along the North American west coast reveals enigmatic, thriving ecosystems hundreds of meters deep. These harsh environments demand specialized adaptations from their inhabitants. Developments in field technology grants us access to these unique ecosystems, enabling the exploration of species interactions and ecosystem dynamics. Sponges play a pivotal role in nutrient cycling and movement across the food web. Certain deep-sea sponges possess traits that are distinctly different from their shallow water counterparts, such as exhibiting carnivory as opposed to filter-feeding. The sponges in our studies use spicules, which are microscopic hooks spread about their tissue, as a mechanism to catch prey. Through utilizing compound and electron microscopy, we can look more closely into the dynamics of their spicules, which we are finding useful for species differentiation. Our goal is to expand the understanding of deep-sea species, as it will be invaluable to similar research in this field. Presented at the CSUMB summer symposium, our project advances the documented knowledge of deep-sea carnivorous sponge taxonomy and adaptations. Various imaging methods unveil different aspects of sponge and spicule morphology, crucial in distinguishing species. Our work edges toward naming a new species, further broadening the scale of known deep-sea biodiversity. Investigating novel deep-sea species will enrich our grasp of deep-sea biodiversity and highlight rarely seen parts of our world.

44 - EFFECTS OF MULTIPLE STRESSORS ON METABOLIC RATE AND THERMAL PERFORMANCE OF MYTILUS TROSSULUS AND M. GALLOPROVINCIALIS

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Climate change is predicted to increase seawater temperature and decrease salinity, exposing marine animals to environmental stressors. Mytilus trossulus is a blue mussel species that is native to the U.S. North Pacific and is being outcompeted by the invasive M. galloprovincialis. Due to the limited stress tolerance of M. trossulus, we sought to investigate the thermal performance and metabolic response of M. trossulus and M. galloprovincialis to changes in environmental temperature and salinity to understand the potential effects of climate change. M. trossulus was collected from Coos Bay, OR, and M. galloprovincialis from Marina del Rey, CA. Both were acclimated to control conditions (34ppt, 17ºC) for 2 weeks. Following acclimation, mussels were exposed to combinations of stressors (salinity: 20, 28, 34ppt; temperature: 17, 20, 25ºC), and metabolic rate was determined. In addition, a thermal performance curve was generated by exposing mussels to increasing degrees of heat stress and measuring metabolic rate. We found that the optimal temperature of M. trossulus for metabolic performance was 14 ºC. We found no interaction effect of hyposalinity and heat stress and only a heat effect suggesting that temperature is the main influencer of metabolic rate for M. trossulus. Peak metabolic performance for M. galloprovincialis was 29 ºC. There was a significant increase in metabolic rate with hyposalinity exposure (20 ppt) in M. galloprovincialis. Thus, exposure to heat stress and hyposalinity suggests that mussels are energy-limited in stressful environments.

45 - QUANTIFYING AND DISTINGUISHING CHARACTERISTICS BETWEEN KELP FORESTS AND URCHIN BARRENS ALONG THE SOUTHERN OREGON COAST

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Kelp forest ecosystems are collapsing along parts of the North American West coast, concurrent with recent marine heat waves, and population increases of purple sea urchins. Long-term ecological monitoring studies have been essential in documenting these changes, especially in California. Oregon is less well-understood due to the lack of local long-term ecological monitoring. Recently, members of the Oregon Kelp Alliance (ORKA) launched a coordinated large-scale field sampling effort to gather a comprehensive snapshot of the status of kelp forests across

the Oregon Coast. Rapid assessment kelp forest subtidal dive surveys quantified bull kelp (*Nereocystis luetkeana*), subsurface kelps, sea urchins, abalone, sea stars, and other conspicuous rocky reef macroinvertebrates. Here, we report on the data collected so far by the University of Oregon and Reef Check team surveys from 2021 through 2023, to investigate the distribution of kelp forests and urchin barrens on various spatio-temporal scales. Preliminary results indicate that in Oregon, there is a mosaic of both healthy kelp beds and denuded sea urchin barrens at multiple scales, sometimes near each other, on the nearshore reefs of the Southern Oregon Coast. We summarize the spatial distribution of the surveys to date along with key statistics on kelp and macroinvertebrate densities in this generally poorly studied region. These surveys will be used as a baseline to inform our understanding of the status of Oregon's kelp forests and help identify possible future restoration efforts and further monitoring.

46 - QUANTIFYING REMOTELY-SENSED HABITAT CHARACTERISTICS FROM ARTIFICIAL REEFS IN SOUTHERN CALIFORNIA

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Over the past half century artificial reefs (ARs) constructed from a variety of materials (e.g., quarry rock, light posts, concrete rubble) and other forms of marine infrastructure (e.g., offshore oil platforms) have been built in the southern California marine environment. These can change the distribution and abundance of local marine habitats and species via the introduction of artificial hard substrate, which varies in terms of size, vertical relief, and habitat complexity. We have quantified the physical characteristics of ARs in southern California (Bolsa Chica, Hermosa Beach, and Marine del Rey) by analyzing geophysical (bathymetry and acoustic backscatter) data collected by the Vantuna Research Group at Occidental College with a Multi-Phase Echo Sounder. Sonar data is analyzed in ArcGIS Pro and in R with the MultiscaleDTM package. A habitat classification model has been developed to identify artificial reef habitat, which is exported as a polygon shapefile. Then reef habitat metrics are quantified for each reef module including location, depth, areal extent (footprint), surface area, slope, rugosity, bathymetric position index, heterogeneity, and vertical relief. These metrics will then be used to examine which habitat features best explain patterns in corresponding fish assemblage structure. Results should improve forecasts about the consequences of decisions related to marine infrastructure and artificial reefs, support environmental review, and contribute to the California Department of Fish and Wildlife's process of developing and updating their AR assessment and management plan.

47 - A MISSING SEX: ENVIRONMENTAL INFLUENCES ON THE POPULATION SEX RATIO OF FARMED PACIFIC OYSTERS IN SOUTHEAST ALASKA

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Pacific oysters (*Crassostrea gigas*) are an important species for Alaska's growing aquaculture industry. However, expansion is limited by access to oyster seed imported from out-of-state. A key component of a successful oyster hatchery is access to male and female oysters. Pacific oysters begin as males and change to females as they mature. Past studies found higher proportions of females in warm, phytoplankton-rich water, while ratios favored males in less ideal growing conditions. There are no studies on sex ratios of oysters on Alaska farms. To test the impact of environmental conditions on sex ratio, we collected water samples and 15-20 oysters (aged 2-3 years), from an oyster farm in Juneau, AK for eight weeks. Water samples were analyzed for temperature and phytoplankton abundance. Gonadal samples were viewed under a microscope to determine sex. Results showed a male bias with hermaphrodites making up about 20% of samples; we observed no females. The percentage of hermaphroditic oysters was non-significantly correlated with water temperature and not with diatom abundance. The large proportion of hermaphrodites was surprising, as studies from other regions observed very low (<1%) proportions of hermaphrodites. Hermaphrodite presence could result from cold water inhibiting sex change or sampling highlighting sex transition. Future research should expand sampling throughout the year and investigate older age classes. An improved understanding of the drivers and timing of oyster sex changes will be critical if Alaska is to establish an in-state hatchery industry.

48 - DEVELOPING METHODS TO ASSESS THE SPATIOTEMPORAL DISTRIBUTION OF PISMO CLAMS (TIVELA STULTORUM) ON THE CENTRAL CALIFORNIA COAST

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The Pismo clam *(Tivela stultorum)* is an iconic species on the Central California Coast, due to its cultural importance and significant presence in the sandy intertidal ecosystem. This species supported a successful recreational fishery until the population declined in the 1980's, potentially due to the combination of harvest pressure and predation by sea otters. Over the last several years, populations have begun to recover, but the reasons behind the recent increases are unclear. Spatial information about Pismo clams within the intertidal ecosystem can inform future predictions about the impacts of potential biotic and abiotic factors contributing to their population increase. This project provides methods to assess spatial and temporal trends of Pismo clams along three survey sites on Pismo Beach, California. We utilized spatial data to determine areas of high abundance, changes in spatial distribution over time, and the spatial scale in which we can apply these methods in future studies. This information will also inform land management strategies to further improve the protection of Pismo clams, especially in areas with high abundance, larger clams, and thereby more vulnerable to poaching.

49 - AGE-AND-GROWTH RELATIONSHIPS OF AN ECOSYSTEM ENGINEER SHRIMP AND ITS INVASIVE PARASITE

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The northeast Pacific intertidal blue mud shrimp, *Upogebia pugettensis*, is in steep decline range-wide due to intense infestations of the introduced Asian bopyrid isopod parasite, *Orthione griffenis*. The absence of refuges for mud shrimp from the invasive parasite preclude assumptions of host resilience or otherwise long-term co-existence. Intervention by delaying or reversing the decline of mud shrimp will only be possible through understanding the ecology, energetics, and population dynamics of this system, which has not been resolved for any other marine bopyrid isopod and hosts. Bopyrid parasites effectively castrate their female hosts by hemolymph extraction, leading to total reproductive losses in female mud shrimp. Although host biomass can only be lost to isopods, mud shrimp mass-per-length does not decline with increasing parasite load. The energetics of this interaction are critical for understanding the population dynamics of this system. However, there are no simple direct measurements of growth, and if mortality rates also change with size, it is challenging to deduce size-dependent growth rates from observations of population size distributions over time. We have addressed that problem by developing size-based integral projection models that incorporate the temporal variation in size frequency of mud shrimp and their parasites. Our model analysis narrows the range of possible patterns of size-dependent age and mortality for infected and non-infected mud shrimp, suggesting new testable hypotheses for the key drivers of mud shrimp population dynamics.

50 - EXTENT OF OYSTER SHELL BURIAL IN NEWPORT BAY, CA

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Oysters deliver important ecological functions to intertidal estuarine communities, including provision of microhabitat for various marine species and filtration of the water column. In southern California, two oyster species, the native *Ostrea lurida* and non-native *Magallana gigas*, co-occur. Increased sedimentation by human activity threatens to bury oysters and lead to a loss of the ecological services they provide. *Ostrea lurida* is especially vulnerable as they are found at lower intertidal elevations and are smaller than *Magallana gigas*. To assess the extent of burial on oysters, we conducted a series of surveys at three sites in Newport Bay, CA, including the Pacific Coast Highway, 15th Street and Coney Island. Our main objectives were to characterize the percentage of oysters that were buried and the extent to which individual oyster were buried. Following the surveys and several statistical tests, about 85% of oysters found at 15th street were buried and only about 20% of oysters were buried at the other two sites. There were no significant differences between the two oyster species in percentage buried. Understanding the impact of sedimentation on oysters is integral to successful conservation and restoration efforts. Further knowledge will allow for more comprehensive approaches in aiding the native *Ostrea lurida* from various threats it is facing in human impacted bays.

51 - FISH CHORUSES IN MONTEREY BAY NATIONAL MARINE SANCTUARY

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Monterey Bay National Marine Sanctuary is home to a symphony of sounds that contribute to the underwater soundscape. A soundscape includes biotic, abiotic, and anthropogenic sounds in an environment. Hidden within the well-understood whale calls are the understudied chorusing of fish. To produce these unique songs, fish inflate their swim bladder, which then vibrates against vocal muscles and produces a call. When fish continuously call it is referred to as a chorus, and can last for hours at a time. By analyzing these choruses, we can gain insight into the behaviors and population distribution of different fish species. The underwater soundscape was recorded at two locations in the sanctuary, one in a deeper underwater canyon and the other in a shallower kelp forest, using hydrophones called Soundtraps. This project evaluated Long Term Spectral Averages (LTSAs) using three years of acoustic data from the NOAA SanctSound project. Utilizing Matlab and RStudio, we evaluated the LTSAs for spatial and temporal patterns in fish choruses. The analysis revealed potential mating seasons, habitat preference (canyon or kelp forest), and the timing and duration of the chorusing. Overall, the fish species commonly chorused at night, with some singing continuously from sunset to sunrise. Through analyzing fish chorusing, we were able to learn about fish behaviors in Monterey Bay National Marine Sanctuary, and find clues to identifying unknown chorusing species. This project advanced the utility of this non-invasive tool with the goal of monitoring and protecting fish populations.

52 - THIAMINASE I CONCENTRATIONS IN ALEWIFE (ALOSA PSEUDOHARENGUS) IN THE GULF OF MAINE

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Thiamine (vitamin B1) is essential for vertebrate physiological functioning, playing a crucial role in neurologic and metabolic processes. Thiamine deficiencies have become increasingly prevalent and are impacting fish populations worldwide, especially in the Great Lakes where these deficiencies were linked back to consumption of alewives, an invasive forage fish. Alewives and other clupeid fish produce thiaminase I, an enzyme that breaks down thiamine, contributing to deficiencies in predators. While the causes of thiaminase I production in alewives are still unclear, hypotheses suggest it may be linked to immune activation in clupeid fish. Thiaminase production has not been quantified in marine alewives.This study investigated the presence of *Ichthyophonus hoferi* and erythrocytic necrosis virus (ENV) pathogens once present in the Gulf of Maine and their correlation with thiaminase I concentrations in adult marine alewives. 120 alewives were sampled in Damariscotta, Maine, USA in late spring 2023. *I. hoferi* infections were quantified by cardiac culture and ENV was diagnosed by examining blood smears. Ten of these samples, based on variable sex and size, were selected for thiaminase quantification using the 4-nitrothiophenol colorimetric assay. Preliminary results show variable thiaminase concentrations, but were negative for both pathogens, preventing further investigation. Nonetheless, this project provides baseline data for examining disease in wasp-waist species and methodology for investigating trophically-mediated thiamine deficiencies in the Gulf of Maine ecosystem.

53 - VARIABLE HOST SHELL TRAITS MAY HELP IDENTIFY PATTERNS OF ISOLATION AND CONNECTIVITY IN THE HERMIT-CRAB-SHELL-ENCRUSTING HYDROZOAN HYDRACTINIA SYMBIOLONGICARPUS

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Towson University

The US Atlantic Coast south of Cape Cod is characterized by extensive salt marshes, shallow bays, and barrier islands. This habitat forms a complex matrix of resource-rich aquatic environments isolated by elevated hummocks, impenetrable oyster reefs, and thickets of cordgrass. For benthic marine species lacking planktonic stages, we expect these features to act as barriers to movement and dispersal. Thus, we expect such species to function as metapopulations, where sites experience somewhat closed population dynamics and independent patterns of selection. However, it is difficult to predict the spatial scale at which populations will act independently without detailed knowledge of a specific system. Here we use similarities in the patterns of shell size, shell species identity, and colonization rate by the encrusting hydrozoan Hydractinia symbiolongicarpus to investigate the spatial scale at which populations of hydrozoans become isolated. We found substantial variation in the species diversity and size of shells being used by H. symbiolongicarpus at ten sites, both within and among bays arranged across the Eastern Shore of Virginia. These differences suggest limitations in the free movement of hermit crabs among sites, which in turn suggests reduced connectivity of associated non-planktonic hydroid colonies. Ultimately, the study aims to shed light on the fundamental mechanisms contributing to population isolation in these habitats while identifying host traits that may influence population dynamics and selection on non-planktonic estuarine invertebrates.

54 - GROWTH AND MORPHOLOGY OF SACCHARINA LATISSIMA IN RESPONSE TO VARYING EXPOSURE TO HYDRODYNAMIC CONDITIONS: A RIPPLE EFFECT

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1- UC San Diego 2- Oberlin College and Conservatory 3- San Francisco State University

Kelps (Order Laminariales) exhibit high morphological plasticity across their ranges. *Saccharina latissima*, or sugar kelp, exhibits this variation and is found commonly in the Pacific Northwest's rocky intertidal and subtidal. Prior studies have linked *Saccharina latissima*'s morphological variability to the surrounding physical environment. In order to better understand this relationship, we gathered morphological, growth, and environmental data from three different field sites on San Juan Island, Washington: Friday Harbor Laboratory, Cattle Point, and Deadman Bay. We found significant variation between our sites in growth rate ($p < 0.01$), bullation pattern and prevalence ($p < 0.05$), and wave exposure ($p < 0.01$). However, we were unable to conclusively link the kelp's growth and morphology to its environmental conditions. Our results appear to conflict with the outcomes of previous studies. Furthermore, this experiment highlights implications for *S. latissima*'s role in climate resilience and further understanding of coastal ecology. As climate change is expected to increase the frequency and severity of extreme weather events, documenting *S. latissima*'s morphology and reaction to environmental change is critical to detecting and understanding a "ripple effect" of intertidal dynamics vulnerable to hydrodynamic disturbance.

55 - HOSTILE TAKEOVER: URCHIN RECRUITMENT IN MONTEREY BAY

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affiliation not listed

Kelp forests are essential to the ecological health of Monterey Bay. Climate change and increasing urchin populations have decreased kelp biomass, causing a loss of habitat and food sources for other marine life. At high densities, sea urchins can form urchin barrens which impede kelp growth and limit nutrient supply and shelter. Knowledge about sea urchin recruitment is necessary for effective restoration of kelp forests.This project is part of a long-term and geographically diverse study to understand how urchin recruitment relates to adult urchin population densities. Long-term and wide-ranging monitoring provides critical data on analyzing changing ocean conditions, including warming due to climate change and shorter-term variations like ENSO. We are expanding this project to include a new subtidal arm, providing a different lens through which to view urchin recruitment.Our collection methods were modified from Schroeter et al.. Recruitment collectors were placed in several locations around Monterey Bay. We intend for our data to indicate potentially successful environments for kelp restoration. Kelp health affects all organisms in Monterey Bay, and as such it is a major priority for local conservation efforts.

56 - INVESTIGATING LABORATORY FOOD COMPOSITION FOR THE EELGRASS SEA HARE

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Eelgrass beds provide a safe nursery habitat for juvenile organisms, contribute to carbon sequestration, and protect coastlines from erosion. The eelgrass sea hares (*Phyllaplysia taylori*) living in this ecosystem help the eelgrass prosper by removing epiphytic material, which is composed of algae, diatoms, cyanobacteria, and decaying invertebrates. Epiphytes prevent direct sunlight from reaching eelgrass blades and compete with the eelgrass for nutrients, thus threatening the livelihood of the ecosystem. We have a limited understanding of how sea hares will continue to provide this ecosystem service as their physiology is impacted by climate change. To better understand their physiology, we must mimic their food in the laboratory to conduct realistic climate resiliency experiments. We created fish food mixtures that stall disintegration and prevent it from floating, since sea hares typically graze directly from blades not in the water column. We investigated their preferred food through several feeding trials via food mixtures smeared on a 3x6 window screen that was inserted into each tank ($n=40$) for 3 hours. We determined the preferred food mixture by weighing the remaining food and sea hares before and after the trail. We found the sea hares preferred a brand called "vegetable shrimp pie"; the ingredients being ground shrimp meal, spirulina, and algae composition. Thus, their preferred laboratory food closely mimics their omnivorous natural diet. This work is a vital step towards creating a more robust aquarium simulation of climate change impacts on eelgrass sea hares.

57 - INFLUENCE OF HABITAT ON MORPHOLOGY AND MATERIAL STRENGTH OF PURPLE SEA URCHIN JAWS

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Purple sea urchins *(Strongylocentrotus purpuratus)* play a crucial role in shaping kelp forest and rocky reef ecosystems. Recent changes in surface ocean conditions and the widespread decline of key marine species like kelp and sea stars have induced large shifts in ecosystem dynamics along the coast of California. In particular, “urchin barrens,” grazing-based ecosystems dominated by sea urchins, are expanding while kelp forests are diminishing. The habitats in which sea urchins reside can profoundly influence urchin feeding behavior, diet composition, and morphology. While much research has focused on urchin tests, reproductive capacity, and development, research on sea urchin feeding, especially in the context of a changing ocean, is lacking. This study examines the relationship between habitat, morphology, and feeding mechanics. We conducted morphological measurements and material testing (break force) on jaw components collected from 10 sites spanning from Monterey to Fort Bragg, CA and included barrens, restoration areas, and kelp forests. Our findings corroborate previous research, demonstrating that relative jaw size is greater in barrens compared to kelp forests ($n= 249$, $p<0.001$). Additionally, material testing results indicate that jaw strength, when adjusted for jaw size, is higher in barren habitats ($n= 45$, $p<0.05$). We postulate that this discrepancy in size and strength may be attributed to diet differences, as previous research found that specific calcifying algal groups cause an increase in test thickness, although further work is needed to determine specific mechanisms behind this. Our results provide further insights into the relationship between habitat, morphology, and material strength in purple sea urchins, contributing to our understanding of how their grazing behavior may change in the coming decades.

58 - EFFECTS OF LONG-TERM DIET OF BULL KELP *NEREOCYSTIS LUETKEANA* EXPOSED TO EUTROPHIC CONDITIONS ON THE MICROBIOME FUNCTIONALITY OF THE PURPLE SEA URCHIN *STRONGYLOCENTROTUS PURPURATUS*

Wang, L.[*]; Stiemsma, L.; La Valle, F.F.

Pepperdine University

The microbiome of sea urchins is critical to their digestion, immune system regulation, and reproductive success. In this experiment, we will examine whether long-term (60-90 days) feeding of bull kelp *Nereocystis luetkeana* exposed to high nutrient estuary water affects the microbiome of the purple sea urchin *Strongylocentrotus purpuratus*, a common sea urchin found in Southern California. Two feeding treatments (“polluted” vs. “non-polluted”) are configured by collecting stipes from bull kelp at Malibu Lagoon for the “polluted” treatment and Point Dume for the “non-polluted” treatment Levels of ^{15}N isotope will be measured in both kelp treatments. The “non-polluted” kelp will be used as a control group. At the end of the feeding, we will remove the sea urchin’s digestive system and coelomic fluid and save them for DNA isolation and sequence analysis to quantify the microbiota composition. We will also examine the different microbial communities extracted from (1) water samples from the collection sites, (2) the surface of the kelp, and (3) sea urchins’ digestive systems and coelomic fluid. Comparisons will be made between the richness and variability of the microbial communities of the two groups of sea urchins fed with different treatments of kelp and the differences in the microbial communities of the different urchin sexes. Studies of the sea urchin microbiome can help us better understand how ocean pollution affects the health and physiology of sea urchins, therefore the results of this study can help predict and mitigate the impacts of pollution on marine ecosystems.

59 - ASSESSING THE DIRECT EFFECTS OF AERIAL AND OCEANIC TEMPERATURE VARIABILITY ON LOTTIA GIGANTEA GRAZING, GROWTH, AND METABOLISM AND THE INDIRECT EFFECTS ON LOCAL BIODIVERSITY

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Rocky intertidal organisms living along the California coast are adapted to extreme fluctuations in temperatures. As both ocean and aerial temperatures continue to become more variable, it is imperative to understand how changing thermal conditions affect intertidal species. *Lottia gigantea*, or owl limpets, are an important space occupier that help maintain biodiversity on rocky shores. Therefore, how owl limpets respond to changing temperatures could have cascading effects on rocky intertidal ecosystem functioning. This study quantified owl limpet grazing and growth rates, and downstream impacts of limpets on local biodiversity living in different temperature regimes in southern California. In a field experiment, I measured owl limpet growth rates, grazing rates, territory sizes, and benthic biodiversity at two sites (a warm and a cool site) two times within a year to capture spatial and seasonal changes in both aerial and oceanic temperatures. These results will provide information on changes on multiple metabolic rates, territory size, and indirect effects on biodiversity of this species, giving insight to the future of the communities found on rocky shores.

60 - UNIQUE DIET AND PHILONEMA ONCORHYNCHI INFECTIONS IN RESERVOIR-REARING JUVENILE CHINOOK SALMON (ONCORHYNCHUS TSHAWYTSCHA)

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1- Oregon State University 2- St. Norbert College 3- U.S. Geological Survey

Dams and reservoirs can alter juvenile growth and survival of migratory salmonids through several physical and biological mechanisms. Juvenile Chinook Salmon (Oncorhynchus tshawytscha) produced above large hydropower dams may have associated passage mortality, but reservoirs created by these dams can support rapid growth. Characterizing the biotic drivers of growth and mortality in reservoirs may aid in understanding the cumulative effects of river impoundments on migratory salmonid populations. The purpose of this study is to understand how reservoirs facilitate rapid growth in juvenile Chinook Salmon by characterizing diet composition throughout the summer and fall. We found that juvenile Chinook Salmon frequently consume young-of-year centrarchids, which likely contributes to rapid growth. Piscivory was highest from July through September and decreased with surface temperature beginning in late September and continuing through December. Correspondingly, zooplankton and arthropod consumption increased in November and December. We also recorded prevalence of the parasitic nematode Philonema oncorhynchi in the coelom. Prevalence of macroscopic P. oncorhynchi infections was high (35%) but decreased over time and was lower in the larger fish, indicating parasite-associated mortality.

61 - TISSUE-SPECIFIC HIF-1A EXPRESSION IN ADULT GOPHER ROCKFISH (SEBASTES CARNATUS) UNDER UPWELLING STRESS IN CENTRAL CALIFORNIA

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Seasonal upwelling exposes nearshore organisms to periodic acidic and hypoxic conditions. Climate change is expected to increase the frequency and severity of these events. Nearshore fish in upwelling systems may already be well adapted to cope with fluctuations in low dissolved oxygen (DO) and low pH, but climate change may push them beyond their environmental thresholds. In this study, we examined the expression of a biochemical indicator of hypoxia (hypoxia inducible factor 1 [HIF-1α]), under varying levels of upwelling stress in adult gopher rockfish, to establish if current and future predicted levels of upwelling induce hypoxia stress. HIF-1α upregulates cellular and physiological responses to cope with low DO conditions (e.g., erythropoiesis and anaerobic metabolism). We compared HIF-1α protein expression between gill and liver tissues in adult rockfish exposed to ambient (pH ~7.8, DO ~8.0mg/L) and extreme (pH 7.3, DO 2.8mg/L) treatments for several weeks to determine which tissue type is more sensitive to hypoxia. We expect to see a significant increase in HIF-1a in the extreme treatment to compensate for low DO and pH in both tissues. Future work will examine intermediate levels of upwelling stress to determine the threshold level of combined low DO and pH. Tolerance thresholds can be used to improve predictions of environmental conditions that trigger hypoxia stress in nearshore rockfish. Given the energetic cost of mounting a stress response, this information may be useful for predicting the impact on growth, fitness, and population size of nearshore rockfish.

62 - THE EFFECT OF SUBMARINE GROUNDWATER DISCHARGE ON GREENHOUSE GAS EMISSIONS IN MAUNALUA BAY, HI

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1- Pepperdine University 2- Hawai'i Pacific University

In the urban coastal environments of Honolulu, Hawai'i, water high in inorganic nutrients such as nitrates, phosphates, and ammonia, often becomes further enriched by human activity. This water seeps into the ocean by mode of submarine groundwater discharge (SGD). We hypothesize that SGD influences greenhouse gas (GHG) production in coastal systems at a measurable rate and is overlooked as a significant source of methane emissions. Marshes and wetlands are the largest contributors to methane production due to methanogenic bacteria metabolizing large amounts of organic matter, but this phenomenon is less studied in coastal systems with SGD because these systems are not usually oxygen-limited. Our research seeks to quantify methane production in areas with low salinity and high nutrients by collecting water and sediment samples from coastal areas near SGD and creating closed systems where methane and other greenhouse gasses can accumulate. The methane, nitrous oxide, and other GHG rates of production will be measured with respect to the water and sediment samples' proximity to the SGD so we can quantify the magnitude of GHG on SGD in coastal systems.

63 - INTERLINKED OR INDEPENDENT? EXAMINING THE RELATIONSHIP BETWEEN SHELL GAPING AND EXHALANT CURRENTS IN MARINE MUSSELS

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Mussels are foundational species on many rocky intertidal shores and hold significant potential to transform local water chemistry due to their physiological activities. Positive correlations between shell gaping and clearance and/or respiration rated have led many to use the proportion of gaped individuals in a population to estimate feeding/respiration for entire mussel beds. However, these field estimates consistently underestimate the maximum rates measured directly in the lab. This may be due, in part, to the lack of exhalant jet currents, even when shell valves are open. Given that shell gaping occurs for various reasons (e.g., respiration, feeding, to reduce oxidative stress), it is possible that exhalant currents may also vary independent of gaping. Here, we present results from experiments measuring both shell gaping and exhalant jet currents simultaneously in the bay mussel, *Mytilus trossulus*. Shell gaping ranged from 1 to 4 mm, whereas exhalant velocities ranged from 2 to 11 cm s-1. Preliminary results suggest a nonlinear response between the two metrics with slow exhalant currents at extremely narrow and wide shell gaping.

64 - SO SIZE DOES MATTER… ANALYZING SEDIMENT AS HABITAT FOR THE PISMO CLAM (TIVELA STULTORUM) ON THE CALIFORNIA CENTRAL COAST

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Pismo clams were once a popular recreational fishery species on the Central California coast, but this fishery has essentially been closed since the 1980's due to population declines. Recently, populations have been recovering, so learning more about this species' ecology will be important to inform future management decisions. This project explores the relationship between the Pismo clam and its habitat by conducting an analysis of spatio-temporal changes in the sediment profiles of local sandy beaches. We tracked spatial and seasonal differences in median grain size by measuring sediment along Pismo beach and Morro strand over the course of a year. We also conducted abundance surveys at these sites to compare abundance trends with grain size trends. We found that while position up and down the intertidal did not have a significant effect, position along the shoreline and time of year did. Additionally, we found evidence that Pismo clam abundance decreases with increasing grain size. This information can be used to learn more about how much Pismo clam habitat is available, which can inform monitoring programs, restoration efforts, and population estimates.

65 - SEASONAL CHANGES IN PURPLE SEA URCHIN GONADAL SOMATIC INDEX IN THE SANTA BARBARA CHANNEL

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In California kelp forest ecosystems, marine heatwaves (MHWs) have become frequent and persistent since the 2014 Blob event and occur during important life history stages for benthic marine invertebrates. In the Santa Barbara Channel (SBC) region, MHWs have occurred in late summer into fall, aligning with sea urchin gametogenesis. We investigated how MHW thermal stress impacted fecundity, by determining seasonal changes in the production of gonad and protein content in the purple sea urchin, Strongylocentrotus purpuratus. For this study, S. purpuratus (N=10) were collected monthly from a kelp forest reef, Arroyo Quemada, in the SBC. Gonadal somatic index (GSI) was measured and total protein content was assessed for gonad tissue dissected from each adult urchin. Temperature data from the SBC was obtained from the SBC Long Term Ecological Research program's database. During this collection period, MHWs were present during these important life history stages. Our analysis revealed a pattern of gonad growth where GSI in S. purpuratus was highest in the late fall/early winter and lowest during early spring into summer. Additionally, protein content was highest and lowest coinciding with the highs and lows of GSI. Gonadal development has important repercussions for determining future populations, making the understanding of MHW timing and life history events critical as they become more frequent. These findings are ecologically important as they provide insight into how the reproductive output of benthic marine invertebrates may change in response to climate change.

66 - PHENANTHRENE AND INCREASED TEMPERATURE COMBINED CAUSE SUBLETHAL EFFECTS TO EARLY-STAGE ZEBRAFISH
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UC Davis

In an era of fossil fuel growth, the inevitability of the next major oil spill poses significant threats to marine life. Global warming exacerbates this risk, with recent studies emphasizing the intensified harm when oil exposure and increased temperature interact synergistically. Embryonic fish are highly vulnerable to crude oil toxicity due to their lack of defense mechanisms, transparency, and limited mobility. Phenanthrene is a polycyclic aromatic hydrocarbon (PAH) that occurs naturally in crude oil and has toxic effects on developing fish. While its effects on early-life stage fish are well-studied, there is limited research exploring shorter, stage-specific exposures that may reflect more realistic environmental conditions. In addition, few studies investigate the combined effects of PAHs with multiple relevant stressors. We conducted a multi-stressor experiment to examine the additive and interactive impacts of a short term phenanthrene exposure and increased temperature during zebrafish development. We exposed zebrafish embryos to 0, 0.01 , 0.1 , 0.5, 1, or 1.5 ppm phenanthrene for 24 hours from 24-48 hours post fertilization at either 28°C (ambient) or 32°C (elevated). To investigate the combined effects of these stressors, we measured mortality and several sublethal effects, including oxygen consumption, length, hatching rate, heart rate, and morphological abnormalities such as spinal curvature and pericardial edema. Our findings suggest that phenanthrene and increased temperature combined have sublethal effects, which may lead to population-level consequences.

67 - *MYTILUS GALLOPROVINCIALIS* HEART RATE AND VALVE-GAPING BEHAVIOR IN RESPONSE TO ACUTE SALINITY STRESS
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Low-inflow estuaries in Southern California can experience rapid shifts in abiotic conditions linked to events such as tidal inlet closures and terrestrial runoff. Runoff from intense episodic rainfall events can rapidly shift water column salinity over the course of a few hours. Sessile organisms, such as bivalves, must change their behavior and physiology in order to tolerate the shift in conditions. The Mediterranean mussel *Mytilus galloprovincialis* became established in Southern California estuaries in the 20th century. In Los Penasquitos Lagoon (San Diego county), the population disappeared from the 1980s through the 2010s, potentially due to poor growing conditions linked to mouth closures and runoff, though the species has returned in recent years. We monitored the cardiac and valve gaping activity of *M. galloprovincialis* in response to rapid declines in salinity associated with large rain events in the field and in a controlled laboratory experiment designed to mimic the stress of rainfall events. As salinity declined, the mussels closed their valves and tended to remain closed throughout the duration of the low-salinity exposure. Prolonged valve closure was also found to be associated with a decline in heart rate, but heart rates rose to high levels following the reopening of the valves as salinity was increased. Mussels rapidly responded to changing salinity and appeared capable of tolerating the short-term impacts of large rain events, though they likely incur oxygen debt that must be recovered following the reopening of the valves.

68 - SOUTHERN OREGON COAST ABALONE SIZE AND DENSITY AT VARYING DEPTHS
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Abalone have a long and rich ecological and cultural history across the North American west coast. Abalone meat and their shells can signify status, a connection to nature, or be a subsistence food. Although this species is important to many people, it has been overharvested to the point where harvest is no longer legal. Even with these protections, abalone are still at risk of extinction due to poaching, disease, and habitat loss. **I set out to assess red, flat, and pinto abalone densities at Nellie's Cove on the Southern Coast of Oregon and to determine (1) the current population densities, (2) if there is a density gradient with depth, (3) if the gradient is more prevalent in smaller or larger abalone, and (4) if mortality differs between abalone species.** To answer these questions, I conducted multiple transect surveys in the intertidal, shallow subtidal, and received similar transect data from Reef Check for subtidal depths. I found only 7 flat, 21 red, and 20 pinto abalone in 2172 m^{-2} . I found no density gradient with depth for red abalone, though pinto abalone were only found in the subtidal. Red and flat abalone size decreased with depth. Dead abalone shells found in the intertidal were substantially more abundant for flat abalone (11 / 17) compared to red abalone (0 / 17), suggesting flat abalone may be experiencing mortality on Oregon's South Coast. Overall, these trends suggest that these abalone populations are not thriving. It is crucial that measures, such as habitat restoration, are taken to prevent further loss of these species.

69 - COMPARATIVE VISUAL ANALYSIS OF URCHIN DISEASE AT THE ULTRASTRUCTURAL LEVEL

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With the regime shift from kelp beds to urchin barrens along northern California's rocky reefs, there has also been an increase in sea urchin disease. Utilizing Scanning Electron Microscopy (SEM), we did a comparative visual analysis of purple sea urchin test composition to examine the physical differences in black spot, wasting and 'healthy' sea urchins at the ultrastructural level. Describing the physical differences caused by both diseases can help to further characterize these infections, and to help understand how they may affect an urchin's ability to move, feed, or defend itself. These observations could also help to characterize how urchin diseases could potentially affect changes in aggregate urchin populations as urchin barrens continue to persist.

70 - LONG-TERM POPULATION TRENDS OF THE PIEDRAS BLANCAS NORTHERN ELEPHANT SEAL BREEDING COLONY

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Northern elephant seals (Mirounga angustirostris, NES) are an example of conservation success, having bounced back from near extinction to a total population of more than 200,000 individuals. The recolonization of rookeries (breeding sites) at different times presents a unique opportunity to analyze marine mammal population dynamics across their range and within individual rookeries. The Piedras Blancas (PB) rookery in San Simeon, CA was recolonized by NES in the early 1990s. The objectives of our study were to (1) determine whether the PB population is approaching carrying capacity (k), which is an indicator of the maximum population a habitat can support, and (2) explore how abundance of NES varies at each individual beach site of the PB rookery across breeding seasons. Using published data from Lowry et al. (2014) and ground census data, we analyzed the total estimated NES population at PB and its seven established beaches during the breeding seasons from 1990-2023. We expected that the population numbers would begin to level off as the population approaches k, and we observed this in the years 2020-2022. This leveling out could be indicative of the PB NES colony reaching carrying capacity, or it could be a result of intense storms in the winter breeding season. Understanding the growth of this population and its movements will provide a better understanding of NES recovery and will help inform conservation and management efforts for this ecologically and culturally important species.

71 - BARNACLE FACILITATION OF AN INVASIVE BRYOZOAN (WATERSIPORA SPP.)

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Cal Poly, Humboldt

Many non-indigenous species have been transported globally through anthropogenic vectors such as hull-fouling via commercial shipping vessels. Efforts have been made to prevent non-indigenous species from being able to travel on these ships, including the use of antifoulants. However, some bryozoan species of the genus *Watersipora* have been documented to have a tolerance to copper which is commonly found in antifoulants. Thus, this marine-encrusting bryozoan has been able to invade estuaries and bays worldwide. The Eureka Public Marina (EPM) within Humboldt Bay is one of the numerous locations that *Watersipora spp.* have invaded. It was previously observed that *Watersipora spp.* had higher success when settling in the presence of the barnacle *Balanus crenatus*, a barnacle that is highly abundant at the EPM. Our research aimed to see if this barnacle plays a facilitating role in the larval settlement of *Watersipora spp.* Previous research has focused on the role *Watersipora spp.* plays in facilitating the transport of other non-indigenous marine species. However, little research has been done on what species facilitate *Watersipora spp.* invasion success, especially natural settlement of larvae in the field. We found that, on average, there were more settlers in the presence of barnacles, supporting the hypothesis that the presence of barnacles may facilitate invasions by this bryozoan.

72 - FIELD BASED ESTIMATES OF DISEASE TRANSMISSION, PROGRESSION AND MORTALITY IN AN INTERTIDAL ECOSYSTEM ENGINEER

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The loss of ecosystem engineers such as eelgrass (Zostera marina), due to disease can compromise biodiversity and physical processes. Yet quantifying the impacts of pathogens on wild marine populations, remains a significant challenge. For sessile organisms, multi-state mark-recapture is an underutilized tool for quantifying disease incidence, progression and associated mortality. To understand how eelgrass wasting disease (EWD), caused by the stramenopile, Labyrinthula zosterae, may be contributing to population declines, we used a multi-state mark-recapture approach, tracking disease in more than 500 intertidal eelgrass ramets across four sites in Padilla Bay, WA over a growing season (mid-April through early August 2023) and quantifying their growth, disease prevalence, disease severity and survival. Across sites, EWD prevalence increased from close to 0% to between 60 and 100% in June and July, and remained high for the rest of the growing season. In contrast, disease severity peaked once in mid-June, and had a second disease peak in late July. Multistate-mark recapture analyses, run with the software ESURGE, estimated that survival estimates for ramets were lowest in the early growing season, when the plants were small, and found no impact of disease on the survival of ramets. This suggests that at this study site, impacts of disease on eelgrass beds may be more likely to be manifested through slower growth and rhizome spread resulting from compromised photosynthetic capacity as opposed to mortality.

73 - THE ONGOING RECOVERY OF THE SEA STAR HELIASTER KUBINIJI FOLLOWING A DISEASE AND SUBSEQUENT MASS MORTALITY EVENT

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UC Santa Cruz

Few studies have evaluated the abundance of the Gulf sun star, *Heliaster kubiniji*, since a disease and resulting mass mortality event in 1978. Little is known of the recovery of this top carnivore and quantifying current *H. kubiniji* populations throughout its range in the Gulf of California has potential to contribute valuable insights into the recovery of other important sea star predators affected by the 2013 sea star wasting disease. In this study, we evaluate current *H. kubiniji* populations throughout the Gulf and synthesize all available data pertaining to *H. kubiniji* since 1907. We found *H. kubiniji* to be unevenly distributed throughout its range, current population levels remain below that of pre-disease populations and using a probability model, we provide an estimate of recovery. These results contribute to a synthesis and update of *H. kubiniji* with the intention of assembling a more complete understanding of Gulf populations through time to aid in the future monitoring of this important species.

74 - ANTHROPOGENIC STRESSORS MAY NEGATE THE POSITIVE EFFECT OF NO-TAKE MPAS

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Marine Protected Areas (MPAs) often use a species-specific no take approach as a means of conservation and protection. However, this approach offers little to no protection against the influx of potential anthropogenic stressors such as the inflow of nutrients and sediment from terrestrial sources, potentially compromising MPA effectiveness. The objective of this study was to understand the effects of key anthropogenic stressors on fish and invertebrate populations and benthic composition in a no-take MPA in Mo'orea, French Polynesia. We compared 2 sites within an MPA that differed in proximity to anthropogenic stressors (high and low impact sites) and then measured these stressors, and quantified differences in target species populations. To compare we measured nutrient supplies with a bioassay, sedimentation rates with traps, sediment composition with benthic samples, and differences in fishes, invertebrates, and of the stressors between sites, nutrients and terrestrial sediment trended higher in our high impact site. In contrast, the low impact site had significantly larger fishes (measured as length) and more invertebrates. Further, the high impact site had more hard bottom and sand while the low impact site had significantly more live coral. Our results imply that anthropogenic stressors other than overfishing may have negative impacts on species of fishes and invertebrates that no-take zones aim to conserve. These results suggest that environmental stressors need to be considered along with traditional metrics of MPA protection for better MPA management.

75 - EFFECTS OF A SEA URCHIN'S DIET ON ITS COMMENSAL POLYCHAETE, *FLABESYMBIOS COMMENSALIS*

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The grazing impacts of the purple sea urchin, *Strongylocentrotus purpuratus,* have received considerable attention, but the ecological roles urchin feces can play in nutrient cycling, carbon export, and food webs in kelp forests are understudied. Several detritivores may consume the feces, but the most intimate trophic link with purple urchins is their commensal polychaete *Flabesymbios commensalis*, which obtains much of its nutrition by consuming the feces of its host urchin. On 9 sampling dates spanning February 2023 to July 2023, we collected urchins from the Point Loma kelp forest to determine the proportion of *S. purpuratus* inhabited by one or more worms, the number of worms living on an urchin, and their size distribution. 64.02% of urchins had at least 1 worm on them, with a mean of 1.32 worms (SD = 1.5). Size ranges of these worms are still being processed and results will be presented. Seasonality may play a factor as there were generally more worms present on urchins towards summer and fall. We also conducted experiments to measure the rates of feeding and growth of *F. commensalis* fed feces produced by *S. purpuratus* that were fed one of two different diets: *Macrocystis pyrifera* or a commercial aquaculture feed (Urchinomics pellets). The growth rate of *F. commensalis*, was 1.75% per day when worms were fed the Urchinomics fecal diet and was significantly faster (P = 0.028) than the growth rate of worms fed feces from urchins that consumed the *M. pyrifera* diet (1.02%). The feeding rate experiment of *F. commensalis* fed each type of urchin feces is in progress. Results will clarify the trophic ecology of the urchin-polychaete symbiosis, the potential effects of urchin diet on other detritivores that consume urchin feces, and the potential to use other polychaetes in Integrated Multi-Trophic Aquaculture systems as a means to manage urchin's fecal waste.

76 - DOES EELGRASS HETEROGENEITY AFFECT FISH PREDATION? A CASE STUDY USING ZOSTERA MARINA FLOWERING SHOOTS

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Structural complexity shapes predator-prey interactions in foundation habitats such as eelgrass. Research linking eelgrass structural complexity and predation typically focuses on the effects of shoot density or biomass on predator foraging and prey survival. Few studies, however, have tested the role of habitat heterogeneity (i.e. variety in structural type) in driving predator-prey interactions. We investigate how the morphological differences between flowering and vegetative eelgrass shoots affect the relationship between predatory juvenile giant kelpfish (*Heterostichus rostratus*) and their prey, grass shrimp (*Hippolyte californiensis*). Flowering shoots add surface area and heterogeneity to eelgrass beds by virtue of their branching structure, which differs from the strap-like leaves of vegetative shoots. We tested whether the ratio of flowering shoots to vegetative shoots affects (i) tethered grass shrimp relative survival in the field, and (ii) kelpfish predation rates on grass shrimp in laboratory mesocosms. The presence of flowering shoots in field plots increased the odds of grass shrimp survival, and the odds of survival were highest in high heterogeneity plots consisting of a mix of flowering and vegetative shoots. In laboratory mesocosms, shrimp survival rates were highest in flowering shoot plots, but also in vegetative plots in with enhanced surface area matching that of flowering shoot plots. Our results suggest that both heterogeneity and surface area are an important aspect of habitat structure that can affect epifaunal survival and mesopredator foraging.

77 - COMPARING VISUAL IDENTIFICATION AND DNA BARCODING OF STOMACH CONTENTS TO INCREASE THE RESOLUTION OF SHARK DIET RECONSTRUCTION

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Understanding the diets of animals can uncover their role in ecosystems which in turn helps to inform conservation and management strategies. Traditionally, studies evaluating the diets of marine animals have relied on visually identifying stomach contents. Many of the prey items found within the stomach can be significantly digested, therefore leading to high proportions of unidentifiable prey. With large percentages of unidentified prey often reported, a comprehensive view of the diet is unable to be obtained. To test whether DNA barcoding would increase the taxonomic resolution of visually identified prey we visually identified and barcoded the same prey items found in the stomach contents of four species of sharks commonly found off the coast of North Carolina: *Rhizoprionodon terraenovae* (Atlantic sharpnose shark), *Carcharhinus acronotus* (blacknose shark), *Carcharhinus limbatus* (blacktip shark), and *Sphyrna tiburo* (bonnethead shark). Of the four species of sharks analyzed, all but one species (i.e., bonnethead) contained a majority (as much as 84.6%) of "unidentified" prey (e.g., unidentified teleost fish), according to visual identification. However, only 5.9% of all prey samples were unable to be identified to species level using DNA barcoding. Therefore, we suggest pairing visual identification efforts with DNA barcoding to increase the taxonomic resolution and reduce error for shark diet reconstruction.

78 - INVESTIGATING FACTORS THAT INFLUENCE THE ULVA MICROBIAL COMMUNITY AND MERCURY ACCUMULATION

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The complex relationships between organismal hosts and their associated microbial communities, are an integral, but largely unknown factor in many systems. The microbiome of a host organism is attributed to benefitting host fitness, because the microbiome is adapted to the environment and host condition. Although microbes may make species more adapted to environmental stressors, stressors can also cause microbial shifts that disrupt the host-microbial relationship, lead to dysbiosis, and negatively affect host health. Seaweed from the genus *Ulva* accumulate toxins from the water column with seemingly little effects, but the mechanism driving *Ulva*'s tolerance to pollution remains unclear. It is possible the macroalgal microbiome may be responsible, and mercury uptake through microbes is environmentally and host driven. The current study builds off previous work investigating differences in collection location on mercury accumulation and bacterial community composition in *Ulva*. Here, estuarine and coastal *Ulva* were exposed to mercury in experimental microcosms with two temperature and salinity treatments. Total mercury accumulation will be analyzed using a DMA-80, species of *Ulva* will be determined by sequencing the *tuf*A gene, and *Ulva* microbial samples will be collected and analyzed using a metagenomics approach to sample the *Ulva* microbiome across time and in the environment. This work will provide insight into how site origin, abiotic conditions, and microbial changes in the *Ulva* holobiont influence mercury cycling through nearshore ecosystems.

79 - DIVING THROUGH HISTORY: EXAMINING THE EFFECTS OF SEA OTTERS ON DUNGENESS CRAB DEPTH DISTRIBUTIONS

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Here we explore if Dungeness crab (*Metacarcinus magister*) avoid predation from sea otters (*Enhydra lutris*) by seeking refuge in deeper habitat beyond regular sea otter diving limits as a mechanism for coexistence. Sea otters typically forage shallower than 60m and Dungeness crab depth range can extend beyond 200m, so it is plausible that crab may shift their distribution in response to predation. A 1996 study in Glacier Bay National Park and Preserve (GBNPP) where sea otters had been present for ~5 yrs documented higher catch per unit effort (CPUE) of Dungeness crab beyond 60m (3.9-4.0 CPUE) than at depths 0-20m (0.04-0.2 CPUE) or 20-60m (0.4 CPUE). Aerial sea otter surveys in GBNPP indicate the population grew from an estimated 893 in 1993 to 8,108 in 2018. We sampled Dungeness crab CPUE and depth distributions to examine whether this depth refuge persisted in 2023. We caught one crab at 20-60m depth (0.06 CPUE, n=18 pots) and 0 at both 0-20m (n=32) and >60m (n=10). We hypothesize that the previously documented depth refuge developed after intermediate (~5 yrs) exposure to sea otter predation during early colonization, but faded with sustained predation pressure and high densities of sea otters. These results, combined with our studies in areas with recently (<5 yrs) established sea otters where we also found no evidence of depth refugia, suggest that a depth refuge is not occurring. Our continued work will explore other mechanisms that may contribute to the coexistence of sea otters and Dungeness crab in Southeast Alaska.

80 - WHERE ARE THE WHALES? CONTINUED ACOUSTIC MONITORING EFFORTS OF CALIFORNIA'S CENTRAL COAST

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Understanding and conserving ocean ecosystems is a difficult, but important task made easier with bioacoustic technology. Although marine mammal monitoring efforts can be done with visual surveys, they are often lacking temporal information on a finer scale. Long-term passive acoustic monitoring efforts of critical migratory species can provide detailed information about the region's marine soundscape that is key to conservation efforts. The aim of our project is to establish a long-term bioacoustic monitoring station off the coast of central California and help close the gap in our understanding of marine mammal presence along the Pacific coastline. The goals put forth by the bioacoustic lab for this academic year include (1) determining probable species presence, (2) ascertaining temporal (day/night) variations of vocalizations, and (3) examining key differences in species and call type between two deployments from Fall 2022 and Winter 2023. These comparisons will be crucial to help develop a baseline understanding of seasonal and temporal variations of the soundscape in our region. We aim to implement various long-term deployments in order to gather more complete and consistent bioacoustic data in our local waters. These deployments and the subsequent analysis will contribute to large scale marine mammal monitoring and conservation efforts.

81 - ECOLOGY OF THE INTERTIDAL SEA ANEMONE ANTHOPLEURA SOLA: INTRASPECIFIC AGGRESSION, DISPERSION, AND COMMUNITY ROLE

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Anthopleura sola is a large, solitary sea anemone found from Baja California to Bodega Head, California, that can often be spatially dominant in rocky intertidal ecosystems. Here, we are conducting a series of studies which will shed light on the factors influencing the dispersion of *A. sola* in the intertidal zone, along with characterizing trophic and associational interactions surrounding *A. sola* in California rocky intertidal communities. First, we have created spatial maps of *A. sola* in two habitats at Coal Oil Point, Santa Barbara County, California. Analyzing this data set using spatial point-process methods indicates significant spatial regularity, apparently mediated by intraspecific aggressive interactions. Moreover, the extent of spatial regularity differs across the two habitats. This indicates that environmental factors may influence the dynamics of intraspecific aggression. To investigate the basis of both environmental and morphological factors influencing variability in aggressive dynamics, we are characterizing the nature of intraspecific aggression at the individual-level by staging intraspecific contest experiments. Also, to investigate the types of resources which drive intraspecific competition, we are quantifying the characteristics of the two habitats along with the trophic role of *A. sola*. Lastly, we have identified an association between the gastropod, *Tegula funebralis*, and *A. sola* and are investigating this association using behavioral preference assays.

82 - ECOSYSTEM SERVICES OF CULTIVATED BULL KELP (NEREOCYSTIS LUETKEANA) IN SITKA SOUND, AK

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UC Santa Cruz

Kelp aquaculture has experienced a recent rise in popularity for its potential to replicate some of the well understood ecosystem services of wild kelp forests. Few studies, however, have looked at how these ecological processes play out in cultivated systems. I use a case study to investigate the ecosystem services provided by bull kelp *Nereocystis luetkeana* aquaculture in a small-scale farm system in Sitka Sound, Southeast Alaska. Across three habitat types (kelp farm, open water, and wild kelp forest) in each of two experimental production sites in Sitka Sound, I measured three categories of ecosystem services: regulating (dissolved inorganic nitrogen (DIN)), provisioning (particulate organic material (POM)), and supporting (fish and zooplankton community structure) services. We report elevated nitrox and ammonium concentrations at both kelp dominated treatments across both sites compared to open water. There was no discernible variation in POM concentrations among treatments, and alternative methods are recommended. The variation in diversity among treatments differed among taxa, with lower zooplankton taxonomic richness but higher fish species richness at kelp farms compared to both wild kelp forests and open water. There was a strong association between breeding tubesnout *Aulorhynchus flavidus* and cultivated kelp that was not found in other habitats, which suggests this aquaculture system may be an ecological trap for this species. These findings suggest that these *Nereocystis luetkeana* aquaculture systems act as agroecosystems with unique ecosystem services.

83 - DEMOGRAPHIC OR EVOLUTIONARY RESCUE: HOW TO CONSERVE SICK POPULATIONS?

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Disease-induced population declines are an increasingly relevant concern in marine systems. Outbreaks of seastar wasting disease, eelgrass wasting disease, and abalone withering syndrome have contributed to considerable population declines of *Pycnopodia sp.*, *Zostera sp.*, and *Haliotis sp.*, respectively, in the East Pacific. In these same populations, there might be selection for disease-resistance, allowing for possible evolutionary rescue. Simultaneously, managers can reintroduce individuals into these populations to address demographic concerns. However, these reintroductions could have two impacts: (1) they can amplify disease, and (2) they increase gene flow by introducing individuals from populations without disease (i.e., non-resistant individuals). Here, we propose a mathematical model to describe the relative importance of demographic and genetic rescue for reversing disease-induced population declines. We will test our model across different management strategies (no reintroduction, single large reintroduction, multiple small reintroductions) and different dimensions of host evolution (resistance, tolerance, recovery framework).

84 - SPORO-FIGHT: COMPETITION INHIBITS SPOROPHYTE GROWTH AND PRODUCTION IN THE EARLY LIFE STAGES OF GIANT KELP

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UC Santa Cruz

Competition for space, light, and nutrients among newly settled individuals shapes population dynamics, connectivity, and community assembly. Giant kelp (*Macrocystis pyrifera*), which has experienced dramatic declines in parts of California, undergoes a dispersal and recruitment process that spans multiple microscopic life stages, complicating study of the ecological forces that shape growth and survival. In this study, we asked how competition shapes the survival and production of the early life stages of giant kelp by seeding spores at four initial seeding density treatment levels (1, 10, 100, and 1000 spores/mm^2) and tracking gametophyte, egg, and sporophyte densities for 39 days in the lab. We found that survival of gametophytes was relatively density independent; intermediate seeding density levels experienced slightly higher survival. However, the production and survival of sporophytes was highly density dependent; the lowest seeding (and thus competition) levels produced far more sporophytes per capita than high levels. Despite initial seeding densities spanning four orders of magnitude (1-1000 spores/mm^2), sporophyte densities converged across all treatment levels to ~0.3 sporophytes/mm^2. Sporophytes from the least dense seeding level grew faster than denser levels as well. This study broadens our understanding of how ecological forces shape the early stages of giant kelp and can inform kelp restoration work that relies on outplanting and seeding by providing optimal seeding densities for early sporophyte growth and survival.

85 - IMPACTS OF SHADING AND AGITATION ON THE MORPHOLOGY AND COMPOSITION OF BOTRYOCLADIA PSEUDODICHOTOMA

† Nijjar, J.K.*

Moss Landing Marine Labs

Land-based seaweed aquaculture using tumble-culture tanks as a method of propagation is a relatively new but promising approach to sustainable seaweed farming. *Botryocladia pseudodichotoma* (commonly known as sea grapes) is a unique species that can potentially be highly lucrative in the seafood market. Rather than typical blade-like structures, sea grapes contain briny, mucilage-filled vesicles, which make their commercial demand exceedingly high due to their novelty. Little is known about how environmental factors affect the morphological plasticity and chemical composition of sea grape vesicles, which are critical to their economic importance in the seaweed aquaculture industry. Initial observations suggest that *Botryocladia pseudodichotoma* vesicle morphology and texture vary significantly as abiotic factors fluctuate. Natural conditions tend to yield varying-sized elongated vesicles along the individual's stem-like structure. Meanwhile, water motion and shading are two variables that impact sea grape morphology in the aquaculture setting. Shading and water motion may be easily manipulated and are standard parameters controlled using shade cloths and tumble culture tanks. These parameters often maintain seaweed quality and establish the ideal environment for growth. However, due to insufficient research, the optimal growth conditions for *Botryocladia pseudodichotoma* still need to be discovered. The impacts of light inhibition and water motion on sea grape morphology and composition will be assessed through a series of shade and agitation treatments.

86 - HOW DOES A LOBSTER TRAP MODIFICATION FOR SEA OTTER EXCLUSION AFFECT THE CATCH OF CALIFORNIA SPINY LOBSTERS(*PANULIRUS INTERRUPTUS*)?

† Lopez Neri, M.D.S.[1*]; Harris, M.[2]; Needles, L.[1]; Liwanag, H.E.M.[1]

1- Cal Poly, San Luis Obispo 2- California Dept. of Fish and Wildlife

Southern sea otters (*Enhydra lutris nereis*) have been known to become incidentally trapped in various forms of shellfish and finfish traps. Recent research indicates that a modification to the entrance of lobster traps, in the form of a 5-inch rigid ring, can prevent sea otters from entering. Currently the California spiny lobster (*Panulirus interruptus*) fishery extends south of Point Conception to San Diego, including the Channel Islands, which overlaps with the range of the southern sea otter. A reduction in size of the lobster trap fyke ring from its current 6-to-7-inch diameter to a 5-inch diameter rigid ring could eliminate the incidental bycatch of diving sea otters. However, there is no information on whether this 5-inch rigid ring would affect the number of spiny lobsters caught, their size, and/or their weight. To investigate this, we will fish paired lobster traps with a standard fyke ring (n=15) and a modified 5-inch rigid ring (n=15) off the Santa Barbara coast and compare the catch per unit effort (CPUE) of spiny lobsters caught, their size, and their weight. If modified traps with a 5-inch rigid ring do not cause a significant reduction in these parameters, this modification can be a simple mitigation to potentially aid in the recovery and population expansion of the southern sea otter.

87 - EFFECTS OF DEPTH, HABITAT, AND ENERGY REGIMES ON NEARSHORE FISH COMMUNITY STRUCTURE IN CENTRAL CALIFORNIA

† Todd, J.W.[1*]; Starr, R.M.[1]; Lindholm, J.[2]

1- Moss Landing Marine Labs 2- CSU Monterey Bay

A wide variety of environmental variables, such as depth, habitat, and wave energy, can influence the composition and distribution of nearshore fish communities. Remote underwater video (RUV) systems, equipped with underwater cameras situated in stereo format, allow fish communities to be surveyed from smaller vessels than other imagery-based tools. These systems can be used to collect visual data to estimate fish abundance, size composition, and community composition. We are using stereo-video RUVs on the central coast of California to determine how nearshore, rocky reef fish communities change with respect to depth, habitat relief, and wave energy. In the summer of 2022, we conducted 165 individual drops of RUV systems. Within those drops, we were observed over 1,110 fishes belonging to 31 different species. We surveyed fish communities using stereo-video at three different sampling sites, four different depth strata, two different habitat types, and three different energy regimes. Results of this study should contribute to and/or influence study designs for long term monitoring of nearshore fish communities and their respective habitats.

88 - TO CLAM OR NOT TO CLAM: EXPLORING HUMAN INTERACTIONS AND KNOWLEDGE OF PISMO CLAMS (TIVELA STULTORUM) ON PISMO BEACH, CALIFORNIA

Key, C.E.[*]; Ippoliti, G.M.; Bills, M.; Moon, R.H.; Ruttenberg, B.I.

Cal Poly, San Luis Obispo

The Pismo clam (Tivela stultorum) is an important recreational fishery species on the California Central Coast. They supported a thriving recreational fishery until the 1980s when Pismo clam populations in California declined and the last legal-sized clam was found on Pismo Beach in the early 1990s. Recently, Pismo clam populations have been increasing and the poaching, or illegal take, of these clams also appears to be increasing. As human interactions with clams are becoming more prevalent with the population recovery, we wanted to understand how much the public knows about the fishing regulations and how knowledge varies with demographic information, such as zip code and age. We additionally sought to document how much the public handles Pismo clams without intentionally fishing for them. We conducted two surveys: a regulation knowledge survey where we surveyed beachgoers on Pismo Beach about their knowledge of Pismo clams and observational surveys, where we documented beachgoers interacting with clams. These surveys help illuminate what the public knows about this species and how much they interact with them. This information can help improve future public outreach and hopefully reduce illegal take.

89 - EMPIRICAL STUDIES ON CLIMATE RESILIENCE IN MPAS DEMONSTRATE EFFECTIVENESS IN LIMITED CONTEXTS

† Kelkar, M.[1*]; Couture, J.[2]; Ferraro, D.[1]; Bradley, D.[1,3]; Free, C.[1]

1- UC Santa Barbara 2- Conservation International 3- The Nature Conservancy

Marine protected areas (MPAs) have demonstrably improved local biodiversity and biomass, but their ability to maintain ecosystem function in the face of climate change is not well understood. Unlike when extractive activities such as fishing threaten marine ecosystems, MPAs do not directly regulate climate-driven changes within their borders. We sought to identify 1) which ecological features within MPAs should theoretically mitigate

negative ecological effects of climate change, and 2) the extent to which evidence exists to support their effectiveness. We conducted a systematic literature review of empirical studies on the effect of MPAs on local ecosystems impacted by climate change to identify cases in which MPAs mitigate known climate impacts, have no mitigation effect given climate impacts, or exacerbate climate impacts. Of the 59 papers that met our inclusion criteria, a roughly similar number found positive effects as found no effects, while less than 10% found negative effects. Positive MPA effects were mostly driven by trophic interactions; for example, some MPAs fostered higher top predator or herbivore abundance, which prevented the dominance of sea urchins (in kelp forests) or algae (in coral reefs) relative to reference sites when faced with temperature-driven community shifts. The findings from this study identify when MPAs are best-suited to be a climate solution, when MPAs are unlikely to be an effective climate solution, and where more information is needed to determine the MPA effectiveness.

90 - SPATIOTEMPORAL VARIABILITY OF ZOOPLANKTON COMMUNITY ASSEMBLAGES IN SANTA BARBARA CHANNEL KELP FORESTS

† Grant, S.N.*; Michaud, K.M.*; Miller, R.J.*

UC Santa Barbara

Marine zooplankton play a critical role in supporting kelp forest food webs and population connectivity of benthic invertebrates. However, the drivers of variability in zooplankton abundance and community structure have not been assessed in local kelp forests within the Santa Barbara Channel (SBC). There is strong seasonality in oceanographic conditions, nutrient delivery, and primary production within the channel, likely driving changes in zooplankton assemblages over time. To investigate the response of zooplankton communities in the SBC to temporal and spatial variability, we sampled zooplankton using vertical net tows at two inshore kelp forest sites and one offshore site seasonally over 6 days for two years. Preliminary findings suggest that community composition differs considerably between offshore and reef sites, and there is strong seasonality in density. Further analyses will assess how oceanographic conditions within and around kelp forests (i.e temperature, chlorophyll- a, and current speed and direction) explain variability in community assemblages.

91 - EFFECTS OF ROCKY INTERTIDAL SPECIES ON TIDEPOOL WATER CHEMISTRY AND MICROBIOMES

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The Pacific rocky intertidal has documented major losses of foundation species (i.e., anemones, mussels, and macroalgae) due to climate change and habitat loss. This shift in benthic community composition directly impacts microbial and biogeochemical cycling in isolated pools. Microorganisms play a critical role in nutrient cycling, yet their influences on biogeochemical patterns and ecosystem metabolism of rocky intertidal systems remains largely undescribed. This study provides the first co-occurring microbial and biogeochemical surveys across isolated rocky intertidal pools of varying species diversity at the Scripps Coastal Reserve in San Diego, CA. We have combined analyses of benthic composition and chemical measurements with modern molecular techniques to describe the microbial community assemblage in these pools. Changes in the concentration of inorganic nutrients such as nitrate and phosphate suggests that remineralization by microorganisms can modify these microhabitats during the isolation period. Enrichment of microbial families *Flavobacteria*, *Cyanobiaceae*, and *Thiotrichaceae* are seen in all isolated pools when compared to the adjacent coastal seawater, suggesting that intertidal foundation species create unique microbial-rich microhabitats. By developing a more comprehensive understanding of how foundation organisms influence microbial community composition and their function in isolated tidepool ecosystems, we can elucidate the impact of changing community structure on nutrient availability and net community metabolism of these intertidal environments.

92 - AFTERMATH OF SEVERE WINTER STORMS ON A COLONIAL TUNICATE INVADING THE ROCKY INTERTIDAL OF CA

† Chu, A.[1*]; Soberanis, T.[2]; Ono-Kerns, E.[1]; Chapman, E.[1]; Paguio, K.[1]; Davila, K.[1]; Young, S.[1]; Cohen, C.S.[1]

1- San Francisco State University 2- affiliation not listed

San Francisco Bay is heavily invaded, but few known invasive species have ranges extending to the relatively untouched outer coast of California. *Didemnum vexillum* (Dvex) is a yellowish, highly invasive colonial tunicate, an invertebrate that has spread to fouling communities worldwide. Dvex is abundant at Point Bonita, a National Park site at the mouth of the Golden Gate, demonstrating the spread of invasive species to the outer coast from more common bay and fouling community sites. After back-to-back atmospheric rivers depositing heavy rainfall across the span of five months during winter 2022-2023, Dvex at Point Bonita was significantly reduced; remaining colonies were thin, patchy, and heavily regressed. Similar Dvex population loss after heavy rainfall has been observed on the Irish east coast. These results suggest that salinity stress and mechanical removal of colonies on rolling boulders due to high wave energy had severe impacts on population abundance at Point Bonita. Data collected across survey trips before and after heavy winter storms revealed the extent to which they affected Dvex abundance at Point Bonita, documenting the gradual resurgence of Dvex populations during summer 2023. Several management strategies have been discussed, and spot treatments showed promise. As Dvex continues to spread along the outer coast from this crucial site, intertidal and subtidal ecosystems will be smothered by this highly invasive species. Understanding how increasing storms interact with invasive species at sites like these will help shape management plans.

93 - LONG-TERM MONITORING OF BRITISH COLUMBIA'S CENTRAL COAST ZOSTERA MARINA MEADOWS DEMONSTRATES STABILITY THROUGH HEAT WAVE EVENTS

Monteith, Z.L.*; Olson, A.M.; Prentice, C.; Van Maanen, D.; Bachen, K.; Froese, T.; Saldier-Brown, G.; Hessing-Lewis, M.

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The ability for coastal seagrass meadows to persist and/or recover through climate-related stress and disturbance is key to predicting and managing these habitats, and the ecosystem services they provide. Seagrasses form key nearshore habitats and provide a range of essential ecosystem functions including nursery habitat for marine fisheries, increased biodiversity, sediment stabilization, nutrient cycling, and carbon sequestration. Global trends indicate seagrass habitats have experienced declines from anthropogenic causes such as coastal development and

nutrient runoff, but local trends may vary in concert with local and regional environmental conditions. Thus, it remains critical to monitor the extent and health of seagrass meadows locally and globally. Essential Biological Ocean Variables (EBOVs) are standardized measurements that act as key indicators of ocean health and help inform policy and management in the context of increasing pressure on marine ecosystems. We present a long-term monitoring dataset of subtidal *Zostera marina* meadows on the Central Coast of British Columbia, Canada, spanning eight years (2015-2022), including multiple seagrass EBOVs and paired environmental variables. We compare how shoot density, flowering shoot density, and sheath length are each influenced by *in situ* temperature, and which variables best indicate overall health and productivity of seagrass meadows. Despite fluctuations in environmental conditions (including multiple atmospheric and oceanic heatwave events), seagrass meadows in this region remain relatively stable through time. EBOVs associated with stability include shoot density and seagrass bed area (extent), whereas flowering shoot density and sheath length, as a metric of seagrass growth, were associated with a lagged response to short term heat waves. This regional study demonstrates which EBOV parameters may be most appropriate as indicators of seagrass resilience to climate stress.

94 - POLAR PELTS; MORPHOLOGY AND THERMAL FUNCTION OF THE PELTS OF WEDDELL SEALS

† Raymond, S.R.*; Twisk, D.; Taylor, A.; Liwanag, H.

Cal Poly, San Luis Obispo

Weddell seals (*Leptonychotes weddellii*) are the southernmost breeding mammal on Earth and therefore face extreme conditions from birth. Initially, these Antarctic pups possess no substantial blubber layer. Unlike many phocid (true seal) pups, Weddell seals begin swimming in polar waters at around two weeks of age, relying primarily on their lanugo (neonatal) fur for thermoregulation. Because seawater is 25x more conductive than air, this is thermally challenging for young pups. We hypothesized that lanugo pelts would be morphologically distinct from adult pelts, and that these differences would make lanugo pelts superior insulators both in air and in water, as compared to adults. To test this, we compared the morphological characteristics (hair length, circularity, and density) and thermal function (thermal resistance) of Weddell seal lanugo (n=6) and adult pelts (n=5) in air and water. We found that lanugo hairs are longer and more circular compared to adult hairs. Lanugo pelts also had a higher fur density than adult pelts. As expected, both pelt types had reduced thermal resistance in water compared to air. Additionally, neonate pelts had higher thermal resistance than adult pelts in both conditions. These results demonstrate the importance of the lanugo coat for thermoregulation in Weddell seal pups, while they develop their blubber layer. This has implications for how climatic changes that accelerate melting of the fast ice could impact pup survival.

95 - HOW HEAT STRESS AFFECTS EARLY LIFE-HISTORY STAGES OF THE INTERTIDAL PORCELAIN CRAB PETROLISTHES CINCTIPES

Torres, M.*; Stillman, J.

San Francisco State University

Climate change increases the amount of thermal fluctuations in intertidal zone habitats. Extreme temperatures can have a significant impact on the reproductive fitness of Petrolisthes cinctipes and their embryonic development. A previous study found that some females produced broods tolerant to heat stress. To further our understanding, we used embryos from P. cinctipes to test whether there is a thermal threshold for energetic demands. We hypothesized that broods would experience a thermal threshold when exposed to extreme temperatures and show a decrease in reproductive fitness. Embryonic sensitivity of split broods (N= 7) was measured following a one-hour incubation at 14°C or heat shock at temperatures ranging from 28-34°C (N=12 embryos per temperature). Oxygen consumption rate, survival rate, and yolk consumption were determined throughout embryonic development. On average, survival percentage showed temperature sensitivity in broods of three females when exposed to 32, 33, and 34°C. Where embryo survival was significant at 34°C due to high embryo fatality after heat shock. In contrast, broods of three different females demonstrated less temperature sensitivity when exposed to 32, 33, 34°C. Low embryo fatality was noticeable for extreme temperatures as well as high survival for low temperatures.Females that produced tolerant broods had a survival average of 37% in exposure to temperatures >32°C, whereas in 3 females that produced sensitive broods, survival was 22% lower after exposure to those temperatures. Studying the impact of rising thermal fluctuations with extreme thermal limits, can emphasize the lasting effects on the reproductive fitness of P. cinctipes and supplement our understanding.

96 - GENETIC DIVERSITY OF NEMATODE PARASITES WITHIN AND ACROSS ROCKFISH SPECIES: THESE FISH HAD A VER-MILLION WORMS

† Curiel, G.E.*; Phan, V.T.; Smith, L.A.; Siegel, M.; Alter, S.E.

CSU Monterey Bay

Despite their generally small size, parasites have significant influences on the size and health of host populations. Parasites are able to influence population dynamics, behavior, and host evolution, and thus have a significant role in ecosystem diversity, including in marine systems. Rockfish are a group of marine fishes belonging to the family Sebastidae that are ecologically important as predators that can help regulate prey populations and maintain marine ecosystems. There is very little research done on rockfish parasites, especially comparisons of parasites between rockfish species, despite rockfish being an important commercial fishery. While it is thought that parasites found on rockfishes are similar between species, little is known about the genetic identity of these parasites. Parasitic nematodes were extracted from multiple rockfish species collected in the Monterey Bay area and their morphology and internal anatomy of the parasites were assessed. We extracted DNA from 25 nematode parasites across three host species (Sebastes constellatus, miniatus, paucispinis), and amplified and sequenced the CO1 mitochondrial locus from each to determine the relationships between nematodes within and across individual hosts.

97 - UTILIZING MOLECULAR METHODS TO IDENTIFY A CRYPTIC SPECIES IN THE STRIPETAIL ROCKFISH (SEBASTES SAXICOLA)

† Corleto, L.I.*; Aguilar, A.

CSU Los Angeles

The rockfish genus *Sebastes* contains high species diversity, and the center of its diversity is in the northeast Pacific. Cryptic species, groups of individuals within a species that are only distinguishable through genetic data, are important to study from a conservation and evolutionary perspective. The purpose of this project is to understand the genetic differences between cryptic lineages of stripetail rockfish, *S. saxicola,* as little is known about the geographic distribution of these lineages. We sequenced the cytochrome b gene of 84 individuals from 14 locations throughout the distribution of the species to characterize these lineages. We also compared the resulting sequences to published *Sebastes* cytochrome b data. Pairwise distances from the two *S. saxicola* lineages were greater than distances observed from other Sebastes sister species. This data provides support for the cryptic *S. saxicola* lineages as distinct species.

98 - SURVEYING *ZOSTERA MARINA* IN SAN PEDRO, CA TO DOCUMENT SEAGRASS REGROWTH

† Klishevich, A.*; O'Riordan, S.*; Abi-Hanna, N.; Devine, T.; LaGuardia, A.; Guerrini Romano, E.; and Bittick, S.J.

Loyola Marymount University

Seagrass beds are a vital aspect of healthy marine environments. In addition to protecting humans from impacts of climate change by sequestering carbon and stabilizing shorelines, they also serve as a nursery ground and food source for countless marine organisms. Over the past year, a combination of king tides and strong winter storms had a damaging effect on a known population of *Zostera marina* seagrass in the San Pedro Marsh of Los Angeles. In the summer season following the disruptive events, we aimed to document the health and regrowth of this *Z. marina* population. Over the course of six weeks, sampling of the marsh was conducted. Three sites were selected within the marsh, and transects were used to randomized quadrat areas for survey of seagrass and community characteristics. Shoot density, bedcover, maximum blade height, and percent algal cover were measured at each quadrat. Sediment samples were cored to analyze grain size and organic content. Results showed average height and shoot density differences were significantly greater at the end of the six week collection in comparison to the samples measured at the beginning of sampling season. Data from the sites illustrated a decrease of variation in maximum shoot heights as the grass grew over the course of the season. It was also determined that there was a negative correlation between shoot density and agal coverage, which should be further investigated to help inform seagrass restoration initiatives.

99 - PRELIMINARY EFFECTS OF FRESHWATER ON PURPLE SEA URCHIN AND KELP DYNAMICS AT THE MOUTHS OF RIVERS ALONG THE MENDOCINO COAST

† Storey, M.R.*; Jackson, D.G.; Moitoza, F.D.; Craig, S.F.

Cal Poly, Humboldt

Anecdotal observations have been made of persistent kelp beds at river mouths along the Mendocino coast has been of great interest since the dramatic decline of kelp beds in the mid 2010's. Our group at Cal Poly Humboldt has recently begun a project to test the hypothesis that purple urchin grazing is reduced at river mouths along the northern coast of California. Towards this goal our group has conducted SCUBA surveys at four river mouths and four references with little to no freshwater influence. Initial results show dramatic difference in urchin populations, with virtually no urchins present in the kelp beds at river mouths. Preliminary lab experiments show a strong reduction in urchin grazing with decreases in salinity, without much effect of decreased salinity on kelp growth. In addition there is little evidence of small juvenile urchins at river mouths possibly meaning there is a lack of recruitment at these sites. We plan to further test these hypotheses by continuing lab experiments and conducting temporal field surveys coupled with deployed conductivity loggers to measure salinity changes after rainfall as well as recruitment of urchins into brushes deployed at these sites in the near future.

100 - MORPH/SEX DIFFERENCES IN SIZE/COLORATION, AND THEIR RELATIONSHIP TO BEHAVIOR, IN A LIVEBEARING FISH

† Goel, S.*; Kasper, J.; Francisco, E.; Kwon, M.S.; Wedworth, J.C.; Kolluru, G.R.

Cal Poly, San Luis Obispo

Understanding polymorphism requires characterizing phenotypic differences between morphs, as they are likely to impact morph-specific selection pressures. This is especially true when morphs also differ in mating tactics or strategies. Most *Girardinus metallicus* males (plain morphs) are yellowish and sneak copulate, whereas rare, black morph males exhibit a black ventral surface and black gonopodium (copulatory organ), and perform a mating display that involves the gonopodium. We describe quantitative differences in hue, saturation and brightness of the body, body size, and gonopodium size between morphs. We found differences in coloration between male morphs, and examined how this correlates with male morph differences in aggression. We then characterized sexual dimorphism in body coloration, and evaluated whether plain morphs and females differ in the relationship between morphology and behavior (activity, aggression, and mating). Our results have bearing on the differences in sexual selection acting on each male morph.

101 - RESPONSES OF JAW MORPHOLOGY TO ENVIRONMENTAL CONDITIONS IN RED SEA URCHINS FROM AN URCHIN BARREN AND KELP FOREST

† Ly, N.*; deVries, M.S.

San José State University

The red sea urchin *(Mesocentrotus franciscanus)* and the purple sea urchin *(Strongylocentrotus purpuratus)* share a range along the west coast of North America. Both species are considered ecosystem engineers in kelp forests as they both can consume large amounts of kelp and decimate kelp forests. Additionally, *M. franciscanus* gonads are a traditional indigenous food source and important for commercial fisheries. Recent changes in ocean conditions and diminishing urchin predator populations have allowed California's kelp forests to transition into barren states devoid of kelp. A wide body of literature on *S. purpuratus,* shows that jaw length relative to test diameter increases as food availability decreases. Despite their prevalence in kelp forest communities, the relationship between jaw morphology and kelp abundance in *M. franciscanus* remains less understood. To explore this relationship, We examined jaw length in *M. franciscanus* collected from two sites in Northern California, Noyo Harbor, an urchin barren, and Portuguese Beach, a kelp forest in Winter 2021. Although we predicted that red urchins would show a similar

pattern to purple urchins, we found that jaw lengths of red urchins from Portuguese Beach were greater than those from Noyo Harbor (n=53, p=.01). This finding is contrary to what was expected, and suggests a different response of jaw morphology to kelp abundance in *M. franciscanus*. Although preliminary, our results provide a basis for understanding how jaw morphology, and therefore feeding behavior, might differ between red and purple urchins.

102 - THE EFFECTS OF LIGHT LEVEL, FOOD QUALITY, AND TEMPERATURE ON THE REPRODUCTIVE MODE OF THE WIDESPREAD SEA ANEMONE, DIADUMENE LINEATA

† Stern, T.*; Caccamese, L.; Galaviz Garcia, A.; Gonsalez, Y.; Steward, J.; Ryan, W.H.

Towson University

Partially clonal species are capable of both asexual and sexual reproduction. The adaptive value of such life cycles depend on when and why energy is allocated into each process. In the sea anemone Diadumene lineata, seasonal environmental changes mediate the switch in sexual and asexual reproduction with large bodies and gamete production in the spring followed by increased fission and reduced body sizes in the summer. However, simulating a spring-like temperature alone in the lab was insufficient to stimulate gametogenesis. Thus, we chose to investigate additional factors influenced by seasonality. In this study we set out to determine the proximate drivers of gamete production. Over two months, we cultured anemones in a 2x2x2 factorial cross of temperature, light, and food quality to determine which combination of factors stimulated gametogenesis. We measured each anemone's fission rate, body size, tissue density, and mesentery development to assess the contribution of each factor to reproductive behavior. While mature gametes were not produced in this experiment, we did detect the early stages of gametogenesis in the mesenteries of anemones in cold water with enriched food. Understanding the relationship between environmental conditions and reproductive investment can help us identify regions where sexual reproduction is likely contributing to populations growth and invasion success. Identifying drivers of gametogenesis is also important for inducing sexual reproduction in cultured anemones, which will facilitate a range of future experiments.

103 - EXAMINING GENETIC VARIATION OVER A LARGE GEOGRAPHIC RANGE IN A BIOLUMINESCENT FISH-BACTERIA SYMBIOSIS

† Neff, E.E.*; Gould, A.L.

California Academy of Sciences

Siphamia is a genus of symbiotically bioluminescent cardinalfish. There are currently 25 recorded species of *Siphamia*, but none are as broadly distributed as *S. tubifer*. To date, most studies of *S. tubifer* have been based in Okinawa, Japan, so relatively little is known about the diversity of these fish and their symbiotic association across their broad range. Within Okinawa it appears that the fish only associates with a specific sub-species of *P. leiognathi* called *P. mandapamensis*, but it is still unclear whether this holds true throughout the host's Indo-Pacific distribution. To understand this symbiotic association further, we are examining the genetic diversity of the host and symbiont from several locations, including the Philippines, New Caledonia, and the Red Sea using low-coverage whole genome sequencing on light organ DNA. Characterizing patterns of genetic differentiation across the hosts' range will help us understand population connectivity patterns of *S. tubifer*. We can characterize light organ symbionts from these new locations to determine the degree of specificity of the symbiosis over the host's broad range. Our preliminary analysis of more than twenty thousand single nucleotide variants indicate that *S. tubifer* populations in the Philippines and Japan are highly connected, which is most likely due to the Kuroshio current. Further, fish from the Philippines also associate with *P. mandapamensis*, indicating a high degree of specificity regarding this bioluminescent symbiosis. Overall, this reduced-complexity system can help us understand how specificity and stability of host-microbe associations are maintained over space and time, even in highly connected marine environments.

104 - THE EFFECTS OF HABITAT COMPLEXITY ON ANTIPREDATOR RESPONSES IN *CHROMIS VIRIDIS*

† Davis, D.[1*]; Sellers, A.[2*]; Viveros-Martir, R.[3*]; Williams, M.[4*]; Barber, P.H.[5]; Fong, P.[5]; Davis, A.[5]

1- Eckerd College 2- Virginia State University 3- CSU Long Beach 4- Howard University 5- UC Los Angeles

Positive species-species interactions are key relationships in many ecosystems, particularly coral reefs, where many species depend on live corals for shelter and protection from predators. However, these critical relationships are threatened globally by habitat loss, specifically loss of branching coral to myriad global environmental challenges. These losses may affect the antipredator behavior of fishes that depend on live coral, extending sheltering time when they are not feeding and putting them at risk as well. Our objective was to determine if the traits of coral hosts and the surrounding habitat affects the antipredator behavior of *Chromis viridis*, a site-attached coral mutualist. To quantify perceived fear of fish shoals associated with branching corals, we performed replicate trials measuring flight initiation distance and time to re-emerge from shelter for *C. viridis* on fringing reefs of Moorea, French Polynesia. We found that the perceived threat to shoals of *C. viridis* was reduced with larger host corals and increased with distance to the nearest branching coral or other hard substrate. Further, in areas with more complex and continuous reefs, we found *C. viridis* had a lower perceived risk measured as decreased flight initiation distance. Increased perception of threat also lengthened the time to re-emerge, extending the time in the coral when they do not feed. As their habitat is fragmented due to anthropogenic stressors, their antipredator behaviors shift to allocate more energy to sheltering from predators instead of feeding in the water column.

105 - SEASONAL DIFFERENCES IN BEHAVIOR BETWEEN LEPTASTERIAS SPP. IN EXTREME INTERTIDAL HABITATS

† Vaniotis, C.H.[1*]; Bland, R.W.[1]; Cohen, C.S.[2]

1- San Francisco State University 2- affiliation not listed

Leptasterias sea stars inhabit the rocky intertidal, an environment defined by physical stress in a constrained area where animals must adapt to periods of arid and submerged conditions. Physical stress such as temperature, sea level, and wave force are exacerbated by climate change through the increasing frequency and intensity of summer heat waves and winter storms. Sea star behavior may be a measure of intertidal predator/prey response to increasing physical stress. Additionally, detection of *Leptasterias* in Central California has declined with sea star wasting disease. *Leptasterias* spp. are limited dispersers which increases their potential for local adaptation and habitat partitioning. Behavioral

variation in *Leptasterias* collected in extreme intertidal zones suggest a potential tradeoff between tenacity to hold on in wave-exposed areas and agility to chase down prey in wave-protected areas. Previous studies conducted primarily during summer months found *L. pusilla* more commonly in wave-exposed and *L. aequalis* in wave-protected. I measured behaviors in winter months to compare to summer with the hypothesis that increased winter storm activity would displace stars and reduce behavioral variation. Indeed, less variation in righting was seen between habitats in winter. In addition, stars righted more slowly in winter than in summer, on average. In summer, there was a greater difference in attachment strength across habitats and wave-exposed stars continued to show greater tenacity over both seasons. *Leptasterias* seem to show less behavioral variation in winter months than summer months suggesting possible displacement from winter storms or response to physical stress.

Poster Session II

* indicates presenting author, † indicates eligibility for Best Student Paper Award

106 - INTEGRATING SCAT COLLECTION AND HAIR SNARES TO EXPLORE MARINE-TERRESTRIAL CONNECTIVITY ALONG THE GAVIOTA COAST IN CALIFORNIA

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Noninvasive survey methods are becoming increasingly crucial in field studies, as they allow for larger sample sizes, cover wider areas of research, and are beneficial in the long-term studying of elusive and rare species. This research project investigates the marine influence on the diets of large terrestrial mammals at the Jack and Laura Dangermond Preserve in California, aiming to understand their potential role as ecological connectors between the coastal and terrestrial environments. This study includes a comprehensive analysis of marine-trophic interactions by surveying scat samples collected from the six target species– coyotes (Canis latrans), bobcats (Lynx rufus), mountain lions (Puma concolor), American black bears (Ursus americanus), wild pigs (Sus scrofa), and mule deer (Odocoileus hemionus). Additionally, this study also includes an independent project to design and test different hair snare designs, with the goal of evaluating the effectiveness and capabilities of these hair snares for noninvasively capturing hair samples from the same target species. Three distinct hair snare designs were researched and constructed, and a 4-week deployment and collection plan was implemented to evaluate their performance. Isotope analysis of the hair samples will provide valuable insights into the feeding habits and trophic ecology of these mammal species. The integration of scat collection and hair snares provides a noninvasive approach to studying diet distribution, offering significant insights for wildlife management and conservation along the California Gaviota coast.

107 - FLOCS (FLOATERS-COUPLED-TO-SINKERS)-NATURE BASED SYSTEM FOR EXPORT AND STORAGE OF CARBON DIOXIDE AND OTHER COMPOUNDS

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Floaters-Coupled-to-Sinkers (FloCS) are hypothetical devices to export and store carbon dioxide in the deep ocean. FloCS are physically coupled “floaters” (i.e., photosynthetic organisms that float in the ocean photic zone to capture CO2 and convert into biomass) to “Sinkers” (i.e., calcifying organisms whose purpose is to gain mass and drag the “floater” through the thermocline to the deep ocean). To build FloCS systems with a positively buoyant “initial” phase and a negatively buoyant “terminal” phase, density and buoyancy metrics must be identified for potential “floaters” and “sinkers” across their life histories, however, these data are sparse in the literature. Here, wet weight measurements and volume data derived from the Archimedes volume displacement method were used to calculate density and buoyancy values for 10 potential “floater” and 10 potential “sinker” species in San Diego, California. We also demonstrated that this method is precise and accurate in measuring organism densities by comparing the density values obtained from the volume displacement method with the known densities of 30 distinct materials. Additionally, we used pressure vessels to simulate the conditions at sequestration flux depth (~1000 meters, 4°C) to measure the density of several “floaters/sinkers” and determine how density metrics will change as FloCS sink into the deep ocean. This work explores allometric patterns of marine organisms’ growth through changes in density and introduces a potential bioengineering solution to rising CO2 by exporting it into long-term carbon storage.

108 - NEW SPECIES AND A PHYLOGENETIC RESOLUTION OF THE DEEP-SEA FAMILY OCTACNEMIDAE (TUNICATA)

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Octacnemids are an exclusively deep-sea family of phlebobranch ascidians. They are unusual tunicates in that they have hypertrophied oral siphons with well-developed musculature and reduced pharyngeal sacs. These features allow octacnemids to have a macrophagous predatory feeding strategy. Collecting octacnemid specimens is difficult owing to their living at extreme depths and having fragile gelatinous bodies. Collections housed at the Scripps Institution of Oceanography (SIO) and Western Australian Museum (WAM) provided many well-preserved specimens for this research that were also suitable for DNA analysis. The main goals of this study were to describe new species from the genus Megalodicopia and to develop the first phylogenetic assessment of relationships within Octacnemidae. DNA data from Sanger sequencing, as well as whole mitochondrial genomes acquired via genome skimming, was combined with morphological data. This has allowed for the description of at least two new species of these remarkable animals.

109 - COMPARATIVE ANALYSIS OF THE GUT OF MARINE INTERTIDAL PRICKLEBACKS (FAMILY: STICHAEIDAE) FOR ACCUMULATION OF MICROPLASTICS

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Pricklebacks (*Stichaeidae*) are long, eel-like fishes that can be found around the coastal zones specifically near the shore and tidal habitats of Oregon to Baja, California. Pricklebacks are best known for dietary diversity, ontogenetic (the course of development of an organism from embryo to adult) dietary shifts, sister taxa with different diets, and convergent evolution of herbivory as well as independent intertidal invasion. Our project is focusing on three different intertidal species of pricklebacks to quantify the number of microplastics which have accumulated in the guts due to different dietary specializations. Here are the species we examined: *Xiphister mucosus* (ontogenetic shift from carnivory to herbivory), *X. atropurpureus* (ontogenetic shift from carnivory to omnivory), and *Anoplarchus purpurescens* (carnivores, no shift). Our samples were collected during the summer of 2022 from Friday Harbor Laboratories, Washington (48°32'45.2"N 123°00'43.6"W). Thirteen fish were collected and brought back to California State University of San Bernardino to be dissected which included taking out the stomach and intestine in which we measured gut length and standard length. We are currently working with the Moore Institute for Plastic Pollution Research in Long Beach, California to examine the types and quantify of microplastics present. This study was developed to address how much microplastics have accumulated in intertidal fishes, which gives us a better understanding of how humans have impacted our local marine communities.

110 - EXPLORING THE SPATIAL DISTRIBUTION OF THE PISMO CLAM IN THE MONTEREY BAY

† Jimenez, M.E.[1*]; Borromeo, I.M.[1*]; Patel, M.[2]; Haupt, A.J.[1]

1- CSU Monterey Bay 2- Bakersfield College

Over-harvested species can recover and form self-sustaining populations through well-enforced marine reserves, de facto closed fisheries, and careful recovery and management plans. Long-term datasets can inform such management, conservation efforts, and population trends by providing essential information, such as an organism's abundance and size. Dr. Ruttenberg's lab at Cal Poly San Luis Obispo (Cal Poly SLO) has been building such a dataset monitoring Pismo clams since 2014. The Pismo clam (*Tivela stultorum*) is geographically distributed in the sandy beach intertidal from Monterey Bay, CA, to Baja California, MX. As a result of overfishing and natural predation (e.g., sea otters), their population experienced a decline. Within the past decade, their population has increased throughout its geographic range. This past summer, we investigated if disturbances from California's large winter storms influenced the size and recovery status of Pismo clam populations. We found that the storm impacted their density but not size. This emphasizes the significance of long-term management considering anthropogenic and environmental disturbances. To prevent further declines of the Pismo clam, the findings of our study underline the importance of continuing monitoring and flexible conservation efforts. This project also hopes to add a mark-and-recapture method, which could provide valuable information for the clam's population dynamics, thus informing marine conservation initiatives.

111 - LEVERAGING A SYSTEMATIC REVIEW TO MAP AND IDENTIFY MULTIPLE STRESSORS TO SEAGRASS IN THE ZOSTERA GENUS

† Lyford, H.R.[1*]; Guerrini Romano, E.[2]; Sura, S.A.[3]; Bittick, S.J.[2]

1- UC Santa Barbara 2- Loyola Marymount University 3- UC Los Angeles

Seagrass meadows are ecologically significant habitats experiencing losses estimated above 50%. Thus, there is interest in the conservation of these marine macrophytes as they face possible global depletion. Various biotic and abiotic factors that influence seagrass may also be classified as stressors, such as nutrients and temperature. Many studies investigating seagrass focus on a single stressor, species, or geographic area. These studies are useful, but it can be difficult to apply their findings broadly. Our study met an imminent need for the consolidation of data from previous studies to discern knowledge gaps and identify trends in what is known about and most studied for certain stressors, species, and geographic regions for the seagrass genus *Zostera*. For this systematic review, our objectives were to 1) qualitatively assess the current state of literature focused on seagrasses within the *Zostera* genus and their stressors; 2) utilize data extracted from full-text articles to identify stressor frequencies, response variables measured, and occurrence of multiple stressor research; and 3) map the distribution, type, and number of studies globally. We utilized a standardized screening and data extraction protocol to review 7,331 abstracts and extract data from 1,098 full-texts. We found nutrients, temperature, and light were the most studied stressors, separately and in combination with each other. Geographically, we found hotspots of high research effort in the United States and Australia, while other countries with known seagrass populations had low article numbers, such as Canada and Chile. We created a centralized knowledge base that is a vital information source for stressor knowledge and management efforts of *Zostera*, and it will exist as an open access data source for continued public use and interpretation.

112 - ENVIRONMENTAL DNA DETECTS DIVERSE MARINE SPECIES AT POINT REYES NATIONAL SEASHORE, NORTHERN CALIFORNIA

† Holmes, A.E.[1*]; Killeen, H.J.[2]; Monuki, K.S.[1*]; Gonzalez, C.[1]; Ly, T.[1]; Pasparakis, C.[1]

1- UC Davis 2- Farallon Inst.

Characterizing species distributions is key to understanding ecological processes and the impacts of global change and human activity. Environmental DNA (eDNA) is a sensitive, non-invasive method for characterizing aquatic communities, but the capabilities for marine monitoring in Northern California are poorly characterized. The purpose of this study is to (1) assess eDNA detection for species of management interest and (2) use eDNA to evaluate biodiversity differences across Marine Protected Areas (MPAs) and unprotected sites. We collected samples for eDNA analysis from MPA and unprotected sites (n=6) at Point Reyes National Seashore, where management actions include fishery regulations and habitat restoration. Samples were sequenced on an Illumina MiSeq at a DNA barcode targeting fishes and other vertebrates. Preliminary analysis of ~2M DNA sequences identified over 50 species of bony fishes (26 families) and elasmobranchs (2 families), as well as marine mammals (4 families). The most frequently detected species were Northern anchovy and California halibut, an active recreational fishery. Rockfishes, lingcod, and cabezon, also species of management concern, were detected frequently. Ongoing analysis will examine spatial variation in biodiversity between MPA and unprotected sites; additional sequencing will apply a rockfish-specific DNA barcode to resolve species. Overall, this study demonstrates the capability of eDNA to detect diverse marine species in coastal Northern California, and indicates eDNA data may be a useful complement to existing monitoring of marine species.

113 - WHAT ARE THE EFFECTS OF EUROPEAN GREEN CRAB (*CARCINUS MAENAS*) ON BIVALVE COMMUNITIES IN COOS BAY?

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University of Oregon

The South Slough National Estuarine Research Reserve (SSNERR) has been monitoring the invasion of European green crab (*Carcinus maenas*) in Coos Bay, Oregon, where there has been a consistent increase in green crab abundance from 2016 to 2021. The effects of the growing population of green crab on the estuary ecosystem and significant local fishery species are currently unknown. European green crab are known to have a variable and omnivorous diet, including bivalves as the most common prey item. Invasion of green crab in Newfoundland, Canada was correlated with up to 95% decreases in abundance and biomass of fish communities, likely due to green crab destroying eel grass nursery habitat. In my PhD dissertation research, I will characterize green crab trophic ecology and their ecosystem impacts in the SSNERR. I hypothesize that green crab are negatively affecting the abundance of bivalve communities throughout the Coos Bay estuary. My specific aims are to (1) use fatty acids as trophic biomarkers to infer whether green crabs are consuming particular bivalve species, (2) to compare fatty acid profiles of experimental animals with wild caught green crabs and determine bivalve species preference, and (3) to determine the per capita impact of green crabs on the bivalve community. The specimen collection will utilize Fuki traps as these traps are the most effective for monitoring, yielding higher catch per unit effort (CPUE). This research will benefit the community of Coos Bay by determining the impact of an invasive species on important local fisheries.

114 - EFFECTS OF EELGRASS PRESENCE AND ESTUARINE ABIOTIC FACTORS ON OYSTER PHYSIOLOGY

Strope, L.T.[1]; Zacherl, D.C.[2]; Whitcraft, C.R.[3]; Carlin, J.A.[2]; Arre, C.[4]; Miller, L.P.[1*]

1- San Diego State University 2- CSU Fullerton 3- CSU Long Beach 4- Orange County Coastkeeper

Seagrass meadows and oyster beds are in decline because of anthropogenic climate change and human impacts on coastal habitats. In Newport Bay, California, restoration of both the native eelgrass (*Zostera marina*) and the native Olympia oyster (*Ostrea lurida*) was conducted. This paired restoration aimed to restore both species to functional population sizes, and return valuable ecosystem services to the estuary. However, sedimentation by *Z. marina* can smother oysters and prevent filter feeding, counteracting *O. lurida* restoration efforts. We studied the performance of *O. lurida* in three habitat types, *Z. marina* beds, *O. lurida* beds, and mudflats, and monitored temperature and rainfall effects. Performance was evaluated through variations in valve gaping and heart rates. Under stressful conditions bivalves close their shell valves, but in doing so, no longer feed or respire. When stressed, oysters increase or lower their heart rate to cut their energetic losses, with greater variations in heart rate relating to higher stress. The loss of feeding time and need to divert energy to maintenance could impact growth and reproduction. Over the course of 11 months, we found no effect of site or habitat on oyster physiology. There were seasonal effects, linked to rainfall, as oysters were more closed in the winter than other seasons. But closures were temporary and growth metrics were not affected by season, so rain events may only have short term effects. These findings support paired oyster-seagrass restoration in Newport Bay.

115 - EFFECTS OF CURRENT AND FUTURE UPWELLING ON RED ABALONE (HALIOTIS RUFESCENS) LARVAL DEVELOPMENT AND SURVIVORSHIP

Juarez-Gonzalez, J.E.[1*]; Litvin, S.Y.[2]; Lovera, C.[2]; Barry, J.P.[2]

1- CSU Monterey Bay 2- Monterey Bay Aquarium Research Inst.

Monterey Bay lies within the California Current system where many ecosystems are influenced by coastal upwelling. The high productivity of these upwelling regions comes in conjunction with naturally low oxygen and low pH levels, which periodically expose nearshore organisms to potentially stressful conditions. Environmental conditions in upwelling-driven ecosystems are affected by climate change and the dynamic relationship between temperature, dissolved oxygen, and pH may change and create increasingly stressful conditions. It is projected that temperatures will increase, while dissolved oxygen and pH levels will continue to decrease. We investigated the effects of current and future upwelling on the development and survival of larval red abalone, *Haliotis rufescens.* Our approach was to rear red abalone larvae in experimental chambers under four different temperatures, pH, and dissolved oxygen conditions, two of which simulated current and future upwelling, including daily diel fluctuations, and means of the current and future variable conditions. While survivorship was low across all conditions, differences in survivorship and development in the first days of the experiment were likely associated with constant vs. variable conditions with faster development in the warmer scenario.

116 - SOMETIMES SIZE DOESN'T MATTER: EVEN SMALL WASTING DISEASE LESIONS REDUCE SEAGRASS GROWTH AT THE WHOLE-PLANT SCALE

† Reiss, M.N.*; Stachowicz, J.J.; Brown, A.L.

UC Davis, Bodega Marine Lab

Eelgrass (*Zostera marina*) meadows provide key ecosystem services but are threatened by seagrass wasting disease, caused by the slime mold *Labyrinthula zosterae*. Infections produce lesions of necrotic tissue, but sometimes these are only a small fraction of total leaf area, leading to some doubt about the effect of this disease on plant health in nature. However, a small lesion at the base of an actively growing blade may have a plant-wide impact by reducing translocation of photosynthetic sugars or causing early leaf senescence. To test this, we compared photosystem activity before and after a disease lesion using MINI-PAM-II and observed that photosystem activity in green tissue distal to a lesion decreased relative to green tissue of the same age on an undiseased plant. We assessed the effect of this on leaf growth by comparing the effect of removing the leaf tissue distal to a lesion, with a healthy leaf with the same amount of tissue removed. We measured growth over 4 weeks and found that clipping had a negative effect on both lesioned and healthy plants, but had a more severe negative impact on healthy plants,

demonstrating that infection not only reduces the productivity of lesioned area, but also the rest of the leaf. Unlesioned plants also experienced quicker and more dramatic recovery after clipping versus clipped diseased plants. Together our results suggest that even a small lesion can affect plant growth and that plant-wide lesion area measurements may not scale directly with costs in plant growth.

117 - ANNUAL URCHIN RECRUITMENT ALONG THE MONTEREY COAST

Gil, M.W.[1,2*]; Haupt, A.[2]; Wise, L.[2]; Wrinkle, J.[2]

1- Monterey Peninsula College 2- CSU Monterey Bay

Kelp forests support rich biodiversity and many Californian industries rely on the health of these ecosystems. Purple sea urchins present a serious threat to California's coastal kelp forests. They feed heavily on kelp and increases in sea urchin populations combined with marine heat waves have led to rapid shrinking of kelp forests. We wanted to know what the seasonal patterns of urchin recruitment are and how they compare to past studies. Prior studies in southern California have found evidence that suggests high variability of purple urchin recruitment with peak recruitment between the months of March and July. To measure the rate of settlement of juvenile purple urchins throughout the year we attached brushes to ropes that were suspended in the water column. Sonicators were used to separate urchin larvae from the brush hairs and then filtered into collection vials. The contents of collection vials were examined under a dissection scope to record the presence of juvenile urchins. Dissection scope examination is a lengthy process and other outside factors such as the covid-19 pandemic have limited the amount of data points that could be collected. Because of these limitations we decided to examine the percent likelihood of urchin larvae being found by month. Initial results suggest a low rate of urchin recruitment throughout the year with a significant increase in spring. It is important to try and understand the factors which affect purple sea urchin recruitment so that appropriate action can be taken to protect kelp forests.

118 - USING EDNA METABARCODING AND CRISPR-BASED TECHNOLOGY TO INVENTORY VERNAL POOLS ON USFWS REFUGE LANDS

† Tate, A.D.[*]; Schreier, A.M.

UC Davis

Introduction California vernal pools are complex and assessing the biodiversity of the pools remains challenging due to multiple factors: the pool's ephemeral nature, the expertise needed to differentiate between certain morphologically similar invertebrates inhabiting them, and the fragility of resident species and the pools themselves. To aid federal wildlife managers in assessing the biodiversity of managed pools, we are developing environmental DNA (eDNA) approaches using metabarcoding. **Results** The results of this study are ongoing and are not ready for analysis as gene marker testing and field sample collection are in progress. **Goals** This study examines multiple questions about local vernal biodiversity and differences in sampling methods; 1) The ability of eDNA metabarcoding will be compared to non-invasively detect target taxa to current field methods. 2) An assessment of biodiversity within and among pools by estimating species richness. 3) Identifying significant differences in species composition among sampling methods and between restored and natural pools. **Significance** This study will aid managers in non-invasively monitoring and assessing biodiversity in vulnerable vernal pool ecosystems over multiple years. The development of a localized reference sequence database increases the accuracy of detections by metabarcoding. In addition, the development of assays for rapid field identification will reduce the time and effort spent surveying rare and sensitive wildlife. By providing managers with more efficient monitoring methods, this study will improve management's capacity to make data-based decisions to close the gap between understanding the ecosystem and implementing conservation actions often found in agency adaptive management cycles.

119 - EFFECTS OF MICROPLASTIC FIBERS ON THE IMMUNE SYSTEM OF THE PACIFIC OYSTER (CRASSOSTREA GIGAS)

† Adams, A.M.[*]; Bennitt, A.M.; WIlliford, S.T.; Adams, N.L.

affiliation not listed

Oysters are an important species for both commercial aquaculture and estuarine health. As ecosystem engineers, they create habitat for other estuarine organisms and are capable of filtering large volumes of water, which improves bay and estuarine water quality. The Pacific Oyster, *Crassostrea gigas*, is a cosmopolitan and important species that may be susceptible to anthropogenic pollutants such as microplastics. Microplastics (mps) are pieces of plastic smaller than 5mm in length, come in many shapes (fibers, angular pieces, etc.) and chemical compositions and are widely bioavailable in the marine environment. They have been known to induce changes in inflammatory response and energy metabolism and reduce lysosome membrane stability in *C. gigas*, among other physiological responses. We investigated differences in hemocytes among treatment groups after exposing oysters to environmentally relevant concentrations (0, 10, 20, 40 mps/oyster) of low-density polyethylene microplastic fibers for two weeks. Following exposure, we preserved hemolymph using 10% neutral buffered formalin and performed counts of total hemocytes. Preliminary results demonstrate that the average number of hemocytes increases across treatment groups in a dose-dependent fashion, indicating an immune response. To our knowledge, these data are the first to reflect if microplastic fibers induce an immune response in *C. gigas* and are contributing to the growing knowledge of how seafood species are responding physiologically to microplastic exposure.

120 - ECOLOGICAL RESTORATION USING INTERTIDAL FOUNDATION SPECIES: CONSIDERATIONS AND POTENTIAL FOR ROCKWEED RESTORATION

Smith, J.R.[1*]; Whitaker, S.G.[2,3]; Anderson, L.M.[4]; Fales, R.J.[5]; Sutton, S.G.[1]; Miller, R.J.[2]

1- Cal Pol, Pomona 2- UC Santa Barbara 3- Channel Islands National Park 4- UC Santa Cruz 5- UC Irvine

Rockweeds (Phaeophyceae; Fucales) are conspicuous brown seaweeds that can dominate temperate rocky intertidal habitats worldwide. These canopy-forming seaweeds are considered autogenic ecosystem engineers or foundation species, playing an essential role in ecosystem functioning and facilitating high biodiversity through modification of the physical environment. Like many foundation species globally, there has been a precipitous population decline in rockweeds due, in part, to their sensitivity to environmental change and limited capacity to disperse and

recover from disturbance. The ecological importance and long-term decline of rockweeds highlight the need to conserve remaining populations and reestablish or enhance depleted ones. Through robust scientific testing and a comprehensive review of the literature, we show that restoration of rockweeds can be successful, but that further work is required to improve our ability to implement scalable restoration efforts.

121 - GENETIC SEX DETERMINATION OF KELLETIA KELLETII

Richardson, G.*; Jaynes, H.; Hutchinson, K.*; Watt, O.*; Daniels, B.; White, C.; Davidson, J.; Peterson, D.

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Kelletia kelletii, a kelp forest gastropod, fisheries species, and historical non-model species, is increasingly becoming a subject of research for understanding its ecology and management. A method for determining *Kelletia kelletii* sex non-invasively (e.g., without dissection) is needed to support cross-mating experiments and other research on this species. We used genomics and molecular biology techniques to sex *Kelletia kelletii* non-invasively, with our methods requiring a small, easily obtainable sample of foot tissue. Dissection of whelks yielded samples for RNA extractions and allowed physiological sexing to be done with the purpose of determining controls. Whelk sex-determining genes were found through analysis of a previously assembled transcriptome, then aligned with sequences from model species to design primers for use in RT-qPCR. The genes used were SOX9, FOXL2, WNT4, SRY, and DMRT1. RT-qPCR was used to test for quantitative differential gene expression between males and females; statistical analysis showed that SOX9, WNT4, and DMRT1 had significant differences in expression between males and females, indicating that foot tissue can potentially be used to sex the whelks, although further testing must be done. Future directions of this project include designing primers for and performing RT-qPCR on genes involved in the whelk endocrine system, as these genes are likely functioning as direct indicators of sex in whelk foot tissue. These findings will help contribute to ecological and fisheries management research on *Kelletia kelletii*.

122 - THE DEVELOPMENT AND IMPLEMENTATION OF A NEAR REAL-TIME AUTONOMOUS CLICK DETECTOR

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1- CSU Monterey Bay 2- Naval Postgraduate School

Passive acoustic monitoring (PAM) has become a popular tool in marine mammal observation. This has become increasingly useful in cetacean observation due to the vocalizations produced to interact with each other and their environment. There are two primary analysis approaches in PAM: manual logging and automated detectors. While automated detectors are generally more efficient, they often require human supervision to achieve better performance. Moreover, both methods lack the ability to effectively analyze data in near real-time. Due to these limitations, there is a need for high-performance, computationally inexpensive, and near real-time autonomous detectors. We have developed a small-form factor detector that is capable of recording and reporting detection results in near real-time. Using acoustic data from the MBNMS SanctSound project, we gathered audio files containing Sperm Whale (*Physeter macrocephalus*) clicks while considering various factors such as acoustic propagation conditions and ambient noise levels. These audio files were used to train and test our detector in Python before implementing the code onto a Raspberry Pi computer. We reported performance metrics including precision and recall, and compared them with the PAMGuard sperm whale click detector to ensure a high performance rate. The developed detector has the potential to significantly enhance acoustic monitoring by enabling more efficient and effective detection and analysis of marine mammal vocalizations, contributing to a better understanding of ocean soundscapes and ecosystem health.

123 - EXAMINATION OF HEMOLYMPH OSMOLARITY IN THE MUSSEL M.GALLOPROVINCIALIS IN RESPONSE TO HYPOSALINITY CHANGES

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Loyola Marymount University

Climate change is bringing about frequent fluctuations in seawater salinity through increased evaporation and precipitation events. This change in the water cycle exposes the marine mussel, Mytilus galloprovincialis, to gradual and acute salinity stresses. M. galloprovincialis is a good model organism to monitor the impact of salinity changes associated with climate change due to its limited hyposalinity tolerance and role as a keystone species. The purpose of this studyis to examine the osmotic tolerance of M. galloprovincialis to variable salinity conditions through comparison of hemolymph osmolarity. Mussels were collected from Marina del Rey and Ballona Creek, CA and acclimated to control conditions (17°C, 35 ppt) prior to experimentation. Mussels (N = 12 per treatment) were exposed to salinity treatments (5, 10, 15, 20, 25, 30, 35, 40 ppt) for one week, and then hemolymph extracted from the posterior adductor muscle. Extracted hemolymph osmolarity (mOsm) was measured using an osmometer. Initial findings indicate that M. galloprovincialis is nearly isosmotic above 500 mOsm, and becomes a hyperosmotic regulator below 500 mOsm. Deviation in osmoconformation may indicate greater energy use under conditions of hyposmotic stress.

124 - YOU SHOULD SEE THE OTTER GUY: IMPACT OF SEA OTTER FORAGING ON PISMO CLAMS

† Mattioli, I.*; Bills, M.; Ruttenberg, B.

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Pismo clam (Tivela stultorum) populations were previously abundant on the California central coast before declining dramatically in the late 1970s and 1980s. However, recently their population has been increasing. The southern sea otter (Enhydra lutris nereis) was hunted to near extinction in the 1800s, leading to a dramatic reduction of their range, including their extirpation from Pismo Beach. Sea otter population has since been recovering and they are repopulating historic range locations including Pismo Beach in the 1970s, which coincided with the decline in clam populations locally. Since sea otters are an important predator of Pismo clams, we sought to explore the potential impact of sea otter predation on Pismo clam population abundance and recovery by conducting otter foraging surveys on three local beaches. Our preliminary results found

that sea otters are commonly seen at Pismo State Beach and Avila Beach, but are scarce at Morro Strand Beach. Sea otter diet consists of mostly Pismo clams at Pismo Beach, and is void of Pismo clams at Avila Beach. This data will help illuminate the impact of sea otter predation on Pismo clam populations and we hope it can help inform management practices to support both species' recoveries on the Central Coast.

125 - THE EFFECTS OF HYPERSALINE BRINE SOLUTION ON THE METABOLIC RATE OF PURPLE SEA URCHINS (STRONGYLOCENTROTUS PURPURATUS)

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affiliation not listed

The scarcity of freshwater for human use is increasing due to urbanization, pollution, climate change and the rapidly growing human world population. The reverse osmosis (RO) process underlying commercial desalination produces a hypersaline (70‰) brine solution which is typically discharged into the nearshore marine environment (typically 35‰). We became interested in how this dense brine discharge could affect coastal benthic communities. We focus on the purple sea urchin, a common species along the Central California coast, and one whose abundance has a large impact on kelp forest habitat persistence and habitat biodiversity. Here was examined how the concentration of hypersaline brine affects the metabolic rate of purple urchins. The metabolic rate was chosen as a general indicator of activity and growth. In the lab, the purple sea urchins were placed in respiration chambers to analyze oxygen consumption rate as a proxy for metabolic activity in response to various concentrations of laboratory-made artificial seawater brine solutions (15, 50, 80, 120, and 160‰). A linear model of regression between salinity and metabolic rate indicates no significant effect of salinity. This suggests that purple sea urchins may be metabolically resistant to fairly large changes in salinity- at least over short time scales (minutes to tens of minutes). This indicates that the purple sea urchins may be resilient to the changes in local salinity associated with desalination plume discharges.

126 - TEMPERATURE AND PHYSIOLOGICAL SCOPE FOR GROWTH OF THE BLACK TURBAN SNAIL, *TEGULA FUNEBRALIS*

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Rates of growth increase with temperature, yet organisms generally grow to larger sizes in colder environments. General reasons for this pattern are still unclear and, in this study, we examined in detail energetics underlying growth in an intertidal snail, *Tegula funebralis*. The physiological scope for growth was studied by taking measurements of energy acquisition and expenditure across a range of body sizes and temperatures. This was paired with field measurements of growth in both cool and warm water locations to evaluate whether the effects of temperature on bioenergetic processes can explain variation in growth form. We found that respiration was more sensitive to temperature than feeding rate was (Q10 respiration: 1.89; Q10 feeding: 1.50). Taken together these results suggest reduced physiological scope for growth at high temperatures. Overall, energetic scope for growth was highest at intermediate masses but eventually declines with large size. The effect of increased temperature was to shift this curve such that growth asymptotes at a smaller size. Our field data generally agree with these predictions in that asymptotic sizes are smaller in southern populations that experience warmer water temperatures.

127 - A GLOBAL REVIEW OF KILLER WHALE PREY AND PREDATORY INTERACTIONS

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Oregon State University

Killer whales *(Orcinus orca)* take a remarkable size range and taxonomic diversity of prey. Jefferson et al. (1991) provided the first and only summary of killer whale predatory interactions and prey species based on a review of published literature and eyewitness accounts. Despite being published over 30 years ago, their paper has been cited over 500 times (Google Scholar) and remains the only publication of its kind although research on killer whales has increased dramatically over the intervening three decades. In addition, since that original publication, the significance of ecotype variation and prey specialization among killer whale populations has been amply documented, along with the distinct possibility that there might be more than one species of killer whale. Killer whale ecotypes show differences in morphology, behavior, range, prey choice and/or social structure among populations. Interbreeding is not observed among ecotypes even when their distributions overlap. I am updating Jefferson et al. (1991) by conducting an exhaustive literature search on killer whale predation and prey species, including information on ecotype identification when known. My compendium and synthesis will provide an important summary of the current knowledge and will benefit future research on trophic interactions between killer whales and their prey species. I am collecting, quantifying, indexing, and analyzing the latest scientific knowledge on killer whale predatory interactions and offer insight on knowledge gaps and research questions to further killer whale science.

128 - AREAS OF HEAT RETENTION WITHIN MONTEREY BAY: A THERMAL REFUGE FOR JUVENILE WHITE SHARKS?

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Climate warming has shifted marine species' ranges poleward, including juvenile white sharks (*Carcharodon carcharias*). Previous research has documented a climate-driven range shift on a regional scale, but less is known about the fine-scale habitat selection of this endothermic predator at the cold edge of its range. Monterey Bay provides a unique study system with high spatial temperature variability. We analyzed high-resolution sea surface temperature obtained via satellite to identify persistent heat anomalies in relation to juvenile white shark abundance assessed from drone surveys. Two areas of interest were identified with consistent anomalously warm waters where the juvenile white sharks have been concentrated in recent years. With increased ocean warming juvenile white sharks may extend their range further north. We propose that they may be utilizing pockets of warm water as thermal refuges in regionally cooler areas and that their novel and dense concentration in these locations will have important top-down effects on local ecosystems.

129 - THE MICRO-SCALE AND MACRO-SCALE CHANGES OF ROCKY SUBTIDAL COMMUNITIES FOLLOWING THE OUTBREAK OF SEA STAR WASTING SYNDROME

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Linfield University

In 2014, Sea Star Wasting Syndrome (SSWS) killed an estimate of ~90% of sea star populations on the Oregon coast. Sea stars, such as *Pisaster ochraceus*, are keystone predators in benthic communities where they are known to impact the abundance of other benthic organisms. Communities in Netarts Bay and Yaquina Bay, Oregon were studied to examine the changes within the macro-scale and micro-scale benthic communities. To assess micro-scale changes, we used tunicate and sponge tissue samples collected in 2012 and 2013, before the SSWS outbreak, and tissue samples from 2021, following SSWS recovery. We analyzed the bacterial communities of these tissues using high throughput sequencing and microbiome bioinformatics analyses. To assess macro-scale changes, we used video transects that have been taken at both sites nearly annually since 2011 to monitor how the abundance of higher order taxonomic groups have changed over time. Percent coverage of these groups of benthic organisms were calculated using CPCe 4.1. Interestingly, microbiomes were not significantly different between the pre-SSWS and post-SSWS samples. Though our qualitative observations of the benthic community suggests that there were stark differences before, during, and after SSWS, our quantitative analysis has high variability in the data and only a few statistically significant differences. Though the micro-scale community was stable, macro-scale changes did occur throughout the years from 2011 to 2021, with the sudden decline of sea star populations in Oregon via SSWS as the most likely cause of these changes.

130 - USING SENTINEL-2 SATELLITE IMAGERY TO TRACK KELP CANOPY PATCH EXTENT AND PERSISTENCE IN MONTEREY BAY

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Santa Catalina School

Kelp forests provide a critical habitat for diverse marine species. Seasonal and annual variation in kelp forest canopy cover is typically based on winter swell and other environmental factors. Declines in kelp forest extent have been observed along the California coast. To better understand how kelp-dependent ecosystems respond to these changes, eight study sites in the Monterey Bay National Marine Sanctuary were investigated by looking at trends of kelp canopy cover. Sites were chosen based on historical kelp abundance and MPA status. Our study focused on whether all kelp patches in a region vary synchronously - or if individual interannual patch dynamics were idiosyncratic between 2015-2023. We used Sentinel-2 satellite imagery analysis to map canopy extent during late summer. We were also interested in determining if Sentinel-2 was a good substitute for more commonly used aerial or Landsat data. Most sites fluctuated in synchrony in all years except 2016. Some years, cloud cover impeded canopy detection. Overall, Sentinel-2 was an effective tool for evaluating kelp canopy trends and persistence, especially because it provided higher resolution (10m) than Landsat (30m) for patch analysis. These results and similar studies are essential in understanding temporal variation in kelp forest extent, and the resulting impacts on kelp-dependent species.

131 - THERMAL TOLERANCE LIMITS IN ACROPORA HYACINTHUS CORALS FROM AMERICAN SAMOA

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Old Dominion University

Rising ocean temperatures and an increase in the frequency and intensity of heatwaves threaten the persistence and functioning of the world's tropical reefs by directly increasing the mortality of the reef forming corals. A central question then is the extent to which corals will be able to adapt to this changing environment. If heritable, diversity in thermal tolerance among coral colonies may provide the raw material on which selection may act, yielding an increased population fitness over time. To better understand the diversity of thermal tolerances present within coral populations in the tropical Pacific, we used the coral bleaching automated stress system (CBASS) to phenotype over 300 colonies of *Acropora hyacinthus* from American Samoa (response to thermal stress). Tissue samples were also taken from each colony for whole genome resequencing, which will allow the association of genotypes to thermally tolerant phenotypes in a genome-wide association study (GWAS). This work will not only provide insight into the genetic basis of thermal tolerance, but enable the development of molecular markers for use in conservation and restoration efforts.

132 - A PEER-MENTORING CASCADE PROMOTES INCLUSIVE RESEARCH TRAINING AT THE COASTAL AND MARINE INSTITUTE LABORATORY

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In the United States, over 8 million college students are enrolled in two-year colleges, making up one third of undergraduates nationwide. Additionally, 69% of the population of community college students in California are from underrepresented communities. These students often lack the access to hands-on research opportunities that are available at four-year universities. Research experience enhances understanding of scientific concepts and connects students to a scientific network, making it a valuable opportunity for education and career advancement. To address a lack of research opportunities in our community, we created a mentored marine science research experience through the opportunity to work closely with graduate student researchers at the Coastal and Marine Institute Laboratory of San Diego State University (SDSU). We assembled 6 "research pods" , each composed of a graduate student mentor, an upper division student from SDSU, and a community college student, to create a near-peer mentoring group. We conducted pre- and post-program surveys to quantify student attitudes towards science careers, their identity as scientists, and their sense of belonging in science. Further, pre- and post-program surveys for the graduate mentors evaluated the effects of mentorship workshops on their mentoring competency. The survey results indicate favorable outcomes for participants.

133 - DEVELOPMENT OF PROCEDURE FOR COLLECTION AND ANALYSIS OF MICROPLASTICS IN SAN DIEGO BAY

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1- San Diego State University 2- San Diego City College

San Diego Bay is the second most polluted bay in the United States. Data is sparse on San Diego Bay microplastic dispersion trends such as vertical water column profiling and sediment concentration. We intend to explore any links between differential microplastic concentration and functional carbon sequestration by benthic organisms. This study intends to supplement existing data by examining patterns of microplastic aggregation specific to San Diego bay's macrophyte community. Using a plankton net, we formulated and executed a field collection protocol to satisfy environmental rigor and ensure negligible sample contamination. Following sample collection and purification, molecular analysis can provide comprehensive data about microplastic distribution. The findings obtained using this protocol will be applied in future investigation to characterize the cyclical interactions between microplastics and the marine atmosphere.

134 - IMPACT OF NUTRIENT ENRICHMENT AND HERBIVORY ON PHENOLIC DEFENSES OF A TEMPERATE INTERTIDAL SEAWEED

Devine, T.[1*]; Muranaka, M.[1*]; Gowton, C.M.[2]; Roe, J.[1]; Patel, S.[1]; Kenny, S.[1]; Bittick, S.J.[1]

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Silvetia compressa is a brown macroalga and an important habitat forming species in the rocky intertidal zones of California. Human caused nutrient enrichment can impact the prevalence of anti-herbivory defenses in brown algae. One of these defenses is the production of phlorotannins, a class of phenolic compounds. Phlorotannins bind to the gut of herbivores to reduce the palatability of the macroalga. Our experiment examined the impact of increasing nutrient concentrations on the presence of phlorotannins in *S. compressa*, and the resulting response of herbivores to nutrient enrichment and phlorotannin concentration. Algae were grown in tanks for 10-days under 4 differing nutrient regimes, ranging from 1-5 μM of NO3- and 0.1-0.5 μM of PO4-. After this nutrient exposure, algae of each nutrient regimen were exposed to treatments of zero, 15, and 35 herbivorous crabs for 10-days. Algal growth was measured before and after each experiment by weighing. Initial and final phlorotannin concentrations were measured using the Prussian Blue Assay, a reduction reaction, and by measuring absorbance following the reaction with a spectrophotometer. Phlorotannin was highest at an intermediate level of nutrients and crab herbivores preferred algae grown under high nutrient concentrations. This suggests that allocation of nutrients to phlorotannin production may not sufficiently deter herbivory on this alga and herbivory may increase as human-caused nutrient enrichment increases.

135 - REPRODUCTION AND RECRUITMENT OF POSTELSIA PALMEAFORMIS ALONG A GEOGRAPHICAL GRADIENT

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Oregon State University

Postelsia palmaeformis is a kelp species found along the western coast of North America, on rocky intertidal shores highly exposed to intense wave activity. Wave action is essential to their recruitment and life history cycles as it clears the mussel bed and allows *P. palmaeformis* to recruit to newly exposed surfaces. *P. palmaeformis* is foundational to the rest of the ecosystem by acting as a primary producer and modifying its surrounding environment to provide habitat for other species. Previous research has analyzed the distribution of *P. palmaeformis*, but the reproduction and recruitment (settlement of new individuals) of this species has received less attention. This project addresses that gap by examining the reproduction and recruitment density of *P. palmaeformis* at three capes along the Oregon coast during the spring and summer of 2023. Preliminary data indicates that *P. palmaeformis* recruits between March and June and reaches its reproductive peak in late August, without a significant difference between capes for either process. This is important because reproductive cycles in *P. palmaeformis* populations may impact the greater intertidal ecosystem.

136 - EXAMINING THE PORITES SPECIES PROBLEM: RESOLVING CORAL DEMOGRAPHY BY COMBINING MOLECULAR APPROACHES WITH CONSERVATION TECHNOLOGY

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Many species of Hawaiian corals display a variety of morphologies. Existing on a dramatic continuum, phenotypes of the reef-building coral *Porites* spp. include diverse growth forms, variable pigments, and different corallite sizes and shapes. Further, demographic questions arise when investigating the boundaries between individual colonies as *Porites* can integrate through fusion or hybridization and separate through fragmentation, physical disruptions, or partial mortality. To investigate these questions and offer increased resolution of population dynamics, this project examines the genetic structure and intraspecific relatedness of *Porites lobata* and *Porites compressa* colonies across Maui. Molecular approaches are being employed (i.e., genotyping, symbiont profiling) to characterize the reproductive strategies and species boundaries between these two key reef-building corals. Additionally, this study leverages a decade-long monitoring program that utilizes Large-area Imaging technology to map genetic structure onto 3D models made for coral reefs. These outputs allow us to easily quantify a population's vital signs (i.e. rates of growth and mortality, as well as colony survivorship and longevity). Importantly, fates of specific genets are being tracked throughout time, identifying potential trends in resilience associated with unique genotypes. The goal of this research is to better understand how reef demographic patterns relate to environmental stressors and use this knowledge to inform management decisions.

137 - ENEMY ANEMONES: THE AGGRESSIVE BEHAVIOR AND COMPETITIVE INTERACTIONS BETWEEN A NATIVE AND NEWLY INTRODUCED ANEMONE

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Marine invasions have become increasingly common as human activities link regions previously separated by natural barriers. These invasions pose substantial threats to biodiversity as nonindigenous species can impact native species through predation, disease, or competition. The sea anemone *Anthopleura hermaphroditica* is native to Chile, New Zealand, and Australia and was recently identified for the first known time in the

Northern Hemisphere in Tomales Bay, California. It has spread prolifically in some areas of this estuary, reaching high abundances and densities, but it is unknown how its introduction affects the co-occurring native anemone *Anthopleura elegantissima*. We ran a lab experiment where we staged one-on-one encounters between the two species and quantified aggressive interactions and competitive outcomes during one-hour trials held at two different temperatures: 12℃ and 18°C. We found that *A. hermaphroditica* was a weaker competitor, with *A. elegantissima* winning more encounters, especially when temperatures were warm. Additionally, *A. elegantissima* exhibited dominance in several other aggressive behaviors including inflating more acrorhagi (club-shaped tentacles), inflating acrorhagi faster, and initiating more acrorhagial contacts. Although these findings suggest that *A. hermaphroditica* may not pose a direct threat to the native anemone, its potential for rapid proliferation and spread may be a concern for estuarine communities in California.

138 - MICROFIBERS NEGATIVELY IMPACT LONG-TERM DEVELOPMENT OF THE CALIFORNIA PURPLE SEA URCHIN, *STRONGYLOCENTROTUS PURPURATUS*

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Microplastics are defined as particles less than 5 mm in length and range in shape (fibers, spheres, particles) and chemical composition (polyethylene, polystyrene, nylon, etc.). Polyethylene is found in some of the most common plastic products including plastic bags and disposable water bottles. In studies, including those performed in Morro Bay, microfibers are found in higher concentrations than other types of microplastics. The California purple sea urchin (*Strongylocentrotus purpuratus*) is a model and ecological indicator organism in California ecosystems that has planktonic embryonic and larvae life stages that are sensitive to pollutants. The objective of this study was to identify whether microfibers cause abnormal and delayed development on sea urchin embryos. *S. purpuratus* embryos were exposed to 60 µm microfibers in a control (0 mg/L), low (0.5 mg/L) and high (1.7 mg/L) treatments. We compared timing of the first cleavage stage and whether later development was on time and normal or abnormal every 24 hours for four days after fertilization. Exposure of embryos to microfibers did not significantly affect early cleavage rates ($p>0.05$). Nevertheless, exposure to microfibers decreased normal development. For example, high concentrations of microfibers caused significant abnormalities in development at 24, 72, and 96 hours ($p<0.05$). Low (more environmentally-relevant) microfiber concentrations caused significant abnormalities in development at 72 and 96 hours ($p<0.05$). Therefore, embryos exposed to microfibers experience negative consequences to development.

139 - QUANTIFYING SYMBIONT COMMUNITIES IN GALÁPAGOS *PAVONA CLAVUS*.

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Coral reef ecosystems support incredible amounts of diversity and provide ecosystem services worldwide. However, coral reefs are experiencing mass bleaching and mortality as a result of climate change. Bleaching can occur during extreme seawater temperature anomalies, such as those associated with El Niño-Southern Oscillation events (ENSO). The Galápagos archipelago provides a unique site for studying bleaching, with a long history of both heat- and cold-stress induced bleaching. Coral recovery has been strongest in the far northern region of the Galápagos where corals experience warmer, less variable temperatures compared with those in the southern region. To explore the possible role of endosymbiotic algae in setting coral thermal tolerance, we quantified symbiont communities of leaf coral *(Pavona clavus)* from seven sites throughout the archipelago using quantitative PCR (qPCR). Preliminary results (n=4-5/site) show that corals from the far northern sites of Darwin and Wolf contained both the heat-sensitive *Cladocopium* and heat-tolerant *Durusdinium* symbionts, with a greater abundance of *Cladocopium*, whereas corals from the southern islands contained only *Cladocopium*. These data suggest that symbiont communities may contribute to the greater thermal tolerance of coral from far northern sites. By elucidating mechanisms underlying stress tolerance in corals, we can make better predictions about the effects of future warming on coral communities and inform ongoing conservation and restoration efforts.

140 - MOBILE RECIRCULATING AQUACULTURE SYSTEM (MRAS) FOR INTERACTIVE ENVIRONMENTAL EDUCATION

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1- Cal Poly, San Luis Obispo 2- California Sea Grant

One approach to increasing aquaculture literacy among the general public is to provide aquaculture-focused educational opportunities at the highschool level. To achieve this goal, we have developed a mobile recirculating aquaculture system (MRAS) designed to be taken to highschools in historically underserved communities where students will be mentored through seaweed cultivation and learn basic principles of aquaculture. The MRAS will provide students with learning opportunities through hands-on learning projects where they will monitor growth rates of algae and water quality in the system. In the development of the MRAS, we have tested the potential to cultivate Ulva spp. and Sarcodiotheca spp. using artificial seawater. To date our trials have found growth rates ranging from a 50 - 100% increase in biomass over two-week periods with fluctuations related to nutrient concentrations. Here we present our system design and initial data from the system with the goal of encouraging other regions to develop similar systems for outreach and education. The final system will provide students with standardized procedures for measuring algae growth, where algae weight is measured weekly, sensors are calibrated weekly, and results correlated with fluctuations in water quality and water nutrient concentrations. Our ultimate goal is that the system will provide hands-on learning opportunities that inspire pre-collegiate students while fulfilling the Next Generation Science Standards with an emphasis on instrument calibration, water chemistry, seaweed growth, and data analysis.

141 - SPATIAL VARIATION IN BULL KELP (*NEREOCYSTIS LUETKEANA*) BLADE SIZE AND CELL TYPES

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Bull kelp, (*Nereocystis luetkeana*), is a foundational species of temperate rocky shore ecosystems. In recent years, there has been a 90% decrease in northern California bull kelp, though remaining populations tend to persist near freshwater inflows. Previous studies have shown that purple sea urchins, (*Strongylocentrotus purpuratus*), that can deforest bull kelp, do not exhibit a high tolerance for decreased salinity. This may put bull kelp at an advantage and may be why persistent populations are often found in areas with freshwater inflows. This study analyzes the different cell types found in the blade of bull kelp from different locations with varying freshwater input. Blades were collected from two sites, one with great freshwater input, and one with less freshwater input. The first site was Albion Cove in Mendocino CA with a large freshwater input from the Albion River. The second site was Timber Cove in Sonoma CA with a smaller freshwater input from Timber Cove Creek. Five blades from different individuals were collected from each site in July 2023. These blades were viewed and photographed under a compound microscope. These photos were analyzed using Image J software, where cellular area was measured for epidermal, cortical, and medullar cells. Blades collected from Timber Cove were measured to be smaller than the blades collected from Albion Cove. This preliminary data will be built upon by completing an experiment to analyze the adaptive ability of bull kelp at the cellular level to develop in water with increased temperature conditions and varying salinities.

142 - COMPARISON OF SHELL LENGTH FOR C. BATTELARIAE INFECTED AND NON-INFECTED B. ATTRAMENTARIA WITHIN ELKHORN SLOUGH AND JAPAN

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The Japanese mud snail (*Batillaria attramentaria*) is an invasive species introduced to North America's West Coast from Japan between 1920 and 1930. Although *B. attramentaria* is host to numerous trematode parasites within its native range, only one is known to infect the introduced population- *Cercaria batillariae*. The native population of *B. attramentaria* display a unique physiological phenomenon due to *C. batillariae* infection known as gigantism, which is hypothesized to be caused by this castrating parasite inducing continued growth after snail maturation. We seek to study the relationship between infection status and shell size within the Elkhorn Slough's (Monterey, Co.) *B. attramentaria* population and compare results to published data from populations in their native range. To study this, we collected *B. attramentaria* from three locations within the Elkhorn Slough and measured their shell length before examining their gonads for signs of *C. battelariae* infection. Based on a comparison of our current sample and published data from native populations in Japan, snails infected with *C. battilariae* in the Elkhorn Slough have shell sizes 12.22% larger than non-infected snails, while in their native range the shell size increase between infected and non-infected snails is 26%. As our introduced population has been isolated from the native population for over one hundred years, differences in trends seen in the native range as a result of *C. battelariae* infection may suggest the occurrence of localized adaptation in response to *C. battelariae* infection.

143 - POSITIVE EFFECTS OF A PREDATOR ON PREY GROWTH RATE THROUGH REDUCTION OF PREY FORAGING

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1- Cal Poly, Humboldt 2- Washington Dept. of Natural Resources

Many prey species change their behavior in response to predation risk in a way that leads to a reduction in foraging rate. Although predator-induced foraging reduction can and has been shown to have clear and direct negative effects on prey growth rate, theory and a limited amount of empirical work predict that predators can also have net positive effects on prey growth rate when the combined reduction in foraging by the entire prey population leads to a large increase in resource availability. We found support for this counterintuitive prediction in the results of a manipulative field experiment in which risk of predation from sea stars (*Pisaster ochraceus*) caused a net increase in the growth rate of marine snails (*Tegula funebralis*). Although the snails' increase in avoidance behavior and reduction in foraging rate in the presence of predators was likely to have negatively affected their growth, it was eclipsed by a positive effect on growth from a large increase in available resources. Further, this positive predator effect was dependent on prey size, predator abundance, and the temporal pattern of risk, highlighting the importance of ecological context in shaping the risk effects of predators. This study indicates that predator-induced reductions in prey foraging can have both negative or positive effects on prey growth, the sign and magnitude of which are dependent on relative predation risk, prey density, and resource dynamics.

144 - PREDATOR-PREY DYNAMICS OF SEMI-AQUATIC SNAKES OF THE SACRAMENTO-SAN JOAQUIN RIVER DELTA

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The Sacramento-San Joaquin River Delta is the primary water source for California's urban and agricultural development and provides critical habitat for many predators and prey alike, including garter snakes, obligate carnivores with a middle position in this aquatic landscape. Our goal is to document snake diversity and use a mechanistic approach to understanding their functional role and distribution in the ecosystems of the Delta. Using modified minnow traps and camera traps placed along irrigation canals on Staten Island in the heart of the Delta and a private wetland in the Northern Delta, we surveyed which predators and prey utilize these aquatic spaces. Prey captured were similar at both sites including invasive mosquitofish, red-swamp crayfish, and American bullfrogs. Similarly, predators observed using aquatic resources at both sites included native valley garter snakes, river otters, great-blue herons and great egrets. Prey counts, manual palpation, and self-regurgitation showed that valley garter snakes were primarily feeding on American bullfrogs, an invasive species, suggesting that they have a role in non-native population control. These results help illuminate the role these cryptic and complex snake species play in managing invasive pests, can inform management plans for their protection, and ultimately combat ophidiophobia in the public eye.

145 - TRENDS IN BIODEPOSITION ACROSS TIDAL HEIGHT AND IMPLICATIONS FOR COMMUNITY METABOLISM IN MYTILUS TROSSULUS AGGREGATIONS

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In the marine environment, ecosystem engineers modify local chemical conditions through biological processes and flow modifications. Mussel respiration drives changes in oxygen and pH, and aggregation structures impede water flow driving chemical gradients. Impeded flow can concentrate particulate matter (PM), either produced by mussels or externally derived, a process complicated in intertidal systems experiencing periodic flushing. Accumulated microbial community can influence the respiration signal of a mussel bed, as PM is broken down. We performed two multi-day experimental trials at Friday Harbor Labs using four tidal heights, to test the role of PM on community metabolism in live and mimic *M. trossulus* aggregations. The amount of accumulated PM and composition varied by tidal height and between aggregation types. Higher total accumulation was observed in mimic and live aggregations at the lowest height (0.30g and 0.45g avg per aggregation) and lower accumulation in aggregations at the highest tidal height (0.06g and 0.17g). On average, PM accumulation in live aggregations was 0.2g greater than accumulation in mimic aggregations. The organic composition of the PM was greater at higher tidal height. The microbial community present on the PM contributed to whole community metabolism, but not enough to match that of the live mussels alone. Variations in the tidal environment of the aggregations result in modifications to accumulated matter and though this matter is acted upon by microbes, the respiratory signal of the bed is largely indicated by live mussels.

146 - COMBING FOR CUTTLEFISH: A PARTICIPATORY APPROACH FOR CUTTLEFISH POPULATION MONITORING IN CORSICA (WESTERN MEDITERRANEAN)

† Luccioni, M.[*]

affiliation not listed

Cuttlefish are one of the most important species for small scale fisheries in the Mediterranean sea. Understanding spawning trends and indicators of cuttlefish health is especially important on the island of Corsica, where food sovereignty is of social and political importance. However, fishers and fisheries managers lack the resources to conduct regular and population-specific surveys to monitor population health. Here we present a participatory approach to cuttlefish monitoring using detailed daily records of cuttlebones washed up along a 10km stretch of coastline over 10 months. The resulting dataset allowed us to distinguish 3 species found in local waters, record traces of predation from different predators and observe the frequency of growth deformities. Furthermore, our size and frequency measurements point to distinct reproductive trends for different age classes over the course of the year. The timing of cuttlefish spawning appears specific to this locality, which implies that caution should be taken for management decisions made on the basis of general spawning data from other parts of the Mediterranean. This simple approach to data collection has encouraged public participation for improved ocean literacy, and is contributing to the development of a community-based monitoring scheme to inform future management decisions.

147 - IF YOU CAN'T HANDLE THE HEAT, GET OUT OF THE TIDEPOOLS: EVALUATING THE HABITAT SELECTION OF LINED SHORE CRABS

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As temperatures in many habitats continue to rise due to climate change, conditions in these habitats may become too extreme for many organisms to withstand. Our objective was to determine what habitats the lined shore crab (*Pachygrapsus crassipes*) is selecting during low tides to expand the groundwork for how future climate change may affect their distribution and thermal habitat selection. We used GoPro footage from field sites in San Diego, CA and Bodega Bay, CA to analyze the habitat selection *P. crassipes* when there are no humans present. Additionally, to see if there was a difference in *P. crassipes* habitat selection while we were there in person, we went to Harbor Island, San Diego, CA and quantified their habitat selection in addition to abiotic conditions on that day. We found that during low tide, *P. crassipes* chose crevices more often than pools or exposed habitats. We also found that *P. crassipes* still selected crevices more often when observed in person, but chose exposed habitats less often when compared to recorded footage, so both remote and in-person surveys are important. While our study has demonstrated that *P. crassipes* selects crevice habitats most often during thermally stressful low tide conditions, future studies will be imperative to understanding how habitat selection of *P. crassipes* may change in an attempt to cope with the inevitable effects of climate change and how that may affect their behavior and physiology.

148 - EFFECTS OF INTERTIDAL POSITION ON SURVIVAL AND RESPONSE TO HYPOXIA AND ANOXIA IN THE COMMON ACORN BARNACLE, BALANUS GLANDULA

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Sessile rocky intertidal invertebrates experience intermittent periods of air exposure due to tidal flux. Air exposure is longer and more frequent higher on the shore, therefore higher settled barnacles may be better adapted to utilize oxygen-limiting desiccation survival strategies, such as prolonged shell closure. This study explored whether tidal position dependent differences exist in the response to oxygen stress in the common acorn barnacle (*Balanus glandula*). We hypothesized that *B. glandula* from high tidal heights will be better suited to tolerate low oxygen stress than conspecifics from lower tidal heights. We compared responses of *B. glandula* from high and low intertidal positions to anoxia and hypoxia on survival, behavior (closed opercular plates, cirral beating, pneumostome formation), enzyme activity (lactate dehydrogenase (LDH), superoxide dismutase (SOD)) and tissue-lactate accumulation. Relative to barnacles from low positions, we found that barnacles from the high intertidal survive longer during anoxia, but do not exhibit tidal height dependent differences in behavior, enzyme activity, or lactate accumulation. High intertidal *B. glandula* survive environmental stress longer than low conspecifics in anoxia as well as desiccation and heat stress. The mechanism by which they survive, and the source of this disparity remains to be seen. Differences in intertidal position dependent stress tolerances highlight the potential importance of microscale stress heterogeneity in influencing species climate change tolerance and potential distribution patterns.

149 - PLANNING FOR RECOVERY: CHARACTERIZING ENVIRONMENTAL CHANGE IN HISTORICAL HABITATS OF PYCNOPODIA HELIANTHOIDES

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Sea Star Wasting Disease outbreak (SSWD) had a severe impact on sea star populations from Alaska to Baja California from 2013 to 2014 and led to local extirpation in many habitats. In some locations, declines in *Pycnopodia helianthoides* caused important ecological shifts, as overpopulation of sea urchins converted kelp forests to barrens. Patterns of Sea Surface Temperature (SST) change along the Northeast Pacific creates the possibility that locations that were once optimal (or sufficient) habitats for *P. helianthoides* may be approaching or exceed niche boundaries. We examined *P. helianthoides* populations before and after SSW outbreak in southern and central California locations to determine: (1) if *P. helianthoides* recovered in some locations more than others and (2) the temperature characteristics of these sites. We obtained *P. helianthoides* densities from PISCO swath surveys of kelp forests in Monterey Bay, sites facing the Santa Barbara channel, and ocean facing Channel island sites. Prior to 2014, *P. helianthoides* were common in all areas. After the SSWD outbreak (2014-2019), *P. helianthoides* were absent at southern sites and were rare to absent in the more northerly Monterey Bay sites. Data from NOAA buoys reveals that mean sea surface temperatures post-SSWD (2018-2022) were warmer than pre-SSWD (2008-2012) conditions in all three areas. Monterey Bay temperatures were cooler overall, however *P. helianthoides* populations have not recovered. Site specific temperature data and other factors are needed for future assessments of the ideal habitat to support successful restoration efforts of these important predators.

150 - EFFECTS OF WARMING OCEAN TEMPERATURES ON THE RELATIONSHIP BETWEEN *PENTIDOTEA RESECATA* , SEAGRASS WASTING DISEASE AND *ZOSTERA MARINA*

† Sparenberg, N.L.*; Brown, A.L.; Stachowicz, J.J.

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Eelgrass, *Zostera marina*, is a cosmopolitan foundation species whose populations are declining due, in part, to seagrass wasting disease (SWD) and ocean warming. Because warming can increase disease, it is important to understand how the dynamics of SWD will change with rising temperatures, for example how grazers mediate disease. Common seagrass grazer, *Pentidotea resecata*, preferentially feeds on diseased tissues implying they may reduce disease spread. The relationship between grazing, disease and temperature is unknown.We hypothesized that disease severity (area of disease lesions on a blade) and grazing show a unimodal relationship with temperature, where severity would be highest when grazing is lowest. To test this, we exposed eelgrass blades with and without isopods to five temperature treatments. Grazing was highest between 14-16ºC and lowest at 10ºC. Between 18-20ºC, disease severity was not significantly affected. To test whole plant response to grazing and temperature, we exposed diseased plants and grazers to an ambient and elevated temperature treatment and measured plant growth, grazed and diseased area on blades. At ambient temperatures, plants expended more energy into growth when grazers were present. At higher temperatures, grazing did not affect plant growth, likely because isopods were not grazing. Disease was not significantly affected by grazing or temperature. These experiments suggest that high and low temperatures limit isopod grazing, which can influence the effects grazers have on eelgrass growth, but minimally affects disease severity.

151 - THE INFLUENCE OF TEMPERATURE ON THE SEX RATIO OF NEREOCYSTIS LUETKEANA GAMETOPHYTES

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University of Washington

There has been a documented decline of the canopy-forming kelp *Nereocystis luetkeana* in the Salish Sea due to increasing water temperatures and nutrient limitation, among other stressors. The microscopic life stages of the species remain poorly studied yet are particularly vulnerable to environmental stressors. Past work has demonstrated that temperature significantly affects gametophyte growth, density, and survivorship in *N. luetkeana*. However, the impact of temperature on the *gametophyte sex ratio* of *N. luetkeana* is unknown. This study explored how temperature affects the proportion of female to male gametophytes of *N. luetkeana* through a temperature-controlled experiment. Zoospores were germinated in treatments across their thermal tolerance range (10-18°C). Cultures were maintained for 12 days, then gametophytes were imaged and scored by sex. We observed no difference in the mean ratio of female to male gametophytes between temperature treatments ($p=0.13$). However, we found that the gametophyte sex ratio was not the expected ratio of 1:1 and male gametophytes were consistently more abundant in the samples. These results suggest that higher water temperatures anticipated with global climate change are unlikely to significantly affect the development of female and male *N. luetkeana* gametophytes within their thermal range. Further research on the effects of environmental stressors on the microscopic phases of *N. luetkeana* is required to better understand population dynamics under future conditions.

152 - GETTING THE SHOT: THE EFFECT OF CAMERA USE ON SOUTHERN SEA OTTER (ENHYDRA LUTRIS NEREIS) DISTURBANCE IN CENTRAL CALIFORNIA

† Hamilton, S.N.[1,2*]; Bentall, G.B.[2]; Barrett, H.E.[2]

1- Johns Hopkins University 2- Sea Otter Savvy

The popularity of wildlife photography has substantially increased in recent decades, intensifying pressure on charismatic species. Previous research has shown that photos taken at close distances can elevate stress, cause behavioral changes, and sometimes lead to habituation to humans. Here, we determine if camera use by marine recreationists affects the distance maintained from sea otters at various Central California sites. From February 2021 to September 2023, scan-sampling methods were used by Sea Otter Savvy staff and community science members to collect observational data. We found that individuals with a camera had an average distance of 24.5 meters from sea otters while those without a camera were 41.3 meters away ($p<0.001$). Among camera users, those with a cell phone were 5.97 meters closer to sea otters on average than those with a single-lens reflex camera ($p<0.005$). These results demonstrate that cameras, especially on cell phones, significantly shorten the

human-otter distance and increase the probability of disturbance. Sea otters are particularly vulnerable given their high energetic demands and can have their survival or reproductive success comprised by human disturbance. Thus, individuals engaging in photography should maintain a respectful distance to achieve peaceful co-existence with sea otters.

153 - HUMAN IMPACTS ON CALIFORNIA SEA LIONS: A CASE STUDY ON ENTANGLEMENT AND GUNSHOT SKULLS

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Dominican University of California

Entanglements and gunshot wounds commonly affect pinnipeds worldwide and drastically impact their populations. Entanglement affects 2.3% of California sea lion (Zalophus californianus) population, of which primarily males are impacted (Allyn, 2020). California Academy of Sciences (CAS) houses the world's largest collection of California sea lion skulls with over 3,000 specimens. It features a prominent example of entanglement in one specific skull. This skull features extreme deformities of the mandible and teeth, from where the fishing line became embedded into the skull. Gunshots are often seen as a result of fisheries attempting to reduce competition. CAS database shows that 5.9% of California sea lions have been inflicted with gunshot wounds, which correlates to a study stating 4.2% of sea lions have been affected by gunshots (Lenting 2019). The gunshot wounds of the CAS specimens were predominantly found in the cranial or mandible portion of the sea lion's skull. It was mainly a single gunshot wound to either the cranium or facial portion. Of the 17 gunshot wounds to the cranium, 60% were to the parietal bone and the remainder were found in occipital and temporal bones. In comparison, there were only seven gunshot wounds to the facial portion that included the mandible and maxillary.. Entanglements and gunshot wounds are a common occurrence. Often the animal may die of another illness and past gunshots and entanglements are discovered. Collections, such as CAS are valuable to understanding the impact of human interactions.

154 - HOW STRESSED ARE YOU? EFFECTS OF BIOMASS LOSS AND DEPTH ON *MACROCYSTIS PYRIFERA'S* REPRODUCTIVE OUTPUT AND GROWTH

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Moss Landing Marine Labs

Disturbances occur in all ecosystems and are a driving force for reshaping or renewing species dynamics. The resilience of foundation species, as in kelp forests, relies heavily on few species as their detriment affects many functional groups dependent on habitat and nutrients. Central California's kelp forests rely on *Macrocystis pyrifera's* populations to recover after winter storms uproot holdfasts and test canopy or frond tensile strength through strong wave action. It is well documented that giant kelp canopies may be over 50% of a giant kelp's individual biomass, translocating necessary photosynthates to the subcanopy biomass. Moreover, the canopy is vital to new frond initiation, as well as sporophyll production for new growth in the individual and thereafter the population. The effect of biomass loss to spore release and the viability of spores has not been tested experimentally. This study is investigating light (through depth) and sub lethal biomass loss effects on spore viability and vegetative biomass. Five biomass manipulations were conducted on *M. pyrifera* individuals to provoke a stress response and a comparison between deep and shallow individuals. Giant kelp's induced response after biomass loss may show investment in either reproductive or vegetative biomass production. This study provides the link between the adult sporophytes and the vital microscopic stages which set a precedent for all kelp forest ecosystems as climate change varies storm severity and causes giant kelp to lose biomass.

155 - CAN ROCK CRABS ASSIST IN THE RECOVERY OF NORTHERN CALIFORNIA KELP FORESTS?

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Worldwide, kelp forests are threatened by regional abiotic and biotic stressors, including overgrazing by sea urchins. On the coast of California, purple sea urchins, *Strongylocentrus purpuratus*, are prolific grazers of kelp and with the regional extinction of their main predator (sunflower stars, *Pycnopodia helianthoides*), it is unknown whether any remaining mesopredators could partially fill the role of top-down control of purple urchin populations. Other known predators of purple urchins in northern California include rock crabs. Little is known about the importance of these predators in mediating purple urchin distribution, abundance, and feeding behavior. Yet, rock crabs have been shown to control urchin populations in Atlantic kelp forests. To better understand the predatory effects of rock crabs on purple urchins in northern California, we performed mesocosm experiments to determine the feeding rates of two common rock crab species (*Romaleon antennarium* and *Cancer productus*) on urchin barren and kelp forest urchins. Preliminary results indicate that rock crabs: (1) consume purple urchins at nearly two and a half times the rate of that reported for sunflower stars; and (2) consume barrens urchins at almost twice the rate of kelp forest urchins. Further, surviving urchins in the presence of feeding crabs reduced their grazing activity. These results suggest that stocking of rock crabs in urchin barrens could be used in conjunction with other methods as part of a temporary kelp restoration plan, until reintroduction of apex predators can be accomplished.

156 - DIVERSITY OF THE GENUS ANTHOPLEURA ON HOPE ISLAND MARINE STATE PARK IN WASHINGTON STATE

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The Evergreen State College

Several species in the genus *Anthopleura* have been found in Puget Sound. *Anthopleura artemisia* and *Anthopleura elegantissima* have been reported by the public using iNaturalist on Hope Island Marine State Park (Mason County) in southern Puget Sound beginning in 2019. The goal of this project was to understand the diversity of the genus *Anthopleura* on Hope Island and learn how they got there. We collected *A. elegantissima* , *A. artemisia* and a putative third species of *Anthopleura* on Hope Island during Spring of 2023. DNA from the three *Anthopleura* species was extracted, amplified and sent out for sequencing. We were then able to analyze 395 base pairs of the 16S mitochondrial rRNA gene

and 410 base pairs of the mitochondrial cytochrome oxidase subunit III gene using MEGA X and BLAST. Symbionts and nematocysts were compared using light microscopy and scanning electron microscopy. This research furthers our knowledge of the biogeography of *Anthopleura* and may provide insight into the immigration of coastal marine animals into estuaries.

157 - EXPLORING THE FEEDING HABITS OF DORYTEUTHIS OPALESCENS (MARKET SQUID) IN PUGET SOUND, WA

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Doryteuthis opalescens, or market squid, make up one of the most sustainable fisheries in the world. In California, there is a robust fishery for market squid and research on these animals is extensive. However, due to an almost non-existent commercial fishery of the same species in Washington State, little research has been done on this population. Partnering with the Washington Department of Fish and Wildlife (WDFW), who are conducting population counts and creel surveys on market squid, we are monitoring how squid diet changes as they make their annual migration into the Puget Sound. This research will be done by analyzing the gut contents of captured squid, and by comparing carbon and nitrogen isotopes of squid collected from Aug-Feb from two locations, Port Angeles and the South Sound. Understanding whether or not squid undergo a change in trophic level during migration will further inform us as to what patterns influence this population's migration behavior and what resources they rely on… By combining our data with our partners at WDFW, we can begin to understand the life history of Washington's squid population. The necessity to maintain sustainable food sources amidst a changing climate demands the monitoring not only of the California population of market squid, but the Washington population as well. Having a strong knowledge base for both populations is a necessity since the recreational harvest is rapidly increasing.

158 - A COMPARISON OF THE EFFECTS OF TEMPERATURE AND SALINITY ON THE ANTIOXIDANT ACTIVITY OF MYTILUSGALLOPROVINCIALIS AND M. TROSSULUS

† Zepeda Guinea, O.F.*; Vasquez, M.C.

Loyola Marymount University

Mytilus trossulus is a blue mussel species that is native to California but has contracted its species range due to environmental stressors and competition with the heat tolerant M. galloprovincialis. Studies have shown that hyposalinity and heat stress separately increase the activity of cellular antioxidants in Mytilus mussels. However, we do not know how antioxidant responses shift under combined stressors in M. trossulus and M. galloprovincialis. The purpose of our study was to quantify the enzymatic levels of antioxidants (superoxide dismutase, SOD; catalase, CAT) and oxidative damage (lipid peroxidation; LPO) in M. trossulus and M. galloprovincialis when exposed to multiple stressors. Mussels were exposed to combinations of hyposalinity (20, 25, and 34 ppt) and heat stress (17, 20, and 25°C) and then dissected so the gill tissue was isolated for antioxidant analysis. We found that there was an increase in SOD activity in mussels exposed to the mild temperature stress (20ºC) combined with hyposaline conditions for both species. M. trossulus under 25°C, 20 ppt showed the highest CAT activity. In addition, LPO in M. trossulus was the greatest under control conditions. M. trossulus increased both CAT and SOD at the most extreme condition (25°C and 20 ppt) while M. galloprovincialis did not, which suggests that it may use other methods to withstand multiple stressors biochemically. Thus, our study suggests that M. trossulus relies more on antioxidants to combat oxidative stress during multiple stressor exposure than M. galloprovincialis.

159 - ASSESSING THE ROLE AND VALUE OF MULTIPLE EDNA COLLECTION METHODS IN RECONSTRUCTING KELP COMMUNITY STRUCTURE

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1- Hopkins Marine Station, Stanford University 2- Liverpool John Moores University

Environmental DNA (eDNA) – with its agile and powerful way of detecting multiple organisms across habitats – is poised to be an efficient and inexpensive technique for making rapid biodiversity assessments. However, in many cases - especially in the sea - we do not know the best way to collect eDNA samples in order to comprehensively measure biodiversity. This study addresses this knowledge gap by comparing 3 distinct eDNA collection methods aimed at detecting the invertebrate community within kelp forests. Collection methods consist of cobbles covered in >30% crustose-coralline algae (CCA), kitchen sponges scrubbed on similar cobbles, and kitchen sponges that were scrubbed on general CCA-covered surfaces (n = 10 each). We find that while the three methods often return similar community compositions, certain methods amplify different aspects of the kelp forest community. Specifically, we find that both sponge methods pick up more biodiversity than cobbles, but there were a greater number of species found only in cobble samples than in the cobble-sponge and CCA-sponge samples (55 unique species vs. 43 vs. 15, respectively). We also found that there was similar overlap between cobble and cobble-sponge samples (312 shared species), and between cobble-sponge and CCA-sponge samples (302 shared species). There was the least amount of species overlap between cobbles and CCA-sponge samples with only 247 shared species. We discuss these results in light of future studies and monitoring efforts aiming to capitalize on the goals and promises of this technique.

160 - KELP IN SPACE: PATHWAYS BETWEEN ECOSYSTEM STATES

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In quantum mechanics, Hilbert spaces delineate system states using infinite vector spaces. In ecology, phase space has traditionally served as a concept, leveraging basins of attraction to depict how systems gravitate toward stability. However, kelp forest ecosystems don't necessarily stabilize into one state; they continuously adapt to changing environmental conditions and human interventions. Incorporating basins of attraction into a Hilbert space framework, we aim to unravel kelp forest trajectories to identify optimized measures for their recovery and resilience.The concept enables the integration of dynamics like superposition, suggesting that kelp forests might exist in intertwined states. For example,

oscillating between recovery and degradation, contingent on evaluation methods and aimed outcomes. Our central question is:Under what conditions will kelp forests optimally recover or transition to a desirable state? We invite attendees to use the QR code, sharing insights on ecosystem drivers, refining our understanding of these pathways.

161 - SPECIES COMPOSITION OF PHYTOPLANKTON VARIES IN MARINE HEAT WAVES

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Phytoplankton are primary producers in all ocean ecosystems and thus an important food source. A change in phytoplankton abundances could impact the health of coastal ecosystems. Different species of phytoplankton have different compositions in their fatty acids, which determines how these phytoplankton contribute nutritional value, the food quality, to higher trophic levels. Nutrients at the ocean surface become impacted by ocean conditions such as water column stratification. The species composition of phytoplankton, as well as the food quality, adjust to these changes. Marine heat waves disturb the species composition of phytoplankton,which could affect food quality. Remote sensing is a cost effective way to detect phytoplankton changes over large distances. The U.S. west coast from 2010-2020 is studied to observe how marine heat waves cause changes in phytoplankton species assemblages. The taxonomic groups of phytoplankton are identified and the food quality index calculated. It is likely that a shift in phytoplankton species assemblage is affecting the food quality an ecosystem receives. I processed and analyzed MODIS Aqua satellite data to identify phytoplankton taxonomic groups and their nutrition during a marine heat wave disturbance. It is expected that prokaryotes will thrive in warmer waters brought on by a marine heat wave, but nutritionally rich diatoms will decrease. Prokaryotes have less nutritional value than diatoms so an ecosystem could receive less nutrition. A shift in food quality at the base of the food web could alter what higher trophic species can be supported, and potentially guide stock assessments for fisheries.

162 - POPULATION CENSUS OF THE NORTHERN ELEPHANT SEAL WITH UNMANNED AERIAL VEHICLE

Springer, O.E.*; Fiskum, E.M.; Liwanag, E.M.H.

affiliation not listed

Piedras Blancas in San Simeon, CA is home to the largest mainland breeding colony of northern elephant seals (Mirounga angustirostris), estimated at over 25,000 seals. The Vertebrate Integrative Physiology (VIP) lab at Cal Poly conducts regular surveys of the seals, to estimate the population and track trends throughout the year. Accurately estimating population numbers using ground surveys is a challenge. The natural camouflage with the environment allows for seals to hide from view when a researcher may be counting from a peripheral or level perspective. The use of an unmanned aerial vehicle (UAV) can improve the accuracy and efficiency of our population census for the Piedras Blancas colony. When deployed, the UAV follows a pre-programmed flight pattern to take overlapping aerial photos of the entire beach. Once these photos are collected, they need to be stitched together to create a single image per beach before they can be analyzed to generate seal counts. Since 2021, the VIP lab has collected hundreds of aerial photos, and our team has gone through a stitching and tagging process to create an overall census of the Piedras Blancas northern elephant seal colony. We are analyzing the images for comparison to our concurrent ground surveys, to determine whether the use of a UAV is in fact increasing the accuracy of our seal counts. In collaboration with Dr. Alex Dekhtyar's COMPSCI Lab, we are generating data for the development of recognition software that will use artificial intelligence (AI) to enable automated surveys of these tagged drone images.

163 - BABY CRABS ON THE MOVE! TRACKING LARVAL ABUNDANCE OF DUNGENESS CRABS AS A PROXY OF ADULT POPULATION IN THE SALISH SEA.

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Dungeness crabs (*Metacarcinus magister*) are the most valuable commercial species in Washington state making them economically essential to state and tribal communities. Recently, there have been sharp declines in adult crab catch, resulting in the closure of the south Puget Sound fishery. Previous research has shown larval abundance is a clear driver of adult yield in other regions, but many gaps in research remain in the Salish Sea. Our research aim is to describe the spatial and temporal larval distribution in order to aid in restoration efforts and predict harvest limits. Through Pacific Northwest Crab Research Group (PCRG), simple light traps are deployed across the Salish Sea from mid-April to September for three consecutive years. Data was collected four days a week and includes counts of Dungeness crab at various larval stages, presence of other species of interest, and environmental information. From the data collected thus far, patterns in Dungeness larval abundance–specifically seasonal pulses–are evident throughout the Salish Sea. We are continuing to gather data on how ocean surface temperatures correlate to Dungeness crab size morphology in the megalopal stage. Additionally, we are creating a species level identification guide of all larval crab caught in the trap through detailed documentation of individual characteristics of each organism with confirmation of species identification through genetic barcoding at Seattle University. Our results will inform the rest of the PCRG and improve the reliability and impact of the larger network.

164 - DO NATURAL HABITATS SUPPORT BETTER BIVALVE HEALTH RELATIVE TO HUMAN-INTRODUCED HABITATS?

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affiliation not listed

Estuarine habitats worldwide have been extensively modified by human-introduced structures such as seawalls. Human-introduced structures may favor non-indigenous species (NIS), but few studies have directly compared species health (i.e. condition index) on various habitat types. NIS Mytilus galloprovincialis is a dominant space-occupier on seawalls throughout Southern CA estuaries including Newport Bay. In a preliminary study, it had better conditions on natural cobble vs. human-introduced seawall (2-way ANOVA, site*habitat, p=0.0001) but tidal elevation was not controlled, confounding our ability to discern a habitat effect. Lower tidal elevation should improve species condition due to longer immersion*

*time, so for this follow-up study, we hypothesized that condition index (CI) would vary both across habitats and among tidal elevations. M. galloprovincialis were collected from a seawall and from cobbles at a site in upper Newport Bay, CA, and on the north and south-facing surfaces of an outfall pipe in San Diego Bay, CA, while recording tidal elevation for each individual. M. galloprovincialis experienced a nominally significant habitat*elevation interaction (2-way ANOVA, elevation*substrate, p=0.0595) with higher CI at lower elevations on seawalls only, and higher CI on cobble versus seawall but only at higher tidal elevations. Data from the outfall pipe are still being processed. Understanding habitat and tidal elevation effects on the health of a broader selection of both native and non-native bivalves will inform future management decisions about the use of natural and anthropogenic habitats.

165 - SEA OTTER FORAGING BEHAVIOR IN AN EXPANDING POPULATION IN MORRO BAY, CA

Chevalier, Z.*; Johnson, L.*; Lopez-Neri, M.; Landry, E.; Mayer, S.; Diaz, D.; Bentall, G.; Needles, L.

affiliation not listed

Long-term ecological monitoring can help inform potential factors influencing recovery of at-risk species. The southern sea otter (*Enhydra lutris nereis*) remains at risk despite intensive management efforts. Re-establishment of sea otters into historically occupied habitats is of primary interest to managing agencies and understanding changes in otter prey composition can provide information about the diet, health and carrying capacity of otter populations. While there is substantial data on sea otter foraging in coastal habitats, little is understood about characteristics of foraging during expansion into estuaries. In Morro Bay, CA, the otter population has increased in the last twenty years. However, until recently, otters primarily occupied the region towards the mouth of the bay and were infrequently observed in the back part of the bay. To understand spatial and temporal patterns in sea otter foraging, we conducted foraging observations of otters at different areas within Morro Bay. We found differences in prey composition between the mouth and back bay with crabs comprising a greater percentage of sea otter diet in the back bay. These findings are consistent with other studies in which otter diet shifts from primarily epifaunal invertebrates to more infaunal species as otter populations in an area increase. As otters expand into the salt marsh, we are also assessing their foraging behavior in this novel habitat. Our study can help inform managers by predicting sea otter foraging behavior during natural or facilitated range expansion into estuarine habitats.

166 - THE EFFECTS OF FLOODS ON BENTHIC MACROINVERTEBRATE-BASED BIOASSESSMENTS OF THE SAN ANTONIO RIVER

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CSU Monterey Bay

Benthic macroinvertebrates (BMIs) are often used as biological indicators of stream water quality, but are also impacted by naturally occurring floods. To assess a stream's ecological health, a bioassessment approach is taken to observe the extent of stream alteration from floods. The risk of large, damaging floods is worsening as climate change exacerbates these events. Increased temperatures cause more rain and snowfall, resulting in more frequent and vigorous flooding. Although it is expected that large floods have a negative relationship with freshwater ecosystems, little is known to what degree floods alter assessments of ecological health. To examine this, we compared California Stream Condition Index (CSCI) scores from San Antonio Watershed after winters with and without significant flooding to determine if flooding events affect bioassessment scores. This research aims to better understand how stream bioassessment scores are impacted by flooding. It is hypothesized that the amount of BMIs and CSCI scores will be lower during flood years due to scouring of benthic macroinvertebrates. Stream quality is important to assess after extreme stressors to understand potential for lasting environmental impacts. Research in this area is critical for us to understand the effects of floods on freshwater ecosystems as they are worsening with climate change.

167 - THE EFFECTS OF TIDAL ELEVATION AND WIND/WAVE EXPOSURE ON OYSTER RECRUITMENT IN SAN DIEGO BAY, CALIFORNIA

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CSU Fullerton

Human introduced habitats such as seawalls and pier piles in California coastal areas have led to increased erosion and shoreline loss. Oyster restoration may reduce shoreline loss by reintroducing complex structure that slows wave action. The Port of San Diego installed spherical concrete Living Shoreline structures ("reef balls") on the mudflats of the Chula Vista Wildlife Reserve in San Diego Bay to protect shorelines while also increasing native oyster (Ostrea lurida) populations and discouraging recruitment by non-native Pacific oysters (Magallana gigas). I surveyed the reef balls to determine the abundance and relative cover of native and non-native oysters to understand the distribution of both species relative to wind exposure and tidal elevation. I found that native oysters occupy more space on reef balls than non-native, but only on the outside of reef balls at lower elevations. Tidal elevation also had a significant effect on both species in which native oyster densities increased and non-native oyster densities decreased with lower elevations. However, there was no significant wind/wave action effect on oyster recruitment. These findings will contribute to efforts by the Port of San Diego to further adapt the building and construction of Living Shorelines to restore the population of native oysters and reduce erosion in San Diego Bay.

168 - AN UPDATED PHYLOGENY AND DRIVERS OF DIVERSIFICATION IN ROCKFISHES

† Torres, B.T.*; Vayder, Z.E.; Curiel, G.; Swann, A.D.; Vanderpoel, K.; Alter, S.E.

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Understanding the mechanisms that drive biodiversity can be challenging, particularly for marine fishes. Unlike most terrestrial and freshwater ecosystems, marine environments have few geographic barriers, reducing opportunity for diversification. Defying this trend are rockfishes (genus Sebastes), which comprise over 100 species and occupy several ecological niches. The exact reasons for this rapid adaptive radiation are poorly understood, and past attempts at constructing phylogenies relied on inadequate sample sizes, which fail to account for intraspecific variation. A comprehensive analysis of the clade using multiple samples per species is necessary to create an accurate phylogeny, as well as an analysis for selection in genes undergoing positive selection, in order to reconstruct the mechanisms underlying diversification in this clade. We anticipate that by analyzing neutrally selected regions across multiple samples per species, we will observe new cryptic lineages forming in the clade.

Similarly, by comparing the mutations in genes undergoing selection in species segregated by depth, we can determine if adaptation to differing depths is a main driver of diversification. This study allows us to trace the evolutionary history of the Sebastes genus, filling in the gaps of past phylogenetic studies. This will not only inform more effective MPA legislation, which will account for cryptic species and habitat depths, but also propose a method of predicting evolutionary potential in other populations.

169 - THE EFFECT OF A SEA URCHIN'S (STRONGYLOCENTROTUS PURPURATUS) DIET ON ITS COMMENSAL POLYCHAETE (FLAYBESYMBIOS COMMENSALIS).

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Sea urchins are a crucial part of the kelp forest ecosystem, but one organism that is often overlooked are the commensal polychaetes that live on these urchins. *Flabesymbios commensalis*not only uses the sea urchins as shelter, but the worms also feed on urchins' feces. This species interaction demonstrated the importance of species relationships of lower trophic levels. This relationship between the polychaete and the urchin also promotes nutrient cycling to the ecosystem around them. . Our research looked into how the diet of the sea urchin impacted the growth and feeding rate of these worms. We looked at survey data over time. *Strongylocentrotus purpuratus* were collected from Point Loma, San Diego, CA. These urchins were then fed one of two diets: *Macrocystis pyrifera* or Urchinomics pellet feed. Worms were collected from the urchins, measured using FIJI, and then put into one of the two diet treatments. Worms were measured at the beginning and end of the 47 day growth rate experiment. It was found that a higher amount of worms were attached to urchins in the summer rather than the winter. In general there was no correlation between urchin weight and the number of worms found on that urchin. To better understand how carbon and nitrogen move through this system, the C:N content will be analyzed of the macroalgae, the urchin feces and the worms feces.

170 - EVALUATING EFFICIENCY OF THREE URCHIN REMOVAL METHODS FOR OREGON KELP FOREST RESTORATION

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1- Oregon State University 2- Oregon Kelp Alliance

Many of Oregon's kelp forests have recently shifted to an urchin barren state due to urchin overgrazing after losing the sunflower sea star, the primary predator of urchins, to sea star wasting disease in 2013. The Oregon Kelp Alliance (ORKA) has initiated an ecosystem-based approach to restoration of bull kelp forests targeting 1) purple urchin removal, 2) kelp enhancement, and 3) potential reintroduction of the sunflower sea star. ORKA launched in-situ purple urchin culling efforts in 2021 with volunteer divers which continued on small scales in 2022 and 2023. More recently, ORKA has been experimenting with purple urchin removal by contracted divers and through the use of kelp-baited urchin traps. To determine the efficiency of each practice, we will calculate the Catch-Per-Unit-Effort (CPUE) of urchin removal for each of the three methods based on urchins removed per hour, and perform a cost analysis based on CPUE. Comparisons of results will be used to assess feasibility of continuing each strategy on a larger scale and how ORKA should approach urchin removal efforts in the continuing years. Preliminary data analysis shows contracted diving to have the highest CPUE and trapping the lowest, with volunteer divers being between the two.

171 - RELATIONSHIP BETWEEN WATER PARAMETERS AND FISH COMMUNITY STRUCTURE ON RESTORED EELGRASS AND OYSTER BEDS

† Cooper, M.A.*; Taylor, A.; Zacherl, D.; Whitcraft, C.R.

CSU Long Beach

California wetland loss over the past 200 years has been significant, with over 90% of coastal wetlands lost to human development. Wetlands that remain are degraded by human activities. One solution to loss & degradation is restoration of key species in the habitats. In 2016, a collaborative team began work to restore paired eelgrass & oyster beds in Upper Newport Bay. In order to understand the restoration trajectory of this project, we have monitored fish response using BRUVs placed in both the eelgrass beds & more recently the oyster beds. Preliminary data show that overall fish within certain life history groups (e.g. roving foragers, schooling fish) & larger size class species spend more time in eelgrass than in bare or oyster habitats; they appear to linger for feeding or other behaviors while in sites without eelgrass fish are typically observed swimming past without pause. In comparison, the oyster beds are dominated by smaller fish (e.g. bay blennies & gobies) that appear to use the complex structure provided by the shells as refuge. The presence of key species & overall number of fish correlate with seasonal shifts of water temperature & salinity, aligning with the literature showing fish react to these changes for a variety of reasons. Understanding the association between fish communities & these restored habitats as well as how this relationship varies seasonally is crucial to inform restoration practices & to better evaluate the efficacy of the protective measures enacted to support the marine habitats.

172 - COLONY GROWTH AND HABITAT USE OF AN EMERGING ELEPHANT SEAL COLONY IN NORTHERN CALIFORNIA

† Jacob, A.N.*; Goley, D.

Cal Poly, Humboldt

Elephant seals *Italic text*(Mirounga angustirostris)*Italic text* (ESEAL) depend on terrestrial habitat for breeding, resting, and molting. The habitat is impacted by increasing temperatures, storms, sea level rise, recreational use and coastal development. They were hunted to near extinction in the 1800's, but population recovery allowed their range to expand from Mexico to Northern California. In 2015, a colony was established at the King Range National Conservation Area (KRNCA), the first new colony in 20 years. I have monitored this colony since 2022 to document colony growth, describe effects of environmental factors on habitat use, and predict future habitat availability. Counts and seal distribution were documented during weekly beach surveys. Habitat use (area occupied by seals/available habitat) was calculated for three habitat zones: water/intertidal, beach, and bluff. Tide, swell height, and sand temperature were recorded at the beginning and end of each survey and human disturbance was recorded throughout the day. The colony has grown each year and habitat availability was dependent on tide/swell height. Habitat use in the water/intertidal and beach zones increased with increased temperatures, while habitat use in the bluff was dependent on

ESEAL beach abundance and storm severity. A baseline of ESEAL habitat use is important for managers as the colony grows and impacts of climate change and recreational use increase. The KRNCA is less vulnerable to higher terrestrial temperatures that are limiting growth south, serving as a climate refuge and seed colony for ESEAL northern expansion.

173 - INTERTIDAL FOUNDATION SPECIES ALTER SEAWATER BIOGEOCHEMISTRY AT HIGH TIDE

Abbott, M.H.*; Huson, V.; Dhayalan, T.; Fajardo, C.; Dellinger, R.; Reed, K.; Silbiger, N.J.

CSU Northridge

Organisms living within coastal ecosystems exist in highly dynamic physiochemical environments. In order to make informed predictions about how these ecosystems may change in the future, it is critical to understand the natural drivers of this variability, which is a product of both physical (e.g., flow rate, tidal height, and wave exposure) and biological processes (e.g., photosynthesis, respiration, and calcification). It has been established that rocky intertidal foundation communities can significantly affect water chemistry in tide pools while exposed at low tide. However, due to logistical constraints, there has yet to be a study that explores whether these effects are still detectable during high tide, when there is increased water mixing and shorter water residence times. Our study employs Subsurface Automated Samplers (SAS) to collect seawater samples during high tide during the day and at night in benthic communities dominated by four different foundation species: *Mytilus californianus*, *Phyllospadix sp.*, *Balanus/Chthamalus*, and *Silvetia compressa*. We processed these water samples for nutrients, total alkalinity, and pH. We also compared the TA/DIC slopes between the benthic communities as a proxy for ecosystem metabolism. Our data show that biologically-driven changes in seawater biogeochemistry are detectable during high tide and may be pronounced enough to lead to feedback loops due to effects on community member physiology. These results will lead to an improved understanding of the interplay between biotic and abiotic factors in a changing climate.

174 - HYDROLOGY DRIVES INTERANNUAL VARIABILITY IN HYOPXIA IN LAKE LILLINONAH (NORTHEASTERN USA)

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1- CSU Monterey Bay 2- Moss Landing Marine Labs 3- Fairfield University

Interannual variability in environmental conditions has important consequences for the organisms living within aquatic systems. For example, years with higher incidence of stressful conditions such as deepwater hypoxia can restrict habitat use by fish. We studied drivers of interannual variability in deepwater hypoxia in Lake Lillinonah, a eutrophic reservoir in the Northeastern USA. The lake may be dimictic or polymictic depending on the amount of river inflow. Although deepwater hypoxia occurs in most years, the timing of onset and total number of hypoxic days varies. Using data from a 10-year period, we found that years with lower early summer river flow had higher rates of early summer oxygen depletion which translated to earlier onset of hypoxia and more total days of hypoxia. These findings indicate that hypoxia within this system is driven by river hydrology. As changes in river hydrology are expected with the progression of climate change, uncovering consequences is essential for protecting biota that make use of deepwater habitat.

175 - EFFECT OF ALKALINITY MANIPULATION ON MONTIPORA CAPITATA LARVAL METABOLISM AND METAMORPHOSIS

† McClintock, R.W.*

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Ocean alkalinity enhancement is a proposed carbon sequestration technique involving the dissemination of alkaline rich minerals like olivine or brucite into coastal waters to mitigate ocean acidification and reduce atmospheric carbon dioxide. The addition of these cationic materials induces the formation of carbonate and bicarbonate altering pH, DIC, and aragonite saturation state benefiting calcifying organisms, however the ecological impacts have not been thoroughly explored. This experiment studied the effect of total alkalinity (TA) manipulations on *Montipora capitata* larvae by exposing planula to a solution enriched with magnesium hydroxide at levels ranging from ambient TA (~2,200 umol/kg) to high TA (~3,200 umol/kg) over a 10 day period. Mortality rate was measured through visual scoring, settlement phase was determined through observation under a stereo microscope, and metabolism was quantified through respirometry. There was no significant impact of high alkalinity on mortality. Higher alkalinity appeared to facilitate earlier metamorphosis from the planular lifestage to settler life stage indicated by the development of radial symmetry and polyp mouth. Oxygen measurements during light and dark incubation periods indicated a slight effect of alkalinity manipulation on settler metabolism resulting in higher rates of respiration in higher alkalinity treatments. This study indicates that alkalinity enhancement techniques may be useful for coral restoration activities and facilitate larval settlement if deployed in coastal regions.

176 - FEEDING TRIALS DURING SIMULATED MARINE HEATWAVES WITH THE WILD KEY FISHERY SPECIES, THE RED SEA URCHIN, MESOCENTROTUS FRANCISCANUS

† Cabral, S.*; de Leon Sanchez, E.; Hofmann, G.

UC Santa Barbara

The red sea urchin, (*Mesocentrotus franciscanus*), is a kelp forest ecosystem engineer and a multi-million dollar fishery species where their gonads are sold as uni. The red sea urchin may be affected by marine heatwaves (MHWs) - events of extreme ocean warming - since previous MHWs have coincided with urchin mass mortality events due to diseases and food shortages. In terms of feeding ecology, giant kelp is the red urchins' preferred food source, and diminishing biomass and quality of giant kelp due to MHWs could be detrimental to the urchins' gonad growth. To observe how MHWs will affect urchin gonad quality and grazing behavior, urchin feeding trials were conducted with giant kelp as the food source at non-MHW (15°C) and MHW (18°C) temperatures in a flow-through seawater system. We also manipulated food amounts at each temperature treatment with low-kelp and high-kelp feeding regimens to mimic the differing amounts of kelp abundance in the wild. Results showed that temperature treatment was not a significant factor on uni quality, scored as a color-based grade. However, when comparing the different feeding regimes, the urchins in the high-kelp treatments had a greater quantity of high-grade uni than the low-kelp treatment. These

results may indicate that kelp biomass may be a more important factor on urchins' gonads compared to MHWs. The project's findings will provide an understanding of MHWs' effect on urchin grazing behavior, gonad quality, and the quality of the red sea urchin fishery in the face of future MHWs.

177 - BOTH BARNACLES AND TREMATODES DROVE A RAPID YET SPATIALLY VARIABLE OUTBREAK OF PINK LESIONS ON CORALS IN THE GENUS PORITES IN MOOREA, FRENCH POLYNESIA

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UC Los Angeles

Outbreaks of infectious coral diseases can alter ecosystem functioning and services, and evidence suggests they may be increasing in magnitude and duration due to human impacts, including climate change, that will only increase in the Anthropocene. Massive corals in the genus *Porites* respond to infection by forming raised pink lesions (PL). While outbreaks of PL have been observed globally, and recently in Moorea, French Polynesia, temporal patterns of prevalence (% of colonies infected), net infection rates of individual colonies (frequency of new occurrences), and causative agents (trematodes vs barnacles) within an outbreak have not been evaluated. In 2021, I chose 5 sites within two bays with human impacts in Moorea, French Polynesia and photographed 8-10 infected coral colonies per site over a 4 week times series. Although the maximum prevalence of infections varied from 63-100%, prevalence first increased and then decreased at all sites, suggesting we captured the outbreak mid-cycle. While prevalence of infections generally followed the same temporal pattern across sites, the net infection rate of individual colonies over time varied greatly each week at all sites, ranging from almost complete loss (-100%) to substantial gains (+50%). Both trematodes and barnacles occurred at all sites and over all times. Although the abundance of trematodes always exceeded barnacles, the proportions were extremely variable, ranging from equal abundance to almost twice as many trematodes. These results illustrate that severe outbreaks of PL in areas impacted by humans can develop rapidly over time, vary considerably across individual colonies, and be caused by more than one infective agent. More research is needed to determine if these agents interact to increase outbreak severity or if they function independently.

178 - HIGH GENE FLOW IN WIDOW ROCKFISH POPULATIONS FROM CALIFORNIA AND OREGON

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1- CSU Los Angeles 2- Southwest Fisheries Science Center 3- UC Los Angeles 4- UC Santa Cruz

Widow rockfish *(Sebastes entomelas)* is a major fisheries species on the West Coast of the United States. The species abundance declined in the 1980s due to overfishing and subsequently rebounded following harvest restrictions. To assess population structure for widow rockfish, we performed low-coverage whole genome resequencing on 174 widow rockfish individuals from 16 locations in California and Oregon. A principal component analysis (PCA) of single nucleotide polymorphism data showed evidence of subtle population structure. An admixture analysis also supports this finding of weak structure with potential differentiation between populations from Oregon/Northern California and Central/Southern California. An analysis of genome-wide F_{ST} found low differentiation throughout the study area (range: 0.009 – 0.019) and no evidence for isolation by distance. These findings suggest little population structure for widow rockfish from Oregon to California, in agreement with the predicted potential for high gene flow due to long pelagic larval durations for this species.

179 - THERMAL AND SPATIAL ECOLOGY OF SHARKS OFF THE COAST OF CENTRAL FLORIDA

† Masters, S.[1*]; Brusch IV, G.A.[1]; Moore, A.[2]

1- CSU San Marcos 2- Coastal Marine Education and Research Academy

Most shark species in the Gulf of Mexico have an inshore to offshore migration pattern that is similar year-to-year. However, temporal variations in shark migrations have also been observed. In this study, we analyzed water temperatures and spatial dynamics of 8 species of sharks off the central Gulf coast of Florida to determine if water temperature increases had an impact on migratory behavior. Sharks were captured from May to August 2023 during the day and night using scientific longlines, tangle nets, and rod and reels. Each day, 5 longlines were set for 45-minute intervals and 10 tangle nets for 30-minute intervals. Captured sharks were brought onto the research vessel where we collected DNA samples, measured, and then tagged each shark. DNA samples were sent to a laboratory for species identification verification. Average temperatures were then compared to catch counts for each month. Tag locations were also mapped using ArcGIS to analyze where the species were caught each month. Significant statistics show a large decline in capture numbers during the hottest month of the study which may indicate a sooner offshore migration due to temperature. Determining if temperature is a factor in the changing migratory patterns of shark species is essential to determine how climate change may affect sharks and their ecosystem in coastal environments. Most shark species in the Gulf of Mexico have an inshore to offshore migration pattern that is similar year-to-year. However, temporal variations in shark migrations have also been observed. In this study, we analyzed water temperatures and spatial dynamics of 8 species of sharks off the central Gulf coast of Florida to determine if water temperature increases had an impact on migratory behavior. Sharks were captured from May to August 2023 during the day and night using scientific longlines, tangle nets, and rod and reels. Each day, 5 longlines were set for 45-minute intervals and 10 tangle nets for 30-minute intervals. Captured sharks were brought onto the research vessel where we collected DNA samples, measured, and then tagged each shark. DNA samples were sent to a laboratory for species identification verification. Average temperatures were then compared to catch counts for each month. Tag locations were also mapped using ArcGIS to analyze where the species were caught each month. Significant statistics show a large decline in capture numbers during the hottest month of the study which may indicate a sooner offshore migration due to temperature. Determining if temperature is a factor in the changing migratory patterns of shark species is essential to determine how climate change may affect sharks and their ecosystem in coastal environments.

180 - TRACKING THE INTENSITY OF THE ATMOSHPERIC RIVER STORMS ON THE CALIFORNIA COAST

Ramos, G.A.[*]; Haupt, A.J.

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The intertidal is an ecosystem that faces both natural and anthropogenic disturbances, specifically storms. The California intertidal is primarily a rocky ecosystem that houses many key species such as urchins, abalone and sea stars. In early 2023, Northern California experienced intense storms over a period of a month due to the atmospheric river. During this period coastal California was exposed to increased wave exposure and saw heightened wave height. Understanding the storm's impacts on this area is crucial to make predictions about how intertidal ecosystems will change with increasing storm activity due to climate change. Using wave data from the NOAA data buoy center we were able to look at 7 Sites around the Monterey Peninsula and determine the intensity of waves on each site. By combining both the wave direction and height, we were able to classify our sites as low, medium, or high impact sites. With this study it will be easier to understand how large scale disturbances, such as storms can have different impacts on intertidal communities.

181 - EXPLORING COASTAL GRADIENTS OF CRAB COMMUNITIES AS MODELS FOR ECOSYSTEM HEALTH

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1- Sonoma State University 2- Southern California Coastal Water Research Project 3- Central Coast Wetlands Group 4- CSU Long Beach

Estuaries across Northern California serve as nurseries for numerous crab species. Some crabs, such as Dungeness (*Metacarcinus magister*), will reside in the estuary until later juvenile stages when then transition towards deeper offshore rocky reefs for their adult years. Previously crabs have been used as indicators of trophic balance and ecosystem health. The Dungeness crab could serve as an indicator species across all of its coastal transition zones. Taking advantage of several research monitoring programs, we aim to utilize crabs as indicators of community change and ecosystem health across coastal systems in California. Specifically, we are researching crab community dynamics across gradients, both latitudinal and throughout coastal transition zones: estuary to outer rock reef. To explore these gradients we are proposing to test two main hypotheses: 1) do certain species, such as Dungeness crab, depend on the presence of healthy migratory corridors as they transition throughout coastal zones to complete their full life cycle?, and 2) are there latitudinal gradients in crab abundance and community dynamics that correlate with either a) anthropogenic effects, or b) natural environment factors, such as temperature? We will utilize existing programs such as the California Estuarine Marine Protected Areas (EMPAs) monitoring combined with additional observational studies to explore these hypotheses. Overall this project aims to inform ecosystem health along the California coast. In doing so, we hope to provide guidance for future estuary, kelp restoration, and crab fisheries management.

182 - ACCLIMATING TO THE TIMES: EXAMINING TRANSGENERATIONAL PLASTICITY IN BIVALVES EXPOSED TO CHANGING PCO2 CONDITIONS

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1- Hakai Inst., Canada 2- Fisheries and Oceans Canada

In a dynamic ocean environment, the ability to phenotypically acclimate can determine population survival through environmental stressors. As adult shellfish experience warming temperatures and ocean acidification events, we investigate evidence of transgenerational plasticity (TGP) in their offspring. In a series of controlled experiments conducted at the Hakai Institute's Marna Lab on Quadra Island, British Columbia, adult bivalves were exposed to various static and novel dynamic PCO2 treatments during gametogenesis. Adults were spawned, and offspring were reared in treatments simulating future climate change scenarios. A variety of response variables were measured during vulnerable early larval stages including size, shell development, and DNA methylation. Results from an adult mussel experiment, using a local population of mixed species, show no significant effects on growth and survival of adults. However the dynamic treatment may have resulted in thinner shells, which could be an indication of stress. Larval results show a variety of interesting responses, including larval size being influenced by parental treatment, and no benefits to larval development from adult exposure to dynamic or high PCO2 treatments. Preliminary methylation results show regions of hypomethylation in larvae from parents exposed to ambient PCO2. These results provide a greater understanding of how an ecological and economically important shellfish species will respond as the ocean continues to change due to anthropogenic impacts.

183 - SEARCHING FOR SEAWEED SOLUTIONS: GENETIC INFORMATION NEEDS TO INFORM A GROWING ALASKA MARICULTURE INDUSTRY

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Preservation of genetic diversity remains an important topic in conservation genetics and aquaculture. Resource managers in Alaska are concerned about the genetic impacts of aquaculture on wild stocks, and as a result have adopted a precautionary approach. This precautionary regulation mandates that a minimum of 50 wild individuals within a 50 km radius be used as a seed source for seaweed farming. This regulation has the potential to limit the growth of the industry, and so the industry is interested in identifying alternative approaches. Seaweed genetics remains lesser known, despite the commercial and ecological importance of these species. Our goal is to illuminate areas of research to support the sustainable management of seaweed aquaculture and initiate a conversation between scientists and industry. The genetic structure of seaweed species can vary from region to region and across spatial scales. We are interested in exploring how biotic/abiotic factors may influence gene flow and to address additional questions to support growing the industry in a sustainable manner. Are there methods that could be implemented to reduce genetic impacts between farmed and wild populations? Are there geographic boundaries with genetic structure and to what extent would the mixing of populations influence wild seaweed genetic diversity? We are interested in talking with scientists outside of Alaska to learn how other regions address these challenges and to synthesize the state of knowledge to inform management practices that can support industry growth without harming wild stocks.

184 - GOING BEYOND PRESENCE AND ABSENCE: DEVELOPMENT OF NOVEL EDNA TECHNIQUES TO MONITOR GAMETOPHYTE-BANKS IN WILD POPULATIONS

† Liggan, L.M.[1*]; Rolheiser, K.C.[2]; Ramírez-Ibaceta, B.[1]; Giménez, I.[2]; Alberto, F.[1]

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Kelps have a complex life-history where the microscopic gametophyte phase alternates with the forest-forming sporophyte phase. Both phases are free living and interact with their surrounding environment independently. Though microscopic, gametophytes are shown to be resilient to environmental stress and have the potential to protect kelp species during disturbance events. However, gametophytes are notoriously hard to study in-situ, which creates many uncertainties surrounding their life expectancy and their ability to create a long-lived seed bank that could preserve a population. In this study, we developed a monitoring tool that estimates gametophyte densities through the collection of environmental DNA (eDNA). Because eDNA methods can only estimate species presence-absence, we have developed a Simulated Maximum Likelihood Estimator (SMLE) to estimate the number of gametophytes most likely to have produced a panel of microsatellite alleles amplified from eDNA. The method is akin to forensic analyses of crime scenes, where multiple suspects are identified from contaminated DNA. We first tested if all alleles added to a mixed sample would amplify during PCR by creating artificial eDNA with cultured gametophytes. Individual clones were genotyped for three markers and gametophyte DNA was mixed using a factorial design that varied in allele richness and evenness. Sequencing data shows that alleles were amplified during PCR regardless of richness and evenness, suggesting that eDNA can be used to effectively sequence microsatellite markers. We then tested the accuracy of the SMLE to estimate gametophyte numbers from an eDNA sample. Eight cultured gametophytes with known genotypes were seeded onto artificial seed banks and grown in mesocosm tanks. eDNA was then sampled from each seed bank and sequenced with 10 microsatellite markers. The SMLE estimated 7 gametophytes with a 95% confidence interval between 6 and 10 individuals. This study provides evidence that our methods coupled with the resolution offered by new sequencing technologies will provide a genetic monitoring case study to move the analysis of eDNA beyond presence-absence data.

185 - SYMBIONTS OF THE AGGREGATING ANEMONE, ANTHOPLEURA ELEGANTISSIMA, IN SOUTHERN PUGET SOUND

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Evergreen State College

Anthopleura elegantissima is a species of anemone commonly found on rocky coasts in the eastern Pacific Ocean from Alaska to Southern California. A population of this species has recently been identified in the southern Puget Sound estuary on the gravel beaches of Hope Island. In order to investigate the source of the estuarine specimens, we collected *A. elegantissima* from two separate populations: Hope Island and Point Grenville on the coast of the Olympic Peninsula on Quinault tribal land. We used scanning electron microscopy to examine the morphological differences in symbionts. SEM images showed similar morphology which was further confirmed by light microscopy. The symbionts in these two populations were also analyzed for genetic similarity. DNA was extracted and the LSU rDNA was amplified using PCR. Chromatograms were edited using MEGAX and matched using BLAST. DNA analyses suggest that *Symbiodinium muscatinei* was found to be the most prominent species of symbiont on Hope Island. This study is valuable for the scientific community because this population of anemones is an anomaly, as the *Anthopleura elegantissima* has only recently been discovered at Hope Island. The community in Western Washington and the greater Pacific Northwest will benefit from furthering understanding of the local ecosystem and the study of movement of this species into a new area.

186 - EFFECTS OF MICROPLASTICSPHERES ON HEMOCYTE COUNTS OF THE PACIFIC OYSTER (*CRASSOSTREA GIGAS*)

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The presence and effects of plastic pollution on marine organisms has been documented since the mid-1900s. Microplastics, fragments or fibers of plastic smaller than 5mm, are pervasive throughout the marine ecosystem and have been found in the guts of the smallest marine organisms causing deleterious effects. Suspension feeders, like the Pacific Oyster, *Crassostrea gigas*, that accumulate these microplastics on and in their gills and guts, may be at the highest risk of physiological distress. *C. gigas* is an ecologically and economically important aquaculture species and a part of a multibillion dollar per year fishing industry. Oysters are susceptible to anthropogenic pollutants, like microplastics, which may alter their immune function. To test the effects of microplastics on *C. gigas'* immune system, I exposed oysters to variable concentrations of microspheres (mps) (0 mps/L, $1x10^4$ mps/L, $1x10^5$ mps/L, $1x10^6$ mps/L) for one week. After exposure, I extracted, preserved and counted hemocytes from the oysters to quantify the immune response of *C. gigas*. Our preliminary results indicate there is a positive trend between the concentration of microplastics and the number of hemocytes in *C. gigas*. Therefore these results indicate that oysters may become more immunocompromised when there is a higher concentration of microplastics in the environment.

187 - LINKING SEAWEED FUNCTIONAL TRAITS TO ECOSYSTEM FUNCTION TO ASSESS VULNERABILITY TO SPECIES LOSS AND ENVIRONMENTAL CHANGE

Fales, R.J.[1*]; Griffin, J.[2]; Arenas, F.[3]; Dolbeth, M.[3]; Fairchild, T.[2]; Hall, H.[1]; Parks, M.[2]; Martins, M.[3]; Zawadzka, M.[2]; Bracken, M.E.S.[1]

1- UC Irvine 2- Swansea University, UK 3- CIIMAR

Functional traits which describe morphology and physiology, measured at the level of the individual, are used to understand form and function. With support from the NSF and Natural Environment Research Council (UK), we are linking species traits to marine ecosystem functioning by evaluating functional redundancy and vulnerability in seaweed communities and associated ecosystem processes across environmental gradients: wave exposure, tidal elevation, and latitude (N. and S. California, Portugal, and the UK). We are partnering with local experts in each region including Swansea University in Wales, UK and Centro Interdisciplinar de Investigação Marinha e Ambiental (CIIMAR) in Matosinhos, Portugal. We are currently building a trait database for California seaweeds and enhancing a complementary database for NE Atlantic seaweeds based on community surveys in each location. We will combine survey and trait data to evaluate how species are distributed in community trait

space, then use those relationships to assess functional redundancy vs uniqueness of species. Ultimately, our goal is to evaluate the functional consequences of the loss of unique and redundant species by conducting species removal experiments. Collectively, these measurements and experiments will allow us to assess how differences in seaweed traits translate to changes in species interactions and ecosystem functioning when species are lost, understand of the mechanistic relationship between form and function across environmental gradients, and increase our ability to predict consequences of species loss.

188 - CAN OVERFISHED STOCKS IN THE NORTHEAST REBUILD IN A CHANGING CLIMATE?

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1- University of San Diego 2- Rutgers University

Overfishing is an ongoing concern, and many U.S. Atlantic fish stocks have been declared as overfished. As fisheries managers plan to rebuild stocks by reducing fishing pressure, it is important that climate variability is considered while developing rebuilding scenarios, especially since recruitment may be environmentally driven. The goal of this research is to evaluate the relationship between recruitment and ocean temperature to determine whether stocks can rebuild in a warming environment. We evaluated the relationship between sea surface temperature (SST) and recruitment for 14 stocks in the Northeastern United States. Rebuilding simulations were run for a subset of overfished stocks to determine if rebuilding to historic baselines can occur under non-warming and predicted-warming conditions for two different levels of fishing pressure. For stocks with temperature-driven recruitment, rebuilding within the next two decades is unlikely under any scenario, but this is especially so under predicted warming conditions. Contrastingly, a non-SST-driven stock is expected to rebuild under reduced fishing pressure. Lower fishing pressure was found to mitigate somewhat against warming, but was not sufficient for rebuilding. This research emphasizes the need to consider environmental parameters, such as SST, when projecting future stock populations for management purposes.

189 - POTENTIAL ANTIMICROBIAL ACTIVITY FROM THE MARINE SPONGES CINACHYRA ALLOCLADA AND HALICHONDRIA PANICEA

Zou, J.[*]; Qiang, B.

affiliation not listed

Marine sponges have frequently been identified as potential pharmacological reservoirs. Their production of secondary metabolites supplies antimicrobial activities to ensure their survival in inhospitable environments; however, many such activities have yet to be described. We are interested in the interaction between sponge-associated chemicals (either produced by the sponge or by its associated microbiome) and common bacteria. Here we investigate two types of marine sponges, *Cinachyra alloclada* (distribution in the Western Central Atlantic) and *Halichondria Panicea* (distribution in the North Atlantic and Mediterranean Sea). We examine the reactions of sponge material (tissue snips, liquid extracts, and boiled liquid extracts) against lawns of *E. coli* (a gram-negative bacteria) grown on nutrient agar. While *H. panicea* material did not visibly affect *E. coli* growth, we found clear inhibition zones around *C. alloclada* material (both tissue snips and liquid extracts) and that boiled extracts showed smaller inhibition zones. This may indicate that an active agent may be proteinaceous. Extracts of *H. panicea* have presented different results in earlier studies, which may indicate such activity is more variable than previously appreciated. Extracts of *C. alloclada* have been found to have activity against tumor cell lines in the past, and we believe that the nature of this antimicrobial activity is worth further study as a potentially useful natural product, and for its role in the sponges' microbiome.

190 - WHAT'S CRACKING: INVESTIGATING GULL PREDATION PISMO CLAM POPULATIONS AT PISMO BEACH.

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Cal Poly, San Luis Obispo

Pismo Clams (*Tivela stultorum*) were once abundant on Pismo Beach until the 1980s when populations declined. However, recent years have seen a notable increase in their numbers. With the potential return of these clam populations to their legal size, we sought to investigate the factors that contribute to their predation, such as humans, otters, and shorebirds. This study focused on quantifying the extent of shorebird predation. We observed a specific clam-dropping predation behavior, where shorebirds dropped clams onto compact sand to crack them open, allowing them to feed on the clam. Our research aimed to identify the species of shorebirds involved, the size of clams they targeted, and the spatial distribution of predation on the beach. Through surveys on Pismo Beach, we found that Western Gulls (*Larus occidentalis*) were the sole shorebirds engaging in this behavior. The median clam size targeted was 71 millimeters, and predation almost entirely occurred in areas of the beach in which cars weren't allowed. Based on this spatial trend, we hypothesize that anthropogenic disturbance from vehicles is a major factor influencing predation frequency. Future work will further explore the impact of Off-Highway Vehicles and other environmental factors on gull predation.

191 - EFFECT OF FEEDING STATE ON STRONGYLOCENTROTUS PURPURATUS METABOLIC RESPONSE TO FOOD STIMULUS

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Santa Catalina School

The purple sea urchin (*Strongylocentrotus purpuratus*) is a key member of kelp forest communities whose abundance and grazing behavior strongly affects the persistence of these habitats. Recent studies indicate that urchins in overgrazed barrens have reduced internal energy stores and behavioral changes characterized by reduced use of shelter and increased roaming. We became interested in the metabolic costs associated with this behavior change and hypothesized that urchins fed minimally would have a greater metabolic response to food cues than those fed *ad libitum*. To test this, urchins were habituated in the lab to either a minimal or *ad libitum* feeding regimen and their oxygen consumption rate was measured before and after exposure to a kelp stimulus. We found that while a kelp stimulus consistently stimulated a temporary increase in metabolic rate, the magnitude of that increase was consistent regardless of feeding regimen. The *ad libitum* group had more extreme outliers and greater variability, potentially contributing to the lack of statistical significance. Additionally, preliminary evidence indicates that moderate changes

in temperature, stimulus concentration, and source habitat (intertidal or subtidal) do not have additional effects on response to kelp stimuli, though captivity may have a dampening effect on responses to kelp stimulus over time. Understanding the effects of feeding state on urchin response to kelp could help predict urchin barren dynamics and how changes in kelp forest abundance affect persistent zombie urchin behavior.

192 - COMPARING MORPHOLOGY, KINEMATICS, & SWIMMING PERFORMANCE IN TWO CTENOPHORE SPECIES (BOLINOPSIS INFUNDIBULUM & BEROE SPP.)

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Ctenophores are predatory marine zooplankton characterized by their gelatinous bodies and rows of cilia, termed ctene plates, which they employ for locomotion through metachronal beating. Ctenophores are ecologically important carnivores in oceanic food webs, and their predatory impact depends in part on swimming speed. In this comparative study, we used high-speed videography to examine how body size and ciliary kinematics mediate swimming speed of two ctenophore taxa, *Bolinopsis infundibulum* and *Beroe spp.* We found that body length had no significant effect on the distance traveled over a single ctene beat in both *Bolinopsis infundibulum* (n= xx; p= 0.37) and *Beroe spp.* (n=xx; p= 0.32). Comparisons of body length and swimming speed in both *Bolinopsis infundibulum* and *Beroe spp.* showed weak correlations suggesting other aspects of morphology may affect swimming across varying body plans. *Bolinopsis infundibulum* showed a significant relationship (p=0.02) between swimming speed and ctene beat frequency, but in *Beroe sp.*, swimming speed and ctene beat were not correlated (p=0.63), indicating there may be differences in beating patterns or ctene characteristic of lobate and beroid ctenophores. Our findings suggest that other aspects, such a ctene morphology, play a role in swimming performance in beroid ctenophores. Differences in swimming mechanics across ctenophore species may be driven by trade-offs with other ecological traits.

193 - IMPROVING CULTURE TECHNIQUE OF A SMALL SENSITVE ENDANGERED FISH SPECIES

Huynh, K.[*]; Hammock, B.; Dhayalan, T.; Teh, S.

UC Davis

Fish hatcheries have become an essential part of many conservation programs. However, low survival during early fish development can interfere with efforts to develop a healthy and representative hatchery population for imperiled fish species. Potentially, early larvae could be more sensitive to factors such as salinity, temperature, and nutrients than adult fish in the hatchery. Therefore, learning about the effects of these abiotic factors on larvae is critical to rear endangered fish in hatcheries. In this study, we will improve the larviculture of the endangered Delta Smelt by determining the effects of abiotic factors such as temperature, salinity, and prey on the survival and growth of Delta Smelt larvae from 0 to 45 days post hatch. In addition, we will run a feeding experiment using different algae enrichment on rotifers to determine how different fatty acid profiles in the diet affects the growth and survival of larvae. The results from this study will determine the optimal conditions for culturing Delta Smelt larvae, increasing survival at the hatchery, minimizing genetic drift, and informing management of the species in the wild.

194 - DIVERSIFICATION IN CHELAETHIOPS FISHES OF THE CONGO RIVER: PHYLOGENETIC PATTERNS AND ONGOING MYSTERIES

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1- CSU Monterey Bay 2- UC Davis 3- AMNH

The African tropics represent a global hotspot of freshwater biodiversity, but phylogenetic patterns remain poorly known in many taxa, including fish in the genus Chelaethiops (Family: Cyprinidae). The goal of this project is to investigate evolutionary relationships within this genus, with particular attention to a proposed new species, C. luluae. This taxon has only been described from morphological differences, and our study represents the first genetic investigation of genetic differentiation between C. luluae and other lineages. Our results, based on data from the COI mitochondrial gene, show a strong disconnect between putative species IDs based on morphology versus genetic relationships. Consistent clustering corresponding to geographic location was observed, contrasting with original species assignments based on morphology. Several samples showed strong genetic divergence from known (sequenced) species. One sample did not match any species previously sequenced, and may represent a new species. The remaining samples clustered together well based on geographical location, but still show a great amount of taxonomic disorganization within this genus, as well as possible mitochondrial introgression/hybridization and/or plasticity. These results call into question how Chelaethiops species are currently defined, and if there may be more species than currently known. We are currently analyzing nuclear genes in order to better investigate phylogenetic relationships and a possible history of hybridization between Chelaethiops species.

195 - IMPROVING SPECIES DISTRIBUTION MODELS OF CONTINENTAL SHELF FISHES OFF CALIFORNIA

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Moss Landing Marine Labs

Species distribution models (SDMs) relate species occurrences with environmental data to predict species distributions. While marine SDMs are gaining traction in the scientific community, they have yet to successfully predict the fine-scale distribution of continental shelf fishes off California. We examined how SDMs could be improved through the inclusion of seascape variables, different spatial resolutions, additional years of data, and various modeling techniques such as generalized linear models, generalized additive models, and machine learning methods. We combined multibeam bathymetry maps with remotely operated vehicle surveys to obtain remotely-sensed habitat and occurrence data of four continental shelf fishes: Blue Rockfish (*Sebastes mystinus*), Gopher Rockfish (*S. carnatus*), Lingcod (*Ophiodon elongatus*), and Vermilion Rockfish (*S. miniatus*). Baseline models for each species were created at three geographically disparate locations in California.The inclusion of seascape models and different spatial resolutions either decreased or did not affect model performance whereas more years of data and machine learning methods increased model performance. However, coastwide species-specific models that were tested at an independent location performed

poorly, as did most models created at Point Sur and extrapolated to the nearby locations of Big Creek and Point Lobos. These results suggest that these fine-scale SDMs for continental shelf fishes can be improved and utilized for specific management reasons, but are not yet useful for extrapolating to new areas of the coast.

196 - SURF'S UP: THE INTEGRATION OF SURFING AND SCIENCE

† Skustad, A.D.*; Palacios, S.L.

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Surfing can help us gain knowledge about the effects of ocean mixing caused by crashing waves in a way that current data collection methods can not accurately record. Over a short period of time, we have been observing drastic changes in ocean conditions, involving sea surface temperature and phytoplankton abundance present in the water. Examining phytoplankton productivity and chlorophyll-a is crucial to providing insight into nutrient levels in the ocean. Our design focuses on engineering a fin-mounted device that captures the measurements of major variables in the surf break. The data obtained by this device will help provide real-time and accessible data to represent nearshore measurements. This can contribute to the contrasting data between nearshore and offshore environments under different conditions given. The hypothesis of this study suggests that temperature and chlorophyll-a do not exhibit any variation or disparities. There is a need for a new data collection method that is able to bypass this issue by using an approach that provides insight into the nutrients in the surf zone. The overall research aims to identify any discrepancies between satellite and mooring data, shedding light on the potential limitations between different locations in the ocean by utilizing the engineered surf fin. The combination of innovative devices and other scientific approaches can open opportunities to enhance our understanding of oceanic changes and look for possible solutions.

197 - ANALYSIS OF FIRE RETARDANT IN RUNOFF

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As wildfires increase in both intensity and frequency throughout California and the world, humans look for ways to mitigate impacts. One of those ways is spraying aerial fire retardant. While many different brands and concentrations are used in fighting wildfires, impacts on water chemistry and aquatic ecosystems are not known. By mimicking a watershed, water, and fire retardant can be applied to soil to provide a faux spraying and precipitation event. Collecting and analyzing water samples after being filtered through soil will allow different fire retardants to be chemically tested and quantified along with comparisons to other brands. With a more developed understanding of fire retardants, recommendations for wildfire management can be established to reduce negative impacts on aquatic ecosystems.

198 - COMPARING THE EFFECT OF HYPOSALINITY ON MYTILUS GALLOPROVINCIALIS' CLEARANCE RATE IN BALLONA CREEK AND MARINA DEL REY, CA

† Carr, C.[1*]; Irribarren, L.[1]; Erickson C., [1]; Vasquez M.C., [2]

1- affiliation not listed 2- Loyola Marymount University

Mussels (Mytilus) occur along the Pacific coast where they filter water, provide habitat and food, and contribute to coastal health and biodiversity. Mytilus galloprovincialis is an invasive species that has colonized the brackish seawater in Ballona Creek (BC) and Marina Del Rey (MDR), CA. Climate change is predicted to increase precipitation that will decrease seawater salinity, which may influence mussel survival. Our project focused on comparing the effect of hyposalinity on the clearance rate (CR) of M. galloprovincialis from BC and MDR. We hypothesized that exposure to hyposalinity (<25ppt) will result in a significantly lower clearance rate compared to the control salinity (34ppt) for both mussel sites. M. galloprovincialis were collected from BC and MDR and acclimated to control conditions (17ºC, 34ppt) with food in recirculating seawater tanks. Following acclimation, mussels (N = 12) were exposed to different levels of hypo- or hypersalinity (40, 35, 30, 25, 20, 15, 10, 5ppt) for one week without food and then CR measured. For the 30 and 25ppt treatment, mussels from both locations had CR decrease significant compared to the control. We predict that mussels rom BC will exhibit higher CR at severe hyposalinity (<15 ppt) compared to the CR from MDR mussels. Understanding how Mytilus species respond to different salinities aids in our understanding of climate change induced environmental changes on a broader ecosystem scale.

199 - UPDATING TAXONOMIC KEY AND HERBARIUM COLLECTION OF *ZOSTERA PACIFICA* SEAGRASS

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Loyola Marymount University

Seagrass beds are vital ecosystems to marine health that provide habitat, nursing ground, and food source to countless species. Effects of climate change have led researchers to observe rapid bed degradation globally. This loss has created an imminent need for seagrass research. A taxonomic key is a useful tool because it provides observable morphological traits associated with specific genera and species. For seagrass, the most current and complete published taxonomic key is *Global Seagrass Research Methods*. This publication from 2001 is missing a taxonomic key and species description for *Zostera pacifica*, a genetically distinct species from *Z. marina* and *Z. asiatica*. *Z. pacifica* was historically *Z. marina var. latifolia* , but updated in literature in 1947. *Z. pacifica* grows off the coast of Southern California including the Channel Islands, Ventura and Orange Counties. It grows in deeper waters than *Z. marina* , explaining the typical "wide-leaved" characteristic attributed to the species. Creating a taxonomic key describing *Z. pacifica* is essential to ensure correct and consistent identification of the species. This project synthesized information on *Z. pacifica* herbarium presses from Global Biodiversity Information Facility to determine the recorded characteristics and the quality of existing knowledge on *Z. pacifica* . This synthesis established a dire need for updated herbarium presses of *Z. pacifica* . To remediate this, we made herbarium presses of *Z. pacifica* at Loyola Marymount University and documented key characteristics to update current collections and keys.

200 - DEPTH MATTERS: REPRODUCTIVE BIOMASS DISPARITIES IN THE CANOPY-FORMING FUCOID STEPHANOCYSTIS OSMUNDACEA

† Franks, J.J.*

Moss Landing Marine Labs

Stephanocystis osmundacea, a canopy-forming seaweed in California's giant kelp forests, plays a crucial role in habitat structure, demonstrates a unique, plant-like reproductive seasonality and its persistence relies heavily on reproductive investment and output. This study quantifies reproductive output, finding a strong positive correlation between size and gamete output. Thus, size metrics can act as a proxy for reproductive output in the field, providing the foundation for a year-long survey of a shallow and deep (4.5, 12m) population in Stillwater Cove, CA, recording both the vegetative and reproductive sizes of individuals and the presence of fecundity. Data inform the magnitude and seasonality of reproductive output and how that varies with depth, with extreme differences between depths observed in the first three months. Shallower populations (4.5m) have larger and more reproductive fronds, with 57-100% of individuals being reproductive (peak in July). In contrast, deeper populations (12m) exhibit lower reproductive activity, never exceeding 2% of individuals. Deeper populations are denser (6-11 individuals/m^2) than the shallows (~1 individual/m^2). Given such variable biomass with depth, the data suggest that reproductive investment depends heavily on recruitment location. A population may persist in deeper water if given higher density, placing less onus on an individual to become reproductive. Sunlight availability, interspecific competition, and grazing may contribute to these depth differences and necessitate further scrutiny.

201 - A MULTIFACETED APPROACH TO ASSESS BIODIVERSITY, AND RED TREE CORAL (PRIMNOA PACIFICA) DISTRIBUTION, IN A FJORD MARINE RESERVE IN BRITISH COLUMBIA

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Knight Inlet is a long, deep fjord in Canada with a shallow underwater ridge, the Hoeya Sill, emerging to 65 m depth midway down its length. Its unique hydrodynamics support high biodiversity including the shallow occurrence of the octocoral *Primnoa pacifica*. In 2021, the Hoeya Sill and surrounding areas were declared an Indigenous Protected and Conserved Area (IPCA) by the Mamalilikulla First Nation, and in 2023 designated as the first marine refuge in the Northern Shelf Bioregion. As part of a broader monitoring effort, we assessed biodiversity at the Hoeya Sill using dive observations and eDNA. We generated a bathymetric map using multibeam to help identify *P. pacifica* distribution. Due to the large depth range in the area, an ROV was also deployed to investigate coral extent beyond SCUBA depths. We found that *P. pacifica* was distributed across the sill in varying density and size classes, and bathymetric mapping was crucial in this effort. The IPCA supports high echinoderm biomass, including the persistence of remnant populations of healthy adult sunflower stars (*Pycnopodia helianthoides*). For a comprehensive understanding of biodiversity, paired dive and eDNA surveys were important for capturing different groups of organisms, with dive surveys capturing size class information on focal species, elucidating the sill's unique ecosystem function in providing a disease refuge. Due to its unique environmental characteristics and the large depth range of *P. pacifica*, effective marine monitoring of this area's biodiversity likely requires implementing a multifaceted approach.

202 - ASSESING POPULATION DENSITIES & AGGREGATION OF BLACK ABALONE (*HALITOSIS CRACHERODII*) ALONG THE MONTEREY PENINSULA

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1- CSU Monterey Bay 2- Grossmont Community College 3- CSU Northridge 4- Stanford University

Abalone are gastropod molluscs that live in subtidal and intertidal environments and are a popular food source for many coastal communities. The decline in the black abalone (*Haliotis cracherodii*) species has made it a priority for management and conservation efforts. In 2003, the Department of Fish and Wildlife established the Abalone Recovery and Management Program (ARMP) which uses the minimum population viability (0.2 individuals/m2) as a criterion for assessing abalone recovery (ARMP, 2005). Findings that included past and present data from the 2002-2022 ANOVA model confirmed temporal differences in black abalone populations and over twenty years at eight intertidal sites across Monterey Bay, black abalone populations have been stable, yet below the minimum population viability. Since smaller populations face a decline in genetic diversity due to density-dependent phenomena, such as the allele effect, some populations, especially broadcast spawning populations, display aggregated distribution patterns. In the summer of 2023, we revisited the sites of our current study to assess intertidal abalone densities by conducting six, 20mx2m transects at each site. We ran a t-test that was adjusted for the low sample size and found that 4 out of 7 sites were not significantly different from the population viability. Distance histograms for 2022 also suggest that the black abalone populations were aggregated. With our findings, we will gain a greater understanding of the local black abalone communities that can aid in properly managing the populations in the future.

203 - LONG-TERM COASTAL MONITORING BY THE MULTI-AGENCY ROCKY INTERTIDAL NETWORK (MARINE)

Smith, J.R.[1*]; Ambrose, R.F.[2]; Bell, C.A.[3]; Burnaford, J.L.[4]; Caselle, J.[5]; Gaddam, R.[3]; Gilbane, L.[6]; Miner, C.M.[3]; Parsons-Field, A.[5]; Raimondi, P.T.[7]; Sutton, S.G.[1]; Whitaker, S.G.[8]

1- Cal Poly, Pomona 2- UC Los Angeles 3- UC Santa Cruz 4- CSU Fullerton 5- UC Santa Barbara 6- Bureau of Ocean Energy Management 7- UC, Santa Cruz 8- Channel Islands National Park

The Multi-Agency Rocky Intertidal Network (MARINe: pacificrockyintertidal.org), a partnership of over 40 groups including agencies, private organizations, and universities, is the largest and longest-running monitoring project of its kind. There are more than 200 sites, stretching from Alaska to Mexico, some with 40+ years of data. MARINe surveys provide valuable information on large spatial and long temporal trends for rocky intertidal communities. Long-term data collection, which allows us to detect changes in species abundances and distributions that are outside the "expected" range, is essential for informing science-based management decisions. Publicly available MARINe data have been used for:

performing Natural Resource Damage Assessment (e.g., for oil spills); providing a baseline for designing Marine Protected Areas (MPAs) and evaluating their effectiveness; comparing areas within and outside of Areas of Biological Significance (ASBS); documenting the presence and spread of introduced species and disease outbreaks; assessing impacts of urban runoff, fire related debris flows, and human use; assessing populations for fisheries management; examining biogeographic and ecosystem resilience patterns; and detecting range shifts and alterations in community structure associated with climate change. The MARINe partnership has proven to be a successful model for responsibly informing management and the preservation of our coastal ecosystem across the US West Coast.

204 - INFLUENCE OF GROWTH RATE ON SHELL THICKNESS IN CRITICALLY ENDANGERED H. SORENSENI AT OUT-PLANTING SIZE

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White abalone (Haliotis sorenseni) are the first marine invertebrate to receive a critically endangered classification. In an effort to restore this critically important species, their restoration team has out-planted twelve thousand captively-bred juveniles. Current out-planting protocols combat high juvenile mortality by enforcing a 2.5 cm size minimum irrespective of age (1 - 5 years). In field settings, gastropod growth rate variability can reflect evolutionary tradeoffs in shell development. Populations exposed to crushing predation prioritize shell thickening, while those in high-wave energy environments prioritize extension for attachment. We investigate evidence of these “tradeoffs” in shells of captively bred juvenile H. sorenseni near out-planting size (1.0 - 3.8 cm) using x-ray diffraction, image analysis, and scanning electron microscopy. As the first to describe white abalone shell structure and mineralogy, we found an outer prismatic calcite layer and an inner nacreous aragonitic layer as seen in closely related species. At 1 cm, shells lack defined mineralogical layers, regardless of age. At 1.2 cm or longer, shells have defined mineral layers, and the aragonite layer thickens with age. We also found that slow-growing organisms (<0.65cm/year) have proportionately thicker shells (length normalized) than fast-growing organisms (>1.1 cm/year). The influence of growth rate on shell thickness in captively bred juvenile H. Sorenseni reared under controlled conditions (food, temperature, competitors, no wave action) suggests inherent genetic variability in shell thickening and extension rates. However, it is unclear whether documented differences in shell thickness are biologically significant for out-planted juvenile abalone as they navigate predation and wave action.

205 - VARIATION IN ZOSTERA MARINA SEED AND FLOWERING CHARACTERISTICS IN THE SOUTH SLOUGH ESTUARY: IMPLICATIONS FOR RESTORATION.

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1- University of Michigan-Ann Arbor 2- South Slough National Estuarine Research Reserve 3- Oregon State University

Eelgrass beds are essential ecosystem engineers that provide a host of services including carbon capture, shoreline protection and habitat for juveniles of innumerable species. However, recent climate trends have put these systems under great pressure, causing global declines. In the South Slough estuary, OR, sharp declines in eelgrass abundance were observed following a marine heat wave in 2013-15. Therefore, we evaluated seed and flowering characteristics to inform seed-based restoration. Seeds were collected via sediment cores from upper (shallow) and lower (deep) transects at 5 sites in the Coos Bay/South Slough estuary. Seed area, weight and settling velocity were measured for 219 seeds. Seed energy density was determined for a subset of seeds using calorimetry. Flowering shoot densities were collected at the same locations. Seeds from 4 sites did not show significant variation in weight or area while seeds from one site were larger than other sites. Mean seed energy density (338.8 Kcal/100g) also did not vary by site. Across sites, seeds from lower (deeper) transects were heavier and larger than upper transect seeds ($p<0.001$ 3 sites, $p>0.05$ 2 sites). Flowering shoot densities were higher at deeper transects than at shallower ones. With heavier seeds producing more robust seedlings (Jørgensen et. al. 2019), combined with higher flowering densities at lower transects, these results suggest seeds for restoration should be collected from deeper elevations at sites in the estuary.

206 - BIOTIC AND ABIOTIC DRIVERS OF JUVENILE PENAEUS SHRIMP GROWTH AND MORTALITY IN A SALT MARSH

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1- Universityof Connecticut 2- University of South Carolina, Baruch Marine Field Lab 3- North Inlet-Winyah Bay National Estuarine Research Reserve

Salt marshes across the southeastern US serve as essential habitat for a diverse suite of nekton, including larval, post-larval, and subadult stages of two species of Penaeid shrimp, *P. aztecus* and *P. setiferus*. We conducted a field experiment to determine the impact of biotic and abiotic drivers on juvenile *Penaeus* growth and mortality in salt marsh pools, a common but under-studied habitat feature. We used three marsh pools in the North Inlet estuary, South Carolina during summer 2023, deploying three shrimp density and species composition treatments in experimental cages at each pool. Daily water quality sampling was conducted in each pool, in addition to deployment of an in situ data logger which recorded water level and temperature. Variation in shrimp growth and mortality rates was hypothesized to be linked both to environmental conditions, such as temperature, salinity, dissolved oxygen, or tidal connectivity, as well as the relative densities of both species. Generally, we observed a weak trend towards more rapid growth and reduced mortality for *P. setiferus* across our experimental treatments. However, additional experimentation across a broader range of shrimp densities is needed. Quantifying the effects of competition between *P. aztecus* and *P. setiferus* will improve our understanding of each species life history and provide additional insights on the importance of marsh pools as nursery habitats within salt marsh estuaries.

207 - ASSESSMENT OF ENVIRONMENTAL DNA IN COMPARISON TO ACOUSTIC TRACKING FOR DETECTION OF WHITE SHARKS

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White sharks (*Carcharodon carcharias*) are ecologically important top predators, but their populations are challenging to monitor due to their high mobility and elusiveness. Traditional tracking methods like acoustic tagging are labor-intensive and costly, as well as constrained by tag lifespans, detection ranges of receiver networks, and the need for close encounters to tag sharks. As an alternative, noninvasive environmental DNA (eDNA) methods are being developed and used in proof-of-concept studies. We are assessing the correlation between white shark presence and the concentration of their DNA in seawater by analyzing eDNA samples, cross-referencing them with shark activity detected on the same day by two acoustic receiver buoys near Año Nuevo State Park in California. We will use DNA amplification to confirm the presence of white shark eDNA and quantify concentrations. The results of this study will reveal the degree to which eDNA is effective at capturing white shark abundance, accounting for variability introduced by dynamic oceanographic conditions. Species-specific eDNA analysis has great potential as a routine tool to complement biotelemetry, especially since it has the capacity to provide both presence and genomic data for a greater proportion of the population than traditional methods. Overall, our correlative analyses of marine wildlife tracking methods will provide a thorough assessment of eDNA as a tool for detection of marine wildlife distribution and abundance in oceanic environments.

208 - EXPLORATORY ANALYSIS OF 20+ YEARS OF DATA ON KELP FOREST COMMUNITY STRUCTURE FROM THE SANTA BARBARA COASTAL LTER SAMPLING PROGRAM

Codding, A.*; Allen, B.J.

CSU Long Beach

Giant kelp (*Macrocystis*) is among the fastest growing plants found on earth. Reaching from the seafloor to the ocean surface, it provides extensive vertical habitat that is the foundation for one of the most species-rich, productive, and widely distributed ecological communities in the world. The Santa Barbara Coastal Long Term Ecological Research (SBC LTER) site is an interdisciplinary program established in 2000 to understand the ecology of southern California coastal kelp forest ecosystems. We used data from their ongoing 20+ year monitoring at 11 sites to explore a variety of ecological theories about how natural communities are structured and function. We evaluated the presence and/or strength of trophic cascades, biodiversity-ecosystem function relationships, correlations between species and functional group diversity, links to local and regional climate drivers, and more. Although many hypotheses were supported, others were not – even those generated from other kelp forest datasets. Overall, our results highlight the importance of replicating previous analyses and suggest that large-scale observational data can be an informative complement to small-scale experimental manipulations, particularly when replicating a given experiment in the field would be difficult or impossible.

209 - CALIFORNIA COASTAL VISITATION CORRELATES WITH CONSERVATION OPINIONS AND ENGAGEMENT

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affiliation not listed

Strong engagement with nature has generally correlated with greater concern for environmental conservation over the past century. Since 2008, students enrolled in CSU Channel Islands' *Coastal and Marine Management* class (ESRM 462) have conducted our annual *CSUCI Survey of Public Opinion of Coastal Resources* across Santa Barbara, Ventura, and Los Angeles Counties in early fall, typically surveying 1,000 to 1,500 people per year. Visitation to natural and open spaces has fluctuated over the past two decades, but is in decline over the past decade (peaking at 73.6 ± 3.2 days per year in 2017, mean ± 1 se) with current self-reported rates (~48 days in 2023) similar to immediate pre-pandemic rates (50.9 ± 2.8 in 2019). As annual visitation to National Parks (8.8 days) and California's Channel Islands (6.9 days) was unchanged over this period, fewer trips to southern California's mainland beaches appear to best explain these reduced overall outdoor experiences. Beach visitation was highest in 2015 (53.0 ± 4.0 days) with pre- and post-pandemic rates similar (~36 days in both 2019 and 2023). Lower visitation rates correlated with reduced support for conservation policies (e.g. 38% of those visiting open spaces less than once a year felt we should expand Endangered Species protections vs. 57% for those visiting daily) and personal engagement with coastal issues (e.g. infrequent beach visitors are half as likely to ask about the source of their seafood relative to daily beach visitors).