Program and Abstracts

86th Annual Meeting
Monterey Bay, California
November 17-20, 2005
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<th>Thursday, Nov 17</th>
<th>Friday, Nov 18</th>
<th>Saturday, Nov 19</th>
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<td>PLENARY SPEAKER: Joseph Connell</td>
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<td>It Takes Good Science and . . . to Make Good Policy</td>
<td>SALON A/B/C/D</td>
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<td>0805 - 1100</td>
<td>Advantages of long-term ecological research</td>
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<td>0825-1200</td>
<td>0830 - 0920</td>
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<tr>
<td><strong>Registration</strong></td>
<td>Sessions 1 &amp; 2 (SALON A/B)</td>
<td>Sessions 9 &amp; 10 (SALON A/B)</td>
<td>Sessions 17 &amp; 18</td>
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<td>Community ecology I</td>
<td>Applied ecology</td>
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<td>Community ecology II</td>
<td>Intertidal ecology I</td>
<td>Invasive species I (SALON A/B)</td>
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<td>Sessions 3 &amp; 4 (SALON C)</td>
<td>Sessions 11 &amp; 12 (SALON C)</td>
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<td>Species-habitat associations I</td>
<td>Dispersal and recruitment II</td>
<td>Intertidal ecology II (SALON D)</td>
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<td>Evolutionary biology</td>
<td>Plant/algal ecology</td>
<td>Community ecology IV (SALON E/F)</td>
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<td>Sessions 5 &amp; 6 (SALON D)</td>
<td>Sessions 13 &amp; 14 (SALON D)</td>
<td>Sessions 21 &amp; 22 (SALON A/B)</td>
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<td>Behavioral ecology I</td>
<td>Session to honor A.Todd Newberry</td>
<td>Behavioral ecology II</td>
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<td>Dispersal and recruitment I</td>
<td>Community ecology III</td>
<td>Intertidal ecology III</td>
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<td>Sessions 7 &amp; 8 (SALON E/F)</td>
<td>Sessions 15 &amp; 16 (SALON E/F)</td>
<td>Sessions 23 &amp; 24 (SALON C)</td>
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<td>Population biology and ecology I</td>
<td>Population biology and ecology III</td>
<td>Invasive species II</td>
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<td>Population biology and ecology II</td>
<td>Physiological ecology</td>
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<td>WSN Poster session (SALON E/F/G)</td>
<td>WSN business meeting (SALON C)</td>
<td>Sessions 25 &amp; 26 (SALON D)</td>
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<td>1800 - 2000</td>
<td>1730 - 1900</td>
<td>Community ecology V &amp; Conservation biology</td>
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<td>Species-habitat associations II</td>
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<td>Sessions 27 &amp; 28 (SALON E/F)</td>
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<td>Community ecology VI</td>
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<td>Population biology and ecology IV</td>
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<tr>
<td><strong>Student workshop SALON A/B</strong></td>
<td>WSN Attitude Adjustment Hour (tickets required)</td>
<td>Presidential Banquet (tickets required)</td>
<td><strong>WSN Poster session (SALON E/F/G)</strong></td>
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<td>1800-2000</td>
<td>SALON D</td>
<td>Auction for student travel (no ticket)</td>
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<td><strong>Student mixer 2000-2400</strong></td>
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Western Society of Naturalists
~ 2005 ~

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Mark Carr
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86th Annual Meeting
Embassy Suites Hotel
Seaside, California

General Information

Registration and Information
The WSN registration and information table will be located in the foyer outside the main ballroom on the first floor of the hotel. Registration packets will be available at the table for those that have pre-registered. Those not pre-registered but wishing to attend the meeting can pay for membership, registration, banquet tickets, and Attitude Adjustment Hour tickets at the table. WSN t-shirts also will be available at the table.

Special Event Information
On Thursday, November 17th, there will be a student workshop entitled “Alternatives to Careers in Academia” at 6 PM in Salons A/B. Immediately following will be the student mixer. On Friday, November 18th, the WSN poster session will be held from 6-8 PM in SALONS E/F/G, and the infamous Attitude Adjustment Hour (AAH) will begin at 7 PM in SALONS C/D. The Presidential Banquet will be held on Saturday, November 19th at 7 PM in the main ballroom, immediately followed by the Auction for the student travel fund at 9 PM.
SPECIAL EVENTS

Thursday, November 17

1800 – 2000  WSN Student Workshop (SALON A/B)
2000 – 2400  WSN Student Mixer (off-site)

Friday, November 18

1800 – 2000  WSN Poster Session (SALON E/F/G)
1900 – 2200  AAH: Attitude Adjustment Hour (SALON D)

Saturday, November 19

1800 – 1900  WSN Annual Business Meeting (SALON E/F)
1900 – 2100  WSN Presidential Banquet (SALON A/B/C)
2100 – 2300  WSN Auction (SALON A/B/C)

PROGRAM OF EVENTS

* Indicates person presenting
§ Indicates eligibility for Best Student Paper or Best Student Poster Award

THURSDAY, NOVEMBER 17, 2005

1600 – 2200  Registration

1800  WSN student workshop: Alternatives to Careers in Academia  SALON A/B

Featured speakers:
Dr. Mike Sutton, Director of the Center for the Future of the Ocean at Monterey Bay Aquarium
Dr. Andrew DeVogalaere, Research Coordinator and Program Director of Sanctuary Integrated Monitoring Network
Mr. John Steinbeck, Vice President and Principle Scientist, TENERA Environmental

2000  WSN Student Mixer
Open to all graduate and undergraduate students (off-site location).
No ticket required.
FRIDAY, NOVEMBER 18, 2005

SYMPOSIUM 1

NATURALISTS WITHOUT BORDERS: CONSIDERING CROSS-Ecosystem Connections

0825  Introduction: Jarrett Byrnes, University of California, Davis

0830  Drew Talley, University of California, Davis. CONNECTIVITY: HABITAT LINKAGES AT THE LAND-SEA INTERFACE

0900  Jana Compton, Environmental Protection Agency, Corvallis, Oregon. MARINE INPUTS AND TERRESTRIAL BIOGEOCHEMISTRY IN THE PACIFIC NORTHWEST

0930  Jon Witman, Brown University. UPWELLING IN THE GALAPAGO MARINE RESERVE: DOES IT CREATE BOTTOM-UP, TOP-DOWN EFFECTS IN SUBTIDAL FOOD WEBS

1000  BREAK

1030  Julie Ellis, Cornell University. SEABIRDS AS LINKS BETWEEN TERRESTRIAL AND MARINE SYSTEMS

1100  Rich Zabel, NOAA Fisheries, Seattle, Washington. LINKAGES BETWEEN MARINE AND FRESHWATER ECOSYSTEMS IN PACIFIC SALMON

1130  Mary Power, University of California, Berkeley. ECOLOGICAL REGIME CHANGES DOWN RIVER DRAINAGE NETWORKS: TOWARDS PREDICTIVE MAPPING

1200  LUNCH
FRIDAY, NOVEMBER 18, 2005

SESSION 1

COMMUNITY ECOLOGY I

Chair: Brenda Konar, University of Alaska, Fairbanks

1310 § Davenport, A.C.* and T.W. Anderson. San Diego State University. ARE THERE DIFFERENTIAL EFFECTS OF REEF FISHES ON GIANT KELP PERFORMANCE?

1330 Konar, B. University of Alaska Fairbanks. ROLE OF GRAZERS ON THE RECOLONIZATION OF HARD-BOTTOM COMMUNITIES IN THE ALASKA BEAUFORT SEA

1350 § Larson, A.*¹ and J. J. Stachowicz², ¹San Diego State University & University of California-Davis, Bodega Marine Laboratory ²University of California-Davis. IMPACTS OF THE CHEMICALLY DEFENDED PHORONOPSIS VIRIDIS ON THE INFAUNAL COMMUNITY OF AN INTERTIDAL MUDFLAT.

1410 § Chang, A.L.* University of California Davis. CONSEQUENCES OF FUNCTIONAL DIVERSITY FOR SPECIES DIVERSITY IN AN ESTUARINE FOULING COMMUNITY.

1430 § Thurber, A.T. Scripps Institution of Oceanography. THE GUTLESS LINK BETWEEN THE PELAGIC MICROBIAL LOOP AND BENTHIC METAZOAN FOOD WEB: FATTY ACIDS AND STABLE ISOTOPES IN ANTARCTIC SPONGES

1450 § Hettinger, A.* and R.C. Carpenter. Department of Biology. California State University, Northridge. PHYSICAL FORCING OF BOTTOM-UP PROCESSES IN A SHALLOW-SUBTIDAL COMMUNITY

1510 BREAK
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<tr>
<th>Time</th>
<th>Speaker</th>
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<tbody>
<tr>
<td>1530</td>
<td>Jayewardene, D.*</td>
<td>Department of Zoology, University of Hawaii. CHRONIC PREDATION ON CORAL IN HAWAII</td>
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<tr>
<td>1550</td>
<td>Stallings, C.S.</td>
<td>Oregon State University. FISHING OUT DIVERSITY: NON-TARGETED PREDATORS REDUCE RECRUITMENT OF CORAL-REEF FISHES.</td>
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<tr>
<td>1610</td>
<td>Pister, B.A.* and K. Roy</td>
<td>University of California, San Diego. URBAN ECOLOGY IN A MARINE ECOSYSTEM: ARE JETTIES AND BREAKWATERS SUITABLE HABITAT FOR INTERTIDAL COMMUNITIES?</td>
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<tr>
<td>1630</td>
<td>Harley, C.D.G.¹, and J. O’Riley²</td>
<td>University of British Columbia, ²University of Vermont. NON-LINEAR COMMUNITY-LEVEL EFFECTS OF AN INTERTIDAL ECOSYSTEM ENGINEER.</td>
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<td>1650</td>
<td>terHorst, C.P.* and P. Munguia</td>
<td>Florida State University. BIOMASS AND PRODUCTIVITY RELATIONSHIPS ARE LIKE A BOX OF CHOCOLATES…</td>
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<td>1710</td>
<td>Ruttenberg, B. I.¹, A. Hearn², L. R. Vinuesa³, S. Salazar⁴, S. Banks², and V. Francisco⁵</td>
<td>¹University of California Santa Barbara, ²Charles Darwin Research Station, Galápagos ³Oregon State University, ⁴CICIMAR, La Paz, Baja California Sur, Mexico, ⁵CICESE, Ensenada, Baja California, Mexico. THE EFFECTS OF BOTTOM UP PROCESSES ON REGIONAL DEMOGRAPHIC PATTERNS IN THE GALÁPAGOS ISLANDS</td>
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<td>1730</td>
<td>Janiak, D. S.*, J. York, H. Watts, and S.F. Craig</td>
<td>Humboldt State University. EFFECTS OF CHITONS IN A HUMBOLDT BAY FOULING COMMUNITY: LATE RECRUITMENT, PREDATION, BULLDOZING AND THE MAINTENANCE OF FREE SPACE.</td>
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<td>1750</td>
<td>Thompson, A.R., Thacker, C.E., Shaw, E.Y., and D.M. Roje</td>
<td>Natural History Museum of Los Angeles County. NOW AND THEN: MITOCHONDRIAL AND MICROSATELLITE MARKERS REVEAL PATTERNS OF HISTORIC AND CONTEMPORARY GENE FLOW IN A CORAL REEF FISH</td>
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FRIDAY, NOVEMBER 18, 2005

SESSION 3 SALON C

SPECIES-HABITAT ASSOCIATIONS I

Chair: Phil Levin, NOAA Fisheries, Seattle

1310 § Sandoval, E.J. Moss Landing Marine Laboratories. HABITAT MAPPING AND TOPOGRAPHIC COMPLEXITY: IMPLICATIONS FOR PREDICTING KELP FOREST COMMUNITY COMPOSITION

1330 § Pirtle, J.L.*1, B.N. Tissot 1, D.A. Roberts 2,3, D. Howard 2, 1 Washington State University, Vancouver, 2 NOAA Cordell Bank National Marine Sanctuary, 3 Point Reyes National Seashore. HABITAT-BASED ASSESSMENT OF STRUCTURE-FORMING MEGAFANAL INVERTEBRATES AND FISHES ON CORDELL BANK, CALIFORNIA

1350 § Madin, J.S.*1 and E.M.P. Madin*2. 1National Center for Ecological Analysis and Synthesis, 2University of California, Santa Barbara. MECHANICAL-COMPETITIVE TRADE-OFFS PROMOTE COEXISTENCE ON A CORAL REEF

1410 § Bates, C.R. * and R.E. DeWreede. Department of Botany, University of British Columbia, Canada. DOES MACROALGAL DIVERSITY FACILITATE MICROINVERTEBRATE EPIFAUNA?

1430 § Stier, A.C. *1, Dahlgren C.P. 2 Caribbean Marine Research Center, Perry Institute for Marine Science. RATES OF PREDATION ON JUVENILE QUEEN CONCH (Strombus gigas): HOW DENSITY AND SUBSTRATE AFFECT THE SURVIVORSHIP OF JUVENILES

1450 Sagarin, R. D.*1, W. Gilly2, C. Baxter2, N. Burnett2. 1 Institute of the Environment, University of California, Los Angeles  2 Hopkins Marine Station of Stanford University. REMEMBERING THE GULF: CHANGES IN THE SEA OF CORTEZ SINCE STEINBECK AND RICKETTS

1510 BREAK
FRIDAY, NOVEMBER 18, 2005

SESSION 4             SALON C

EVOLUTIONARY BIOLOGY

Chair: Pete Edmunds, California State University, Northridge


1550 Manier, M.K.* and S.R. Palumbi. Hopkins Marine Station, Stanford University. ADAPTIVE DIVERGENCE OF SPERM MORPHOLOGY IN THE GREEN SEA URCHIN, *STRONGYLOCENTROTUS DROEBACHIENSIS*

1610 § Ramon, M.L.*1 University of California, Santa Cruz. THE POPULATION GENETIC STRUCTURE OF AN INTERTIDAL SCULPIN (*CLINOCOTTUS ANALIS*).


1650 § Roman, Y.J. *, E.M. Gallardo and R.R. Wilson, Jr. California State University, Long Beach. PHYLOGENETIC UTILITY OF mtDNA CONTROL REGIONS AMONG GOBIOIDS

1710 § Barreto, F.S.*1,2 and M.A. McCartney1. 1Dept. of Biological Sciences, University of North Carolina at Wilmington, Wilmington, NC; 2Dept. of Ecology and Evolutionary Biology, University of California, Irvine, CA. STRONG COLOR PATTERN BASED ASSORTATIVE MATING DESPITE WIDESPREAD GENOMIC IDENTITY BETWEEN MEMBERS OF A MARINE SPECIES FLOCK

1730 Schaaf, J.A.*1, D.A. Ebert1,2, and G.H. Burgess3. 1Moss Landing Marine Laboratories, Pacific Shark Research Center, 2Florida Museum of Natural History, University of Florida. THE DESCRIPTION OF A NEW SPECIES OF LANTERN-SHARK OF THE GENUS ETMOPTERUS (SQUALOIDEA: ETMOPTERIDAE) FROM TAIWAN

FRIDAY, NOVEMBER 18, 2005

SESSION 5 SALON D

BEHAVIORAL ECOLOGY I

Chair: Ray Wilson, California State University, Long Beach

1310 Wilson, R.R., Jr., Department of Biological Sciences, California State University, Long Beach. MARINE BIOLOGY FROM THE BOTTOM UP: A REPORT OF THE MIR DIVES TO THE CHARLIE-GIBBS FRACTURE ZONE, CENTRAL NORTH ATLANTIC OCEAN

1330 § White, J. W.* and C. J. Grigsby. University of California, Santa Barbara. CLEANING BEHAVIOR: A HIGH-RISK FORAGING STRATEGY

1350 § Arkema, K.*1, B. Gaylord2, D. Reed1. 1UC Santa Barbara, 2Bodega Marine Laboratory of UC Davis. GIANT KELP INFLUENCES THE FEEDING SUCCESS OF A SUSPENSION-FEEDER, MEMBRANIPORA TUBERCULATA, BY MODIFYING WATER FLOW AND FOOD AVAILABILITY ACROSS A SUBTIDAL REEF

1410 § Cartamil, D.*1, C. Sepulveda2, N. Wegner1, A. Baquero3, S. Albers1 and J.B. Graham1. 1Scripps Institution of Oceanography, 2Pfleger Institute of Environmental Research, 3San Diego State University. AN ARCHIVAL TAGGING STUDY OF COMMON THRESHER SHARK (ALOPIAS VULPINUS) MOVEMENT PATTERNS OFF THE COAST OF SOUTHERN CALIFORNIA: PRELIMINARY RESULTS

1430 Matteson, R.S.*, Boustany, A., Castleton, M.R., Farwell, C., Dewar, H. and Block, B.A. Hopkins Marine Station of Stanford University, Monterey Bay Aquarium. PACIFIC BLUEFIN TUNA BEHAVIOR IN THE EASTERN PACIFIC

1450 § Selgrath, J.C.,† K.A. Hovel1 and R.A. Wahle2 1San Diego State University. 2Bigelow Laboratory for Ocean Sciences. EDGE EFFECTS ON AMERICAN LOBSTER (Homarus americanus) SURVIVAL AND ABUNDANCE.

1510 BREAK
FRIDAY, NOVEMBER 18, 2005

SESSION 6           SALON D

DISPERSAL & RECRUITMENT I

Chair: Alan Shanks, University of Oregon

1530 Shanks, A.L. *1 and G.C. Roegner2 1Oregon Institute of Marine Biology, University of Oregon, 2NOAA Fisheries, Point Adams Biological Field Station. THE COMMERCIAL CATCH OF CANCER MAGISTER VARIES WITH THE ABUNDANCE OF THEIR MEGALOPAE AND THE ABUNDANCE OF MEGALOPAE VARIES WITH THE TIMING OF THE SPRING TRANSITION.

1550 Sanford, E. *1, S.B. Holzman2, R.A. Haney2, D.M. Rand2, and M.D. Bertness2. 1University of California Davis and Bodega Marine Laboratory, 2Brown University. LARVAL TOLERANCE, ADAPTATION, AND THE MAINTENANCE OF GEOGRAPHIC RANGE LIMITS

1610 § Carson, H.S.1,2*, S.G. Morgan2 and P.G. Green1 1San Diego State University 2University of California, Davis A COMPARISON OF THE TRACE ELEMENTAL CHEMISTRY OF PORCELAIN CRAB EMBRYOS AND SETTLERS COLLECTED ALONG THE NORTHERN CALIFORNIA COAST

1630 § Herter, H.L. and Eckert, G.L. University of Alaska Fairbanks, Juneau Center School for Fisheries and Ocean Sciences. TIDALLY-DRIVEN SUPPLY OF DUNGENESS CRAB MEGALOPAE IN GLACIER BAY, ALASKA

1650 § Constable, H.1*, Larson, R.1, Gilbert-Horvath, L.2, Garza, J.C.2 1San Francisco State University 2 National Marine Fisheries Service, Santa Cruz POPULATION GENETICS OF SHORTBELLY ROCKFISH ALONG THE CALIFORNIA COAST, OR Fst: HOW LOW CAN YOU GO?

1710 § Galindo, H.M.* and S.R. Palumbi. Hopkins Marine Station-Stanford University. COHORT GENETICS: DO DISPERSAL PATTERNS CHANGE OVER TIME?


1750 O'Connor, N.E.*1, J.H. Grabowski2 and J.F. Bruno1. 1University of North Carolina at Chapel Hill, 2Gulf of Maine Research Institute. SPECIES LOSS AND ECOSYSTEM FUNCTIONING: EFFECTS OF SIMULATED PREDATOR EXTINCTIONS ON A FOUNDATION SPECIES.
FRIDAY, NOVEMBER 18, 2005

SESSION 7                   SALON E/F

POPULATION BIOLOGY & ECOLOGY I

Chair: Danielle Zacherl, California State University, Fullerton

1310 § Sandin, S.A. *1, J.F. Samhouri2, and S.L. Hamilton3. 1Scripps Institution of Oceanography, 2University of California, Los Angeles, 3University of California, Santa Barbara. HABITAT CHARACTERISTICS CHANGE DENSITY DEPENDENT MORTALITY FROM DIRECT TO INVERSE

1330 § Vega Thurber, R.L.* and D. Epel Hopkins Marine Station, Stanford University. POTENTIATION OF GENOTOXINS VIA INHIBITION OF EFFLUX TRANSPORTERS IN VIVO

1350 § Lester, S.E.* and S.D. Gaines. University of California, Santa Barbara. GEOGRAPHIC PATTERNS OF REPRODUCTIVE OUTPUT IN INTERTIDAL INVERTEBRATES: BAJA TO CAPE TOWN

1410 § Erisman, B.E*1, M. Buckhorn2, and P.A. Hastings1. 1Scripps Institution of Oceanography, 2University of California, Davis. UNUSUAL SEXUAL AND SPAWNING PATTERNS IN THE LEOPARD GROPER FROM THE GULF OF CALIFORNIA: IMPLICATIONS FOR CONSERVATION


1450 § Samhouri, J.F.*1 and M.A. Steele2. 1UC Los Angeles, 2 UC Santa Barbara. THE INFLUENCE OF PREDATOR REFUGES ON SELECTIVE MORTALITY IN A CORAL REEF FISH

1510 BREAK
FRIDAY, NOVEMBER 18, 2005

SESSION 8                  SALONS E/F

POPULATION BIOLOGY AND ECOLOGY II

Chair: Larry Allen, California State University, Northridge

1530 § Wormald, C.L.*, M.A. Steele2, and G.E. Forrester1. 1University of Rhode Island, 2University of California, Santa Barbara. TESTING ASSUMPTIONS OF MARK RECAPTURE THEORY: AN EXAMPLE WITH A TROPICAL SNAPPER

1550 § Bottinelli, D.J.* California State University Northridge. THE AGE, GROWTH AND FECUNDITY OF THE CALIFORNIA BARRACUDA

1610 Rogers, L.K.*1 and R.T. Leaf2. 1CDFG and U.C. Bodega Marine Lab, 2Moss Landing Marine Labs. ELASTICITY ANALYSIS OF SIZE-BASED RED AND WHITE ABALONE MATRIX MODELS: MANAGEMENT AND CONSERVATION

1630 § Rassweiler, A.* University of California, Santa Barbara. A MECHANISME THAT MAY MAINTAIN ALTERNATE STATES ON SUBTIDAL REEFS IN THE SANTA BARBARA CHANNEL

1650 § Ardizzone, D.*1, G. M. Cailliet1, L. J. Natanson2, A. H. Andrews1, Lisa A. Kerr3, and T. A. Brown4. 1Moss Landing Marine Laboratories, 2NOAA Fisheries Northeast Fisheries Science Center, Narragansett Laboratory, 3University of Maryland Center of Environmental Science, Chesapeake Biological Laboratory, 4Center for Accelerator Mass Spectrometry, Lawrence Livermore National Laboratory. APPLICATION OF BOMB RADIOCARBON CHRONOLOGIES TO SHORTFIN MAKO (Isurus oxyrinchus) AGE VALIDATION.

1710 § Hughes, A. R.* and J.J. Stachowicz. University of California-Davis. CAUSES AND CONSEQUENCES OF GENETIC DIVERSITY IN EELGRASS (ZOSTERA MARINA)

1730 § Carlisle, A.B.*1, A. King2, G.M. Cailliet1, and J.S. Brennan3. 1Pacific Shark Research Center, Moss Landing Marine Laboratories, 2BLM/DO California Coastal National Monument, NOAA/DOC National Marine Protected Areas Center, 3Washington Sea Grant Division. LONG TERM TRENDS IN ELASMOBRANCH CATCH COMPOSITION FROM FISHING DERBIES IN ELKHORN SLOUGH, CALIFORNIA

1750 § Ferner, M.C.* and M.J. Weissburg. Georgia Institute of Technology. SEDIMENT ROUGHNESS ALTERS INDIRECT EFFECTS OF GASTROPODS ON THEIR BIVALVE PREY
This year, the AAH will be held in Salon D of the Embassy Suites Hotel, where you can enjoy food and beverages with your colleagues and see posters in the adjacent rooms. Tickets are required.
SATURDAY, NOVEMBER 19, 2005

SYMPOSIUM 2

IT TAKES GOOD SCIENCE AND . . . TO MAKE GOOD POLICY

0805  Introduction:  Mark Carr, University of California, Santa Cruz

0810  Robert Steneck, Darling Marine Center, University of Maine. MIGHT WE IMPROVE MANGAGEMENT OF THE NEW ENGLAND LOBSTER FISHERY BY TAKING AN ECOLOGICAL APPROACH?

0840  David Conover, Marine Sciences Research Center, State University of New York, Stony Brook. DARWINIAN FISHERY SCIENCE

0910  Phil Levin, NOAA Fisheries, Seattle Washington. MARINE ECOLOGY AND FISHERIES MANAGEMENT: WHEN GOOD FENCES MAKE BAD NEIGHBORS.

0940  Barbara Block, Hopkins Marine Station, Stanford University. MOVEMENT PATTERNS AND POPULATION STRUCTURE OF ATLANTIC BLUEFIN TUNA (THUNNUS THYNNUS) AS REVEALED BY ELECTRONIC TAGS

1010  BREAK

1040  Peter Glynn, Rosenstiel School of Marine and Atmospheric Science, University of Miami. ENSO SEA WARMING DISTURBANCES TO EASTERN PACIFIC CORAL REEFS: RESPONSES, RECOVERY, AND FUTURE PROJECTIONS

1115  WSN LIFETIME ACHIEVEMENT AWARD

1125  INTRODUCTION OF THE NATURALIST OF THE YEAR

1130  WSN NATURALIST OF THE YEAR

1200  LUNCH
SATURDAY, NOVEMBER 19, 2005

SESSION 9           SALON A/B

APPLIED ECOLOGY

Chair: Chris Lowe, California State University, Long Beach

1310  § Jarvis, E.T.* and C.G. Lowe.  Department of Biological Sciences, California State University, Long Beach.  THE EFFECTS OF BAROTRAUMA ON CATCH-AND-RELEASE SURVIVORSHIP OF NEARSHORE AND SHELF ROCKFISHES IN SOUTHERN CALIFORNIA

1330  § Guarderas, P.*, Hacker, S. and J. Lubchenco.  Oregon State University.  MARINE RESERVES IN LATIN AMERICA. DOCUMENTED EFFECTS AND CHALLENGES


1410  Lowe, C.G.¹*, E. Jarvis¹, K. Anthony¹, L. Bellquist¹, B. Hight¹, M. McCrea², M. Love², and A. Scarborough-Bull³. ¹California State University Long Beach, ²Univ. of California Santa Barbara, ³Minerals Management Service.  SITE FIDELITY AND EMIGRATION OF FISHES TAGGED AT OFFSHORE PETROLEUM PLATFORMS OFF SOUTHERN CALIFORNIA.

1430  § Granek, Elise F. *¹ and Kaitlin Frasier², ¹Department of Zoology, Oregon State University; ²Biology Program, Oregon State University.  LARVAL AND ZOOPLANKTON COMMUNITIES: COMPARING INTACT AND CLEARED MANGROVE AREAS IN BOCAS DEL TORO, PANAMA

1450  § Ortiz, D.M.*¹ and B.N. Tissot¹. ¹Washington State University-Vancouver  EVALUATING SPATIAL VARIATION IN HABITATS IN RELATION TO ONTOGENETIC VARIATION IN A REEF FISH IN AN MPA NETWORK IN HAWAI’I

1510  BREAK
SATURDAY, NOVEMBER 19, 2005

SESSION 10           SALON A/B

INTERTIDAL ECOLOGY I

Chair: Mark Carr, University of California, Santa Cruz

1530 § Hughes, B.B.* Moss Landing Marine Laboratories. EFFECTS OF *EGREGIA MENZIESII* ON A ROCKY INTERTIDAL ALGAL ASSEMBLAGE

1550 § Shinen, J.L.* University of California Davis. ARE PISASTER AND NUCELLA CONDITIONAL KEYSTONE PREDATORS? SCALING UP FROM CAGES IN THE ROCKY INTERTIDAL.

1610 § Kusic, K. E.,* P. T. Raimondi, H. A. Livingston, D. P. Lohse, and R. N. Gaddam. University of California, Santa Cruz. POINT REYES, AN IMPORTANT GEOGRAPHIC FEATURE, SHAPING ROCKY INTERTIDAL COMMUNITY STRUCTURE IN CENTRAL CALIFORNIA

1630 § Pelc, R.A.*1 and M.L. Baskett 2. 1 University of California, Santa Barbara, 2 Princeton University. THE EFFECTS OF MARINE RESERVES ON HARVESTED INTERTIDAL SPECIES IN SOUTH AFRICA

1650 § Martone, P.T.* and M.W. Denny. Hopkins Marine Station, Stanford University. BREAKING WAVES MAY LIMIT THE SIZE OF THE ARTICULATED CORALLINE *CALLIARTHRON*

1710 § Petes, L.E.*, G.D. Murphy, and B.A. Menge. Oregon State University. EFFECTS OF THERMAL STRESS ON PARASITE LOADING AND REPRODUCTION IN NEW ZEALAND MUSSELS.

1730 § Kinlan, B.P.*1, B.R. Broitman1, S.D. Gaines1, C.A. Blanchette1, E. Wieters2, S.E. Lester1, and P.T. Raimondi3. 1University of California-Santa Barbara, 2University of Cape Town, 3University of California-Santa Cruz. PREDICTABILITY IN INTERTIDAL ECOSYSTEMS: SCALE-DEPENDENT COUPLING OF COASTAL GEOMORPHOLOGY, OCEANOGRAPHY, AND BENTHIC COMMUNITY STRUCTURE

1750 § Hunt, L.J.H., Hopkins Marine Station. TEMPERATURES AT A BIOLOGICAL BORDER.
SATURDAY, NOVEMBER 19, 2005

SESSION 11             SALON C

DISPERsal AND RECRUITMENT II

Chair: Rick Wahle, Bigelow Laboratory for Ocean Sciences

1310 Thiel, M.\textsuperscript{1,2} and L. Gutow\textsuperscript{3}. \textsuperscript{1}Facultad Ciencias del Mar, Universidad Católica del Norte, \textsuperscript{2}Centro de Estudios Avanzados en Zonas Áridas (CEAZA) Coquimbo, Chile; \textsuperscript{3}Alfred Wegener Institute for Polar and Marine Research, Germany. NOT EVERYBODY CAN PARTICIPATE IN THE RAFTING ROULETTE – THE BIOLOGY OF ORGANISMS TRAVELING ON FLOATING ITEMS


1350 § Paddack, M.J.*, S. Sponaugle, R.K. Cowen. Rosenstiel School of Marine and Atmospheric Science, Division of Marine Biology and Fisheries. RECRUITMENT MICROHABITAT SELECTION OF A CORAL REEF FISH IN A CHANGED ECOSYSTEM

1410 Chittaro, P.M.*\textsuperscript{1}, Gagnon\textsuperscript{2}, J. and B.J. Fryer\textsuperscript{2}. \textsuperscript{1}Northwest Fisheries Science Center, \textsuperscript{2}Great Lakes Institute of Environmental Research. THE DIFFERENTIATION OF FISH POPULATIONS USING LAPILLAR AND SAGITTAL OTOLITH CHEMISTRY.

1430 Wahle\textsuperscript{1*}, R.A., M. Gibson \textsuperscript{2} and K.A. Hovel\textsuperscript{3}. \textsuperscript{1}Bigelow Laboratory for Ocean Sciences, \textsuperscript{2}Rhode Island Division of Fish & Wildlife, \textsuperscript{3}San Diego State University. IMPACT OF SHELL DISEASE ON LOCAL RECRUITMENT DYNAMICS OF NEW ENGLAND LOBSTERS

1450 BREAK
SUNDAY, NOVEMBER 19, 2005

SESSION 12            SALON C

PLANT/ALGAL ECOLOGY

Chair: Matt Edwards, San Diego State University

1530 § Donnellan, M.D.* Moss Landing Marine Laboratories. SPATIOTEMPORAL VARIABILITY OF KELP FOREST CANOPIES IN CENTRAL CALIFORNIA, AND A PROPOSED METHOD TO CLASSIFY KELP FORESTS USING REMOTE SENSING

1550 § Dubois, A.* and K. Iken. School of Fisheries and Ocean Sciences, University of Alaska Fairbanks. TEMPORAL AND SPATIAL DISTRIBUTION PATTERNS OF GRAZERS AND KELP CHEMICAL DEFENSES IN ALASKA

1610 Gaylord, B.*, J. Rosman, J. Largier, D. Reed, J. Koseff, C. McDonald, S. MacIntyre, K. Arkema, S. Monismith, P. Raimondi, M. Brzezinski. 1Bodega Marine Laboratory of UC Davis, 2Stanford University, 3UC Santa Barbara, 4UC Santa Cruz. FLOW MODIFICATION BY KELP FORESTS: IMPLICATIONS FOR SUBTIDAL ECOLOGY AND NEARSHORE ECOSYSTEMS

1630 § Talmage, Stephanie C.*, and R.C. Carpenter. Department of Biology, California State University Northridge. PATTERNS OF ABUNDANCE OF SARGASSUM MANGAREVENSE ACROSS HYDRODYNAMIC AND HERBIVORY GRADIENTS IN MOorea, FRENCH POLYNESIA.

1650 Spalding*, H.L., Ross, M., Okano, R. and K. Peyton. University of Hawaii at Manoa, Botany Department. DEMOGRAPHY AND GROWTH OF HALIMEDA MEADOWS IN HAWAII: MAKING SAND IN PARADISE

1710 Al-Humaidhi, A.W.*, M. Brzezinski, K. Arkema, A. Rassweiler, and D. Reed. University of California, Santa Barbara. THE SEASONAL CYCLE OF NUTRIENTS, SUSPENDED PARTICULATE MATTER, AND PRIMARY PRODUCERS AT THREE TEMPERATE REEFS

1730 § Matson, P.G.* and M.S. Edwards. San Diego State University. VARIATION IN STIPE HOLLOWING IN EISENIA ARBOREA (PHAEOPHYCEAE, LAMINARIALES) ACROSS LATITUDES.

1750 § Boizard, S. D.*12 and R.E. DeWreede1. 1University of British Columbia. 2Bamfield Marine Sciences Centre. BLADE ORIENTATION, AND STIPE AND HOLDFAST SHAPE OF LAMINARIA SETCHELLII RELATIVE TO THE DIRECTION OF WAVE SURGE, AND IMPLICATIONS OF HOLDFAST ASYMMETRY FOR SURVIVORSHIP
SESSION 13

SESSION TO HONOR A. TODD NEWBERRY

Chair: Kerstin Wasson, Elkhorn Slough National Estuarine Research Reserve


1330 Eernisse, D.J. Department of Biological Science, California State University, Fullerton. DNA IS TO NATURAL HISTORY AS A DOUBLE HELIX IS TO A TRAFFIC CIRCLE

1350 Griffith, K.A.* and A.T. Newberry. University of California, Santa Cruz. SEPARATING THE EFFECTS OF FLOW REGIME AND PREY CAPTURE ON COLONY MORPHOLOGY OF THE HYDROID, BOUGAINVILLIA MUSCUS

1410 Holyoak, A.R. Department of Biology. Brigham Young University – Idaho. DOES AN INTERTIDAL POPULATION OF THE COMPOUND ASCIDIAN TUNICATE POLYCLINUM PLANUM EXHIBIT A PREDICTABLE REPRODUCTIVE CYCLE?

1430 Basch, L.* 1 National Park Service Hawaii-Pacific Islands Cooperative Ecosystem Studies Unit, University of Hawai‘i, Manoa, Honolulu, Hawai‘i. NATURAL HISTORY TO MARINE CONSERVATION SCIENCE: EXAMPLES IN A NETWORK OF NATIONAL PARKS AND MARINE PROTECTED AREAS IN HAWAI‘I

1450 Saffo, M.B.* Marine Biological Laboratory, Woods Hole, MA. MOLGULID ASCIDIANS AS HABITAT: COEVOLUTION OF NEPHROMYCES WITH ITS MOLGULID HOSTS

1510 Comments by John Pearse, University of California, Santa Cruz

1515 BREAK
SATURDAY, NOVEMBER 19, 2005

SESSION 14  SALON D

COMMUNITY ECOLOGY III

Chair: Jayson Smith, California State University, Fullerton

1530 § Danner, E.M.* University of California Santa Cruz. THE EFFECTS OF INTRODUCED PREDATORS ON ISLAND PLANT COMMUNITIES: A COMPARISON AT MULTIPLE SPATIAL AND TEMPORAL SCALES

1550 § Morrow, K.M.* and R.C. Carpenter. Department of Biology, California State University Northridge. COMPETITIVE AND FACILITATIVE INTERACTIONS BETWEEN CORYNACTIS CALIFORNICA AND BENTHIC ALGAE ARE MEDIATED BY A SHALLOW KELP CANOPY

1610 Rilov, G.1,2 1 University of Canterbury, New Zealand; 2 Present address: Oregon State University SEASCAPES AND COASTAL COMMUNITY REGULATION: DECOUPLING PREY SUPPLY FROM PREDATION INTENSITY

1630 Smith, J.R. California State University, Fullerton. DRAMATIC DECLINES IN MUSSEL (MYTILUS) BED COMMUNITY DIVERSITY ALONG THE WAVE EXPOSED COAST OF CALIFORNIA: RESPONSE TO CLIMATE CHANGE?

1650 § Kimbro, D. L.*1, E. D. Grosholz1, and N. Travis2. 1University of California at Davis, *Brown University. THE DISTRIBUTION OF NATIVE AND NON-NATIVE DRILLS AND ITS EFFECT ON NATIVE OYSTER COMMUNITIES IN TOMALES BAY, CA.

1710 § Byrnes, J.E. Bodega Marine Laboratory. University of California Davis. BIODIVERSITY, INVASIONS, AND EXTINCTIONS: CONSEQUENCES FOR CONSUMER-PREY RELATIONSHIPS IN FOULING COMMUNITIES.

1730 § Kertesz*1, J.S., K.E. Boyer1, J.F. Bruno2, and Z.T. Long21San Francisco State University, 2University of North Carolina at Chapel Hill THE EFFECTS OF RESOURCE AVAILABILITY ON THE RELATIONSHIP BETWEEN MACROALGAL DIVERSITY AND PRODUCTIVITY

1750 White, J.S.* Department of Zoology, University of Florida. DIRECT AND INDIRECT EFFECTS OF A MARINE ECOSYSTEM ENGINEER ON CORAL GROWTH AND SURVIVAL
Chair: Karina Nielsen, Sonoma State University

1310  **Dudas, S.E.*¹ and J.F. Dower²** ¹ Oregon State University, ² University of Victoria. MODELING THE GROWTH AND SURVIVAL OF AN INTRODUCED BIVALVE, THE VARNISH CLAM (*Nuttallia obscurata*), IN THE NORTHEAST PACIFIC

1330  § Benavides, G.* University of California, Santa Cruz (EEB); SWFSC Fisheries Ecology Division, Santa Cruz. MICROSATELLITE DIVERSITY AND GENETIC STRUCTURE OF A TEMPERATE SERRANID, *Paralabrax nebulator*

1350  § Alter, S. E.* and S.R. Palumbi. Stanford University, Hopkins Marine Station. EXPLORING THE POPULATION HISTORY OF EASTERN NORTH PACIFIC GRAY WHALES USING A MULTI-LOCUS GENETIC APPROACH

1410  § Foley, M.M*. University of California Santa Cruz. PREFERENTIAL FEEDING RATES, GRAZING RATES, AND ASSIMILATION EFFICIENCY OF KELP TISSUES IN THE GREEN URCHIN, *Strongylocentrotus droebachiensis*

1430  § Krueger*, S.A. and S.R. Dudgeon. California State University Northridge. REGULATION OF GROWTH AND DEVELOPMENT VIA GASTROVASCULAR TRANSPORT IN A COLONIAL HYDROZOA

1450  Small, S.T.* and J.P. Wares. University of Georgia. IS GENETIC DIVERSITY A CONCERN WITH MARINE MANAGEMENT?

1510 BREAK
PHYSIOLOGICAL ECOLOGY

Chair: Robert Carpenter, California State University, Northridge

1530 § Curtis, D.L.*1,2, E.K. Jensen1,2, and I.J. McGaw1,2. 1 University of Nevada, Las Vegas, 2 Bamfield Marine Sciences Centre. PHYSIOLOGICAL AND BEHAVIOURAL RESPONSES OF THE GRACEFUL CRAB, Cancer gracillis, TO LOW SALINITY

1550 § Floyd, E.Y.*, and T.W. Anderson. San Diego State University. RELATIVE IMPORTANCE OF NUTRITIONAL CONDITION AND REFUGE AVAILABILITY FOR SURVIVAL OF THE BLACKEYE GOBY, RHINOGOBIOPS NICHOLLSII

1610 § Elahi, R. * and P.J. Edmunds. California State University, Northridge. IS BIGGER BETTER? TESTING FOR ENERGETIC CONSTRAINTS ON MAXIMUM SIZE IN THE SOLITARY SCLERACTINIAN CORAL, FUNGIA CONCINNA

1630 § Logan, C.A.*, Gracey, A.Y., and Somero, G.N. Hopkins Marine Station, Stanford University. USING A HETEROLOGOUS MICROARRAY APPROACH TO ANALYZE DIFFERENCES IN GENE EXPRESSION IN RESPONSE TO HEAT SHOCK IN CONGENERIC MARINE TURBAN SNAILS (GENUS TEGULA).

1650 § Mutz, S.J. James Cook University. COMPARATIVE GROWTH DYNAMICS OF ACANTHURID FISHES; AN INTER-OCEAN COMPARISON


1730 § Oliver, T.* and S. Palumbi. Hopkins Marine Station, Stanford University. A MULTI-LOCUS APPROACH TO THE STUDY OF THE FUNCTIONAL DIVERSITY OF CORAL ZOOXANTHELLAE – EARLY EXAMPLES FROM THE PACIFIC.

1750 § Blasius, M.E. California State University Long Beach. LEVELS OF POLYCHLORINATED BIPHENYLS (PCBS) AND CHLORINATED PESTICIDES IN THE CALIFORNIA SEA LION (ZALOPHUS CALIFORNIANUS), NORTHERN ELEPHANT SEAL (MIROUNGA ANGUSTIROSTRIS), AND HARBOR SEAL (PHOCA VITULINA) IN THE SOUTHERN CALIFORNIA BIGHT
SATURDAY, NOVEMBER 19, 2005

1815  WSN Annual Business Meeting  SALON E/F

Please attend this discussion of meeting sites, the election of officers, and other Society business.

1900  Presidential Banquet  SALON A/B/C

Please come enjoy an evening of fun, food, and wine with your fellow WSN members. Features an address by President Mark Carr. Tickets are required.

2100  WSN Auction for student travel  SALON A/B/C

After the banquet, please stay for the annual auction as we try to raise as much money as possible for the student travel fund. Members may attend the auction without attending the banquet.

SUNDAY, NOVEMBER 20, 2005

0830-0920  SALON A/B/C/D

PLENARY SPEAKER: JOSEPH CONNELL

ADVANTAGES OF LONG-TERM ECOLOGICAL RESEARCH
Chair: Jim Hobbs, University of California, Davis

1000 Allan, K.M.*1 and J.A. McGowan2. 1University of California San Diego, 2Scripps Institution of Oceanography. COMPARATIVE ANATOMY OF PELAGIC ECOSYSTEMS

1020 § Fisher, J.L.* Moss Landing Marine Laboratories. RETENTION OR EXPORT OF BRACHYURAN LARVAE IN A NEWLY DESIGNATED MARINE RESERVE IN SOUTHEAST ALASKA: A TALE OF TWO SPECIES

1040 § Kevin C. Weng*1, Andre Boustany1, Scot Anderson2, Adam Brown2, Peter Pyle2, John O’Sullivan1, Christopher G. Lowe4, Chuck Winkler5 and Barbara A. Block1. 1Hopkins Marine Station of Stanford University, 2PRBO Conservation Science, 3Monterey Bay Aquarium, 4California State University, Long Beach, 5Southern California Marine Institute. HABITAT, MIGRATION AND ONTOGENETIC NICHE SEPARATION IN WHITE SHARKS IN THE EASTERN NORTH PACIFIC

1100 § Burford, M. O.* University of California Santa Cruz. COMPARISON OF GENETIC STRUCTURE IN MULTIPLE YEAR-CLASSES OF BLUE ROCKFISH

1120 § Dickens, J.L.*, E.M. Gallardo, A.R. Beck and R.R. Wilson, Jr. California State University, Long Beach. A GENETIC ANALYSIS OF TEMPORAL AND SPATIAL DISJUNCTURE IN POPULATIONS OF YELLOWFIN GOBY (ACANTHOGOBIUS FLAVIMANUS) OF SOUTHERN CALIFORNIA.

1140 Hobbs, J.A* and L.S. Lewis. Bodega Marine Laboratory. University of California, Davis. GONE WITH THE WIND: ROCKFISH RECRUITMENT DECLINES WITH POOR UPWELLING.

1200 LUNCH
SUNDAY, NOVEMBER 20, 2005

SESSION 18             SALON C

INVASIVE SPECIES I

Chair: Catherine deRivera, Smithsonian Institution

1000  **Rodriguez, L.** Section of Evolution and Ecology, 1 Shields Avenue, University of California, Davis, CA 95616 NON-INDIGENOUS AQUACULTURE CROPS AS PREY SOURCES FOR NATIVE PREDATORS

1020  **§ Whiteside, K.E. *, A.M. Bullard, and S.N. Murray.** California State University, Fullerton. DISTRIBUTION, HABITAT UTILIZATION, PRODUCTIVITY, AND REPRODUCTIVE PATTERNS IN **CAULACANTHUS USTULATUS** (CAULACANTHACEAE, GIGARTINALES), A NEWLY ESTABLISHED SEAWEED ON SOUTHERN CALIFORNIA SHORES

1040  **§ White, L.F.** The University of British Columbia. DIVERSITY VERSUS INVASION: INVESTIGATING EFFECTS OF NATIVE MACROALGAL DIVERSITY ON INVASION SUCCESS OF THE INVASIVE JAPANESE ALGA **SARGASSUM MUTICUM** (YENDO) FENSHOLT.

1100  **§ Preisler, R.K.*1,2 and K.R. Wasson**1,2. 1Elkhorn Slough National Estuarine Research Reserve, 2University of California Santa Cruz. ESTUARINE AND COASTAL INVERTEBRATE INVASIONS: A BIOGEOGRAPHIC COMPARISON.

1120  **§ Heiman K. W.** Hopkins Marine Station of Stanford University. IMPACTS OF INVASIVE REEFS ON SOFT SEDIMENT COMMUNITY STRUCTURE

1140  **§ Coates, R.C.* and J. J. Stachowicz.** Bodega Marine Laboratory, University of California, Davis. INVASIVE SPECIES AS HABITAT MODIFIERS: **WATERSIPORA SUBTORQUATA** ’S EFFECT ON NATIVE VS. NON-NATIVE SPECIES

1200 LUNCH
SESSION 19

INTERTIDAL ECOLOGY II

Chair: Steve Lonhart, Monterey Bay National Marine Sanctuary

1000 § Wood, Spencer*1, Amber Tews2, and Roland Russell3. 1University of British Columbia, Biodiversity Research Centre, 2Idaho State University, Department of Anthropology, 3The Earth Institute at Columbia University. COMPARING ANCIENT MIDDEN AND PRESENT DAY MARINE COMMUNITIES TO DETECT LONG TERM CHANGES IN INTERTIDAL COMMUNITY COMPOSITION.

1020 § Conway-Cranos, L.L.* and P.T. Raimondi. University of California at Santa Cruz. GEOGRAPHIC VARIATION IN RECOVERY OF ROCKY INTERTIDAL COMMUNITIES FOLLOWING A DISTURBANCE: LINKING RECRUITMENT TO RECOVERY

1040 § Huff, T.M. Scripps Institution of Oceanography. GOT SAND? SAND ADDITION ALTERS THE INVERTEBRATE COMMUNITY OF INTERTIDAL CORALLINE TURF IN SAN DIEGO COUNTY, CALIFORNIA

1100 § Manzur* T. and S.A. Navarrete. Estación Costera de Investigaciones Marinas & Center for Advanced Studies in Ecology and Biodiversity, Pontificia Universidad Católica de Chile. FORAGING ECOLOGY OF THE SOUTH AMERICAN SUN-STAR: EFFECTS OF PREY ON PREDATOR POPULATION.

1120 § Studebaker, R.S.*, T.J. Mulligan., and K.N. Cox Humboldt State University. USE OF ROCKY INTERTIDAL AREAS BY JUVENILE BLACK ROCKFISH, SEBASTES MELANOPS

1140 Lonhart, S.I.*1 and M. H. Carr2. 1Monterey Bay National Marine Sanctuary, 2University of California Santa Cruz. SUBTIDAL MARINE RESOURCE SURVEYS ALONG THE BIG SUR COASTLINE

1200 LUNCH
SUNDAY, NOVEMBER 20, 2005

SESSION 20                   SALON E/F

COMMUNITY ECOLOGY IV

Chair: Mark Steele, University of California, Santa Barbara

1000  Steele*, M.A., S.C. Schroeter, H.M. Page, and D.C. Reed. University of California, Santa Barbara. AN EXPERIMENTAL EVALUATION OF BIASES ASSOCIATED WITH SAMPLING ESTUARINE FISH WITH SEINES

1020  Goldstein, M.C.*1 and D.C. McNaught1,2 Brown University. 2Victoria University, Wellington, New Zealand. EFFECTS OF SHIFTS IN ALGAL HABITAT ARCHITECTURE ON THE PRIMARY SETTLEMENT OF THE BLUE MUSSEL (MYTILUS EDULIS)

1040  § Munguia, P.* Florida State University AMPHIPOD RECRUITMENT STRATEGIES AND LIFE HISTORY TRAITS ALLOW FOR COEXISTENCE

1100  § Kordas, R.L.* and S.R. Dudgeon. California State University Northridge. LATITUDINAL VARIATION IN INTERACTIONS BETWEEN ROCKWEEDS AND BARNACLES IN THE GULF OF MAINE

1120  § Overstrom-Coleman, M.,* A. Greenley, and A. Alifano Moss Landing Marine Laboratories. IMPACTS OF A WINTER STORM SERIES ON THREE CENTRAL CALIFORNIA KELP ASSEMBLAGES

1140  § Miller, L.P.* and Denny, M.W. Hopkins Marine Station, Stanford University. IN SITU MEASUREMENT OF BARNACLE FEEDING ACTIVITY AT HIGH WATER VELOCITIES ON A WAVE-SWEPT SHORE LUNCH

1200  LUNCH
SUNDAY, NOVEMBER 20, 2005

SESSION 21

BEHAVIORAL ECOLOGY II

Chair: Jim Watanabe, Stanford University

1310 § Bellquist, L.F.*1, C.G. Lowe2, and J.E. Caselle3. 1,2 California State University Long Beach, 3 University of California Santa Barbara. MOVEMENT PATTERNS, HOME RANGE, SITE FIDELITY, AND HABITAT PREFERENCE OF OCEAN WHITEFISH (MALACANTHIDAE) IN A SANTA CATALINA ISLAND MARINE RESERVE.

1330 § Miller, L.P.* and M.W. Denny. Hopkins Marine Station, Stanford University. IN SITU MEASUREMENT OF BARNACLE FEEDING ACTIVITY AT HIGH WATER VELOCITIES ON A WAVE-SWEPT SHORE

1350 § Jordan, L.K.* University of California, Los Angeles. ECOMORPHOLOGY OF STINGRAY MECHANOSENSORY AND ELECTROSENSORY SYSTEMS (ELASMOBRANCHII: BATOIDEA)

1410 Britt, L. L.1,2*, W. N. McFarland2, and B. S. Miller2. 1NOAA/Alaska Fisheries Science Center, RACE Division, Seattle, WA. 2University of Washington, School of Aquatic and Fishery Sciences and Friday Harbor Laboratories, Friday Harbor, WA. THE CHROMATIC ACTION SPECTRUM FOR FIRST-FEEDING LINGCOD LARVAE (OPHIODON ELONGATUS) AND THE POTENTIAL FUNCTIONALITY OF SHORT-WAVELENGTH SENSITIVITY TO FEEDING LARVAE.

1430 H.C. Hess*1, M. Overstrom-Coleman1,2, A.T. Fundis1 and C.W. Petersen1. 1College of the Atlantic, 2Moss Landing Marine Laboratory. THE ROLES OF FACULTATIVE AND OBLIGATE CLEANERS ON A CARIBBEAN CORAL REEF

1450 § Hultgren, K.* and J.J. Stachowicz. University of California, Davis. CAMOUFLAGE IN THE KELP FOREST: DECORATION AND COLOR CHANGE IN THE FAMILY EPIALTIDAE (KELP CRABS)

1510 BREAK
SUNDAY, NOVEMBER 20, 2005

SESSION 22             SALON A/B

INTERTIDAL ECOLOGY III

Chair: Ginny Eckert, University of Alaska Southeast, Juneau

1530 Navarrete, S.A.* and E.L. Berlow2. 1Estación Costera de Investigaciones Marinas and Center for Advanced Studies in Ecology & Biodiversity, Pontificia Universidad Católica de Chile, Casilla 114-D, Santiago, Chile, 2 University of California, San Diego, White Mountain Research Station, 3000 E. Line St., Bishop, CA, 93514, USA. VARIABLE INTERACTION STRENGTHS STABILIZE MARINE COMMUNITY PATTERN.

1550 Carrington, E. Department of Biology, Friday Harbor Laboratories, University of Washington. PREDICTING DISTURBANCE TO MUSSEL BEDS: WAVE VERSUS TEMPERATURE STRESS

1610 Boller, M.L.*1 and E. Carrington2. 1Hopkins Marine Station, 2Friday Harbor Marine Laboratories. INTERSPECIFIC COMPARISON OF RECONFIGURATION IN TEN ROCKY INTERTIDAL MACROALGAE

1630 Moeser, G.M.* and E. Carrington. Friday Harbor Laboratories. MINDING THEIR OWN BYSSUS? PRODUCTION AND QUALITY OF MYTILUS EDULIS THREADS.

1650 Eckert, G.L.* University of Alaska Southeast, Juneau. VARIABILITY IN NEARSHORE GULF OF ALASKA POPULATIONS: EFFECTS OF MEASURES, TIDAL HEIGHT, AND SUBSTRATE

1710 Schiel, D.R. Marine Ecology Research Group, School of biological Sciences, University of Canterbury, Private Bag 4800, Christchurch, New Zealand. RIVETS OR BOLTS? WHEN SINGLE SPECIES COUNT IN THE FUNCTION OF TEMPERATE ROCKY REEF COMMUNITIES

1730 O’Donnell, M.J.* Hopkins Marine Station, Stanford University. REDUCTIONS OF WAVE-IMPACT FORCES WITHIN PATCHES IN MUSSEL BEDS.
INVASIVE SPECIES II

Chair: Jennifer Smith, NCEAS, University of California, Santa Barbara

1310  deRivera,* C.E. 1,2 and G.M. Ruiz1. 1Smithsonian Environmental Research Center, 2Portland State University. SPATIAL PATTERNS OF NONINDIGENOUS INVERTEBRATES IN WEST COAST RESERVES AND SANCTUARIES

1330  § Whitcraft, C.R. *1, J.A. Crooks2, A. Demopoulos1, L.A. Levin1, and D.M. Talley3 1 Scripps Institution of Oceanography, 2 Tijuana River National Estuarine Research Reserve, UC Davis. INVASIVE TAMARISK ALTERS THE PHYSICAL ENVIRONMENT AND SEDIMENT FOOD WEB IN A SALT MARSH ECOSYSTEM

1350  Smith, J. E. *1 and E. J. Conklin2. 1National Center for Ecological Analysis and Synthesis, University of California Santa Barbara, 2University of Hawaii, Manoa. DIVERSITY AND INVASIBILITY IN A CORAL REEF ECOSYSTEM: EFFECTS OF DIVERSITY ON INVISIBILITY AND THE EFFECTS OF INVASION ON EMERGENT ECOSYSTEM PROPERTIES

1410  Padilla, D.K.*1 and T. Klinger2. 1Stony Brook University, 2University of Washington. INVASION OF CRASSOSTREA GIGAS IN MARINE RESERVES: CAN THEY REPRODUCE IN COLD WATERS?

1430  Piotrowski, C.N.* San Francisco State University, California Academy of Sciences. CRYPTICS AND EXOTICS AMONG COSMOPOLITAN POLYCHAETES: SORTING THROUGH AN OPEN CAN OF WORMS

1450  § Zahn, E.F.* California State University, Long Beach INVASIVE CAPABILITIES AND POPULATION DISTRIBUTION OF EXOTIC ICE PLANT IN SOUTHERN CALIFORNIAN COASTAL SALT MARSHES

1510  BREAK
CONSERVATION & RESTORATION ECOLOGY I

Chair: Brian Tissot, Washington State University, Vancouver

1530 Tran, C.*, B. L. Sanderson, H. Coe, K. Macneale, and V. Pelekos. Northwest Fisheries Science Center, NOAA Fisheries. NUTRIENT LIMITATION ACROSS MULTIPLE ANADROMOUS STREAMS IN IDAHO

1550 Wilder, R.M. U.S. Fish & Wildlife Service, Stockton, CA. LONG TERM MONITORING OF JUVENILE FISHES IN THE SAN FRANCISCO BAY DELTA ESTUARY.

1610 Lewis, L.*1,2, J. A. Hobbs1, and W. A. Bennett1. 1UC Davis Bodega Marine Laboratory, 2San Diego State University. ASSESSING THE UTILITY OF OTOLITHS TO INFERENCE AGE, GROWTH AND HEALTH OF A LITTORAL SALT MARSH FISH, GILLICHTHYS MIRABILIS.

1630 Tissot, B. N.*1, W. J. Walsh2, and L. E. Hallacher3. 1 Washington State University Vancouver, 2 Hawaii Division of Aquatic Resources, 3 University of Hawaii Hilo. EVALUATING THE ECONOMIC, SOCIAL AND ECOLOGICAL EFFECTIVENESS OF A MARINE PROTECTED AREA NETWORK IN HAWAI’I

1650 Christopher L. Kitting. California State University East Bay, Hayward. COMPARISONS OF EXTENSIVELY RESTORED AND REFERENCE TIDAL MARSHES IN UPPER SAN FRANCISCO ESTUARY

1710 Fraser, Don.* Species at Risk Secretariat, Department of Fisheries and Oceans, Government of Canada. SPECIES AT RISK: CANADA’S PROGRAM FOR ENDANGERED SPECIES
COMMUNITY ECOLOGY V & CONSERVATION BIOLOGY

Chair: Mike Graham, Moss Landing Marine Laboratories

1310 § Lee, S.C.* and J.F. Bruno. University of North Carolina at Chapel Hill. PROPAGULE SUPPLY DRIVES COMPOSITION AND DIVERSITY OF MOBILE EPIFAUNA COMMUNITIES

1330 § Olyarnik, S.V.* and J.J. Stachowicz. University of California, Davis. UNDERSTANDING THE EFFECTS OF SEASONAL MACROALGAL BLOOMS ON THE SEAGRASS COMMUNITY: IMPLICATIONS FOR HABITAT STRUCTURE AND FISH FORAGING

1350 § Bond, M.H.1, S.A. Hayes2, C.V. Hanson1 and R.B. MacFarlane2. 1University of California Santa Cruz, 2NOAA SWFSC Fisheries Ecology Division. ESTUARIES AS STEELHEAD NURSERY HABITAT: GROWTH AND SURVIVAL OF COASTAL CALIFORNIA STEELHEAD AND THE ESTUARY LIFE-HISTORY STAGE

1410 § Fenberg, P* and Roy, K University of California, San Diego. THE EFFECTS OF SIZE-SELECTIVE HARVESTING ON A SEX CHANGING LIMPET, LOTTA GIGANTEA


1450 § Thompson, S. A.* and K.J. Nielsen. Sonoma State University. ASSESSING THE IMPACT OF COMMERCIAL COLLECTING ON POSTELIA PALMAEFORMIS

1510 BREAK
SUNDAY, NOVEMBER 20, 2005
SESSION 26          SALON D

SPECIES-HABITAT ASSOCIATIONS II

Chair: Kevin Hovel, San Diego State University

1530 Houghton, J.P.*, J. E. Starkes, M.D. Chambers and D. Ormerod. Pentec Environmental, a Division of Hart Crowser, Inc. THE BLIND EATING THE BLIND: ECOLOGY OF KNIK ARM, ALASKA

1550 Sebens, K.P. Friday Harbor Laboratories, University of Washington. CAN CORALS COPE? LIMITS TO GROWTH IN A CHANGING ENVIRONMENT

1610 Hovel, K.A.*1 and C.G. Lowe2. 1San Diego State University, 2California State University, Long Beach. SHELTER USE AND MOVEMENT OF SPINY LOBSTERS IN A SOUTHERN CALIFORNIA KELP FOREST

1630 Pardo, L.-M.1 and L.E. Johnson2.1Universidad Austral de Chile; 2Université Laval. GROWTH RATE, SIZE, AND FECUNDITY IN A MARINE SNAIL ACROSS AN ENVIRONMENTAL GRADIENT LACKING PREDATORS: EVIDENCE FOR COUNTER-GRADIENT SELECTION

1650 Hodin, J.* Hopkins Marine Station, Pacific Grove, CA, USA 93940. WE NEVER SHOULD HAVE MOVED HERE: EFFLUX TRANSPORT INHIBITORS INDUCE INAPPROPRIATE SETTLEMENT DECISIONS IN SAND DOLLAR AND SEA URCHIN LARVAE

1710 Bianchi, C. *1, B.N. Tissot 1, M.M. Yoklavich 2, 1 Washington State University, Vancouver, 2 NOAA National Marine Fisheries Service. ABUNDANCE AND DISTRIBUTION OF MEGAFANAUL INVERTEBRATES IN SUBMARINE CANYONS AND THEIR ECOLOGICAL ASSOCIATIONS WITH GROUNDFOISH

1730 Finley, R.J.*1 and G.E. Forrester2. 1Northwest Fisheries Science Center, 2University of Rhode Island. PARASITISM AND A SHORTAGE OF REFUGES JOINTLY MEDIATE THE STRENGTH OF DENSITY DEPENDENCE IN A REEF FISH
COMMUNITY ECOLOGY VI

Chair: Matt Bracken, University of California, Davis

1310 § Baskett, M.L.*1, M. Yoklavich2, and M. Love3. 1Princeton University, 2NOAA NMFS SWFSC Santa Cruz Laboratory, 3University of California Santa Barbara Marine Science Institute. PREDATION, COMPETITION, AND THE RECOVERY OF OVEREXPLOITED FISH IN MARINE RESERVES

1330 § Benes, K.M.* and R.C. Carpenter. Department of Biology; California State University, Northridge. EFFECTS OF Eisenia arborea ON THE DEVELOPMENT AND STRUCTURE OF AN UNDERSTORY ALGAL COMMUNITY

1350 Bracken, M.E.S.*1 and J.J. Stachowicz2. 1Bodega Marine Laboratory, 2University of California, Davis. TOP-DOWN MODIFICATION OF BOTTOM-UP PROCESSES: SELECTIVE GRAZING REDUCES MACROALGAL NITROGEN UPTAKE

1410 § Masill, K.J.*, W.P. Ritchie, H.J. Desmarais, and E.V. Thuesen. The Evergreen State College. ZOOPLANKTON COMMUNITY STRUCTURE IN SOUTHERN HOOD CANAL IN AREAS OF LOW DISSOLVED OXYGEN

1430 § Griffiths, A.M. University of Victoria. INVESTIGATIONS INTO THE POTENTIAL PREDATORS AND ONTOGENY OF VULNERABILITY TO PREDATORS OF JUVENILE NORTHERN ABALONE, HALIOTIS KAMTSCHATKANA

1510 BREAK
SUNDAY, NOVEMBER 20, 2005

SESSION 28                   SALON E/F

POPULATION BIOLOGY & ECOLOGY IV

Chair: Jenn Caselle, University of California, Santa Barbara

1530 **Kaplan, I.C.*1, Harvey, C.J. 1, Brand, E.J. 1, Fulton, E.A. 2, Smith, A.D.M. 2, and P.S. Levin1.** 1 NOAA Fisheries Northwest Fisheries Science Center, 2 CSIRO Division of Marine Research. AN ECOSYSTEM MODEL FOR THE CALIFORNIA CURRENT.

1550 **Caselle, J.E., S.L. Hamilton* and J.D. Standish.** Department of Ecology, Evolution, and Marine Biology, UC Santa Barbara. SITE-SPECIFIC DIFFERENCES IN LIFE HISTORY TRAITS OF CALIFORNIA SHEEPHEAD FROM CENTRAL BAJA TO SOUTHERN CALIFORNIA ARE RELATED TO FISHING PRESSURE.

1610 **Fielman K.T.* and G. H. Hofmann** Marine Science Institute, UC Santa Barbara COMPARATIVE LARVAL THERMOTOLERANCE AMONG WESTERN STRONGYLOCENTROTID URCHIN CONGENERS

1630 **Edmunds, P.J.** Department of Biology, California State University, Northridge. TEMPERATURE-MEDIATED TRANSITIONS BETWEEN ISOMETRY AND ALLOMETRY IN A COLONIAL MODULAR INVERTEBRATE

1650 **Nakamura, R.*, C. Mireles, E. Nakada, S. Reinecke and D. Wendt.** Biological Sciences Department and Center for Coastal Marine Sciences, California Polytechnic State University, San Luis Obispo, CA. THE LIVE-FISH FISHERY FOR CABEZON: ORIGINS, CHARACTERISTICS, AND STATUS OF CURRENT RESEARCH

1710 **Petersen, C.W.*1,2, R. L. Preston2,3, and George W. Kidder III2.** 1College of the Atlantic, 2Mount Desert Island Biological Laboratory, 3 Illinois State University, Normal. EGG SURVIVAL AND DEVELOPMENT RATES IN THE INTERTIDAL SPAWNER FUNDULUS HETEROCLITUS: A FIELD EXPERIMENT
ABSTRACTS

SYMPOSIUM 1: NATURALISTS WITHOUT BORDERS: CONSIDERING CROSS-Ecosystem Connections

Block, B. A1., Boustany, A.,2 Walli, A.,2 Teo, S. L. H.,2 Farwell, C.,3 Williams, T.,1 Tuna Research and Conservation Center, Stanford University, USA;2 Hopkins Marine Station, Stanford University, USA;3 Monterey Bay Aquarium, USA. MOVEMENT PATTERNS AND POPULATION STRUCTURE OF ATLANTIC BLUEFIN TUNA (THUNNUS THYNNUS) AS REVEALED BY ELECTRONIC TAGS

An electronic tagging program was initiated for Atlantic bluefin tuna (ABFT) in 1996 to assess large-scale movement patterns, population structure, breeding site fidelity, and behavior of western-tagged bluefin tuna. To date over 900 electronic tags have been deployed in the western Atlantic Ocean. Over 100 archival-tagged bluefin tuna have been recaptured providing tracks up to 4.8 years in length. 260 pop up satellite archival tags have transmitted data to Argos satellites after 2 to 260 days post-tagging. Together, these two data sets provide geoposition data that delineate two populations, one utilizing spawning grounds in the Gulf of Mexico and another from the Mediterranean Sea. Trans-Atlantic movements of western-tagged bluefin tuna reveal site fidelity to known spawning areas in the Mediterranean Sea. Bluefin that occupy western spawning grounds move to central and eastern Atlantic foraging grounds. Our results are consistent with two populations of bluefin tuna with distinct spawning areas that overlap on North Atlantic foraging grounds. Movement patterns and oceanographic data reveal regions of foraging and breeding aggregations for the weaker, western bluefin tuna population. Information from electronic tags informs international managers when and where bluefin tuna can be protected.

Conover, D.O. Marine Sciences Research Center, Stony Brook University. DARWINIAN FISHERY SCIENCE

Life histories of fishes and other marine organisms are extremely diverse. Much of this diversity is intrinsic and occurs at the individual, population, species and higher levels. Life history variation is presumably optimized by natural selection in response to age specific probabilities of reproductive success and survival that have evolved over thousands of generations. Fishing radically changes this adaptive landscape. Drawing upon >25 years of research on the Atlantic silverside Menidia menidia, I show how a natural gradient in size-selective mortality causes dramatic variation in a large suite of physiological, behavioral, and life history traits. I then use harvest experiments to show that these traits evolve rapidly in response to size-selective fishing. Such evolutionary changes in life history will generally have detrimental effects on stock dynamics by reducing yield, decreasing population growth rate, and slowing the potential rate of stock recovery when fishing ceases. Fishery science needs to incorporate Darwinian principles into its management framework if sustainability is the long-term goal.

Glynn, P. ENSO SEA WARMING DISTURBANCES TO EASTERN PACIFIC CORAL REEFS: RESPONSES, RECOVERY AND FUTURE PROJECTIONS

Unprecedented zooxanthellate reef coral bleaching and mortality occurred in the eastern tropical Pacific during El Niño-Southern Oscillation (ENSO) sea warming events in 1982-83 and 1997-98. Coral communities from Baja California (México) to coastal Ecuador and the Galápagos Islands were affected with maximum mortality reaching 99% and total coral cover mortality on reefs at some sites. The first large-scale coral reef bleaching event (1982-83) also occurred at sites in the southern and western Pacific, and eastern Indian Oceans. Coral bleaching and mortality resulting from the 1997-98 event were concentrated in the Indian Ocean, Southeast Asia and the far western and eastern Pacific, with mortality levels >90% on many reefs. The close correspondence of size and duration of positive temperature anomalies with the severity of bleaching, and simulated ENSO laboratory experiments, demonstrate the critical role of thermal stress as the causative agent. In addition to an initial bleaching/mortality response, several secondary disturbances can limit and lengthen reef recovery in the short-term and for several years following. Although highly variable, significant coral recovery from ENSO disturbances of the past two decades has occurred on reefs in several areas, notably the eastern Pacific and Indian Ocean. Based on observed responses
and recovery, the impact of continued sea warming may be minimized by protecting reef sites in areas offering (a) resistance to bleaching (e.g., low temperature and light stress, enhanced circulation) and (b) community resilience (e.g., availability of larvae, low abundance of bioeroders and corallivores). Speculations on the fate of coral reefs in the face of continued sea warming suggest major changes, ranging from (a) a shift of reef distributions to higher latitudes, (b) coral host and/or endosymbiont adaptation, (c) the reduction of coral diversity from the loss of bleaching-susceptible species, (d) the elimination of shallow reef structures, to (e) the complete elimination of all coral reefs.

Levin, P.S. NOAA Fisheries, Northwest Fisheries Science Center. MARINE ECOLOGY AND FISHERIES MANAGEMENT: WHEN GOOD FENCES MAKE BAD NEIGHBORS

A number of researchers have pointed out that there is an unnecessary and unproductive divide between basic and applied ecologists. I will expand upon this concept and illustrate that a sharp cultural divide exists between applied ecologists working in an academic setting versus those in government agencies. This gulf lessens the ability of either group to effectively inform management. Ecological approaches clearly have much to offer fisheries. I will use three examples showing how very simple ecological approaches (population viability analyses, stage-structured matrix models, and species-area relationships) can provide useful information to decision makers. In some instances, such simple approaches are useful because they require less data than the more complex methods that are currently employed. In other cases, ecological approaches may yield insight because the assumptions underlying ecological and fisheries models can be very different. While marine ecology has much to offer fisheries science and fisheries management, the converse is also true—fisheries has much to offer marine ecology. I will discuss examples illustrating ways in which marine ecologists might learn from the treatment by fisheries biology of such issues as stochastic processes, scale, and poor-quality data. Boundaries between researchers in government agencies and academia may always exist, but crossing such borders will increase the quality of work on both sides of the fence and will likely increase the chances that ecosystem-based approaches will be constructively incorporated into marine resource management.

Steneck, R. S. University of Maine, Darling Marine Center. MIGHT WE IMPROVE MANAGEMENT OF THE NEW ENGLAND LOBSTER FISHERY BY TAKING AN ECOLOGICAL APPROACH?

The American lobster is New England’s most valuable marine resource. It has been intensively harvested for over 150 years but is doing better today than ever before. For the past two decades, fisheries managers tried to gauge the health of this resource with a single index based on per capita egg-per-recruit estimates. They concluded lobster stocks are and have been seriously overfished. However, during this time, lobster stocks have undergone a population explosion. High rates of settlement have increased juvenile and adult populations throughout the Gulf of Maine. Catch per unit effort has increased, spawning stock (and spawning potential has increase) to new record levels. My talk will illustrate why a more ecological approach to the monitoring and management of this lobsters might provide a better basis on which to manage this species. Specifically, there are too many ecologically important processes and too much change in ecosystem structure and function to manage any species with a single index.
SYMPOSIUM 2: IT TAKES GOOD SCIENCE AND... TO MAKE GOOD POLICY

Compton, J.E.  US Environmental Protection Agency, ORD, NHEERL, WED, Corvallis OR.  FROM THE FOREST TO THE SEA AND BACK AGAIN: MARINE INPUTS AND TERRESTRIAL BIOGEOCHEMISTRY IN THE PACIFIC NORTHWEST

Most models of watershed biogeochemistry include the movement of materials from land to rivers and eventually the ocean. Few conceptual views, however, acknowledge the influence of materials derived from the ocean on terrestrial ecosystem processes. Based on spatial patterns of stream chemistry in the Oregon Coast Range, it is possible that deposition of marine aerosols stimulates nitrate leaching from coastal forest soils. This work also considers the flux of elements from the ocean to the land via current and historic salmon migration. This study induced nitrate leaching by adding salt solutions in lab experiments using root-free soils. Salt deposition may influence nitrate dynamics through a number of mechanisms, including abiotic (direct exchange of chloride for nitrate), biotic (inhibition of microbial activity) and coupled abiotic-biotic effects (exchange of sodium for ammonium, then nitrification). Direct exchange of chloride for nitrate did not occur, but strong salt solutions did displace ammonium from the exchanger. In field experiments, addition of dilute sodium chloride solutions depressed soil respiration, indicating a biotic response at salt concentrations comparable to coastal deposition values. Lab salt additions also decreased the leaching of dissolved organic carbon, which has implications for the cycling of nitrogen and net nitrate production. Our findings of an interaction between marine aerosol inputs and soil processes represent a new perspective on nutrient dynamics in near coastal ecosystems.

Ellis, J.C.  Shoals Marine Laboratory, Cornell University.  SEABIRDS AS LINKS BETWEEN TERRESTRIAL AND MARINE SYSTEMS

Exchanges of nutrients and materials among ecosystems have long been recognized, however a theoretical framework for this process has only recently been generated. One of the predictions of this theory is that nutrients and materials are transported from more to less productive ecosystems. Although physical processes often dictate the delivery of passive materials, input is also greatly influenced by mobile organisms. Seabirds in particular, are highly mobile and play an important role as links between land and sea. For instance, seabirds that exploit intertidal organisms during low tide can have considerable effects on intertidal food webs. In turn, they introduce large amounts of marine-derived nutrients to land thereby altering resource availability to terrestrial species. Nutrients from seabirds can increase soil concentrations, plant biomass, consumer abundance, and reduce plant species richness. However, temperature and precipitation, nesting density, and species-specific behaviors can alter the magnitude and direction of these effects. Dramatic effects of seabirds on soils and vegetation of their colonies have long been noted, but few studies have rigorously investigated the causes of these effects; only some have involved manipulative field experiments or quantitative comparative studies. Because seabirds are highly mobile, they pose unique challenges for experimentation in both terrestrial and marine habitats. For instance, results from studies of seabird predation on mobile invertebrates in rocky intertidal communities show that large-scale exclosures are necessary for detecting predation effects. Similarly, because ammonia can be volatilized into the atmosphere from seabird colonies and deposited to sites far away, guano deposition may have far-reaching effects that extend beyond the scale of many investigations. Studies that incorporate large scale sampling and manipulative field experiments would contribute significantly to a better understanding of how seabirds affect both terrestrial and marine communities.

Power, M.  ECOLOGICAL REGIME CHANGES DOWN RIVER DRAINAGE NETWORKS: TOWARDS PREDICTIVE MAPPING

Longitudinal (downstream) and cross-valley gradients in productivity, disturbance, and habitat structure exert strong effects on organisms and energy sources to river food webs, but their effects on species interactions are just beginning to be explored. Even less is known about how network structure per se (e.g. hierarchical structure, confluence nodes) influences river and riparian food webs and their members. I will discuss research on food webs in a coastal California river system to illustrate how landscape features and shifts in spatial sources of energy can potentially alter interactions in food webs. Increasingly available tracers can reveal flow paths through space and time of organisms or their elemental or molecular constituents. Concurrently, new mapping technologies based on remote sensing are being used to characterize landscape or seascape features (e.g. watersheds divides, thermal cells) that contain and constrain these fluxes and the food webs they support. These tools are providing glimpses of spatial
with food web interactions, and should inform our understanding of context dependent controls on interaction strengths in webs.

Drew M. Talley
San Francisco Bay National Estuarine Research Reserve, SFSU; UC Davis. HABITAT LINKAGES AT THE LAND-SEA INTERFACE

Natural environments, even those traditionally considered “insular”, are not isolated from the effects of often quite distant habitats. Habitats are functionally linked through a number of processes, broadly involving the movement of organisms or materials across boundaries. Cross-boundary linkages can be demographic (e.g., source-sink dynamics or metapopulations), physical (e.g., sedimentation), trophic (spatial subsidies), or some combination of these forms. These connections between habitats are ubiquitous at the marine/terrestrial interface, occurring across a vast range of temporal and spatial scales. Habitat connectivity at this boundary commonly creates dominant effects on community structure and population dynamics that ramify through both ecosystems. Here we focus on the mechanisms and importance of connectivity at the marine/terrestrial boundary, and discuss the implications of these connections to both theoretical and conservation ecology.

Witman, J. D. Ecology and Evolutionary Biology, Brown University. UPWELLING IN THE GALAPAGOS MARINE RESERVE: DOES IT CREATE BOTTOM-UP, TOP-DOWN EFFECTS IN SUBTIDAL FOOD WEBS?

Links between pelagic and benthic ecosystems are created by oceanographic processes. Despite the ubiquity of benthic-pelagic coupling and the vast spatial extent of subtidal benthic habitats, the consequences of cross-ecosystem transfers of food, nutrients and consumers have been largely unexplored from a modern theoretical standpoint. We tested the hypothesis that upwelling creates bottom-up effects that ultimately lead to top-down control of rocky subtidal communities on a regional spatial scale in the Galapagos Islands. Barnacles (Megabalanus sp.) were the major focus of study because they are abundant subtidally and, as important filter feeding prey species, they link water column production to higher trophic level consumers. The hypothesis that vertical currents influence barnacle recruitment and abundance on rock walls (6 and 15 m depth) was supported by 1) repeated patterns of significantly higher average barnacle recruitment to sites with the highest vertical velocities from 2002 – 2004 and 2) the pattern of adult barnacle distribution, which consisted of significantly higher barnacle cover at sites of highest vertical velocities. A major barnacle predator, the whelk Hexaplex princeps, displayed an aggregative response to barnacle prey as indicated by positive linear relationships between barnacle cover and whelk density. Predation intensity experiments conducted at 12 sites across the region revealed high rates of predation with 16 - 81% of adult barnacles eaten by whelks and fish in 2 weeks. The highest predation occurred upwelling sites. A significant relation between barnacle cover and the proportion of barnacles eaten established a linkage between bottom-up and top-down forces. The implications of these results for cross-ecosystem and food web theory will be discussed.

Richard W. Zabel, Northwest Fisheries Science Center, National Marine Fisheries Service, Seattle, WA. LINKAGES BETWEEN MARINE AND FRESHWATER ECOSYSTEMS IN PACIFIC SALMON

Pacific salmon spend substantial portions of their lifetime in radically different ecosystems: from freshwater spawning rearing habitats, often in high elevation streams, to the Pacific Ocean, where the majority of their growth occurs. Highlighting several studies, I ask, what are the implications of this transitory life history for freshwater ecosystems and for salmon population dynamics? While the existence of marine-derived nutrients in salmon streams has been well documented, we estimated the salmon-mediated flux of nutrients out of freshwater ecosystems and found that in some years, particularly when abundance of adults is low, juvenile salmon carried out more nutrients than adult salmon brought in, potentially leading to complex feedback mechanisms in salmon population dynamics. Also, we are examining aquatic food webs to determine the specific pathway of marine-derived nutrients from adult salmon to juveniles and to quantify the relationship between added nutrients and enhanced juvenile growth. In another set of studies, we are examining the effects of climate variability, in both freshwater and marine ecosystems, on salmon population dynamics and viability. We found that ocean survival for Chinook salmon is strongly related to the Pacific Decadal Oscillation (PDO) index and subsequently that different scenarios of future ocean climate greatly influence predictions of population viability. On the freshwater side, we found distinct ecotypes that responded differentially to climate variability depending on habitat type. Also, because terrestrial temperatures are projected to increase under global climate change at a much greater rate than marine
ones, our population viability models predict that while variability in ocean survival currently dominates patterns of salmon abundance, freshwater climate effects will become increasingly prominent.

CONTRIBUTED PAPER ABSTRACTS

Al-Humaidhi, A.W.*, M. Brzezinski, K. Arkema, A. Rassweiler, and D. Reed. University of California, Santa Barbara. THE SEASONAL CYCLE OF NUTRIENTS, SUSPENDED PARTICULATE MATTER, AND PRIMARY PRODUCERS AT THREE TEMPERATE REEFS

Rocky reefs receive subsidies of nutrients and particulate organic matter from the surrounding ocean. Variability or seasonality in the rates of supply of these materials can potentially affect the nutrition and population dynamics of reef primary producers and consumers. Santa Barbara Coastal-Long Term Ecological Research (SBC-LTER) project monitored three reefs spanning the mainland side of the Santa Barbara Channel, California. We measured the concentration of nutrients, particulate organic carbon (POC) and particulate organic nitrogen (PON) at monthly intervals over a 5-year period. An annual cycle in the concentration of nutrients (nitrate, ammonium, silicic acid, phosphate) is observed at all three sites with relatively high concentrations during spring and autumn. Temporal dynamics among reefs are all highly synchronized; but on average there is a gradient of increasing nutrient concentration from the more eastern to the more western sites that can be explained by local topography and sheltering by the Santa Barbara Channel Islands. Concentrations of nitrate are typically < 1.0 µM at all three sites suggesting possible N limitation of the giant kelp, Macrocystis pyrifera. However, no correlation between nitrate concentration and measures of kelp net primary production is found. The concentrations of phytoplankton chlorophyll, POC and PON display a high degree of seasonal variability with elevated phytoplankton chlorophyll present during spring and autumn. Exceptional events, such as an intense red tide in the summer of 2003 are also evident. POC:PON ratios in particles typically were close to Redfield proportions indicating the predominance of living phytoplankton in the particulate pool and relatively high food quality for consumers during most of the year.

Allan, K.M.*1 and J.A. McGowan2. 1University of California San Diego, 2Scripps Institution of Oceanography. COMPARATIVE ANATOMY OF PELAGIC ECOSYSTEMS

Zooplankton play an integral role in marine ecosystems, not only as a significant part of the food web but also in the biological cycling of Carbon and other elements. Thus, zooplankton abundance and the long-term relative stability of taxa can act as valuable indicators of ecosystem health and stability. With natural and anthropogenic perturbations affecting changes to the physical marine environment, it is reasonable to suspect changes in the biota. To test this concept, plankton samples were taken from 1969 and 2004 in both the less variable habitat of the Central Gyre and the more variable California Current. The samples were sorted into taxonomic groups and each group was assigned a rank indicating relative abundance, or dominance. Variability in dominance and overall abundance of zooplankton within each location, between locations and across the 35 year interval will be discussed in conjunction with the relevant corresponding physical data.

§ Alter, S. Elizabeth* and Stephen R. Palumbi. Stanford University, Hopkins Marine Station. EXPLORING THE POPULATION HISTORY OF EASTERN NORTH PACIFIC GRAY WHALES USING A MULTI-LOCUS GENETIC APPROACH

Estimating the historical abundance and ecology of marine mammals often has important implications for the management of today’s populations. Under certain assumptions, the theoretical relationship between genetic diversity and effective population size allows inferences about historical population sizes from genetic data. Though past efforts to explore historical population sizes in baleen whales have focused on the mitochondrial control region, drawing demographic inferences from such data can be problematic since the control region represents only a tiny fraction of the genome and mutation rate has been shown to vary across its length in mammals. Thus, data from multiple, independently evolving regions of the genome are needed to estimate historical parameters. We are using the eastern North Pacific gray whale as a case study by sequencing 8-10 nuclear introns ranging from 600-1200 bp in size from approximately 40 individuals. This population is recovering after two centuries of whaling, and is thought by some biologists to have surpassed the historical population size estimated from whaling records. However, recent studies have shown that it is impossible to reconcile this historical size with recent population increases under density-dependent, age- and sex-structured models. Was the actual historical population size of gray
whales significantly smaller or larger than today’s population? Preliminary results from nuclear genetic data suggest long-term population estimates that are smaller than estimates derived from control region data, but larger than today’s population of eastern North Pacific gray whales. A combination of multilocus genetics, historical records and population modeling will provide an enhanced view of the past history of whale populations.

1Moss Landing Marine Laboratories, California State University, 8272 Moss Landing Rd, Moss Landing, CA 95039; 2NOAA Fisheries Northeast Fisheries Science Center, Narragansett Laboratory, 28 Tarzwell Drive, Narragansett, RI 02882; 3University of Maryland Center of Environmental Science, Chesapeake Biological Laboratory, P.O. Box 38, 1 Williams Street, Solomons, MD 20688; 4 Center for Accelerator Mass Spectrometry, Lawrence Livermore National Laboratory, 7000 East Avenue, Livermore, CA 94550. APPLICATION OF BOMB RADIOCARBON CHRONOLOGIES TO SHORTFIN MAKO (Isurus oxyrinchus) AGE VALIDATION.

Age estimation is an issue for the shortfin mako (Isurus oxyrinchus) because of ongoing disagreement on the periodic deposition of vertebral growth bands. A band pair is defined as a set of opaque and translucent bands in vertebral centra. Using four age determination techniques, Pratt and Casey (1983) concluded two band pairs formed annually; however, Cailliet et al. (1983) assumed one band pair per year. To evaluate the validity of both interpretations, a new technique was applied using radiocarbon measured in shark vertebrae. In the 1950-1960s, thermonuclear testing released large amounts of radiocarbon into the atmosphere, which reacted to form $^{14}$CO$_2$ and entered the ocean through gas exchange over the following years. This influx created a time-specific marker in the marine environment that can be used in age validation. In the first application to elasmobranchs, Campana et al. (2002) validated the vertebral ageing methodology for the porbeagle (Lamna nasus) and assayed four samples from one shortfin mako vertebra, suggesting annual deposition of one band pair for both species. In the present study, band-counting age estimates from 54 shortfin mako vertebrae collected in 1950-1984 ranged in age 1-31 years. Bands in early stages of life appeared broad and clear and became less defined with age. Ageing error between readers was consistent, with 76% of the estimates ranging within two years of each other. Twenty-one radiocarbon values from vertebrae of eight shortfin makos (collected in the Western North Atlantic in 1963-1984) ranged between -160.2‰ and 86.8‰. The resulting concordance with the porbeagle indicated shortfin mako has longevity of at least 31 years and supports annual deposition of a single pair of growth bands. This work was performed, in part, under the auspices of the U.S. Department of Energy by University of California, Lawrence Livermore National Laboratory under Contract W-7405-Eng-48

§ Arkema, K.*1, B. Gaylord2, D. Reed1. 1UC Santa Barbara, 2Bodega Marine Laboratory of UC Davis. GIANT KELP INFLUENCES THE FEEDING SUCCESS OF A SUSPENSION-FEEDER, MEMBRANIPORA TUBERCULATA, BY MODIFYING WATER FLOW AND FOOD AVAILABILITY ACROSS A SUBTIDAL REEF

Sessile marine invertebrates rely on water flow to bring them food. Thus the feeding ecology of suspension feeders is highly coupled with the flow environment in which they live. This is particularly true for sessile invertebrates inhabiting kelp forests, as giant kelp (Macrocystis pyrifera) interacts with impinging currents to produce a complex flow environment. The bryozoan, Membranipora tuberculata, is a prolific epiphyte on giant kelp and feeds on phytoplankton and other particles suspended in the water column. Here we present data from a field experiment investigating the feeding success of Membranipora colonies exposed to different flow regimes in a kelp forest. We transplanted kelp blades colonized by Membranipora to locations at the outside, edge and interior of the kelp forest at Mohawk Reef, Santa Barbara CA. Flow velocities at these locations were measured continuously during the two week experiment, using moored sensors. Food availability (as determined by water column chlorophyll) and feeding success (as quantified by the chlorophyll content in Membranipora guts) were measured on four separate occasions. We found that water flow and gut contents varied both temporally and spatially. Flow velocity explained over 50% of the variability in gut chlorophyll. We found no relationship between water column chlorophyll and gut chlorophyll. Furthermore, spatial differences in flow velocity and gut chlorophyll, on each separate occasion, were related to location in the kelp bed. Our results suggest that large structure forming species, such as giant kelp, modify flow to influence suspension feeding, which may have consequences for patterns of sessile invertebrate distribution, abundance, and fitness.
Basch, L.*1 discovered. work showed that > 98% of matings in the Florida Keys population were positively assortative with respect to color genetically undifferentiated species complex yet studied using this technique.  This is true in spite of the fact that our which species-diagnostic AFLPs were readily isolated.  Hence the AFLP method shows density of our AFLP survey was comparable to other surveys of incipient cichlid fishes and Hawaiian crickets from which 4 showed significant frequency differences between morphospecies, indicative of non-random mating.  The Nevertheless, a survey of 2 of the most apparently diagnostic primer pairs in 35 individuals revealed 254 AFLPs, of adaptive significance of color pattern divergence and color-based assortative mating in pattern, and that even uncommon morphospecies paired and spawned with individuals of like color pattern.  The EXAMPLES IN A NETWORK OF NATIONAL PARKS AND MARINE PROTECTED AREAS IN HAWAI’I

The longjaw mudsucker, Gillichthys mirabilis, inhabits estuaries and sloughs along the Pacific coast between San Francisco and Bahia Magdalena, Baja California. Part of that population was believed isolated in the Sea of Cortez during its formation; its range now includes Mulege, Baja California to Bahia Agiabampo, Sonora. The paedomorphic daughter of G. mirabilis, the shortjaw mudsucker, Gillichthys seta, is endemic to the northern Sea of Cortez, inhabiting the high intertidal zone. Formation of an isolated Sea of Cortez population of G. mirabilis potentially allows study of a natural founder event. Theory predicts that Sea of Cortez G. mirabilis should have lower genetic diversity than the Pacific coast population, and G. seta perhaps even less. To test that hypothesis, 409 bp of the mtDNA control region of 25 Pacific coast and 27 Sea of Cortez G. mirabilis and 25 G. seta were sequenced and analyzed for three indices of genetic diversity. Those were singleton fraction (0.64, 0.81, and 1.0), and nucleotide (1.1%, 1.4%, and 2.1%) and haplotype (0.90, 0.91, and 1.0) diversities. Whereas those indices were higher in Sea of Cortez than Pacific coast G. mirabilis, they were highest in G. seta. Genealogical analysis of haplotypes using statistical parsimony nevertheless clearly indicated that the Pacific coast G. mirabilis is the parent of the Sea of Cortez population. Application of relative rates tests was inclusive, but it is proposed that higher genetic diversities in the Sea of Cortez fish are attributable to increased mutation rates from higher metabolism.


Although assortative mating evolving prior to substantial genetic divergence is a requirement in theoretical models of speciation in the face of gene flow, little is understood about the mechanisms for this phenomenon in marine species. We demonstrate that strong color-based assortative mating has evolved between members of an incipient species flock of coral reef fishes, genus Hypomplectrus. This has occurred despite the near genetic identity of two of the most phenotypically distinctive morphospecies, H. unicolor and H. gemma, when assayed using the sensitive Amplified Fragment Length Polymorphism (AFLP) method of DNA fingerprinting. Our survey of 692 AFLP markers uncovered not a single AFLP that was fixed and diagnostic between H. unicolor and H. gemma. Nevertheless, a survey of 2 of the most apparently diagnostic primer pairs in 35 individuals revealed 254 AFLPs, of which 4 showed significant frequency differences between morphospecies, indicative of non-random mating. The density of our AFLP survey was comparable to other surveys of incipient cichlid fishes and Hawaiian crickets from which species-diagnostic AFLPs were readily isolated. Hence the AFLP method shows Hypomplectrus to be the most genetically undifferentiated species complex yet studied using this technique. This is true in spite of the fact that our work showed that > 98% of matings in the Florida Keys population were positively assortative with respect to color pattern, and that even uncommon morphospecies paired and spawned with individuals of like color pattern. The adaptive significance of color pattern divergence and color-based assortative mating in Hypomplectrus remains to be discovered.

Barreto, Felipe S.*1,2 and Michael A. McCartney1. 1Dept. of Biological Sciences, University of North Carolina at Wilmington, Wilmington, NC; 2Dept. of Ecology and Evolutionary Biology, University of California, Irvine, CA. STRONG COLOR PATTERN BASED ASSORTATIVE MATING DESPITE WIDESPREAD GENOMIC IDENTITY BETWEEN MEMBERS OF A MARINE SPECIES FLOCK

The persistence of benthic ecosystems including coral reefs, and their component species, depends on natural processes affecting the replacement of adult individuals within populations by young life stages (animal larvae or algal spores). Recruitment is defined as the processes by which young individuals enter and inhabit the system. Recruitment of marine organisms typically varies naturally at different time and space scales. However, disturbances, resource exploitation and environmental impacts can limit recruitment and the persistence of species of key ecological, cultural or economic importance. A set of studies in progress are described that address questions of recruitment limitation and connectivity for several populations of reef animals in a network of National Parks and Marine Protected Areas on the Kona coast of the island of Hawai‘i. Some initial results will be presented based on complimentary approaches including basic ecological surveys, natural tags, oceanographic current measurements, remote sensing and GIS, and Traditional Ecological Knowledge.

Basch, L.*1. 1National Park Service Hawaii-Pacific Islands Cooperative Ecosystem Studies Unit, University of Hawai‘i, Manoa, Honolulu, Hawai‘i. NATURAL HISTORY TO MARINE CONSERVATION SCIENCE: EXAMPLES IN A NETWORK OF NATIONAL PARKS AND MARINE PROTECTED AREAS IN HAWAI‘I


The longjaw mudsucker, Gillichthys mirabilis, inhabits estuaries and sloughs along the Pacific coast between San Francisco and Bahia Magdalena, Baja California. Part of that population was believed isolated in the Sea of Cortez during its formation; its range now includes Mulege, Baja California to Bahia Agiabampo, Sonora. The paedomorphic daughter of G. mirabilis, the shortjaw mudsucker, Gillichthys seta, is endemic to the northern Sea of Cortez, inhabiting the high intertidal zone. Formation of an isolated Sea of Cortez population of G. mirabilis potentially allows study of a natural founder event. Theory predicts that Sea of Cortez G. mirabilis should have lower genetic diversity than the Pacific coast population, and G. seta perhaps even less. To test that hypothesis, 409 bp of the mtDNA control region of 25 Pacific coast and 27 Sea of Cortez G. mirabilis and 25 G. seta were sequenced and analyzed for three indices of genetic diversity. Those were singleton fraction (0.64, 0.81, and 1.0), and nucleotide (1.1%, 1.4%, and 2.1%) and haplotype (0.90, 0.91, and 1.0) diversities. Whereas those indices were higher in Sea of Cortez than Pacific coast G. mirabilis, they were highest in G. seta. Genealogical analysis of haplotypes using statistical parsimony nevertheless clearly indicated that the Pacific coast G. mirabilis is the parent of the Sea of Cortez population. Application of relative rates tests was inclusive, but it is proposed that higher genetic diversities in the Sea of Cortez fish are attributable to increased mutation rates from higher metabolism.

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The recovery of previously dominant but currently overfished species is necessary to achieve marine reserves’ goal of protecting ecosystem structure and function. Community interactions alter the management actions necessary to recover overfished species using marine reserves. For example, in communities where a larger species preys on their juveniles’ competitors, overfishing of the larger species may cause prey population expansion; subsequent increased competition for the juveniles of the overfished species may impede recovery within reserves. We explore the implications of such community interactions for reserve design with a model of a subtidal rockfish (genus *Sebastes*) system from the Northeast Pacific Ocean within a no-take reserve. Ignoring community interactions, the model predicts that a reserve large enough for internal recruitment to counterbalance mortality will allow recovery of the overfished species. However, after incorporating community interactions, the model predicts that two alternative stable states exist: one where the overfished species dominates and one where the prey dominates. In the community model, the ability of an overfished system to recover to the equilibrium where the overfished species dominates after reserve establishment depends on the initial densities of both species, and a larger reserve is required for recovery to be possible.

Intertidal macroalgal communities under anthropogenic stress can degrade from diverse mosaics of perennial and annual species to low-diversity assemblages composed of early successional stage, structurally simple species. These changes in algal communities encompass shifts in species diversity, morphological diversity, as well as thallus complexity. To test the relative influence of these three parameters on facilitation of associated motile invertebrate epifauna, we experimentally composed six sets of algal communities, which vary in combination a) algal species diversity, b) algal morphological diversity, and c) algal thallus structural complexity. Results indicate that a) algal species diversity is a poor predictor of invertebrate diversity, b) algal morphological diversity is important in the absence of highly branched species (e.g. *Neoehdomela larix* or *Odonthallia flocossa*), and c) monocultures of highly branched species provide equivalent habitat to morphologically diverse algal communities. We conclude that thallus complexity is the primary driver for facilitation of macroalgal-associated invertebrate communities. These findings are contrary to what would be expected based on long-standing ecological theory about relationships between habitat diversity and species richness.

Due to recent unregulated fishing access to the purple sea urchin, *Strongylocentrotus purpuratus*, populations have suffered a reduction in density and abundance along the Peninsula of Baja California, Mexico. We conducted subtidal population structure surveys at ~20 m depth where an urchin barren and a kelp bed existed (where urchin harvest effort is direct) in order to characterize the similarities of this resource in different environmental attributes. We compared 4 sites: Isla Todos Santos and Campo Kennedy in the north (highly fished), and Isla Natividad and Bahía Tortugas in the south (protected areas). Bahía Tortugas is also the southern limit of the range for purple urchins as well as for Macrocystis pyrifera (its favorite feeding resource). We sampled urchin population density, tested diameter (mm) and gonad index, as well as kelp density and fronds per plants to compare the sea urchin population structure and its association with kelp beds along the Baja peninsula in winter and spring. Even though we found significant differences in density, size and gonad index of the sea urchins, we could not contribute it to the kelp stands because its carrying capacity was homogeneous within all the sampled sites. We assume that factors other than kelp stands, such as temperature and competition are the main cause of sea urchin population dynamics in these areas and that it has to be taken into account to improve the fisheries regulations for this species.
Becker, B.J.\textsuperscript{1*}, Levin, L.A.\textsuperscript{2}, Fodrie, F.J.\textsuperscript{2}, and P.A. McMillan\textsuperscript{2}. \textsuperscript{1}National Park Service/Cabrillo National Monument, \textsuperscript{2}Integrative Oceanography Division, Scripps Institution of Oceanography. DETERMINING NATAL ORIGINS AND POPULATION CONNECTIVITY OF NEWLY-SETTLED MYTILID MUSSELS USING TRACE ELEMENTAL FINGERPRINTING

There is a growing recognition of the importance of small-scale larval dispersal, and a general interest in defining the connectivity between marine populations, although direct evidence of “self-recruitment” has been difficult to collect. In this study elemental fingerprinting was used to determine the patterns of connectivity in mussel populations (\textit{Mytilus californianus} and \textit{M. galloprovincialis}) in San Diego County, California. In situ larval culturing was conducted at thirteen sites, to create reference signals of trace element chemistry in larval shells formed at known locations. This method expanded elemental fingerprinting methods to species with wholly planktonic larval development for the first time. These experimentally-generated elemental fingerprints were compared to the chemistry of retained larval shells of recently-settled juveniles in order to determine the natal origins of 232 juveniles of both species collected at thirteen coastal sites. From these results, it appears that mussel larval retention occurs over small scales (10 to 30 km) and on conservation-relevant time scales (less than one generation). However, these populations could not be considered demographically “closed”. The two mussel species exhibit different connectivity patterns. Most of the \textit{M. californianus} originated from the northern part of the study area, suggesting that these populations follow a “single source” model of larval replenishment. \textit{M. galloprovincialis} populations in San Diego County appear to originate from a larger number of sources including bays and southern sites, although a smaller sample size led to more equivocal results. The details of life-history differences and distribution between the two species provide possible mechanisms leading to different connectivity patterns. The promise of elemental fingerprinting as a larval tracking tool is beginning to be realized, greatly improving our understanding of the connectivity between geographically separated populations. Ultimately, this information will be crucial for scientifically-based management of marine resources.

\textsuperscript{*} Bellquist, L.F., C.G. Lowe\textsuperscript{2}, and J.E. Caselle\textsuperscript{3}. \textsuperscript{1,2} California State University Long Beach, \textsuperscript{3} University of California Santa Barbara. MOVEMENT PATTERNS, HOME RANGE, SITE FIDELITY, AND HABITAT PREFERENCE OF OCEAN WHITEFISH (MALACANTHIDAE) IN A SANTA CATALINA ISLAND MARINE RESERVE

Knowledge of fish movement patterns over multiple temporal and spatial scales is essential for effective management and conservation of fish populations. This study integrates acoustic telemetry and a GIS to quantify movement patterns, home range, site fidelity, and habitat preference of ocean whitefish (\textit{Caulolatilus princeps}) at the Catalina Marine Life Refuge (CMLR) located at Santa Catalina Island, California. Seventeen individuals were tagged with acoustic pingers (2 month battery life) and actively tracked over multiple 24hr periods for a total of 792 hours to measure fine-scale movements and home ranges. Home ranges based on 95\% kernel utilization distributions range from 90 - 348,966 m$^2$, averaging 33,947 ± 86,542 m$^2$ (± SD). Individuals tracked were active during the day, using soft sediment habitats at greater depths, but were inactive at night, taking refuge near rocky reefs in shallower depths. An additional seventeen fish were tagged with coded acoustic transmitters (1-year battery life), yielding continuous presence/absence information within and adjacent to the CMLR. To date (1 yr), 65\% of the individuals acoustically monitored have shown longer-term fidelity to home ranges within the study area as well as consistent diurnal activity. However, diurnal patterns indicate periodic shifts in area use over the 1-year study period. Additionally, individual home ranges extend well beyond the reserve boundary both daily and seasonally, which could potentially make this reserve less effective for protecting adult ocean whitefish than for other less mobile species.

\textsuperscript{*} Benavides, G. University of California, Santa Cruz (EEB); SWFSC Fisheries Ecology Division, Santa Cruz. MICROSATELLITE DIVERSITY AND GENETIC STRUCTURE OF A TEMPERATE SERRANID, \textit{PARALABRAX NEBULIFER}

Barred sand bass (\textit{Paralabrax nebulifer}) is a nearshore benthic marine fish that is distributed along sand-rock interface habitats from Santa Cruz, CA, to Magdalena Bay, Baja CA. While \textit{P. nebulifer} has been excluded from the California commercial fishery for over 50 years, it continues to be one of the most targeted recreational gamefish species, especially during its summer spawning months. Of critical importance to the management and conservation of this ecologically and commercially important marine species will be the establishment of protected areas, whose
design must take into consideration the extent to which a local population reseeds itself or is replenished from other source populations. The population genetic structure of *P. nebulifer* was evaluated using 8 polymorphic nuclear microsatellite loci in 256 individuals sampled from Punta Eugenia, Baja CA to Ventura County, CA. Low Fst values indicate low population structure for the sampled populations, however the results from an assignment test suggest that population structure may exists for *P. nebulifer*. The results and implications of this study will be discussed.

§ Benes, K.M.* and R.C. Carpenter. Department of Biology; California State University, Northridge. **EFFECTS OF *Eisenia arborea* ON THE DEVELOPMENT AND STRUCTURE OF AN UNDERSTORY ALGAL COMMUNITY**

*Eisenia arborea*, a common shallow subtidal kelp in southern California, creates a stipitate canopy that can shade up to 95% of the substratum in the summer and early fall. Algal species assemblages vary significantly under and outside the canopy with the understory foliose algal community dominated by red algae and the outside foliose algal community dominated by brown algae. By altering abiotic conditions and causing disturbance, *Eisenia* may restrict dispersal of algal spores into the canopy or may affect the survival and/or growth of settling spores, thus altering the species assemblage. To determine if *Eisenia* affects algal community development and community structure, algal settlement and recruitment were quantified. To estimate settlement, tiles were placed under and outside the canopy for six day periods in the summer, fall, and spring. A greater abundance and diversity of brown and red algae settled outside the canopy suggesting the canopy reduces delivery of spores into the understory environment or increases early post-settlement mortality. To estimate recruitment, two types of disturbance plots and a control plot were established in the presence and absence of *Eisenia* and the percent cover of all algal species were recorded over time. Recruitment into the disturbed plots was highest outside the canopy whereas under the canopy recruitment was low. Percent cover remained relatively stable in control plots both under and outside the canopy. These results suggest that community development under the canopy is much slower and may be dispersal-limited or affected by early post-settlement mortality compared to communities outside the canopy. This study may also suggest that indirect interactions among organisms and their environment may have an effect on the distribution and abundance of algal species in a kelp forest.

Bianchi, C. *¹, B.N. Tissot ¹, M.M. Yoklavich ², ¹ Washington State University, Vancouver, ² NOAA National Marine Fisheries Service. **ABUNDANCE AND DISTRIBUTION OF MEGAFANAL INVERTEBRATES IN SUBMARINE CANYONS AND THEIR ECOLOGICAL ASSOCIATIONS WITH GROUNDFISH**

Economically important fishes, such as groundfish, have been exploited for years resulting in a dramatic decline in their populations. In addition, commercial fishing practices have extensively damaged deep sea corals and other benthic invertebrates. Conservation efforts are underway to protect commercial fisheries; however, invertebrates are not necessarily protected under the Magnuson-Stevens Act because their relationship to essential fish habitat is uncertain. Scientific research is shifting the direction of fishery management toward ecosystem-based management which attempts to minimize the risk of irreversible change to natural assemblages of species and ecosystem processes. Recent studies have identified that deep sea corals, sponges and other megafaunal invertebrates, can provide important habitat for fishes by adding structure and relief to existing habitat. The objectives of this study are to identify patterns in the abundance and distribution of megafaunal invertebrates and their habitat and to identify their ecological associations with groundfish in submarine canyons along the California and Oregon coast. On September 1994, underwater surveys were conducted using the *Delta* submersible in Carmel Canyon near Monterey, California. Approximately 1020 hours have been analyzed from these dives using videotaped transects. To date, megafaunal invertebrates and habitat have been identified and quantified for Carmel Canyon and an assessment on the importance of megafaunal invertebrates as structure-forming components to groundfish habitat is in progress.

§ Blasius, M.E. California State University Long Beach. **LEVELS OF POLYCHLORINATED BIPHENYLs (PCBS) AND CHLORINATED PESTICIDES IN THE CALIFORNIA SEA LION (*ZALOPHPUS CALIFORNIANUS*), NORTHERN ELEPHANT SEAL (*MIROUNGA ANGUSTIROSTRIS*), AND HARBOR SEAL (*PHOCA VITULINA*) IN THE SOUTHERN CALIFORNIA BIGHT**
Highly industrialized areas, such as the Southern California Bight, have repositories of persistent organic pollutants (POPs), such as polychlorinated biphenyls (PCBs) and Dichloro-diphenyl-trichloroethane (DDT), which can be sources of long-term exposure to marine life well after the inputs of these contaminants have largely ceased. Top-level carnivores such as fish, birds, and marine mammals tend to be inundated with high loads of contaminants, and, therefore, can be useful biomarkers for POPs in the environment. I measured concentrations of total chlorinated pesticides and PCBs in blubber samples collected from California sea lions (n=22), northern elephant seals (n=9), and harbor seals (n=10) that had died at local marine mammal stranding facilities. Of the three species, a total of 29 samples from females and 12 samples from males were analyzed. Total chlorinated pesticides concentrations are higher than PCB concentrations in all samples (n=41). In addition, mean total chlorinated pesticides and PCB concentrations are higher in California seal lions than in northern elephant seals. These preliminary results indicate that the legacy of DDT production and dumping more than 30 years ago off the Palos Verdes Shelf still remains a concern in the Southern California Bight.

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**BLADE ORIENTATION, AND STIPE AND HOLDFAST SHAPE OF LAMINARIA SETCHELLII RELATIVE TO THE DIRECTION OF WAVE SURGE, AND IMPLICATIONS OF HOLDFAST ASYMMETRY FOR SURVIVORSHIP**

This study examined thallus orientation and shape relative to the direction of wave surge in the stipitate kelp Laminaria setchellii in Barkley Sound, British Columbia, Canada. Blade orientation, stipe diameter (blade-stipe transition zone, midway along the stipe and at the stipe-holdfast junction) and holdfast diameter were recorded for 246 individuals, relative to wave direction. Stipe and holdfast diameter were measured in the direction parallel and perpendicular to wave surge. Each holdfast was divided into quadrants (seaward, shoredward, lateral L & R) to quantify biomass allocation. L. setchellii exhibited definite asymmetry. The blade and upper part of the stipe were orientated with the longer axis perpendicular, while the base of the stipe and holdfast were oriented with the longest axis parallel, to the oncoming wave direction. Biomass allocation of the holdfast indicates that L. setchellii allocates more haptera biomass to quadrants parallel to wave direction than to ones perpendicular to it. To assess if the observed patterns of holdfast asymmetry and biomass allocation were important for L. setchellii attachment and survivorship, the haptera within a quadrant were removed, and individual survivorship was monitored over 18 months and compared to the survivorship of non-manipulated controls. There was no mortality in the control group nor in the lateral R group. Individuals with seaward and shoreward manipulated haptera showed significantly lower survivorship than the control group. Lateral L individuals had the lowest survivorship. These results are consistent (in part) with the hypothesis that L. setchellii allocates more biomass to seaward and shoreward quadrants of the holdfast to counteract the bending stresses that develop in these regions.

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**INTERSPECIFIC COMPARISON OF RECONFIGURATION IN TEN ROCKY INTERTIDAL MACROALGAE**

Macroalgae use flexibility to reduce the hydrodynamic forces imposed in the wave-swept rocky intertidal via reconfiguration, i.e., the alteration of shape and size as water velocity increases. Quantifying the effects of flexibility on hydrodynamic performance is difficult, however, because reconfiguration varies with water velocity and the relationship between algal solid mechanics (flexibility) and hydrodynamic performance is poorly understood. In this study, the hydrodynamic performance, morphology and solid mechanics of ten rocky shore macroalga species were measured to evaluate the influences of flexibility and morphology on reconfiguration. Hydrodynamic performance was characterized in a flume by direct measurement of changes in size and shape during reconfiguration across a wide range of velocities; material stiffness was measured with standard materials testing. Direct measurement of reconfiguration successfully characterized the hydrodynamic performance for all species. Additionally, hydrodynamic parameters varied significantly among species, indicating variation in the magnitude of reconfiguration and the velocities required for full reconfiguration. Structural properties also varied among species, and were correlated to hydrodynamic performance in some instances. The relationship between hydrodynamic and structural properties was velocity dependent, such that flexibility influenced different aspects of reconfiguration at low and high velocities. Groups were identified among species based on hydrodynamic and structural properties, suggesting that these properties may be useful for addressing functional form hypotheses and the effects of hydrodynamic disturbance on macroalgal communities.
In Scott Creek, a representative central California coastal stream, steelhead (*Oncorhynchus mykiss*) smolts migrate downstream toward the ocean each spring. While the largest smolts (>150mm fork length (FL)) move directly to sea, some of the smaller smolts remain in a small estuary until sandbar formation creates a closed freshwater lagoon. Steelhead remain in the lagoon at least until bar breakage during winter storms. High growth rates in the lagoon throughout the summer result in a doubling of fork length from the time of lagoon entry (mean FL of spring migrants-112mm, mean FL of fall lagoon resident-206mm). Morphological analysis of returning adult steelhead scales indicate that there is strong size-dependent mortality at sea. Lagoon-reared steelhead show a large survival advantage and comprise a large proportion of the returning adult population. While lagoon resident steelhead may delay ocean entry by 6-12 months, this residence period may not alter the age distribution of returning adults, as fish leaving the lagoon after bar breakage often return at the same time as their upstream reared cohorts by spending less time at sea. The impact of this life history variation may alter the reproductive output and genetic composition of the population. Although the Scott Creek lagoon/estuary comprises less than 1% of the watershed, it may be critical nursery habitat, as lagoon reared juveniles make a disproportionate contribution to the spawning adult pool.

California barracuda (*Sphyraena argentea*) were collected in various mainland and island locations from San Diego, CA to Santa Barbara, CA using gillnets and hook and line from April 2000 to October 2002. For the first time, fish were aged using sectioned sagittal otoliths. This data was then fit to the von Bertalanffy growth equation. Age classes 0 - XVIII were represented and the growth rate was fast during the first year for both sexes. Females were significantly longer than males of the same age (ANCOVA, F = 3.934, F_{0.05(1,402)} = 3.84, P = 0.048). A subset of fishes was also aged using scale analysis for comparison to previous studies. Scale annuli were deemed unreliable as aging structures for fish older than four years. The current study collected more young *S. argentea* than historical treatments. In addition, otolith analysis provided greater age class resolution for older fishes, which were previously assigned unreliable ages. Growth for age classes I through IV were significantly higher than those reported in both Walford (1932) (t = 7.396, t_{0.05(2)} = 4.303, P ≤ 0.05) and Pinkas (1966) (t = 7.245, t_{0.05(2)} = 4.303, P ≤ 0.05). The apparent change in growth rate could be related to the warm/cool regimes of the Pacific Decadal Oscillation. Subsamples of mature eggs from preserved ovaries were counted by eye (mean = 163 eggs/g body mass) to determine batch fecundity, which was best correlated to fish mass. Batch fecundity and the peak-spawning season did not differ significantly (ANCOVA, F = 1.108, F_{0.05(1,31)} = 4.161, P = 0.301) from the two previous reports.

Although nutrient availability and oceanographic context can influence top-down processes in intertidal communities, the reciprocal effects of consumers on bottom-up processes, such as nitrogen uptake by macroalgae, are less well-understood. We performed a combination of field observations, mesocosm experiments, and laboratory nitrate-uptake measurements to evaluate the interaction between juvenile kelp crabs (*Pugettia producta*) and their preferred food-source, the kelp *Egregia menziesii*, in northern California, USA. We found that *P. producta* fed selectively on *E. menziesii*, removing tissues with a high surface-area-to-volume ratio (SA:V). Because these high SA:V tissues are disproportionately responsible for nitrate uptake, selective herbivory by *P. producta* resulted in decreased ability of *E. menziesii* to utilize nitrogen, the primary limiting nutrient in this ecosystem. In field surveys, higher *P. producta* abundances were correlated with lower *E. menziesii* SA:V, suggesting that this interaction has ecological relevance in intertidal communities. Thus, kelp crabs impact *E. menziesii* both by directly removing biomass and by reducing the kelps’ subsequent nitrogen uptake ability. Our work demonstrates that top-down processes, such as selective herbivory, can modify bottom-up processes in a rocky intertidal community.
Britt, L. L., W. N. McFarland, and B. S. Miller. NOAA/Alaska Fisheries Science Center, RACE Division, Seattle, WA. University of Washington, School of Aquatic and Fishery Sciences and Friday Harbor Laboratories, Friday Harbor, WA. THE CHROMATIC ACTION SPECTRUM FOR FIRST-FEEDING LINGCOD LARVAE (OPHIODON ELONGATUS) AND THE POTENTIAL FUNCTIONALITY OF SHORT-WAVELENGTH SENSITIVITY TO FEEDING LARVAE

Visual sensitivity to short-wavelength light has been demonstrated in a number of larval and adult fishes. The full ecological significance of short-wavelength visual sensitivity is poorly understood. Short-wavelength vision has been suggested to aid in prey detection by extending the visual contrast range into the ultraviolet region of the light spectrum, where zooplankton reflect upon a scattering background. This has led to a number of behavioral studies that have proven that short-wavelength sensitive fish larvae can successfully feed in a UV-only environment. However, it has been difficult to determine how this translates to the visual ecology of fishes in the wild, such as whether or not short-wavelength visual sensitivity enhances planktivory. In this study, a chromatic action spectrum was determined for first-feeding lingcod larvae by calculating feeding response at decreasing light intensities of monochromatic light spectrally tuned to the visual pigments expressed by lingcod larvae. This chromatic action spectrum suggests that short-wavelength sensitive vision aids in feeding under low light conditions and may serve as a compensatory mechanism for the lack of a scotopic visual system during the early larval period.

§ Burford, M. O.* University of California Santa Cruz. COMPARISON OF GENETIC STRUCTURE IN MULTIPLE YEAR-CLASSES OF BLUE ROCKFISH

In long-lived species like rockfishes, the genetic composition of the adult population reflects many year-classes, produced under a variety of conditions that affect the mating of adults and dispersal of larvae. In contrast, the genetic composition of an individual year-class is not integrated over multiple years and indicates the effect of factors acting at the time of year-class formation. An analysis of the genetic structure of new year-classes is critical for understanding the dispersal potential for a given adult population as it reveals much more about the movement of larvae and constraints on the reproductive output of the adult population than a similar study of adults alone. As settled juveniles and adults, blue rockfish (Sebastes mystinus) are non-migratory inhabitants of kelp and rocky reef habitats along the California coast, but they possess a pelagic larval and juvenile stage lasting over three months. Using microsatellite genetic markers, I tested whether the juvenile blue rockfish of the 2000 and 2001 year-classes and the corresponding adult population were genetically homogeneous along the California coast. Preliminary results of the microsatellite analyses reveal significant genetic structure among juvenile locations in both year-classes. Settled juveniles are genetically homogeneous within the Monterey Region (Hopkins and Stillwater Cove), however, these locations are genetically heterogeneous when compared to other juvenile locations and this pattern is temporally consistent. In addition, juvenile locations in the central and north coast show signs of chaotic genetic patchiness. These results suggest that individual year-classes are genetically heterogeneous in time and space, possibly the result of low effective population sizes of adults. I will discuss these results in the context of expanded temporal and spatial sampling for the 2002 year-class of blue rockfish and patterns in population structure found in two year-classes of the congener kelp rockfish (S. atrovirens).

§ Byrnes, J.E. Bodega Marine Laboratory. University of California Davis. BIODIVERSITY, INVASIONS, AND EXTINCTIONS: CONSEQUENCES FOR CONSUMER-PREY RELATIONSHIPS IN FOULING COMMUNITIES

While species diversity is declining globally, at the local spatial scale, diversity often stays the same or increases due to the counterbalancing forces of anthropogenic extinctions and species invasions. This does not mean that local communities are static, however. Extinctions are skewed to knock out top predators, potentially leading to increases in the smaller consumers that they control. Species invasions are skewed towards increasing the number of sessile prey species. Here I explore how increases in the species richness of a sessile invertebrates due to invasion and increases in the richness of their consumers interact to affect the strength of top down control. I do this by relating a mean field approach to predator-prey models with observations of marine fouling communities, using free space as a proxy for biomass removed by consumers, as has been demonstrated in experiments and observations. Using this combination of theory and observation, I show that 1) Sessile species richness increases resistance to predation. 2) New exotic species appear to perform similarly to their native congeners, conferring little additional resistance to predation. 3) Sessile diversity increases in importance as consumer diversity and abundance increases. 4)
Consumer diversity increases the strength of top-down control. These results suggest that, as the current pattern of extinctions and invasions continue, community and ecosystem processes will be dominated by interactions at lower trophic levels. Effects of increases in sessile species diversity, however, may either be counteracted or overwhelmed by increases in the diversity of small consumers, depending on the similarity of invaders to existing natives.

§ Carlisle, A.B.*1, A. King2, G.M. Cailliet1, and J.S. Brennan3. 1Pacific Shark Research Center, Moss Landing Marine Laboratories. 2BLM/DO California Coastal National Monument, NOAA/DOC National Marine Protected Areas Center. 3Washington Sea Grant Division. LONG TERM TRENDS IN ELASMOBRANCH CATCH COMPOSITION FROM FISHING DERBIES IN ELKHORN SLough, CALIFORNIA

Long term trends in the elasmobranch assemblage in Elkhorn Slough, Monterey Bay, California, were analyzed by documenting species composition and catch-per-unit-effort (CPUE) from 55 sport fishing derbies during May, June and July, from 1951 until 1995. The most abundant species, bat rays (*Myliobatis californica*), shovelnose guitarfish (*Rhinobatos productus*) and leopard sharks (*Triakis semifasciata*), were also analyzed for size-weight relationships, trends in size class distributions, stage of maturity, and sex ratios. Changes in species composition over the course of the derbies included the near complete disappearance of shovelnose guitarfish by the 1970s and a slight increase in the abundance of minor species (mainly smoothhounds, *Mustelus* spp., and thornbacks, *Platyrhinoidis triseriata*) starting in the mid-1960s. The proportion of bat rays in the catch steadily increased over the years while the abundance of leopard sharks has declined slightly during the last two decades. A peak in overall CPUE was evident during the mid to late fifties. Leopard shark and bat ray size class distribution data showed no obvious changes. The catch of bat rays and leopard sharks was consistently dominated by immature individuals, while the catch of shovelnose guitarfish was heavily dominated by adults. Female bat rays and shovelnose guitarfish were larger than their male counterparts, and outnumbered males nearly 2:1. Female and male leopard sharks were more nearly equal in size and sex ratio. Changes in species composition are likely due to shifts in the prevailing oceanographic conditions and habitat alteration in Elkhorn Slough. The sex ratios, stage of maturity, and size class distributions provide further evidence to the theory that Elkhorn Slough functions as a nursery ground for bat rays and leopard sharks.

Carrington. E. Department of Biology, Friday Harbor Laboratories, University of Washington. PREDICTING DISTURBANCE TO MUSSEL BEDS: WAVE VERSUS TEMPERATURE STRESS

Dense aggregations of mussels often dominate temperate rocky shores, outcompeting some species for primary space while providing secondary habitat for others. The frequency and severity of disturbance to mussel beds therefore influence the structure of intertidal communities. Disturbances often coincide with extreme environmental conditions; two common forms of mussel mortality are dislodgment by storm waves and temperature (heat/cold) stress. Are these disturbances predictable? Carrington (2002) developed a biomechanical model to predict wave dislodgment of mussels (*Mytilus edulis*) on Rhode Island shores based on field measurements of wave height and mussel attachment. During 2001-2003, the model predicts strong wave dislodgment events (up to 40%) during hurricane season (Sep-Nov), a period when large waves coincide with relatively weak mussel attachment. Mussels dramatically increase attachment strength in winter/spring and as a consequence, even large storms during these months are predicted to cause minimal mortality. Concurrent biweekly monitoring of mussel abundance at two wave-exposed sites confirmed the model predictions: dislodgment events were more frequent and severe in early fall and were rare during other seasons. Mortality by temperature stress was also easily quantified in individual photoquadrats, and these disturbances were highly variable in timing and severity. In contrast, wave dislodgment was surprisingly consistent among years, with cumulative annual mortality ranging 26-34%. Over the three-year study, however, wave dislodgment and temperature stress contributed equally to overall mussel mortality.

§ Carson, H.S.1,2*, S.G. Morgan2 and P.G. Green2 1San Diego State University 2University of California, Davis A COMPARISON OF THE TRACE ELEMENTAL CHEMISTRY OF PORCELAIN CRAB EMBRYOS AND SETTLERS COLLECTED ALONG THE NORTHERN CALIFORNIA COAST

To test the hypothesis that crab larvae retain part of the trace-elemental signature of their point of origin throughout larval dispersal, embryos and recently settled juveniles of the porcelain crab (*Petrolithes cinctipes*) were collected along the Northern California Coast from Bodega Bay to Fort Ross. Embryos and larval soft tissues were dissolved and analyzed to determine the levels of 30 elements using Inductively-coupled plasma mass spectrometry (ICP-MS). The chemistry of embryos for each of 16 sites (n = 10 clutches) were evaluated to determine the similarity of
chemical signature among clutches. The settlers collected from 7 sites were assigned to the most likely point of origin based on the similarity to one or more embryo chemistries.

§Cartamil, D.*1, C. Sepulveda2, N. Wegner1, A. Baquero3, S. Albers1 and J.B. Graham1. 1Scripps Institution of Oceanography, 2Pfleger Institute of Environmental Research, 3San Diego State University. AN ARCHIVAL TAGGING STUDY OF COMMON THRESHER SHARK (ALOPIAS VULPINUS) MOVEMENT PATTERNS OFF THE COAST OF SOUTHERN CALIFORNIA: PRELIMINARY RESULTS

Common thresher sharks are a primary target of the California drift gillnet fishery, with average catch rates of ~180 mt annually. However, life history and movement pattern data important for management of this species are scarce. We used archival tags to determine thermal and depth habitat preferences of thresher sharks in the southern California Bight. Between April 2004 and May 2005, 56 thresher sharks were tagged with Lotek LTD 1100 archival tags offshore of La Jolla, CA. Of these, 2 have been recaptured off Dana Point and Malibu, CA, providing 86 days of archived temperature and depth data with a temporal resolution of 1.88 min. The tagged threshers primarily inhabited depths of <10 m by night, while diurnal depth readings indicated two distinct modes of vertical distribution. In the first (‘shallow’) mode, sharks remained in the upper 20 m; in the second (‘deep’) mode, daytime behavior was characterized by repeated dives below the thermocline (maximum depth of 240 m). Shifts in depth mode may be related to migratory activity. Diving activity peaked during morning and late afternoon hours. Current drift gillnet fishery regulations enacted to reduce marine mammal mortality may help to keep thresher shark catch rates at sustainable levels.

Caselle, J.E., S.L. Hamilton* and J.D. Standish. Department of Ecology, Evolution, and Marine Biology, UC Santa Barbara. SITE-SPECIFIC DIFFERENCES IN LIFE HISTORY TRAITS OF CALIFORNIA SHEEPHEAD FROM CENTRAL BAJA TO SOUTHERN CALIFORNIA ARE RELATED TO FISHING PRESSURE

The California sheephead (Semicossyphus pulcher) is a large sequentially hermaphroditic (sex-changing) wrasse that is targeted by both the commercial live-fish and recreational fisheries. Catch by the live-fish fishery has increased by an order of magnitude in southern California in the last decade, though in some years it has remained below the recreational take. The live-fish fishery targets small fish (i.e. dinner plate size), thus most live-landed sheephead are young females. This type of harvesting on a hermaphroditic species of fish such as the sheephead may cause growth overfishing and may affect not only population densities and individual sizes, but also egg production, sex ratios, and the social system. The recreational catch, in contrast, targets the largest individuals that are primarily male and may also alter population densities, sex ratios, and size at sex change. In 1998, we conducted visual surveys and made collections of California sheephead at eight locations throughout southern California and Baja California that differ in fishing intensity. At the time of collection, we gathered data on the following attributes of each individual: standard length, total length, weight, and sex. In addition, we used thin sections of dorsal spines to age a subset of individuals from each site. Preliminary results suggest that sheephead from lightly fished locations (Baja) are comprised of older and larger sized individuals and a high proportion of terminal phase males. In contrast, heavily fished sites (southern CA) show size and age structures shifted towards smaller and younger individuals and sex ratios shifted towards females and immature fish. Selective harvest on a sequentially hermaphroditic species influences site-specific fecundity and growth rates. Future work will use historical data to compare life history traits between a subset of these locations before and after the advent of the commercial live-fish fishery.


Relatively few manipulative experiments have directly tested the consequences of functional group diversity in marine systems despite its increasingly recognized role as a key component of biodiversity. In this presentation, I will discuss preliminary results from a manipulative experiment conducted in San Francisco Bay, California, testing the effects of specific functional groups and functional group diversity on species competition for a limiting resource. Marine fouling communities are characterized by high diversity on small spatial scales and are easily manipulated, making them an ideal system in which to test the effects of diversity. As space is generally the limiting resource for sessile species in these communities, I divided the community into different functional groups according to each species’ mode of space occupation. Using PVC settling plates to create experimental communities, I removed each functional group alone and in combination with others. The experiment was
replicated at two different depths and run times to test for effects of variation at different depths through the seasons. Preliminary results show significant differences between the functional group diversity treatments, indicating that the removal methods were effective in reducing functional group diversity. Previous work has shown that individual species can disproportionately depress overall species and functional group diversity. These results are supported in the current experiment, as overall community species diversity differed between the treatments, with particular non-native species playing dominant roles in each functional group. The number of species per non-target functional group (i.e. those groups not targeted for removal) also differed among the treatments.

Chittaro, P.M.¹, Gagnon², J. and B.J. Fryer². ¹Northwest Fisheries Science Center, ²Great Lakes Institute of Environmental Research. THE DIFFERENTIATION OF FISH POPULATIONS USING LAPILLAR AND SAGITTAL OTOLITH CHEMISTRY.

To assess population structure and the movement of individuals, otolith chemical studies have overwhelmingly favored the use of sagittal otoliths even though different otolith types (sagitta, lapillus, and asteriscus) likely vary in terms of their responses to environmental chemistry. In this study we compared the elemental concentrations of sagittal and lapillar otoliths of *Stegastes partitus* (Poey) and determined that sagittal otoliths were superior at differentiating individuals. The discrimination of individuals was further improved when the elemental concentrations of both otolith types were used in the same analysis. The use of sagittal and lapillar otolith chemistry therefore highlights a practical development for investigations of population structure, particularly in situations where the elemental differences among sites of interest are relatively small.

§ Coates, R.C.* and J. J. Stachowicz. Bodega Marine Laboratory, University of California, Davis. INVASIVE SPECIES AS HABITAT MODIFIERS: *WATERISPORA SUBTORQUATA*’S EFFECT ON NATIVE VS. NON-NATIVE SPECIES

The susceptibility of a community to invasion is thought to be controlled, in part, by completely resources are utilized by resident species and thus made unavailable to invaders. A corollary to this notion is that habitat-modifying species potentially increase a community’s susceptibility to invasion by adding resources (e.g. space, limiting nutrients) to a habitat. However, the provision of such additional resources might benefit both native and non-native, and so the net effect of such species on invasion susceptibility is not obvious. An invasive encrusting bryozoan, *Waterispora subtorquata*, provides a valuable opportunity to investigate how one non-native species affects the diversity and abundance of both native and non-native species. We used field experiments in Spud Point Marina, Bodega Bay, Ca. to examine the effects of three different habitat modifiers on native versus non-native diversity: the exotic bryozoan *Waterispora subtorquata* (both live and dead colonies were used), mussels (*Mytilus galloprovincialis/californianis*), and the native sea squirt *Ascidia ceretodes*. Each was compared to the native and exotic richness found on flat tiles of varying sizes. Fouling habitat that is invaded by *W. subtorquata* has, on average, twenty-five times the surface area and three-dimensional complexity than bare space and at least twice that of other foundation species such as mussels or sea squirts. After three months, species richness was significantly higher in live *W. subtorquata* treatments than any other treatments, which differed little from each other. In particular, the natives *Entodesma navicula, Nerius eakini* and the exotics *Myxicola sp., Didemnum sp.* were found almost exclusively on *W. subtorquata* heads. Both native and non-native richness were affected similarly by *W. subtorquata*. These results suggest that the recent invasion of Bodega Bay and other west coast estuaries by *W. subtorquata* provides added space to fouling communities and subsequently reduces competitive exclusion, increasing the number of species that can be supported in a local area. This alleviation of space limitation may increase the invasibility of fouling communities by reducing native resistance and making resources available to non-native recruits.

§ Constable, H.¹*, Larson, R.¹, Gilbert-Horvath, L.², Garza, J.C.² ¹San Francisco State University ² National Marine Fisheries Service, Santa Cruz. POPULATION GENETICS OF SHORTBELLY ROCKFISH ALONG THE CALIFORNIA COAST, OR FST: HOW LOW CAN YOU GO?

Shortbelly rockfish, *Sebastes jordani*, an abundant and ecologically significant prey species, experience an extended pelagic stage during which extensive larval transport can occur. Using 12 microsatellite loci, we examined temporal
and spatial genetic structure of 850 pelagic juveniles sampled at 9 stations from Mendocino to San Diego, California. Preliminary analyses revealed extensive gene flow across 1,050 km including the potential biogeographic boundaries of Monterey Canyon and Point Conception. This study provides unique perspectives of larval genetic composition during the pelagic stage, and shows the great potential for dispersal and gene flow.

§ Conway-Cranos, L.L.* and P.T. Raimondi. University of California at Santa Cruz. GEOGRAPHIC VARIATION IN RECOVERY OF ROCKY INTERTIDAL COMMUNITIES FOLLOWING A DISTURBANCE: LINKING RECRUITMENT TO RECOVERY

Community dynamics of benthic organisms are often influenced by the processes of disturbance and recovery. Geographic location, disturbance size, recruitment rate, and life-span of affected organisms may all contribute to recovery dynamics. To more fully understand and predict recovery rates of intertidal organisms, we are investigating the relationship between disturbance size, recruitment rate, biogeographic region and recovery rate in four sessile species common to the California rocky intertidal zone. In December of 2003, we made experimental clearings in an array of sizes in benthic intertidal assemblages dominated by the California mussel *Mytilus californianus*, the acorn barnacle *Chthamalus fissus/dalli*, the rockweed *Silvetia compressa*, and the red turf alga *Endocladia muricata* at three sites along the California coast (north, near to, and south of Pt. Conception). Preliminary results suggest that for *Chthamalus dalli/fissus*, recruitment rate may be a good predictor of recovery rate and that at low recruitment rates, smaller disturbances may recover more quickly than larger ones. *Silvetia* recovery has not been dependent on the presence of facilitator species as expected, while recruitment of *Silvetia* has been patchy at all three sites. Understanding how the roles of recruitment rate and disturbance size vary with biogeographic region will aid in the prediction of recovery estimates for benthic species.

§ Curtis, D.L.*1, 2, E.K. Jensen1, 2, and I.J. McGaw1, 2. 1 University of Nevada, Las Vegas, 2 Bamfield Marine Sciences Centre. PHYSIOLOGICAL AND BEHAVIOURAL RESPONSES OF THE GRACEFUL CRAB, Cancer gracillis, TO LOW SALINITY

The graceful crab, *Cancer gracillis*, inhabits muddy bays and is classified as an osmoconformer. Beyond this, there is little documentation on the osmoregulatory ability of this species. In the present study, the physiological and behavioural responses of *C. gracillis* to decreased salinity were examined. The haemolymph was iso-osmotic in salinities above 50% seawater (SW); below this point the haemolymph was slightly hyperosmotic to the external medium. *C. gracilis* did not survive for extended periods in salinities below 75% SW. During exposure to low salinity, there was a decrease in heart rate which was most pronounced in 50 and 25% SW. There was also a significant reduction in oxygen uptake following exposure to 50 and 25% SW. Behaviourally, crabs showed an initial closure response to reduced salinity, wherein antennule flicking ceased, the antennules were then retracted and animals became quiescent. The decrease in behavioural parameters corresponded with an increase in the amount of time that crabs spent with their branchial chamber closed, suggesting that crabs may be using closure, coupled with a decreased heart rate as a means of reducing diffusive salt loss. The results of this study show that osmoconformers have physiological and behavioural responses to low salinity that are distinct from those of osmoregulators.

§ Danner, E.M.* University of California Santa Cruz. THE EFFECTS OF INTRODUCED PREDATORS ON ISLAND PLANT COMMUNITIES: A COMPARISON AT MULTIPLE SPATIAL AND TEMPORAL SCALES

Recent work by Croll et al. (Science 307:1959-1961) and Maron et al. (in press) has demonstrated that “Introduced foxes in the Aleutian archipelago initiated an ecosystem-wide trophic cascade that reduced the transport of nutrients from ocean to land, created nutrient-impoverished soils, and transformed terrestrial grasslands to dwarf shrub/forb-dominated ecosystems’. Their results were based on a standard point method of vegetation sampling during a single time of year (August). I have examined this system at larger spatial scales (across entire islands and the entire archipelago) and at multiple temporal scales (every 16 days from 2000 through 2004) using remotely sensed data. Vegetation indices (MODIS 250m NDVI and EVI) were used to estimate plant biomass and phenological patterns such as start of growing season (SOS), end of growing season (EOS), and growing season length (GSL). Results indicate complex relationships between VI values and bird densities, each island’s physical parameters, and the presence/absence of foxes. In general, grass dominated communities on fox-free islands have seasonally distinct VI characteristics (such as earlier SOS, higher maximum values) in contrast to dwarf shrub/forb dominated
communities on fox-infested islands. The remote sensing approach allows for the examination of patterns in space and time that would not be possible using conventional ground-based methods.

§ Davenport, Andrew C.* and Todd W. Anderson. San Diego State University. ARE THERE DIFFERENTIAL EFFECTS OF REEF FISHES ON GIANT KELP PERFORMANCE?

Previous studies have suggested that microcarnivorous reef fishes (senorita, Oxyjulis californica and kelp perch, Brachyistius frenatus) may reduce populations of grazing invertebrates, yielding positive indirect effects on giant kelp performance and preventing infestations that could have severe impacts to kelp forests. In 2003 and 2004, we examined the effects of invertebrate herbivores on giant kelp performance in the presence and absence of their predators. For both habitat isolates and within a continuous reef, we found that invertebrate herbivore biomass was significantly higher when predators were excluded from giant kelp, which in turn, lowered kelp performance. In addition, herbivore biomass and the abundance of the kelp perch (but not senorita) was inversely related among reefs, suggesting that these effects occur from small to large spatial scales. Because of reported differences in diet and other factors, we asked whether these two fishes differentially affected herbivore biomass and kelp performance and how such effects may be related to their densities. We placed densities of 0, 2, 4, and 8 senorita and kelp perch into separately caged plots of kelp, each containing one species at one level of density. Invertebrate biomass generally declined as the density of fishes increased. Metrics of kelp performance differed with increasing density, but differences between species were less clear. There was a positive relationship between the density of kelp perch and blade growth while the senorita showed no effect. By contrast, the density of senorita showed a positive relationship with the number of meristems while the kelp perch showed no effect, suggesting that these two fishes may affect kelp performance differentially.

deRivera,* C.E.1,2 and G.M. Ruiz1, 1Smithsonian Environmental Research Center, 2Portland State University. SPATIAL PATTERNS OF NONINDIGENOUS INVERTEBRATES IN WEST COAST RESERVES AND SANCTUARIES

Nonindigenous species (NIS) have caused substantial environmental and economic damage to coastal areas. Moreover, the extent and impacts of NIS are increasing over time. Despite the consequences of NIS, there are serious limitations to our understanding of the patterns of marine invasions. Identifying invasion patterns is crucial to developing predictive models of spread and to assessing the relative risk of invasions for different taxonomic groups, geographic regions, and habitat types. Therefore, in a collaborative effort, the Smithsonian Environmental Research Center, the National Estuarine Research Reserve System and the National Marine Sanctuary Program used standardized protocols to collect data on the composition of fouling communities along the US west coast. We sampled using settling plates at multiple sites in and near nine protected coastal areas from Tijuana River, CA, to Kachemak Bay, AK. We identified the four most common taxa on the plates --Bryozoa, Tunicata, Cirripedia, and Hydrozoa-- and also Nudibranchia to species and noted which were nonindigenous. NIS accounted for one quarter of the 132 species in the 5 taxa under study. Over half the tunicate species were non-native. We documented two patterns in NIS, a latitudinal pattern and differences between marina versus non-marina sites. The number and percent of NIS decreased with increasing latitude. Tijuana River had the most, 21, NIS and Monterey Bay had the highest proportion of NIS (57%). Across latitudes, plates in marinas were more impacted by NIS than were plates in more natural areas. All NIS but one were found at marinas, whereas only half the NIS were found at the non-marina sites. In addition, NIS at marinas accounted for almost 80% of the NIS per site. This supports the idea that marinas and ports are the entry point for NIS into more natural habitats in estuaries, bays, and offshore.

§ Dickens, J.L.*, E.M. Gallardo, A.R. Beck and R.R. Wilson, Jr. California State University, Long Beach. A GENETIC ANALYSIS OF TEMPORAL AND SPATIAL DISJUNCTURE IN POPULATIONS OF YELLOWFIN GOBY (ACANTHOGOBIUS FLAVIMANUS) OF SOUTHERN CALIFORNIA

We are interested in determining how invasive populations of yellowfin goby (Acanthogobius flavimanus) establish and maintain themselves within the patchy estuarine habitats of southern California. To determine where local populations fall within a range of being fully self recruiting, or supported by immigration, we examined genetic variability at two microsatellite loci to estimate effective population size (N_e) and migration rates for populations in Newport Bay and the Bolsa Chica Ecological Reserve. Southern California presents an interesting setting within which to study this process as the patchy nature of estuarine habitat creates a series of disjunct populations. Using
we analyzed the relationship of populations in southern California to those from San Francisco and Tokyo bays. Specimens from San Francisco Bay collected in 1960 and Newport Bay in 1980 were also included. Comparison of the historical populations showed that $\rho_{ST}$ was not significant, but that a significant amount of evident drift has occurred since that time. $\rho_{ST}$ was also not significant for comparisons among current populations within southern California. We applied two estimators of genetic effective population size. MIGRATE, a coalescent method, indicated that $N_e$ for Newport Bay was approximately 19 individuals versus 52 for Bolsa Chica. Two variance method estimators showed approximately 7 and 7 individuals for Newport Bay versus 43 and 33 for Bolsa Chica. The discrepancy in the variance indicators for Bolsa Chica is due to a large decline in the frequency of a single allele over the sampling interval.

§ Donnellan, M.D.* Moss Landing Marine Laboratories. SPATIOTEMPORAL VARIABILITY OF KELP FOREST CANOPIES IN CENTRAL CALIFORNIA, AND A PROPOSED METHOD TO CLASSIFY KELP FORESTS USING REMOTE SENSING

For over three decades, aerial surveys of giant kelp (*Macrocystis pyrifera*) and bull kelp (*Nereocystis luetkeana*) surface canopies have been used to document changes in the geographic distribution and the spatial extent of kelp forests in California. However, most canopy studies (and kelp forest research in general) have been conducted in southern California, where “beds” are relatively discrete and seasonal fluctuations in abundance less variable than in central California. Previous research in central California’s kelp forests has indicated that the spatial extent of kelp canopies is highly variable at seasonal and annual time scales, but it is unclear whether these studies may be justifiably “scaled up” because most were done at either small spatial scales (<1 km), short time scales (<5 yrs), or both. To explore these issues of scale, and to provide spatial and temporal perspective for past and future studies in the region, I used a time-series of aerial photographs spanning ~60 kilometers and 6 years to describe the natural spatial and temporal variability of kelp canopies in *Macrocystis*-dominated kelp forests offshore of Monterey, California. To these ends I also developed a method for classifying kelp forests into different types based on the spatiotemporal variability of their associated canopies. The principal findings of this work were that: 1) at a regional spatial scale, the maximum annual canopy abundance occurred anytime from July – October and minimum canopy occurred in either February or March; 2) canopy abundance on any given day of the year was predictable when observed at a regional spatial scale; 3) temporal variability of canopies increased substantially when measured at spatial scales less than ~1.5 km; and 4) kelp forests in the region could be classified into 3-7 different types that were, in part, subjectively consistent with differences in wave exposure.

§ Dubois, A.* and K. Iken. School of Fisheries and Ocean Sciences, University of Alaska Fairbanks. TEMPORAL AND SPATIAL DISTRIBUTION PATTERNS OF GRAZERS AND KELP CHEMICAL DEFENSES IN ALASKA

The health and diversity of Northeastern Pacific coastal ecosystems rely heavily on the abundance of spawning and foraging habitat provided by kelp forests. Canopy-forming macrophytes like *Nereocystis luetkeana*, and bed-forming species such as *Agarum clathratum*, *Laminaria bongardiana* and *L. saccharina*, offer three-dimensional space that is frequently occupied by invertebrate grazers such as snails. These mesograzers are often highly abundant during the summer and may therefore be capable of causing considerable tissue damage to kelp. Consequently, brown algae are able to produce defensive chemicals such as phlorotannins for protection against snail grazing. We seek to support the hypothesis that seasonal and small-scale spatial patterns of phlorotannin production in kelp vary proportionally with grazing intensity by the snail, *Lacuna vincta*. Grazer densities on the four mentioned kelp species were established monthly from May 2004 through November 2005 within Kachemak Bay, Alaska. *Lacuna vincta* demonstrated peak abundance in early to mid-July and preferentially resided on *N. luetkeana* and *L. bongardiana* blades. Additionally, tissue segments from differing thalli regions were analyzed for total phlorotannins. Results demonstrate distinct intra- and interspecific patterns in phlorotannin concentrations, with *L. bongardiana* presenting the lowest and *A. clathratum* the highest overall concentrations in meristematic blade tissue. The greatest *L. vincta* abundance was observed on the two algal species with the lowest overall phlorotannin levels; however, clear patterns of snail distribution were not evident within thallus parts of each algal species in relation to phlorotannin concentrations.
Dudas, S.E.\textsuperscript{1} and J.F. Dower\textsuperscript{2} \textsuperscript{1}Oregon State University, \textsuperscript{2}University of Victoria. MODELING THE GROWTH AND SURVIVAL OF AN INTRODUCED BIVALVE, THE VARNISH CLAM (\textit{Nuttallia obscurata}), IN THE NORTHEAST PACIFIC

Identifying the life history characteristics that contribute to invasion success is crucial to our understanding of invasion dynamics and to identify the species that are likely to exert the greatest impacts. The varnish clam (\textit{Nuttallia obscurata}) was first documented in the Northeast Pacific in 1991 and quickly established dense populations along beaches in British Columbia, Canada. The reasons for its success may lie in its benthic life history characteristics. This study investigates varnish clam individual growth and survival rates using mark-recapture analysis at two sites on Vancouver Island. To facilitate comparison of varnish clam growth rates with native species a size-at-age key was made for varnish clams based on the growth increment data. Size-specific survival rates were determined using a multi-state capture-mark-recapture model. Analysis of covariance results showed significant differences in growth rate between sites, with faster growth corresponding to lower adult densities. Growth rate differences decreased towards larger sizes (i.e. 4 cm) where both populations reach near zero growth. The growth rates observed at both sites are comparable to native species, despite the varnish clams high intertidal height, indicating that they are well adapted to this stressful environment. Monthly survival rates ranged from 0.81-0.99 and appear to be size, time and site dependent with small clams (< 30 mm) suffering higher mortalities at both sites. This may be due to the limited burial depth for smaller clams, increasing their exposure to predation and thermal stress. The rapid growth at small sizes may provide an advantage in establishing and maintaining populations by decreasing predation vulnerability, and by allowing the varnish clam to reach size-at-sexual maturity quickly.

Eckert, G.L.\textsuperscript{*} University of Alaska Southeast, Juneau. VARIABILITY IN NEARSHORE GULF OF ALASKA POPULATIONS: EFFECTS OF MEASURES, TIDAL HEIGHT, AND SUBSTRATE

One of the primary goals of any monitoring program is to detect anthropogenic changes, however natural variability can be so high that it prevents detection of human-induced effects. This project synthesized existing data to identify, within nearshore marine habitats in the Gulf of Alaska, environments and species that have less natural variability so that these variables can be included in the monitoring plan under development by the Gulf Ecosystem Monitoring program, funded by the Exxon Valdez Oil Spill Trustee Council. I collected 663 Gulf of Alaska time series that were greater than two years in length and from unimpacted (control) sites. I compared population variability for time series collected for different measures of abundance, tidal height, and substrate type. For both invertebrates and algae, there was no significant difference in population variability when populations were measured by biomass, density or percent cover. There was less variability in subtidal populations than intertidal populations for invertebrates, whereas there was no significant difference in variability among algal populations at different tidal heights, however the number of time series available for subtidal algae was small. There was less variability in invertebrate populations on bedrock than on soft sediment substrates, and invertebrate populations on cobble varied an intermediate amount. There was no significant difference in variability among algal populations on bedrock and cobble substrates, and algae were not surveyed on soft sediment substrates. Additional analyses are needed before deciding whether to use populations that vary more or less in a monitoring program. Populations with lower natural variability will have less “noise”, however they may also be slower to respond to anthropogenic influences. Further analyses are also needed to examine why populations have less variability.

Edmunds, P.J. Department of Biology, California State University, Northridge. TEMPERATURE-MEDIATED TRANSITIONS BETWEEN ISOMETRY AND ALLOMETRY IN A COLONIAL MODULAR INVERTEBRATE

The evolutionary success of animal design is strongly affected by the scaling of phenotypic traits, and virtually all metazoan lineages are constrained by allometric scaling. One bauplan that provides freedom from these limitations is a colonial modular (CM) design, in which modular iteration is hypothesized to support isometric growth and indeterminate size. The more common unitary design has no such freedom from allometry, and this difference is thought to be important in mediating the success of CM taxa where they co-occur with unitary taxa. Many scleractinians exemplify a CM design, yet there is little experimental support for isometry, and nothing is known about the variance in scaling exponents (b) of specific traits. In this study, annual growth data for juvenile scleractinians were used to test the assertion of isometric growth for a CM design, and to explore the extent of temporal variation in scaling exponents. The data consist of diameters of tagged juvenile corals (initially < 40 mm diameter) at the start and end of nine, year-long periods between 1997 and 2005. For all juvenile corals (i.e., pooled
among taxa), the scaling exponents differed significantly among years, with isometric growth (i.e., $b = 1$) in four years, but allometric growth (i.e., $b \neq 1$) in five years; similar results were obtained with juvenile *Porites* alone. The study years were characterized by differences in seawater temperature, and a multivariate measure of temperature was associated significantly ($P = 0.005$) with the scaling exponent for growth in all juvenile corals; isometry was associated with consistently warm years, while allometry was associated with variable cold years. These results illustrate variable scaling in a CM taxon, and the strong association with temperature suggests that the thermal regime can mediate a directional switch between the selective value of alternative body designs.

Eernisse, D.J. Department of Biological Science, California State University, Fullerton. DNA IS TO NATURAL HISTORY AS A DOUBLE HELIX IS TO A TRAFFIC CIRCLE

Molecular systematics is complementary to careful natural history study. For example, morphological variation often creates an overwhelming confusion in the mind of even the most ardent biologist, as if one is stuck on a roundabout. DNA sequence comparison can provide reciprocal illumination of such bewildering variation, like ascending the axis of a corkscrew or double helix in quest of phylogenetic nirvana. Examples from my own research date to my earliest clarification of *Cyanoplax* spp., a West Coast species complex of chitons that turned out to have fascinating contrasting life history patterns. This was first sorted out while I was a graduate student at UC Santa Cruz based on allozyme distinctions and further clarified more recently using mitochondrial DNA sequence comparisons. Likewise, Ryan Kelly and I (in prep.) have recently used multiple mitochondrial and nuclear gene regions to validate species distinctions and resolve the phylogeny of an impressive “species flock” of some 24 species of *Mopalia*. Although ecologically important, species identifications of this chiton genus had long proven challenging and genealogical relationships had remained mysterious. Collaborating also with Anthony Draeger and Roger Clark, we have now clarified the surprisingly robust diagnostic value of girdle setae, which are congruent with DNA characters. Some times such confusion has been avoided by merely lumping all variation as one species but this can obscure important ecological, geographic, or reproductive distinctions between species, which can lead to spurious conclusions. Biodiversity is also seriously underestimated. Good examples include hidden diversity revealed by DNA sampling of familiar seashore “species” including the lined chiton, *Tonicella lineata*, and the blood star, *Henricia leviuscula*. Collaborating with Reuben Paul (*Tonicella*) and Megumi and Richard Strathmann (*Henricia*), we now have evidence (in prep.) that each of these is also a species complex whose morphological attributes have proven diagnostic, as confirmed with molecular sampling.

‡ Elahi, R.* and P.J. Edmunds. California State University, Northridge. IS BIGGER BETTER? TESTING FOR ENERGETIC CONSTRAINTS ON MAXIMUM SIZE IN THE SOLITARY SCLERACTINIAN CORAL, *FUNGIA CONCINNA*

For many marine invertebrates, the maximum size an individual attains primarily is dependent upon extrinsic environmental factors, and may be limited by energetic constraints. In this study, an energetic model originally developed for anemones was modified in order to test the hypothesis that energetic constraints limit the maximum size of the solitary, mobile scleractinian coral *Fungia concinna*. The model assumed that photosynthesis was the primary source of energetic intake and metabolic cost was quantified as aerobic respiration. Daily energy budgets were calculated for a size range of individuals sampled from the forereef in Moorea, French Polynesia. The scaling exponent on mass was higher for energetic intake ($b = 0.73 \pm 0.09$) than metabolic cost ($b = 0.46 \pm 0.10$), allowing large individuals to maintain an energetic surplus over the size range studied, even when the energy required for daily host tissue and symbiont growth was incorporated into the model. The values of the energetic scaling exponents are consistent with the scaling of physiological traits related to respiration and photosynthesis. Specifically, tissue biomass increased allometrically with respect to surface area, suggesting that surface constraints in large *F. concinna* explained, in part, the low scaling exponent of metabolic cost. However, the capacity for autotrophy, defined as *Symbiodinium* population density and chlorophyll content, increased isometrically with surface area, which likely contributed to the higher scaling exponent for intake relative to cost. The results of the present study suggest that growth in *F. concinna* is not limited energetically. Instead, mechanical constraints on locomotion may set the maximum size, because individuals become disproportionately heavy with increasing size.

‡ Erisman, B.E.*1, M. Buckhorn2, and P.A. Hastings1. 1Scripps Institution of Oceanography, 2University of California, Davis. UNUSUAL SEXUAL AND SPAWNING PATTERNS IN THE LEOPARD grouPER FROM THE GULF OF CALIFORNIA: IMPLICATIONS FOR CONSERVATION
Widespread overharvesting of grouper spawning aggregations has led to major population declines of grouper stocks in many areas of the world, and efforts to improve their management and conservation are hindered by a lack of information on the reproductive patterns and sexuality of most species. We studied the leopard grouper, *Mycteroperca rosacea*, one of several groupers inhabiting the Gulf of California that has suffered significant population declines due to overfishing of spawning aggregations. Spawning aggregations formed from at least April to June in the central Gulf, were restricted to specific sites, and included several hundred breeding adults. Spawning occurred in groups of seven to >100 individuals from 2 hours before sunset until dark. Unlike most groupers, aggregations persisted throughout the spawning season, and spawning occurred on a daily basis and did not follow a lunar rhythm. Adults appeared to be functionally gonochoric with respect to sexuality, a characteristic known only in one other grouper species. These results suggest that a combination of traditional fishing restrictions (e.g. size limits) and management strategies that have been successful in the protection of other grouper species (e.g. seasonal closures of aggregation sites) may curtail current declines in *M. rosacea* in the Gulf of California.

§ Fenberg, P* and Roy, K University of California, San Diego. THE EFFECTS OF SIZE-SELECTIVE HARVESTING ON A SEX CHANGING LIMPET, *Lottia gigantea*

Human harvesting of marine species is nearly always selective for the largest individuals in a population. Size-selective harvesting has been shown to affect the life histories of many fish species, but very little is known about the effect of such harvesting practices on marine invertebrates. The Owl limpet (*Lottia gigantea*) is a highly exploited intertidal gastropod, and illegal size selective harvesting of this species is rampant along the coast of southern and central California. *L. gigantea* is particularly susceptible to selective harvesting because it is a protandric hermaphrodite, sequentially changing sex from male to female, with the largest size classes being predominately female. Thus, frequently harvested sites are likely to be preferentially losing females over males. Life history theory predicts that such exploitation should lead males to change sex at smaller sizes and earlier ages. A comparison of sex ratios from frequently harvested sites versus well-protected reserves provides strong support for this hypothesis. Average size at which males of *Lottia gigantea* change to females is significantly larger within well-protected reserves compared to exploited populations (60 mm versus 40 mm in length). Thus size-selective illegal harvesting is fundamentally altering aspects of the life history of *Lottia gigantea* throughout most of its geographic range.

§ Ferner, M.C.* and M.J. Weissburg. Georgia Institute of Technology. SEDIMENT ROUGHNESS ALTERS INDIRECT EFFECTS OF GASTROPODS ON THEIR BIVALVE PREY

Dissolved chemicals facilitate foraging and avoidance responses of aquatic animals. In soft-sediment marine habitats, water flow across rough surfaces can alter these olfactory behaviors by mixing and diluting chemical plumes. Depending on how different species are affected by the physical distortion of odor signals, bed-generated turbulence could shift the sensory advantage between predators and their prey. Previous research has shown that clams (*Mercenaria mercenaria*) can detect and respond to predatory whelks (*Busycon carica*) over a range of naturally occurring turbulence intensities. To test the hypothesis that turbulence associated with rough sediments does not impair chemically mediated avoidance responses of clams, we quantified the intensity of whelk predation on treatment and control plots of clams in a Georgia salt marsh. Initially, treatment plots contained a caged whelk at their center and paired control plots contained only an empty cage. Greater survival in treatment plots confirmed that clams responded to the presence of a non-feeding whelk, thereby reducing their susceptibility to other whelk predators. In a second experiment, all plots contained a caged whelk but treatment plots were also surrounded with a ring of sun-bleached oyster shells to increase turbulent mixing across the plots. Reduced survival in these treatment plots suggests that turbulence associated with the shells interfered with clam perception of risk and facilitated the ability of natural whelk predators to locate and consume the clams. Although whelks emit chemical cues that allow clams to effectively avoid predation, odor disruption associated with rough sediments appears to diminish the sensory performance of clams and thus reduce the indirect effect of whelk predators on their prey.

Fielman K.T.* and G. H. Hofmann Marine Science Institute, UC Santa Barbara. COMPARATIVE LARVAL THERMOTOLERANCE AMONG WESTERN STRONGYLOCENTROTID URCHIN CONGENERS
The role of larval thermotolerance in setting patterns of distribution and abundance across species’ biogeographical ranges is unclear and little is known of its underlying molecular physiology at the genomic scale. We compared 24 and 48 h survivorship at 1°C heat shock intervals over an 18°C range among four-arm plutei raised from cold water (6°C) white (S. pallidus) and green (S. droebachiensis) urchins with those of their warm water (15°C) red (S. franciscanus) and purple (S. purpuratus) congeners. 100% mortality was observed at 23-24°C for white/green as compared to 26-27°C for red/purple urchin larvae, consistent with the rank order of their adult habitat and larval rearing temperatures. Contrary to our expectations, however, white and green urchin larvae tolerated a much greater relative increase (16-17°C) prior to death as compared to the more eurythermal red/purple urchins (10-11°C). Using nylon macroarrays containing a comprehensive suite (> 100 K) of larval genes, several hundred differentially expressed genes that may underlie these thermotolerance patterns have been identified by comparing global gene expression patterns at heat shock exposures of 0, 5 and 10°C above the larval rearing temperatures.

Finley, R.J.*1 and G.E. Forrester2. 1Northwest Fisheries Science Center, 2University of Rhode Island.

PARASITISM AND A SHORTAGE OF REFUGES JOINTLY MEDIATE THE STRENGTH OF DENSITY DEPENDENCE IN A REEF FISH

Various predator-prey, host-pathogen, and competitive interactions can combine to cause density dependence in population growth. Despite this possibility, most empirical tests for density-dependent interactions have focused on single mechanisms. Here, we tested the hypothesis that two mechanisms of density dependence, parasitism and a shortage of refuges, jointly influence the strength of density-dependent mortality. We used mark-recapture analysis to estimate mortality of the host species, the bridled goby (Coryphopterus glaucofraenum). Sixty three marked gobies were already infected with a copepod gill parasite (Pharodes tortugensis) and 188 were uninfected. We used the spatial scale at which gobies were clustered naturally (~ 4 m²) as an ecologically relevant neighborhood, and measured goby density and the availability of refuges from predators within each goby’s neighborhood. Goby survival generally declined with increasing density, and this decline was steeper for gobies with access to few refuges than for gobies where refuges were common. The negative effects of high density and refuge shortage were also more severe for parasitized gobies than for gobies free of parasites. This parasite has characteristics typical of emerging diseases, and appears to have altered the strength of a pre-existing density-dependent interaction.

§ Fisher, J.L.* Moss Landing Marine Laboratories. RETENTION OR EXPORT OF BRACHYURAN LARVAE IN A NEWLY DESIGNATED MARINE RESERVE IN SOUTHEAST ALASKA: A TALE OF TWO SPECIES

Marine reserves have been proposed and implemented as alternate management strategies for sustaining adult populations of commercially important species. It is hypothesized that marine reserves help sustain fisheries by protecting adult populations within the reserve, and increasing adjacent populations by a direct spillover of adults or recruits to fished areas. Laboratory and field studies suggest that larval dispersal is not a passive phenomenon, and examples demonstrate that brachyuran larvae are able to regulate their vertical position in the water column in tidally influenced estuaries. Therefore, an understanding of species-specific larval dispersal to and from adjacent areas is pivotal in the design of successful marine reserves for the protection of species with complex life stages. I measured the horizontal and vertical distributions of brachyuran crab larvae from 5 families during ebb and flood tides across the mouth of Glacier Bay (Southeast Alaska) to determine larval retention or export. Here, I present the results from two conspecifics as examples of species-specific dispersal patterns. The seasonal distribution and abundance throughout the entire pelagic phase is reported, and the effect of day/night and tide cycles on megalopal vertical distribution is addressed. There was no effect of tide or site on larval abundance for either species. However, all larval stages of Cancer oregonensis were persistent throughout the study, suggesting that these species are retained. Conversely, only the early larval stages of Cancer magister were observed, suggesting that they may be exported from the estuary. Although the dispersal patterns differ for C. magister and C. oregonensis, Glacier Bay acted as a settling area for both species with megalopal abundance highest at the surface during night-time flood tides. These results suggest that Glacier Bay is a potentially effective and sustainable marine reserve for Cancer magister, which is a commercially important species in this region.

§ Floyd, E.Y.* and T.W. Anderson. San Diego State University. RELATIVE IMPORTANCE OF NUTRITIONAL CONDITION AND REFUGE AVAILABILITY FOR SURVIVAL OF THE BLACKEYE GOBY, RHINOGOBIOPS NICHOLLSI

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The supply of larvae to coastal areas, and subsequent post-settlement processes, are important determinants of the population dynamics of temperate and tropical reef fishes. However, variation in individual performance and characteristics such as nutritional condition (i.e., stored energy reserves) of recently settled fishes may also play an important role in population demography. The importance of nutritional condition and growth for survival of larval and juvenile fishes has been demonstrated in field studies conducted in tropical reef systems, but this topic remains relatively unexplored on temperate reefs. The objectives of this study were to determine (1) whether nutritional condition affects the survival of recently settled recruits of the blackeye goby (*Rhinogobiops nicholsii*) and (2) whether refuge availability may influence the importance of nutritional condition. Recruits were fed high or low food rations in the laboratory for 15 d, after which pairs of high- and low-ration fish of the same size were placed on standardized 0.25-m² rock plots constructed in Big Fisherman Cove, Santa Catalina Island. Plots were monitored daily to determine mortality over 12 d. For experiments examining the interactive effects of refuge availability, pairs of fish were placed on plots in three levels of refuge availability: high, medium, and low. On standardized plots, fish fed low rations disappeared before fish fed high rations. However, the importance of condition for survival was dependent upon refuge availability. As expected, survivorship was higher with increasing refuge availability, and low-ration fish tended to disappear before high-ration fish at medium and high levels of refuge. Surprisingly, high-ration fish experienced higher mortality on low-refuge plots. Although the importance of refuge availability for survival outweighed that of individual condition for this species, our results suggest that both the ecology of individuals and post-settlement processes are important constituents in the population demography of temperate fishes.

Foley, Melissa M*. University of California Santa Cruz. PREFERENTIAL FEEDING RATES, GRAZING RATES, AND ASSIMILATION EFFICIENCY OF KELP TISSUES IN THE GREEN URCHIN, *Strongylocentrotus droebachiensis*

The diet of an herbivore is constrained by many factors including food availability, preference, palatability, and digestibility. Recent studies have also shown that food quality can play an important role in an herbivores diet. Ecological stoichiometry is a tool used to analyze how the balance of essential elements (e.g., carbon and nitrogen) affects production, growth, nutrient cycling, and food web dynamics. While autotrophs have large variations in their stoichiometry, heterotrophs are less flexible and are nutritionally constrained by their food sources. The nutritional quality of a food source can impact the amount and type of food eaten by herbivores as they attempt to maintain their stoichiometric balance. In the summer of 2004, I set-up experiments at Friday Harbor Labs to test this theory of ecological stoichiometry. I conducted three different experiments to look at food preference, grazing rates, and assimilation efficiency of a common subtidal herbivore. All three experiments were run using reproductive and vegetative tissue from *Nereocystis leutkeana*. The green urchin,* Strongylocentrotus droebachiensis* was used as the herbivore in all three experiments. My results for all three experiments were consistent with the predictions of the ecological stoichiometry theory; urchins preferred higher quality food; they consumed lower quantities of the higher quality food; and the assimilation efficiency was higher for urchins eating higher quality food. These results suggest that nutritional quality may have large impacts on food web dynamics from the bottom up.

Fraser, Don.* Species at Risk Secretariat, Department of Fisheries and Oceans, Government of Canada. SPECIES AT RISK: CANADA’S PROGRAM FOR ENDANGERED SPECIES

A full 25 years after the passage of the Endangered Species Act in the United States, Canada finally has federal legislation to protect and recover endangered species: the Species at Risk Act (2003). However, the good neighbour to the north, for several years now, has supported a vibrant Strategy at the federal level for Species at Risk, and has had the formal infrastructure both to designate wildlife species’ status, and to foster recovery efforts, for 30 years. Fuller political engagement was always slow, despite broad grass roots support for these initiatives, but with passage of the Species at Risk Act, Canada may have taken the brakes off; the true tests of conservation are ahead. This talk will outline the key points in Canada’s Federal Strategy on Species at Risk, and raise some of the challenges in particular for transboundary marine species at risk.

Galindo, H.M.* and S.R. Palumbi. Hopkins Marine Station-Stanford University. COHORT GENETICS: DO DISPERsal PATTERNS CHANGE OVER TIME?
Larval dispersal is the primary way populations of many marine species are biologically connected, yet the scale and frequency of these connections have remained elusive. While genetic differences between populations are often used to estimate migration rates, increased resolution of genetic data allows us to examine larval dispersal events on an even finer scale. This study follows several cohorts of acorn barnacle (Balanus glandula) recruits collected in Monterey Bay over two settlement seasons. By comparing the genetic signatures of cohorts to a well-defined genetic map of adult populations, we can determine if the geographic ranges from which local recruits originate change both within and between settlement seasons. Eventually, these data will also allow us to construct individual larval trajectories over similar time scales.

Gaylord, B.*,1, J. Rosman2, J. Largier1, D. Reed3, J. Koseff2, C. McDonald2, S. MacIntyre1, K. Arkema1, S. Monismith2, P. Raimondi4, M. Brzezinski3. 1Bodega Marine Laboratory of UC Davis, 2Stanford University, 3UC Santa Barbara, 4UC Santa Cruz. FLOW MODIFICATION BY KELP FORESTS: IMPLICATIONS FOR SUBTIDAL ECOTOLOGY AND NEARSHORE ECOSYSTEMS

Kelp forests and their residents are connected intricately to the fluid milieu that surrounds them. Canopy-forming kelps and benthic macroalgae utilize nutrients delivered by flow, and many sessile invertebrates depend on water movement to bring them suspended particles of food. Fluid turbulence mixes gametes of broadcast spawners to enable successful fertilization, and also influences the time it takes reproductive propagules to settle to the seafloor. Such organism-flow linkages emphasize the potential importance of local differences in characteristics of flow across the spatial extent of a kelp forest. Here we present results of two parallel experiments involving the deployment of extensive arrays of flow sensors within and around a kelp forest at Mohawk Reef, Santa Barbara, CA. Findings indicate a clear reduction of current speeds within the forest that is dependent on the density of kelp individuals, a visible downstream wake characterized by slower flows, a zone of marked flow acceleration along the offshore boundary of the forest, and strong effects of water depth on velocity. These features have clear implications for the ecology of a variety of kelp forest organisms and the interaction of this important ecosystem with adjacent nearshore circulation.

Goldstein, Miriam C.*1 McNaught, Douglas C. 2 182 Dean Street, Brooklyn, New York; Brown University at time of study. 2Victoria University, Wellington, New Zealand; Brown University at time of study. EFFECTS OF SHIFTS IN ALGAL HABITAT ARCHITECTURE ON THE PRIMARY SETTLEMENT OF THE BLUE MUSSEL (MYTILUS EDULIS)

The shallow rocky subtidal of the Gulf of Maine was once primarily composed of Laminaria spp. kelp beds. Overfishing and species introduction shifted the community to a patchwork of urchin barrens, non-native algal associations, and blue mussel (Mytilus edulis) beds. We examined whether an increase in subtidal recruitment of Mytilus can be mechanistically attributed to the shift in dominant subtidal algae. In order to determine whether mussels respond to chemical or structural cues, we compared settlement densities on four natural algae (Polysiphonia stricta, Codium fragilis, Chondrus crispus and Laminaria saccharina) and five algal mimics at a low and high flow site. We also performed band transects, collecting the above four species as well as Chaetomorpha linum, Ulva lactuca, and Trailingla intricata (an alternate form of Bonnemaisonia hamifera) to compare accumulated density of pediveliger mussels on unmanipulated algae. For both natural and experimental algae at each site, filament diameter, but not total surface area, was positively correlated with settlement density. Algae with small interstitial areas also received higher settlement at the high flow site. The data suggest that algae with fine filaments or small interstitial spaces, such as the non-native algae Polysiphonia, Trailingla, and Codium, may have a greater tendency to attract mussels during settlement. It is therefore possible that non-native algae facilitates the formation of subtidal Mytilus beds in the Gulf of Maine.

§ Granek, Elise F. *1 and Kaitlin Frasier2, 1Department of Zoology, Oregon State University; 2Biology Program, Oregon State University. LARVAL AND ZOOPLANKTON COMMUNITIES: COMPARING INTACT AND CLEARED MANGROVE AREAS IN BOCAS DEL TORO, PANAMA

The zooplankton and larval species in a habitat are important indicators of food availability, propagule arrival, and settlement for community structure of future generations. Determining how larval and zooplankton communities differ between intact mangrove and cleared mangrove habitat will clarify the role mangroves play in entraining zooplankton and larvae and the importance of mangrove habitat as a settlement site. Light traps and plankton tows were used to quantify and compare larval communities between intact and cleared mangrove areas in Bocas del
Toro, Panama. Communities within intact mangrove areas had greater species richness and different community composition than those in cleared mangrove areas. Amphipods, ostracods, and larval, postlarval and reproductive mysids were more common in intact mangrove areas. These differences indicate important changes in larval and zooplankton communities following mangrove removal and have implications for food availability and propagule sources within mangroves and adjacent seagrass bed and coral reef habitat.

Griffith, K.A.*, and A.T. Newberry. University of California, Santa Cruz. SEPARATING THE EFFECTS OF FLOW REGIME AND PREY CAPTURE ON COLONY MORPHOLOGY OF THE HYDROID, BOUGAINVILLIA MUSCUS

Phenotypic plasticity is the ability of some organisms to produce different phenotypes in response to environmental flux. For many sessile marine invertebrates, flow regime is an important force that affects morphological traits. For example, colonial cnidarians often grow short and compact in robust flow, and tall and elongated in calm water. Their ability to alter morphology in response to flow regime likely represents an adaptive strategy: these morphologies may permit efficient suspension feeding and gas exchange while reducing the risk of dislodgment (in fast flows). The trigger for these altered growth patterns is often difficult to detect because flow is intimately tied to these multiple factors. In this study, we use hydroids as a study system for detangling the relationships between morphology, flow, and prey capture. While controlling for food intake, we documented the effects of flow regime on aspects of colony morphology. Our results show that regardless of food availability, colonies grew tall and elongated in still water, short and compact in flow. Moreover, colonies exhibited phenotypic flexibility in response to temporal variations in flow. Since water flow and prey capture are intertwined in the natural environment, our study suggests that this hydroid may use water flow as a proximate cue to develop a morphology that permits efficient suspension feeding.

§ Griffiths, A.M. University of Victoria. INVESTIGATIONS INTO THE POTENTIAL PREDATORS AND ONTOGENY OF VULNERABILITY TO PREDATORS OF JUVENILE NORTHERN ABALONE, HALIOTIS KAMTSCHATKANA

Northern abalone, Haliotis kamtschatkana, was listed as threatened by COSEWIC in 1999 and since that time no recovery of the species has been observed in British Columbia. Mortality due to factors such as predation and environmental stressors is thought to be high in early juvenile invertebrates and is a possible explanation as to why northern abalone have not recovered in B.C. Predation pressures on the northern abalone in Barkley Sound, British Columbia, were examined during the summers of 2004 and 2005. Thirty-eight potential predators were tested to determine if they would consume juvenile abalone, 1-25 mm shell length (SL), and four of these potential predators consumed >10% of the abalone offered to them. The four predators include: sharp-nosed crabs (Scyra acutifrons), red rock crabs (Cancer productus), black-clawed crabs (Lophopanopeus bellus), and sunflower stars (Pycnopodia helianthoides). Additional laboratory trials were carried out to determine if juvenile Haliotis kamtschatkana reach a size at which they gain refuge from early juvenile predators. Black-clawed crabs were the only predator tested that could not successfully prey upon abalone greater than 19 mm SL. Surveys were carried out to determine the predator abundances at three field sites and black-clawed crabs were found in highest abundance with one of three field sites having 1.61 individuals m⁻² for a given crab size. The results from this study can be applied to the conservation of northern abalone when deciding the optimal size to release hatchery-reared juvenile abalone into the wild to increase population numbers.

§ Guarderas, P.,* Hacker, S., and J. Lubchenco. Oregon State University. MARINE RESERVES IN LATIN AMERICA. DOCUMENTED EFFECTS AND CHALLENGES

Latin America encompasses a unique array of coastal ecosystems, which add significantly to the region’s diversity and productivity, providing the background for economic development along the coast. However, coastal and marine areas of Latin America are undergoing a rapid and drastic transformation; overfishing, coastal development, uncontrolled discharge of wastes into the oceans and expansion of aquaculture has caused drastic degradation. Networks of marine reserves, where extractive activities are not allowed, appear to be an important management tool to ameliorate the degradation of marine ecosystems; they not only conserve biodiversity but may benefit fisheries by managing population growth of economically important species. At present, the World Data Base on Protected Areas (WDPA) lists 1016 marine protected areas (MPA) in Latin America, from which 6% (59) comprise
management categories where extractive activities are not allowed. The number of protected areas established is an indicator of the commitment of biodiversity conservation but not a measure of effectiveness of the reserves. Therefore, our goal is to understand the ecological effects of marine reserves on species and communities based on the accomplishment of both conservation and management fisheries goals. We are summarizing the documented effects of marine reserve inside and outside their boundaries by using a meta-analysis of published data to address the differential species responses to protection. This approach is especially relevant for management guidelines because it will provide reliable information about the role of marine reserves in ocean management to scientists, policy makers and stakeholders.

§ Harley, C.D.G.¹, and J. O’Riley². ¹University of British Columbia, ²University of Vermont. NON-LINEAR COMMUNITY-LEVEL EFFECTS OF AN INTERTIDAL ECOSYSTEM ENGINEER

Ecosystem engineering is an important process in many ecosystems. However, the relationship between engineer abundance and engineering impact remains poorly understood. We examined the role of engineer density in a rocky intertidal community in northern California. In this system, the intertidal whelk *Nucella ostrina* preys on barnacles (*Balanus glandula* and *Chthamalus dalli*), leaving empty tests which serve as important refuges for small invertebrates. From field surveys and experimental manipulations, we found that the herbivorous snail *Littorina plena* is positively associated with empty test availability and with the percent cover of barnacles. We found that predation by *Nucella* caused a significant increase in the number of empty barnacle tests, but did not change total barnacle cover. In experimentally manipulated plots, *L. plena* abundance was elevated in areas were *Nucella* were actively creating empty tests. To explore the effects of variation in *Nucella* predation, we constructed a demographic matrix model for *B. glandula*. We found that the number of empty tests formed, and therefore in the number of *L. plena* snails occupying an area, peaked at an intermediate level of predation by *Nucella*. The non-linear relationship that we have described between engineer abundance and engineer impact may be an important component of ecosystem engineering in a variety of systems.

§ Heiman K. W. Hopkins Marine Station of Stanford University. IMPACTS OF INVASIVE REEFS ON SOFT SEDIMENT COMMUNITY STRUCTURE

Invasive species with the ability to modify habitat can have dramatic impacts on local communities and ecosystem functions and are of special concern to managers worldwide. The reef-building tubeworm *Ficopomatus enigmaticus* constructs complex hard habitat over native mudflats in Elkhorn Slough, California. To understand what species utilize this new unique habitat, the impact of the reefs on nearby mudflat communities, and to test for the feasibility of controlling this invasive I conducted a reef removal experiment. Twelve 1m diameter intertidal reefs were assigned to one of three treatment groups (removal, control and disturbance control) and the surrounding sediments and infaunal communities were sampled before and after treatment. The complex invasive reefs supported highly abundant non-native crustacean and tube-dwelling species (96% of associated individuals were non-native). Nearby mudflats were also highly invaded, especially in summer samples, with communities dominated by oligochaetes, polychaetes, and surface-feeding amphipods. Reef removal resulted in significant changes to infaunal community composition regardless of the timing of removal. The community changes were limited spatially to newly exposed mudflats under and near removed reefs. Colonization by invasive spionid polychaetes and other opportunistic invaders resulted in increased total infaunal abundances in removal samples. These effects persisted through time and were still present one year after reefs were removed. Reef removal may control *F. enigmaticus* abundance with the added benefit of reducing habitat for those invasive species that associate with the reef structure. However, due to the increase in abundance of invasives in the newly exposed mudflats reef removal may not result in an overall reduction in the total non-native abundance in the system.

§ Herter, H.L. and Eckert, G.L. University of Alaska Fairbanks, Juneau Center School for Fisheries and Ocean Sciences. TIDALLY-DRIVEN SUPPLY OF DUNGENESS CRAB MEGALOPAE IN GLACIER BAY, ALASKA

Spatial and temporal patterns in supply of *Cancer magister* late-stage larvae (megalopae) were studied within Glacier Bay, Alaska during 2004 and 2005. Off the coasts of California, Oregon and Washington, early zoeal stages of *C. magister* are thought to migrate offshore to the continental shelf and return to nearshore areas as megalopae, but little is known about *C. magister* larval dispersal in Alaska. We collected *C. magister* megalopae at three locations using light traps at the surface (0-1 m) and at 10 m depth. Megalopae were caught almost exclusively in
surface traps at the locations sampled. Significantly more megalopae entered the traps during the night time flood tide than at any other tidal stage. Maximum megalopal supply occurred in pulses during new moon phases. The quantity of megalopae supplied to each site decreased with increasing distance from the mouth of Glacier Bay, which may suggest that the larvae are entering Glacier Bay from offshore. The highest relative proportions adult C. magister were also found at the site closest to the mouth of Glacier Bay. Results of this study suggest that megalopae may be transported from an outside source into estuarine areas by a tidally-related mechanism, potentially similar to the pattern in California, Oregon, and Washington, and that megalopal supply may result in differential adult abundances in Glacier Bay, Alaska.

H.C. Hess¹, M. Overstrom-Coleman¹,², A. T. Fundis¹ and C.W. Petersen¹. ¹College of the Atlantic, ²Moss Landing Marine Laboratory. THE ROLES OF FACULTATIVE AND OBLIGATE CLEANERS ON A CARIBBEAN CORAL REEF

Most studies of cleaning associations and community effects of cleaners focus on single obligate cleaner species, such as cleaner wrasse (Labroides spp.) or neon gobies (Gobiosoma spp.). In contrast, on Caribbean reefs, cleaning is performed by several species, with some obligate cleaner species but often by an equally large or larger facultative cleaner community. In this study, we quantified the relative rates of cleaning among different species of cleaners, and the species they cleaned. The study was conducted within a marine reserve in Akumal, Mexico. Cleaning was conducted by both facultative cleaners (juveniles of three species: bluehead wrasse Thalassoma bifasciatum, Spanish hogfish Bodianus rufus, and French angelfish Pomacanths paru) as well as obligate cleaners (neon goby Gobiosoma oceanops and two shrimp Periclimenes pedersoni and Periclimenes yucatanensis). Most of the cleaning on the reef (88%) was done by facultative cleaners, with just over half of the cleaning events performed by T. bifasciatum juveniles. Although much of the cleaning occurred at predictable cleaning stations, incidental cleaning also took place throughout the reef on an unpredictable basis. There were differences among cleaner species in terms of the client species they served, what part of the clients’ bodies they spent most time on, the proportion of time they spent cleaning, and the spatial predictability of their cleaning behavior. In addition, we observed intraspecific variability in most of these parameters as well. This study highlights the importance of facultative cleaners in some coral reef communities and suggests that different cleaner species may be playing different roles in the community.

Hettinger, A.* and R.C. Carpenter. Department of Biology. California State University Northridge. PHYSICAL FORCING OF BOTTOM-UP PROCESSES IN A SHALLOW-SUBTIDAL COMMUNITY

The amount of primary production in a system is a function of numerous abiotic and biotic factors including light and nutrient availability, nutrient flux, temperature, physical disturbance and herbivory. This study investigates how water motion acts as a driving mechanism in determining rates of primary production and initiates a bottom-up cascade in the shallow-subtidal communities of Santa Catalina Island, California. Primary production has been shown to increase as a direct result of flow speed due to boundary layer dynamics that boost nutrient and carbon delivery to algal thalli. When primary production is enhanced as a function of water motion, primary producer turnover can increase. Presumably this amplification in biomass can create a bottom-up trophic cascade affecting the entire community. Several hypotheses were examined using a model system within the larger kelp forest community across a hydrodynamic gradient. Algal turfs were used to quantify primary producer photosynthesis and biomass production rates. Tegula, the dominant herbivore, was used to estimate secondary producer abundance, size-frequency, and secondary production rates. Significant wave heights were recorded using S4 current meters. Results suggest that physical forces affect bottom-up processes resulting in an increase in both primary and secondary biomass production. Furthermore, shallow-subtidal community structure is affected when sites are exposed to water velocities of up to 3 m/s through a significant decrease in herbivore abundance and an increase in herbivore size. Water motion is known to affect physiology and morphology at the organismal level; this work suggests that such patterns extend to have community-level effects.


Climate variability is a major driver of recruitment dynamics in terrestrial, aquatic and marine ecosystems. Recruitment success for many species of rockfish (Sebastes spp.) in California has been attributed to upwelling conditions during spring. However the mechanisms for recruitment success remain unresolved. The spring of 2005
saw very little upwelling due to a prolonged rainy season. The recruitment of some rockfish species was significantly reduced relative to previous years where upwelling was strong. However, Bocaccio rockfish recruitment was high. We discuss some of the potential mechanisms responsible for variable rockfish recruitment and the potential effects of poor recruitment on the eel grass community in Bodega Harbor.

Hodin, J.* Hopkins Marine Station, Pacific Grove, CA, USA 93940. WE NEVER SHOULD HAVE MOVED HERE: EFFLUX TRANSPORT INHIBITORS INDUCE INAPPROPRIATE SETTLEMENT DECISIONS IN SAND DOLLAR AND SEA URCHIN LARVAE

Metamorphosis is a critical process in the life history of a wide array of organisms, animals and non-animals alike. One aspect of metamorphosis that is shared by many of these taxa is a profound, irreversible change in habitat. In marine invertebrates this habitat shift is called “settlement,” where planktonic larvae settle to the benthos to initiate juvenile life. Although it is widely accepted that finding an appropriate place to settle is typically a crucial and difficult undertaking for a larva, relatively little is known about how larvae actually accomplish this feat in the field. In many cases, invertebrate larvae seem to utilize specific chemical cues (such as a metabolite from a favored food source) as initiators of settlement behavior. The presumption is that such chemical (or other environmental) cues initiate neurophysiological responses within the larva that leads to the irreversible habitat shift. How external signals actually induce such internal physiological settlement responses remains an open question in essentially all invertebrates. I will present data suggesting that efflux transporters play a key role in this connection between the external and internal signaling processes surrounding settlement in sand dollar and sea urchin larvae (Echinodermata: Echinoidea). Efflux transporters are membrane proteins thought to have a conserved function across kingdoms in removal of xenobiotic (foreign) compounds from cells. I hypothesize that the ancestral role of efflux transport in settlement was protection from a broad range of potentially harmful compounds encountered by settling juveniles in their benthic habitats. Thus, a role for efflux transporters in regulating settlement behavior itself would have been evolutionarily derived. I will discuss the possibility that certain anthropogenic environmental pollutants could disrupt this efflux transport-regulated settlement process, with potentially disastrous consequences for larvae looking for an appropriate site to settle.

Holyoak, A.R. Department of Biology, Brigham Young University – Idaho. DOES AN INTERTIDAL POPULATION OF THE COMPOUND ASCIDIAN TUNICATE POLYCLINUM PLANUM EXHIBIT A PREDICTABLE REPRODUCTIVE CYCLE?

The ascidian Polyclinum planum produces non-fragmenting colonies that are hermaphroditic at the colony (=genet) and zooid (=module) levels, thus allowing for a wide range of possible reproductive patterns. The population-level reproductive pattern of P. planum has not, however, been described. The focus of this study was to test the hypothesis that P. planum exhibits a predictable reproductive cycle. To test that hypothesis I collected P. planum colonies monthly for 2.5 years from the intertidal zone at Hopkins Marine Station, Pacific Grove, CA, and assessed three factors that reflect the reproductive state of each colony (n=94 colonies): 1) maximum oocyte size; 2) the mean number of larvae brooded per zooid; and 3) the percentage of zooids undergoing budding. I used regression analysis to test for effects of increasing and decreasing day length, of seawater temperature, and of colony size on colony reproductive state. I also conducted monthly surveys to look for the appearance of new recruits at field sites. Regression analyses showed that increasing day length, decreasing day length, and water temperature had no significant effect on any of the reproductive factors considered. There was, however, a significant effect of colony size on oocyte size and on the number of larvae brooded per zooid, but not on percentage of zooids budding. Field surveys showed that new recruits appeared every month. Since colony size was the only factor considered that had a significant effect on colony reproductive state, I conclude that reproductive state in P. planum is regulated primarily by internal factors, such as colony size, and only secondarily, if at all, by external factors such as seawater temperature or day length. Those results help explain why P. planum does not display a clear reproductive cycle, and leaves open the question as to factor(s) that regulate reproduction in this species.

Houghton, J.P.*, J. E. Starkes, M.D. Chambers and D. Ormerod. Pentec Environmental, a Division of Hart Crowser, Inc. THE BLIND EATING THE BLIND: ECOLOGY OF KNIK ARM, ALASKA

Knik Arm, Alaska, is a shallow glacial estuary with extreme physical habitats characterized by large tidal ranges, strong currents, massive inputs of glacial and coastal sediment, extreme turbidity, and severe seasonal ice scour. Despite these conditions, beach seining during spring 1983 demonstrated a surprising level of biological activity.
Eighteen species of fish were captured and all had been feeding. The present work was initiated to expand understanding of the broader temporal fish and invertebrate use of nearshore areas in the Arm and the potential contributions of fish populations to the food web supporting Cook Inlet beluga whales. We conducted beach seining at 6 to 10 sites from July through freeze-up in November, 2004 and again from breakup through September 2005. High abundances of invertebrates, especially gammarid amphipods and crangonid and mysid shrimp were found throughout the area. The data present a remarkable picture of prolonged use of the Arm for rearing and growth by juvenile sockeye, coho, and Chinook salmon as well as several typically more northern species such as Bering cisco and saffron cod. Offshore tow net sampling found a similar biota with several invertebrates commonly considered to be benthic or epibenthic found in the surface layer of waters over 30 m deep. Adult salmon, saffron cod and osmerids (longfin smelt and eulachon) are identified as the most probably prey of beluga whales in the Arm at various times of the year. Presence of so much biological activity where turbidities range from 100s to 1,000s of NTU raises questions regarding how fish feed and migrate with few, if any, visual cues.

Hovel, K.A.*1 and C.G. Lowe2. 1San Diego State University, 2California State University Long Beach. SHELTER USE AND MOVEMENT OF SPINY LOBSTERS IN A SOUTHERN CALIFORNIA KELP FOREST

Spiny lobsters typically occupy discrete shelters during the day but move from shelters at night to forage. Studies with Caribbean and Australian spiny lobsters indicate that after leaving shelter at dusk lobsters often make circuitous movements of tens to hundreds of meters and return to the same shelter or to a nearby shelter at dawn. While California spiny lobsters are found in shelter during the day, their patterns of movement and propensity to home to selected shelters are unknown. We used sonic tagging to map the nocturnal movements of twelve spiny lobsters in the Pt. Loma kelp forest of San Diego in the summer of 2005. For each tagged lobster, we tracked movement from shelter from dusk until shortly after dawn with a Vemco VR60 hydrophone and GPS. Each lobster was tracked from one to four nights, and daytime shelter use for a subset of lobsters was recorded on four additional dates. Lobsters moved an average distance of 600 m per night at a rate of 75 m per hour. Lobsters rarely made circuitous movements but instead generally moved from deep water (10-15 m) shelters in the kelp forest to shallow (2 – 3 m) surfgrass beds where they remained for several days. Lobsters often gregariously sheltered in tunnel-like burrows in surfgrass and under large boulders at the edge of the kelp forest. Our preliminary results indicate that California spiny lobster movement behavior may differ from that of other lobster species.

§ Huff, T.M. Scripps Institution of Oceanography. GOT SAND? SAND ADDITION ALTERS THE INVERTEBRATE COMMUNITY OF INTERTIDAL CORALLINE TURF IN SAN DIEGO COUNTY, CALIFORNIA

Southern California rocky intertidal areas are subject to periodic sand inundations due to a natural cycle of sand movement that is being altered and intensified by human activities. Though sand is thought to be a major structuring force in intertidal communities, little experimental research has been done to investigate its effects on intertidal organisms. The effects of sand inundation on assemblages of meio- and macrofauna in intertidal coralline algal turf have received almost no attention. In this study, sand was added daily to coralline turf plots to maintain depths of either 3 cm or 6 cm for one month. Within one hour of sand addition, faunal community composition had changed significantly due to a decrease in the abundances of highly mobile animals. Another shift was seen after two weeks when abundances of psammophilic gastropods increased. One month after sand addition had ceased, communities in treatment plots again resembled those of the controls. This experiment demonstrates that turf communities rapidly respond to and recover from local physical disturbances due to sand inundation. Since these species form a large component of the base of the marine food web, these results could be significant for the whole community.

§ Hughes, A. R.* and J.J. Stachowicz. University of California-Davis. CAUSES AND CONSEQUENCES OF GENETIC DIVERSITY IN EELGRASS (ZOSTERA MARINA)

Ecologists are increasingly realizing that genotypic diversity, like species diversity, can have important consequences for communities and ecosystems. However, little is known about the degree of genetic diversity in key species or the factors that contribute to variation in diversity among populations. We conducted a survey of genotypic diversity in 7 eelgrass (Zostera marina) beds in Bodega Bay and Tomales Bay, CA. We examined the effects of site, tidal height (high intertidal, low intertidal, and subtidal), and position in the bed (edge and interior) on
clonal diversity by genotyping 20 shoots in 12 1m² plots at each site. In addition, we quantified shoot density, flowering shoot density, and epiphyte biomass each summer and winter from July 2001 to July 2003. The position of the plots significantly affected genotypic diversity: interior plots were 1.5 times more diverse than areas on the edge of the beds. Tidal height also influenced eelgrass diversity, although the magnitude and direction of this effect varied across sites. Eelgrass genotypic diversity was not related to summer shoot densities, or to flowering shoot density or epiphyte biomass in either season. Interestingly, there was a positive relationship between eelgrass genotypic diversity and shoot density in the winter, when eelgrass experiences stress from abiotic (e.g., lower light levels) and biotic (e.g., grazing by migratory geese) factors. This natural pattern is consistent with the results of a previous manipulative experiment in which more diverse eelgrass plots were more resistant to disturbance, suggesting that the effects of genotypic diversity on disturbance resistance are sufficiently strong to affect patterns of shoot density in the field despite the presence of many confounding factors.

§ Hughes, B.B.* Moss Landing Marine Laboratories. EFFECTS OF EGREGIA MENZIESII ON A ROCKY INTERTIDAL ALGAL ASSEMBLAGE

This study investigated the effects of *Egregia menziesii*, a large and robust intertidal kelp, on the structure of rocky intertidal algal assemblages in central California. Experimental plots were established in July 2004 at Soberanes Pt in south Monterey County. A randomized block experimental design was used to compare treatments (complete *Egregia* removal) to control plots. Algal composition and percentage coverage were estimated repeatedly in plots for one year using random point contacts. Treatment plots were maintained monthly by removing creeping *Egregia* fronds and recruits. Differences in percentage cover of algal assemblages between treatment and control plots varied greatly during the experiment. Differences were highest during summer months, due to desiccation stress in treatments, and lowest during winter months, due to waves decreasing coverage in both control and treatment plots. After one year (July 2005), significant differences were detected in algal composition and coverage between treatment and control, but not to the extent observed during the previous summer. These data suggest that *Egregia* does impact the intertidal algal assemblages, likely positively through stress amelioration and negatively through physical scouring, but that the effect may be short lived as algae acclimate to the change in environmental conditions.

§ Hultgren, K. * and J.J. Stachowicz. University of California, Davis. CAMOUFLAGE IN THE KELP FOREST: DECORATION AND COLOR CHANGE IN THE FAMILY EPIALTIDAE (KELP CRABS)

Because of intense predation on crustaceans by fish and other predators, selection for behaviors and morphologies that allow crustaceans to occupy suitable habitat while avoiding detection by predators may be strong. Crabs in the family Epialtidae (kelp crabs) appear to use both carapace coloration and decoration to camouflage themselves against predators, but here we demonstrate that the relative effectiveness of these two types of camouflage in reducing predation varies among species. In field surveys, two species (*Pugettia producta* and *Mimulus foliatus*) decorate little, but exhibit considerable variation in carapace coloration that matches the habitat from which they were collected. Lab experiments show that carapace color in these two species is very plastic: when they molt, the color of their new carapace matches the color of the food on which they were raised (red vs. brown algae). In contrast, three other related species (*Pugettia richii*, *Pugettia gracilis*, and *Pugettia dalli*) decorate a larger portion of their body than *Mimulus* and *P. producta*, but exhibit relatively little plasticity in carapace color in laboratory experiments and field surveys. Combined, these findings suggest that closely related crabs differ in their reliance on decoration versus color change as defense against predation. Indeed, in field tethering experiments in the kelp forest where all these species occur, lab-induced carapace color change resulted in reduced predation on *Pugettia producta* but did not affect predation on *Pugettia richii*. However, decoration with algae reduced predation on red (but not amber) *Pugettia richii* in kelp forests. Because of the different timescales required to adopt appropriate camouflage for new habitats for color changing species (~1 month) versus decorating species (~1 hour), camouflage strategy may affect the distribution of different species across habitat types. This may have considerable implications for the spatial distribution of herbivory by these different species.

§ Hunt, L.J.H., Hopkins Marine Station. TEMPERATURES AT A BIOLOGICAL BORDER

Species’ range limits have long fascinated biologists, and with recent concerns about climatic change, knowledge of these borders is particularly in demand. The rocky intertidal zone has provided a convenient system for studying
species’ borders because of the prevalence of well-developed zones worldwide. The long-standing hypothesis that temperature and desiccation stress determine the upper limit of intertidal species’ ranges continues to guide studies in intertidal physiology, and the thermal physiology of these organisms suggests that they may be poised for dramatic changes under a warming climate. Here I report a detailed look at the thermal environment across the strikingly sharp ecotone and concomitant threshold in biodiversity formed by the upper limit of a habitat-creating intertidal macroalga. The elevation of this upper limit varies from site-to-site. However at an individual site, the upper limit has remained unchanged for 3 decades. This long-term stability of the upper limit suggests it is in tight control, and prompts the question: what sets the elevation of this upper limit? Maximum temperatures along a horizontal reference transect explains 80 percent of this site-to-site variation. However knowledge of the thermal environment alone is insufficient to determine whether acute or sustained temperature stress is more likely to be the causal agent. A novel visualization of temperature and duration provides a method for calculating the risk of exceeding critical temperatures for brief and sustained periods. The ramifications of habitat-forming species that regulate temperatures for the entire community within them (ecological homeostasis) will be discussed.


Marine fouling communities within Humboldt Bay, California show dramatic spatial and temporal variation in species composition. This variation appears to be driven by several factors, including winter storms, seasonality, and consumer-mediated effects of chitons. Fouling panels that were followed through 5 years of development showed little hint of reaching a so-called stable state. Nevertheless, the recruitment of chitons onto some (but not all) panels led to a dramatic increase in the availability of free space, which was maintained as long as chitons were present and active. In order to further examine this effect we removed chitons from 5 of 10 experimental panels on which chitons had naturally recruited into these 5-year-old communities. Results showed that on panels with highly active chitons, significantly more free space was maintained. In contrast, the removal of chitons led to a significant decrease in available free space, with much of the area filled in by colonial tunicates. Additional experiments showed that chitons can be relatively inactive and often disappear or disperse from experimental fouling communities, for reasons that are unclear. During these times, new recruits or resident species (particularly fast growing ascidians) almost always fill in free space. In summary, chitons that recruit, feed, and bulldoze within established fouling communities in Humboldt Bay have dramatic consequences on the availability of free space. Factors that affect their activity and longevity thus have important consequences for community structure.

§ Jarvis, E.T.* and C.G. Lowe. Department of Biological Sciences, California State University, Long Beach. THE EFFECTS OF BAROTRAUMA ON CATCH-AND-RELEASE SURVIVORSHIP OF NEARSHORE AND SHELF ROCKFISHES IN SOUTHERN CALIFORNIA

Due to barotrauma injury experienced upon capture, rockfishes have not been considered good candidates for minimum size limits. However, mandated season closures and depth restrictions do exist that require release of incidentally caught rockfishes. Surprisingly, little has been documented regarding the factors affecting rockfish survivorship upon capture and whether these fish can recover and survive if released at depth. Thus far, we have collected 79 rockfish comprising 16 species by hook-and-line at several southern California locations (25 – 96 m) to characterize external and internal angling induced barotrauma and to quantify survivorship upon landing. Common external signs of barotrauma included stomach eversion, exophthalmia (“pop-eye”), ocular gas, and prolapsed cloaca, while common internal signs included minor hemorrhage, organ torsion, and swim bladder rupture. Despite varying degrees of trauma, landing survivorship was high (71%) regardless of capture depth. The majority of fish dead upon landing suffered swim bladder ruptures. Mortalities were dominated by Sebastes serranoides that showed no signs of external barotrauma. Most other species survived, despite some individuals being in poor external condition upon capture and having swim bladder ruptures and organ torsion. Although our preliminary data show no relationship overall between external fish condition and extent of internal trauma and landing survivorship, there were some species-specific trends. Species having very thin, delicate swim bladders (e.g. Sebastes dalli, Sebastes entomelas, Sebastes semicinctus, S. serranoides, Sebastes umbrosus) showed higher prevalence of stomach eversions and/or swim bladder ruptures, and in some cases, high mortality. Sebastes miniatus, in contrast, having a more robust swim bladder, showed higher prevalence of exophthalmia and ocular gas and less mortality. The high landing survivorship
across species from depths < 96m suggests high post-release survivorship may occur following rapid release back to
the depth of capture.

§ Jayewardene, D.* Department of Zoology, University of Hawaii. CHRONIC PREDATION ON CORAL IN
HAWAII

Predation on living coral by barred filefish (*Cantherines dumerilii*) and spotted puffers (*Arothron meleagris*) is
frequent in the main Hawaiian Islands. *C. dumerilii* preys mainly on *Porites lobata* and *Pocillopora meandrina*,
leaving smaller superficial lesions on the coral tissue. *A. meleagris* on the other hand, makes substantial concave
cavitations on the colony skeletons of *Porites lobata* heads and *Porites compressa* fingers. Here I present results
from experiments and surveys determining the intensity of predation and factors influencing this intensity on a range
of reefs on Oahu and Hawaii. I also present coral tissue regeneration rates for lesions made by bites, and
experimentally determined size thresholds above which predation does not kill the coral. Predation is frequent on
Hawaiian reefs and is likely influenced at each site by the relative abundances of coral prey and predators present.
While predation can kill *P. compressa* smaller than 1-2 cm in height, colonies in a healthy community above this
size survive. This is because coral tissue on *P. compressa* starts to regenerate across exposed skeleton within 8 days,
rapidly enough to keep algae from successfully colonizing the open lesions. This process of frequent predation and
tissue recovery may be a chronic energy drain for *P. compressa*, *P. lobata*, and other Hawaiian coral populations.
Furthermore, at sites where the abundances of predators is high (e.g. within boundaries of Marine Protected Areas)
frequent predation may not only slow coral growth, but may also limit the survival of juvenile corals.

§ Jordan, L.K.* University of California, Los Angeles. ECOMORPHOLOGY OF STINGRAY
MECANOSENSORY AND ELECTROSENSORY SYSTEMS (ELASMORBANCHII: BATOIDEA)

Elasmobranch fishes (sharks, skates, and rays) demonstrate remarkable sensory capabilities which are used for a
variety of purposes including locating and capturing prey. This study relates the feeding ecology of stingray species
representing each of the benthic, benthopelagic, and pelagic habitats to the anatomy of their mecanosensory and
electroosensory systems. These systems allow elasmobranchs to locate prey through detecting water movements and
electric fields respectively. Elasmobranchs are widely considered to be opportunistic generalist feeders, though
there are some species exhibiting dietary specialization. Existing literature on the stomach contents of three species,
*Urobatis halleri*, *Myliobatis californica*, *Dasyatis (Pteropleutrygon) violacea*, is compared to species abundance
data from the same locations to identify selective feeding and potentially preferred prey. Morphometric
measurements and detailed maps of the sensory anatomy were constructed and analyzed for each species. *U. halleri*
is a benthic ray feeding primarily on small epifaunal benthic invertebrate prey. The lateral line of this species shows
a high proportion of non-pored ventral canals while the electrosensory pores are concentrated ventrally around the
mouth. *M. californica* is a benthopelagic ray, capable of utilizing both the benthic and pelagic environment, and
feeds primarily on deeply buried infaunal benthic invertebrates as well as some more mobile invertebrates and
fishes. The lateral line system is highly branched with a large number of pores per branch which may help it locate
water jets from the siphons of buried prey. *D. violacea* is a pelagic ray typically caught in the upper 100m in coastal
waters. *D. violacea* feeds on highly mobile fishes and invertebrates, primarily squid. The lateral line branching and
ratio of pored to non-pored canals is intermediate in this species. Relationships between the ecology of these
species, including their habitat and prey, and sensory morphology are explored.

Kaplan, I.C.*1, Harvey, C.J.1, Brand, E.J.1, Fulton, E.A.2, Smith, A.D.M.2, and P.S. Levin1. 1 NOAA Fisheries
Northwest Fisheries Science Center, 2 CSIRO Division of Marine Research. AN ECOSYSTEM MODEL FOR THE
CALIFORNIA CURRENT

Fisheries managers off the west coast of the US increasingly must balance tradeoffs between competing species and
competing fisheries. They also must build management plans that respond to the dynamic oceanography and
productivity of the region. New management tools, such as spatial closures or climate-triggered fishing policies
could help address some of these issues, but a modeling framework is needed against which to test such potential
policies. To address this need, we built an ecosystem model of the California Current System, extending from the
US/Canada Border to Point Conception, California, and out to the 1200 m isobath. The model structure (Atlantis)
includes the trophic dynamics of 62 functional groups in the food web, using nitrogen as a common currency
between groups. Functional groups include habitat-forming species like kelp, corals and sponges, as well as
phytoplankton, zooplankton, vertebrates, invertebrates, and detritus. The model is divided into 62 spatial zones, each with seven depth layers. This allows us to explicitly test hypotheses regarding migrations, movement, and spatial management options such as marine protected areas. The model is forced with hydrodynamic flows, salinity, and temperature outputs from a high-resolution ROMS oceanographic model, allowing us to test the impacts that climate-driven changes in upwelling or coastal currents have on nutrients and primary productivity. Separate sub-modules simulate the dynamics of fishing fleets, as well as fisheries data collection, assessment, and management decisions. Model outputs reproduce observed seasonal patterns of primary productivity. The model also provides estimates of the unfished abundance of harvested stocks.

§ Kertész*1, J.S., K.E. Boyer1, J.F. Bruno2, and Z.T. Long2 1San Francisco State University, 2University of North Carolina at Chapel Hill. THE EFFECTS OF RESOURCE AVAILABILITY ON THE RELATIONSHIP BETWEEN MACROALGAL DIVERSITY AND PRODUCTIVITY

Recent research in North Carolina benthic marine habitats has found a significant but subtle effect of algal species richness on primary production; however the role of resource (e.g., nutrients, light) availability has not been explored. We examined the effects of elevated nutrients (N and P) on the relationship between algal diversity and productivity in two mesocosm experiments. We measured the change in biomass of macroalgae as a proxy for algal productivity, and included monocultures and a diverse mixture of algal species. Results from the experiment conducted in 2004 did not indicate a diversity effect under ambient nutrient conditions; we found no difference between the growth of the average monoculture and the growth of the mixture. Similarly, the nutrient-enriched mixture did not exceed growth of the average enriched monoculture. We did detect diversity effects in the mesocosm experiment conducted in 2005. Growth of the mixture exceeded growth of the average monoculture under ambient and nutrient enriched conditions. Identity effects were apparent in both experiments; with added nutrients, some species grew while others declined in biomass. Such effects on relative abundance have implications for habitat structure and food web support. We also used the tripartite partitioning method to analyze data from both experiments. In 2004, addition of nutrients increased the trait-independent complementarity as well as trait-dependent complementarity, and decreased the dominance effect. We observed the opposite effect in 2005; nutrient enrichment decreased both types of complementarity and increased dominance. In both experiments overall productivity in mixtures was unchanged with the addition of nutrients. These results suggest that a diverse assemblage of macroalgae provides "insurance" that whole community productivity is maintained under conditions of variable resource availability.

§ Kimbro, D. L.*1, E. D. Grosholz1, and N. Travis2. 1University of California at Davis, 2Brown University. THE DISTRIBUTION OF NATIVE AND NON-NATIVE DRILLS AND ITS EFFECT ON NATIVE OYSTER COMMUNITIES IN TOMALES BAY, CA.

Understanding the factors controlling the distribution of non-native species and the community-level consequences of further invasion are key goals in ecology. We tested abiotic (salinity) and biotic (prey distribution and predation) factors that potentially contribute to a gradient of native and non-native oyster drills in Tomales Bay, CA. The non-native Atlantic oyster drill (Urosalpinx cinera) occurs exclusively in the inner bay and the native drill (Acanthina spirata) occurs from the end of the Urosalpinx distribution in the inner bay through the middle and outer bay. Experiments testing tolerance to low salinities comparable to those during winter runoff events yielded no evidence of differences in physiological tolerance, nor did drill distributions correlate with the distribution of their prey (i.e., barnacles, mussels, and oysters). In contrast, field and laboratory evidence indicates that the distribution and prey preferences of native shore crabs (Cancer antennarius) and non-native European green crabs (Carcinus maenas) may be maintaining this gradient in drill distribution. The distribution of drills, in turn, has important consequences for the sessile invertebrates in this system. The non-native drill (U. cinera) eats oysters (Ostreola conchaphila), barnacles, and mussels, while the native drill (A. spirata) primarily consumes barnacles and mussels. Consequently, sites with non-native drills have more dead oysters than sites without non-native drills. Because oysters act as a foundation species in this system, variation in oyster mortality across the estuary could have important implications for the intertidal community. Our results highlight that feeding preferences of higher level native and non-native predators can maintain a strong distributional gradient of intermediate level predators, with important implications for estuarine communities.
Much recent ecological research has focused on generalizing results from small-scale observations to predict large-scale patterns of distribution and abundance. In coastal ecosystems, nearshore physical processes such as upwelling, circulation, sediment transport, and wave propagation interact with topographic features of the coastline at a range of spatial and temporal scales. These physical processes, in turn, exert a strong influence on the structure of nearshore biological communities. A predictive approach to large-scale coastal ecology requires a quantitative description of biophysical coupling over a continuous range of scales from tens to thousands of kilometers. Here, we introduce a new approach for examining the strength and scale of coupling between biological patterns and coastline topography, and apply this method to develop a quantitative model of spatial variation in intertidal community structure in three eastern boundary current ecosystems: western North America, Chile, and South Africa. Using data from intertidal field surveys conducted over multiple years with similar methods on three continents, we found significant relationships between topographic features and community structure at several distinct spatial scales. When combined in a multi-scale model, simple indices of coastline morphology explained up to 80% of the variance in intertidal diversity and abundance of functional groups. Moreover, the distinct spatial scales of coupling could be traced to distinct physical mechanisms (e.g., upwelling vs. wave exposure), via a combination of theoretical and numerical models and remote-sensing data. The degree of predictability (maximum percentage of variance explained by topography) varied among continents and regions within continents. Preliminary evidence suggests that predictive power is maximized when the length-scales of coastal features closely match the characteristic scales of nearshore physical processes. Thus, the geological history of coastal regions may interact with dominant physical forcing processes to determine the predictability of ecological patterns at large scales.

Comparing population densities in restored and reference marshes, with replication, can suggest major impacts hypothesized for various species, such as predators depleting their food abundance. Fish and macroscopic invertebrate food populations, and hypothetically limiting physical factors, were monitored non-destructively at historical (reference) marshes and nearby marsh restorations on low-salinity shores of the outer California Delta. Wildlands, Inc. (habitat mitigation banking) thoroughly restored the most recent marsh with extensive tidal creeks and planted vegetation in 2002. Catch-record-and-release sampling methods, day and night, included fyke nets, small trawls, seines, and traps, supplemented with portable scanning fish-finders (sonar) and wide-angle underwater video. Nets included air spaces to prevent risks to any air-breathing animals trapped inadvertently. Physical factors sampling throughout the year ranged 10 - 22 degrees C water temperature, 0.2 - 2 ppt salinity, and 40 ~ 70 cm secchi depth (clarity) with the ~2-m deepest water virtually always saturated with oxygen, thus far. Macroinvertebrate and fish population densities were very low at nearby historical marshes. At the 2002 restoration, macroinvertebrate densities were seasonal, reaching over 1 large crayfish / 2 m2 during summer, with moderate densities of smaller invertebrates. Larger fishes, often native species, were common there during summer, exceeding 1 large native fish / 25 m2 during summer. Overall, fish and invertebrate population densities were positively correlated among numerous sites, averaged through time. Additional observations showed unusually abundant air-breathing animals at certain marshes with abundant fishes. Those air-breathing species included frogs, turtles, muskrat, beaver, and possibly important predators on certain marsh fishes, such as certain birds and river otter. Abundant predators were not associated spatially with low prey abundance. Temporal comparisons will continue. Even when animal densities varied widely from season to season, it appears that certain restored marshes yield far higher abundances of virtually ALL animals, compared with other marshes.

Recovery and recolonization of hard-bottom macroalgal communities vary temporally and spatially because of multiple biotic and abiotic factors. This study examined the relative importance of grazing to recolonization rates of sessile organisms in a high latitude environment, the Boulder Patch in the Beaufort Sea. A simple manipulative experiment using cleared boulders and cages was used to test the hypothesis that grazing causes slow recovery of
sessile macrophytic and macrofaunal communities. Monitoring cleared boulders (caged and uncaged) for three years resulted in no growth of any sessile organism for the first two years. In the third year, new invertebrate and coralline growth was seen on 79% of the cleared boulders, with significantly more growth on caged boulders. Uncleared control rocks showed no significant temporal variation. Concurrent surveys and observations suggested that in this arctic community 1) there were two conspicuous types of macrograzers on rocks, chitons and seastars, 2) space was limiting, 3) the dominant alga, *Laminaria solidungula* was reproductive during the study period. This study strongly suggests that any perturbations causing scouring of hard substrate in the Beaufort Sea will result in very slow community recovery.

§ Kordas, R.L.* and S.R. Dudgeon. California State University Northridge. LATITUDINAL VARIATION IN INTERACTIONS BETWEEN ROCKWEEDS AND BARNACLES IN THE GULF OF MAINE

Along moderately exposed and sheltered rocky shores of New England, barnacles and fucoid algae are the most conspicuous species inhabiting the mid intertidal zone. Reciprocal facilitation between species is thought to be a factor that enhances the abundances of barnacles and fucoids. Adult *Ascophyllum nodosum* are found in increasing abundance from south to north in the Gulf of Maine; however the pattern for germlings is the opposite. We hypothesized that this is due to a switch in the barnacle-*A. nodosum* germling relationship from facilitative in southern populations, where barnacles settle earlier and provide a refuge from grazing and desiccation, to competitive in northern populations, where later settling barnacles smother germlings following metamorphosis. We tested these hypotheses by following the survivorship of *A. nodosum* germlings seeded onto epoxy tiles with and without barnacles and outplanted to 12 sites throughout the Gulf of Maine to estimate the per capita effects of established and arriving barnacles, respectively. In contrast to our hypotheses, we found no evidence for barnacles facilitating recruitment of *A. nodosum* germlings in southern populations. In fact, survivorship of germlings in southern populations was negatively associated with the presence of established barnacles within one month of outplanting. This is likely due to two mechanisms. First, established barnacles overgrow, or dislodge, germlings as they expand radially. Second, when the predatory gastropod *Nucella lapillus* consumes barnacles, it indirectly kills germlings growing on, or adjacent to, barnacle tests. We observed regional differences in the interaction between established barnacles and *A. nodosum* germlings and changes in the interaction within a region over time. Facilitation of *A. nodosum* germlings by established barnacles is infrequent in space and time. Finally, competition between established germlings and arriving barnacles in all regions appears weak and inconsistent.

§ Krueger*, S.A. and S.R. Dudgeon. California State University Northridge. REGULATION OF GROWTH AND DEVELOPMENT VIA GASTROVASCULAR TRANSPORT IN A COLONIAL HYDROZOAN

Morphological plasticity enables adaptive responses by sessile species to variable environments. In hydrozoans, evidence implicates the dynamics of gastrovascular fluid transport as the locus regulating colony growth and morphogenesis. If so, then the timing of growth should reflect the temporal pattern of flow. We tested the hypothesis that rates of mitosis of stolon tissue are positively correlated with the onset of maximal rates of fluid transport using surgically constructed single polyp-stolon systems. Polyp-stolon systems were assayed every 2 hours over the course of 30 hours following feeding to estimate rates of transport through the lumen and mitosis of cells in the stolon. Mitotic rates of stolon cells were positively associated with flow rates for the first 18 hours following ingestion, and remained high as flow rates declined thereafter. Mitotic rates per unit area were similar between regions proximal to the polyp and regions near the stolon tip. We tested whether shear stress on cells lining the stolon wall in the gastrovascular system determines cell fate by measuring rates of polyp relative to stolon production in response to manipulation of seawater viscosity. Polyp production per unit length of stolon increased with seawater viscosity up to 2.35 cp with no apparent reduction in rates of transport implying that shear stress is used as a signal to cells lining the lumen to differentiate into polyp tissue. If shear stress regulates growth and morphogenesis of the vasculature of colonial hydrozoans as it is known to do in vertebrates, then it suggests that the signaling mechanisms that regulate vascular development evolved early and have been conserved in metazoan evolution.

Understanding the identity, abundance and origin of larvae is critical to supply-side ecology and conservation efforts. However, most invertebrate larvae are difficult to identify morphologically due to small size and lack of diagnostic characters. A 3-step molecular strategy will be presented to identify larvae to species level and quantify their abundance in coastal waters, requiring no a priori knowledge of species composition. (1) Sequence 1-2 mitochondrial markers from common larvae of barnacles, gastropods, bivalves and polychaetes, and compare them to the NCBI database. Based on intraspecific variation in COI and 16S genes, larvae are assigned to a species or genus, while generating reference sequences for unidentified larvae. All barnacle nauplii were correctly identified; common snail veligers included *Bulla gouldiana*, *Hamiinoa vesicula*, *Crepipatella lingulata*, and *Crepidula cf. onyx*, and morphological traits were documented for larvae of each species. (2) Fill gaps in the database by sequencing local species not represented in GenBank; this allows genus-level matches to be assigned to the correct species, while adding to DNA bar-coding efforts. (3) Design species-specific primers for 6-12 common species in each taxonomic group, allowing cheap and rapid screening of plankton samples by multiplex PCR. Primers for six barnacle and 10 gastropod species are being tested. Larval abundance of *Balanus glandula*, *Cthamalus fissus* and *C. dalli* varied between field sites and at small and large temporal scales; this method can thus provide information on supply-side ecology of multiple species simultaneously. The most abundant pediveliger and trochophore in Newport Bay were the invasive mussel *Musculista senhousia* and the introduced polychaete *Marphysa sanguinea*, demonstrating the utility of DNA-based methods for identifying and tracking propagules of invasive species. By assessing links between larval supply and recruitment, and distinguishing larvae of native versus invasive invertebrates, such methods should be widely useful to basic ecology and management efforts alike.

§ Kusic, K. E.,* P. T. Raimondi, H. A. Livingston, D. P. Lohse, and R. N. Gaddam. University of California, Santa Cruz. POINT REYES, AN IMPORTANT GEOGRAPHIC FEATURE, SHAPING ROCKY INTERTIDAL COMMUNITY STRUCTURE IN CENTRAL CALIFORNIA

Along the temperate Pacific coast of North America, rocky intertidal communities vary with respect to species composition and abundance to create distinct biogeographic groups. These biogeographic groups are highly correlated with oceanographic currents and geographic features along the coast (i.e. Point Conception and the California Current). The Coastal Biodiversity Surveys were established in 2001 to examine biogeographic patterns of intertidal species from South East Alaska to Baja California, Mexico. These surveys were established to compliment both the Partnership for the Interdisciplinary Study of Coastal Oceans (PISCO) monitoring program and the Multi-Agency Rocky Intertidal Monitoring Network (MARINe). A combination of point contacts along transects, sampling within quadrats, and band transects are used to determine abundances of algae and sessile invertebrates, mobile invertebrates, and *Pisaster ochraceous* respectively. These data are further linked to the elevation of the substrate in relation to tide levels to elucidate species vertical distribution. This study combines extraordinary precision at the local scale across an expansive spatial scale to create an unprecedented data set for an investigation of patterns of community structure. Preliminary results of this study show three major biogeographic groups along the Pacific coast, distinguished from one another by their intertidal communities. Within each of these groups, smaller regions of similarity are found. Species richness and abundance vary north and south of Point Reyes to varying degrees dependent upon scale. Point Reyes appears to be an important geographic feature in shaping intertidal communities along the coast of Central California.

§ Larson, Amy*1 and John J. Stachowicz2, 1San Diego State University & University of California-Davis, Bodega Marine Laboratory 2University of California-Davis. IMPACTS OF THE CHEMICALLY DEFENDED PHORONOPSIS VIRIDIS ON THE INFANAL COMMUNITY OF AN INTERTIDAL MUDFLAT

Soft-sediment communities are often structured by habitat- burrow- or tube-building organisms that alter sediment conditions and may provide refuge for smaller infauna. However, it is not always clear how these organisms attain sufficiently high densities to exert such engineering effects. The phoronid, *Phoronopsis viridis*, produces long agglutinated sand grain tubes that create substantial subsurface structure and occur in dense aggregations that cover large areas of the tidal flats. Our previous work in Bodega Bay showed that they persist at high densities in part because they are chemically defended from co-occurring predators. In this study, we assess community level consequences of having very high densities of a chemically defended organism through a combination of field surveys and field and laboratory experiments. Naturally occurring areas with phoronids have a much higher infaunal abundance and greater species richness than adjacent areas without phoronids. Transplants of phoronids and of structural mimics demonstrated that some taxa respond positively to the presence of phoronids and mimics in
comparison to bare plots suggesting that the presence of non-edible structure can positively impact selected species over short time periods (10 months). To determine whether these effects were due to phoronids providing a refuge from predators, we conducted a foraging experiment in the laboratory where shore crabs foraged in paired habitat types (phoronids, mimics, bare). Our results indicate that phoronids are offering a structurally mediated refuge against predation, as live phoronids and mimics reduced predation on clams relative to bare sediment controls. The role of chemistry appears mainly to be to allow the habitat forming species to persist and avoid predation itself. Although soft-sediment communities may have few chemically defended species, the high densities obtained by chemically defended phoronids and their effects on the surrounding infaunal community, suggest that chemical defenses do play an important role in these communities.

§ Lee, S.C.* and J.F. Bruno. University of North Carolina at Chapel Hill. PROPAGULE SUPPLY DRIVES COMPOSITION AND DIVERSITY OF MOBILE EPIFAUNA COMMUNITIES

Regional-scale processes such as extinction and speciation can control species diversity at the local level by regulating the abundance and composition of arriving propagules. Conversely, diversity may also be constrained by local scale processes such as biotic interactions. Here we test the effects of the magnitude of propagule supply on diversity and community composition in a mobile epifauna system. Experiments were conducted in flow-through mesocosms in which natural immigration was experimentally augmented with samples from the regional species pool of mobile epifauna (primarily amphipods and isopods). The experiment included a control and four levels of propagule addition. After 2-3 generations, propagule additions significantly increased species richness and Shannon-Weiner diversity, suggesting that propagule limitation controls community structure. Community composition varied significantly with propagule supply and post-hoc comparisons revealed the greatest differences in composition occurred between treatments with the greatest differences in supply. Primary production (measured as standing algal biomass) significantly decreased with increasing supply of epifaunal grazers while total abundance of individuals did not vary significantly among treatments. Thus, supply effects on primary production may reflect greater use of resources by more diverse epifauna communities in high supply treatments. These results suggest that propagule limitation structures this epifaunal assemblage, reinforcing correlative demonstrations of regional control of local diversity in other marine benthic communities.


Banana slugs (genus Ariolimax) are giant terrestrial slugs with multiple species in central California. In the most recent taxonomic treatment (1948), H. Pilšbry divided the genus into two subgenera, Ariolimax and Meadarion, based on genital morphology. Three allopatric described taxa on the San Francisco Peninsula, A. dolichophallus, A. californicus californicus and A. californicus brachyphallus were included in Meadarion. Recent molecular analysis using three mitochondrial DNA markers, CO1, 16S rRNA and cyt B, confirms the monophyly of the Meadarion clade. Both molecular and morphological data support inclusion of a fourth, unidentified, clade from Fremont Peak, that is the sister to the other three. Although considered by Pilšbry to be endemic to San Francisco, we found additional populations of A. brachyphallus in Hillsborough, Pacific Grove, and Cambria, CA. A. californicus and A. dolichophallus differ strongly in copulation pattern, egg size, and growth rate, but share the traits of a very long apical penis, courtship involving 2 h of Biting and Head-Swinging, apophallation, and transparent hatchlings. A. brachyphallus has a much shorter apical penis, and there is no evidence for apophallation. Data from the Cambria population show a) hatchlings are dark in color, b) eggs average .26 g (similar to A. californicus), and c) growth rate is slow (similar to A. dolichophallus). A. brachyphallus (Hillsborough and Cambria populations) shares the 2h Biting and Headswimming behavior with the two other clades and has bouts of brief, unilateral copulations between partners, very similar to A. californicus. However, in Cambria and San Francisco populations, a penial stroking behavior was seen during courtship that has never been observed in (>100) observations of copulation in the other two species.

§ Lester, S.E.* and S.D. Gaines. University of California, Santa Barbara. GEOGRAPHIC PATTERNS OF REPRODUCTIVE OUTPUT IN INTERTIDAL INVERTEBRATES: BAJA TO CAPE TOWN
The amount of energy an individual allocates to reproduction versus growth, maintenance, or survival is an important life history attribute. It provides a measure of individual performance and when averaged across individuals, suggests the relative contribution of individual populations to the persistence of the species. Furthermore, how reproductive output varies over a species’ range and what factors influence its geographic variation could provide insight into the determinants of species’ distributions and range limits. However, allocation to reproduction is rarely addressed from a biogeographic perspective and thus we lack rigorous predictions about how reproduction should vary across a species’ range. Nearshore marine species are an ideal study system for this question, because their ranges can be described as one-dimensional, along-coast transects, greatly facilitating data collection across all or most of the range. To assess geographic patterns of reproductive output, we measure allocation to reproduction in a suite of intertidal invertebrate species. For the purple sea urchin (*Strongylocentrotus purpuratus*) across the southern region of its range from central California to Baja California, Mexico, there is considerable site-to-site variation in reproductive output, with no evidence of declining reproduction towards the southern range boundary. We explore potential mechanisms driving these meso-scale dynamics. We also measure allocation to reproduction in several intertidal species of barnacles (*Octomeris angulosa* and *Tetraclita serrata*) and limpets (*Scutellastra longicosta*, *S. granularis*, and *Cymbula granatina*) along the entire coast of South Africa. In contrast to the purple urchin, barnacles in South Africa show large-scale biogeographic trends in reproductive output. Furthermore, preliminary data indicates that not all species follow the same pattern. This type of large-scale, multi-species study provides valuable insight into how individuals of different species are performing across their geographic range, with implications for issues such as marine reserve design and predicting the effects of climate change on species’ distributions.

**Lewis, L.**, J. A. Hobbs; and W. A. Bennett. UC Davis Bodega Marine Laboratory, San Diego State University. **ASSESSING THE UTILITY OF OTOLITHS TO INFER AGE, GROWTH AND HEALTH OF A LITTORAL SALT MARSH FISH, *GILLICHTHYS MIRABILIS***

The use of individual species as indicators of biological integrity is a common tool used to evaluate the health of ecosystems. *Gillichthys mirabilis* (the longjaw mudscker) is a large littoral goby that lives in salt marshes and has been used as a model organism for studying fish physiology as well as sublethal anthropogenic effects on salt marsh ecosystems. When assessing fish health, it is common to use growth rate and age-structure as measures of individual and population health; however, little is known about the natural variation of these measures in *G. mirabilis* populations. In this study, we evaluated the efficacy of using saccular otoliths to describe demographics and growth patterns of adult *G. mirabilis* from three regions in California (San Francisco Bay, Tomales Bay and a Santa Barbara lagoon). In outplanted specimens, otolith growth poorly reflected somatic growth. Daily ring counts averaged 10% fewer than the number of days elapsed. In wild-caught fish, annual ages were also quantified revealing age structures of the three regions and a maximum age for *G. mirabilis* of 5-7 years; however, multiple-year recaptures are needed to evaluate the accuracy of our ageing techniques. In addition, daily ageing of wild-caught young fish (age < 1 y) revealed nearly year-round recruitment in San Francisco Bay. Finally, otolith asymmetry and irregularity (e.g. vaterite) were analyzed and are discussed in terms of fish health. We suggest that otoliths can be useful for studying the condition of *G. mirabilis* populations; however, validations of annuli and early life stages and the relationship between otolith measures and fitness have yet to be completed.

**§ Logan, C.A.**, Gracey, A.Y., and Somero, G.N. Hopkins Marine Station, Stanford University. **USING A HETEROLOGOUS MICROARRAY APPROACH TO ANALYZE DIFFERENCES IN GENE EXPRESSION IN RESPONSE TO HEAT SHOCK IN CONGENERIC MARINE TURBAN SNAILS (GENUS TEGULA)**

cDNA microarray technology is a powerful means of analyzing an organism’s response to environmental stress and thus is a potentially important new tool for ecological physiology. Until recently, however, microarrays have been primarily constructed and utilized to study gene expression in model species of biomedical interest. Here, using one of the few microarrays developed for a marine animal, the ribbed mussel *Mytilus californianus*, we examined changes in gene expression in response to heat shock in congeneric marine snails, *Tegula funebralis* and *T. brunnea*, adapted to different temperatures. This study reveals differential gene expression in the heat shock response between two *Tegula* congeners and, importantly, validates using a cDNA microarray developed in one species to probe gene expression in another group of species, which has undergone approximately 575 years of evolutionary divergence.

**Lonhart, S.I.** and M. H. Carr. Monterey Bay National Marine Sanctuary, University of California Santa Cruz. **SUBTIDAL MARINE RESOURCE SURVEYS ALONG THE BIG SUR COASTLINE**
Acoustic telemetry monitoring was used to quantify site fidelity and emigration of economically important fishes tagged at offshore petroleum platforms off the coast of southern California. Fifteen species of fishes were caught on hook & line and brought to the surface where they were fitted with coded acoustic transmitters at three petroleum platforms in the east Santa Barbara Channel ranging from 63-225 m in depth. The numbers of fish detected at the platforms decreased over time, with the most rapid decrease occurring within the first week after catch & release. This initial decrease in detections of fish is most likely attributed to mortality. Vermilion rockfish (*Sebastes miniatus*, 25-33 cm SL) comprised 60% of all fish tagged at all platforms, but only 56% of those fish were detected at their site of capture after 4 months at liberty, whereas other species (*Cabezon – Scorpaeinichthys marmoratus*, Copper – *Sebastes caurinus* and greenspotted rockfish – *Sebastes chlorostictus*) have shown stronger fidelity (avg. 87%) to initial tagging locations. Five vermilion rockfish were found to move from a shallow platform (63 m) to a deeper platform (89 m) 5 km away. Despite the high incidence of barotrauma, acoustic monitoring techniques have so far been effective for assessing short-term, post-release survivorship and platform site fidelity. Qualitative and quantitative data were collected in the intertidal and adjacent subtidal to depths of 20 m. Qualitative data collection included species presence and an estimation of relative abundance at 21 subtidal sites. Quantitative data were collected at 16 subtidal sites using protocols developed by the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO). Preliminary results indicate that while species composition is relatively similar across sites, there is spatial variation in abundance, which may be correlated to local geology, wave exposure, slope, and turbidity/burial/scour as a result of recent landslide activity or proximity to creeks. Survey results will be placed into multiple data layers in a Geographic Information System (GIS) and used to create maps for resource managers at the MBNMS and CalTrans. These data will be publicly available in 2006 at the Sanctuary Integrated Monitoring Network (SIMoN) website: www.mbnms-simon.org.

Lowe, C.G.1, E. Jarvis1, K. Anthony1, L. Bellquist1, B. Hight1, M. McCrea2, M. Love2, and A. Scarborough-Bull1. 1California State University Long Beach, 2Univ. of California Santa Barbara, 3Minerals Management Service. SITE FIDELITY AND EMIGRATION OF FISHES TAGGED AT OFFSHORE PETROLEUM PLATFORMS OFF SOUTHERN CALIFORNIA

A number of mechanisms have been offered to explain the diversity of species found on coral reefs. One hypothesis, the intermediate disturbance hypothesis (IDH), proposes that disturbance is a key process structuring coral assemblages. The IDH suggests that high coral species richness at intermediate levels of disturbance is maintained in a nonequilibrium state which reflects an unstable balance between disturbance and interspecific competitive displacement. Empirical studies of the predictions of, and mechanisms proposed by, the IDH have yielded equivocal results. The present study utilizes a unique system to test these predictions and mechanisms. Wave action on a hydrodynamically-exposed coral reef platform is greatest at the reef crest. The force generated by this wave action rapidly attenuates as waves travel over the reef, creating a continuous gradient of hydrodynamically-induced physical disturbance. Throughout the Indo-Pacific, a competitively dominant coral species is also found in this habitat (*Acropora hyacinthus*). This competitor’s delicate tabular growth form renders it particularly vulnerable to hydrodynamic force. The present study empirically tests the predictions set forth by the IDH by using this system as a means of assessing the effect(s) of disturbance on coral assemblage diversity. Indeed, our results demonstrate that the highest level of coral assemblage diversity is found at an intermediate region of this gradient. To test the specific mechanism(s) driving this pattern, we examined the relative abundance, size structure and proportion cover of both the competitive dominant (*Acropora hyacinthus*) and the remaining species in the scleractinian coral assemblage.
Taken together, our results provide strong evidence that intermediate levels of disturbance promote diversity on a coral reef platform and that this coexistence is mediated by a mechanical-competitive trade-off.

§ Maheigan, Mairead* and Edmunds, Peter. California State University Northridge. VARIATION IN MORPHOLOGICAL TRAITS OF THE COMMON PACIFIC CORAL POCILLOPORA VERRUCOSA AT DIFFERENT SPATIAL SCALES

In recent years it has become evident that biological processes must be analyzed at multiple spatial scales in order understand how results might change with the scale of investigation. Phenotypic plasticity in scleractinian corals has been widely studied, however the degree to which it exhibits spatial scale dependency has not been explored. By investigating morphological variation at several spatial scales, we can gain insight into the mechanistic bases of the patterns observed. The primary question addressed in this study was whether the magnitude of variation in coral morphology is consistent among traits and spatial scales? We quantified morphological traits (from corallum to corallite dimensions) in 160 colonies of a common Pacific coral, *Pocillopora verrucosa*, at four spatial scales, from meters to kilometers, around the island of Moorea, French Polynesia. Principal components (PC) analysis was used to collapse the multivariate data and ascertain the traits that contributed most to variation in colony morphology. PC’s were then tested in a nested ANOVA to determine what spatial scales were the sources of significant variation. Our findings show that 45% of the variation in morphology can be explained by 2 PC’s, which are influenced primarily by corallum traits (PC 1, 26% variation) and verrucae and corallite traits (PC 2, 19%). For corallum dimensions (PC 1), an intermediate spatial scale (100’s of meters) was a significant source of morphological variation, while for verrucae and corallite traits (PC 2), a smaller scale (10’s of meters) was a significant source of variation. This study provides the first evidence that the magnitude and range of morphological variation is not consistent among skeletal traits and spatial scales for *Pocillopora verrucosa*.

Manier, M.K.* and S.R. Palumbi. Hopkins Marine Station, Stanford University. ADAPTIVE DIVERGENCE OF SPERM MORPHOLOGY IN THE GREEN SEA URCHIN, STRONGYLOCENTROTUS DROEBACHIENSIS

Understanding the evolutionary, ecological and genetic basis for adaptive divergence is central to questions of how species evolve. In many cases, local differentiation results from habitat-specific interactions between an organism and its environment, interactions which are controlled by and have repercussions on its evolutionary trajectory. Ongoing research on the evolution of sperm morphology is presented as a case study demonstrating our approach to understanding adaptive divergence from phenotype to genotype and back. Sperm morphology is a trait that can evolve quickly, producing highly variable sperm types among closely related species or even within a single species. Sperm morphology also has direct consequences on reproduction and fitness and has been implicated in speciation. Populations of the green sea urchin (*Strongylocentrotus droebachiensis*) from the northern Pacific exhibit a derived sperm morphology relative to their counterparts in the east and west Atlantic. I discuss our approach to determining the functional significance and genetic basis for these differences and present preliminary results.

§ Manzur* T. and S.A. Navarrete. Estación Costera de Investigaciones Marinas & Center for Advanced Studies in Ecology and Biodiversity, Pontificia Universidad Católica de Chile. FORAGING ECOLOGY OF THE SOUTH AMERICAN SUN-STAR: EFFECTS OF PREY ON PREDATOR POPULATION

The South American sun-star, *Heliaster helianthus*, is the most conspicuous rocky intertidal seastar in Chile. Like other predatory seastars, it is capable of controlling the abundance of prey, playing an important role in the organization of the entire community. Previous studies have shown that variation in prey recruitment over small spatial scales can alter the relative importance of predator species as well as the overall importance of predation in regulating communities. However, little is known about larger scale variation in prey productivity on predator populations. Here, we surveyed diet, density, and size structure of *Heliaster* at the intertidal zone of sixteen sites spanning 900 km of coastline. Using long-term information on recruitment and abundance the main prey species, we assessed the potential effects of prey productivity on the population of this keystone species. Across the entire region, the main prey was the competitively dominant mussel *Perumytilus purpuratus*, followed by barnacles and limpets. Increased consumption of mussels was observed at sites of high prey abundance (cover), but contrary to expectations, higher mussel consumption was associated to higher dietary diversity. Negative correlations were observed between mussel cover and predator density, while prey productivity was positively correlated with mean predator size and weight.

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However, prey productivity was not correlated with predator density or total predator biomass at the site. Together these results suggest that seastars control local abundance of mussel prey across the region, that variation in prey productivity affect individual predator characteristics (diet, size, weight), but the number of predators at the site is controlled by other factors, such as predator recruitment rates.

§ Martone, P.T.* and M.W. Denny. Hopkins Marine Station, Stanford University. BREAKING WAVES MAY LIMIT THE SIZE OF THE ARTICULATED CORALLINE CALLIARTHRON

The rocky intertidal zone along the Pacific coast is home to a wide diversity of organisms, from sea stars to seaweeds, which rarely grow as large as their subtidal counterparts. Researchers have hypothesized that the severe water velocities generated by crashing waves may constrain the size of intertidal organisms by dislodging or breaking organisms that exceed some critical size. However, previous attempts to demonstrate that water velocities limit the size of intertidal organisms have been problematic. One common source of difficulty has been approximating intertidal water velocities in the lab. In the past, slow-speed (0.5 to 3.5 m/s) water flumes have been used to measure drag forces on organisms and to calibrate velocity meters, and these data have been used to make predictions about intertidal water velocities (10 to 30 m/s). Extrapolations of this magnitude can be unreliable. We have developed a high-speed water flume that uses gravitational acceleration to generate water velocities up to 11 m/s. For the first time, we are able to measure drag force on organisms at environmentally relevant velocities and reduce the need to extrapolate. Here we present data on the articulated coralline Calliarthron, which thrives in stressful wave-exposed habitats. We demonstrate that, at fast water velocities, drag force on Calliarthron fronds increases in proportion to surface area. This suggests that, as they grow, fronds become increasingly prone to breaking. We combine break force and drag force measurements to predict the water velocities necessary to break fronds of given sizes. Our model successfully correlates water velocity measurements and maximum frond size in the field, suggesting that hydrodynamic forces may, indeed, limit the size of intertidal fronds.

§ Masill, K.J.*, W.P. Ritchie, H.J. Desmarais, and E.V. Thuesen. The Evergreen State College. ZOOPLANKTON COMMUNITY STRUCTURE IN SOUTHERN HOOD CANAL IN AREAS OF LOW DISSOLVED OXYGEN

Zooplankton are important components of estuarine food webs, but zooplankton communities have been poorly studied in Puget Sound. This study examined zooplankton community structure over spring, summer and early fall in 2005 at two stations in southern Hood Canal, Washington. Hood Canal is a temperate fjord with a midwater hypoxic zone. The depth of environmentally significant hypoxia (25% saturation) decreased from 45 meters in late March to 7 meters by late September. The lowest oxygen concentration (13% saturation) was reached in late September. The relationship between hypoxia and zooplankton abundance was examined, and seasonal changes in species composition and abundance relative to depth were investigated. A total of 60 species of zooplankton were found in this study overall. Species richness was highest in early May (n = 28) and lowest in July (n = 4). Gelatinous zooplankton species richness peaked in early May (n = 10). Copepod species richness (n = 9) was also highest in early May. This study provides a comprehensive examination of zooplankton community structure in Hood Canal and contributes to the growing body of knowledge on the effects of hypoxia.

§ Matson, P.G.* and M.S. Edwards. San Diego State University. VARIATION IN STIPE HOLLOWING IN EISENIA ARBOREA (PHAEOPHYCEAE, LAMINARIALES) ACROSS LATITUDES

Morphological variation is common in kelps (Phaeophyceae, Laminariales) and often results from differences in environmental conditions. Stipe hollowing, in particular, occurs in several kelp species worldwide but to date has been investigated for only a few species and primarily at local scales. Here we describe the patterns of stipe hollowing both within and among populations of Eisenia arborrea across 800 km of its distribution along the west coast of North America. Our results indicate that there are large latitudinal differences among populations in both the occurrence of stipe hollowing (i.e. frequency of hollow stipes within a population) and hollowing extent (i.e. length of the hollow cavity relative to stipe length) in E. arborrea sporophytes. Stipe length varied among locations with the most southern population exhibiting the tallest stipes, the most northern population exhibiting the shortest stipes, and the three central populations exhibiting intermediate stipe lengths. The occurrence of stipe hollowing and hollowing extent varied along a latitudinal gradient, with the more southern populations exhibiting both increased frequencies of hollowing and greater hollowing extent. In fact, while hollowing occurred in almost all (97%) of the
sporophytes examined at the most southern location, it was nearly absent in the sporophytes examined at the most northern location. Finally, while stipe hollowing was more common in larger stipes across all locations, due to the overwhelming effect of location on the occurrence of stipe hollowing, stipe length alone is not a suitable predictor when considered across this species range.

Matteson, R.S.*1, Boustany, A.1, Castleton, M.R.1, Farwell, C.2, Dewar, H.1 and Block, B.A.1 1Hopkins Marine Station of Stanford University, 2Monterey Bay Aquarium. PACIFIC BLUEFIN TUNA BEHAVIOR IN THE EASTERN PACIFIC

Electronic archival tags were used to study Pacific bluefin tuna foraging behavior in waters along the western coast of North America. Between August 2002 and 2005, 259 Lotek LTD2310 archival tags were deployed on Pacific bluefin tuna, Thunnus orientalis. Tagging took place off the coast of Baja California, Mexico and the Southern California Bight in the summers of 2002 through 2005 and the winters of 2002 and 2005. Size of fish at the time of tagging ranged from 63 to 148 cm, curved fork length. Tagged fish were caught on rod and reel from sportfishing boats or released from tuna farming pens along the Baja coast. As of September, 105 archival tags (41%) have been returned with an average track length of approximately one year, providing 38,604 cumulative days of positional data with associated depth, temperature and light measurements at sampling intervals ranging from 4 to 120 seconds. Pacific bluefin move in a seasonal cycle across an approximately 15° span in latitude, spending time at their northernmost latitudes in late fall and appearing the furthest south in early spring. There are two peak areas of aggregation within this range at roughly 27 and 30°N, near Point Conception and Punta Eugenia. Sea surface temperatures range from 10 to 25°C with the largest number of geopositions in areas with sea surface temperatures of 17°C. Fish of this age class spend the majority of time in the upper 40 meters of water. Diel, seasonal and spatial variation in diving behavior are apparent within the data set. A peak in diving activity is consistently observed at both dawn and dusk, with daytime diving correlated with lunar phase. Higher maximum dive depths are seen at northern latitudes. These data are critical for understanding the habitat usage of Pacific bluefin tuna along the continental coast.


Historically it has been assumed that for many free spawning invertebrates, the primary drivers of population structure are geographic boundaries and oceanographic conditions. However, a significant amount of molecular data has suggested that this assumption may be violated in some marine systems. For example, in the tropical Indo-Pacific, one of the largest continuas habitats in our oceans, previous studies using mitochondrial markers have shown significant population structure in the tropical sea urchin, Echinometra mathaei. In order to better understand the true nature of this pattern, we are investigating patterns of population differentiation on genes previously identified to be under natural selection. By including both neutral and rapidly evolving markers into the analysis, we can better understand the role of natural selection in shaping population structure.

§ Miller, L.P.* and Denny, M.W. Hopkins Marine Station, Stanford University. IN SITU MEASUREMENT OF BARNACLE FEEDING ACTIVITY AT HIGH WATER VELOCITIES ON A WAVE-SWEPT SHORE

Barnacle species living in the mid and high intertidal zones on rocky shores are limited in their feeding opportunities to periods when the tide is high and/or when waves are large enough to sweep water over the barnacles. Previous work has shown that barnacles can adjust their feeding appendage size to suit local flow conditions, but only up to flow speeds of approximately 4 m/s, beyond which there is little variation in appendage size. This threshold of feeding appendage size in relation to high water velocities raises the question of how effectively barnacles are able to feed in the breaking waves of exposed rocky coastlines while avoiding damage to the cirral net. Using a video camera along with force and pressure transducers, in situ observations of feeding behavior under breaking waves have been made for Chthamalus barnacles. During the initial impact of large waves, barnacles withdraw the cirral net into the shell. Quickly following the initial impact, they resume feeding during the latter portion of the up-shore swash and following backwash. Utilizing a quick reaction time to wave impacts and minimal lag in resumption of feeding activity, it appears that Chthamalus barnacles are able to feed for a majority of the time they are submerged, despite the high flow speeds created by the breaking of large waves.
Moeser, G.M.* and E. Carrington. Friday Harbor Laboratories. MINDING THEIR OWN BYSSUS? PRODUCTION AND QUALITY OF MYTILUS EDULIS THREADS.

The production of byssal threads allows the blue mussel, Mytilus edulis, to maintain a strong attachment to the substrate in high energy environments. On Rhode Island shores, mussel attachment strength increases two-fold in spring compared to fall. While many factors influence attachment strength (temperature, food supply, predator cues, etc.), it has been proposed that the observed variation is primarily the result of increased thread production during the winter and spring months in response to increased wave action. This study evaluates the potential influence of three aspects of wave action (flow, acceleration, and byssal loading) on the seasonal thread production of M. edulis. Mussels were exposed to flow, acceleration, and byssal loading stimuli in the laboratory and the subsequent number of byssal threads produced was monitored. Increased flow (> 15 cm/s) elicited the strongest response in mussels by significantly decreasing thread production. In contrast, the response of the mussels to acceleration and byssal loading was sporadic and inconsistent. Surprisingly, overall thread production was lowest, both in the field and in the laboratory, in months when mussel attachment is typically strong. Therefore, the seasonal variation in attachment is not due to increased thread production in response to changes in wave action. Instead, reduced attachment strength in summer and fall most likely reflects the production of inferior quality threads that are subjected to increased rates of decay.

Morrow, K.M.* and R.C. Carpenter. Department of Biology, California State University Northridge. COMPETITIVE AND FACILITATIVE INTERACTIONS BETWEEN CORYNACTIS CALIFORNICA AND BENTHIC ALGAE ARE MEDIATED BY A SHALLOW KELP CANOPY

Competitive interactions are common throughout the rocky subtidal and have been shown to be important determinants of organism distribution and abundance. Recent research has also emphasized the effects of facilitation on marine communities. This study uses the non-photosynthesizing, corallimorpharian anemone, Corynactis californica, to examine the relationships that develop spatially and temporally between two shallow kelp forest communities. Extensive sampling along Santa Catalina Island has shown that Corynactis densities vary significantly between two shallow kelp forest habitats distinguished by the presence or absence of the kelp Eisenia arborea, whereas there is a 10-fold greater density of Corynactis under the canopy as opposed to outside. Permanent quadrats were established in these two habitats in which understory algal biomass was manipulated and maintained with three treatments; total removal, thinning by 50%, and a control. Within each quadrat Corynactis numbers were recorded monthly over the course of a year. Corynactis abundance increased by the greatest percentage in the thinned and control treatments under the canopy. The Eisenia canopy determines light and hydrodynamic regime which has been shown to effectively mediate the composition of the understory macroalgal community. The algal community shaded from light and overhead flow by the canopy is distinguished by articulated and foliose red algae as opposed to the non-shaded community which is dominated by foliose and decumbant brown algae. These two opposing algal communities have a direct effect on the density of Corynactis through space evasion as well as indirectly by altering the local flow environment. Further physiological experiments have shown that Corynactis metabolism does not vary between habitats or flow speeds suggesting that their distribution results from interspecies interactions. From these results it appears that the Eisenia canopy is facilitating the expansion of Corynactis under the canopy by altering the understory algal community to create a more suitable habitat.

Munguia, P.* Florida State University AMPHIPOD RECRUITMENT STRATEGIES AND LIFE HISTORY TRAITS ALLOW FOR COEXISTENCE

Marine organisms disperse at a variety of life history stages. In some species, larvae disperse and metamorphose soon after settlement. In other cases, juvenile stages colonize, either as direct developers or species that metamorphose in the water column. Finally, in other species, individuals disperse as reproductive adults. Dispersal phase can be an important determinant of population dynamics and community formation, in particular if species colonize at different life history stages. In sexually reproducing species, sex ratios and size of individuals may be important in order to explain these population dynamics. Coupling dispersal abilities with other aspects of a species population dynamics or a community as a whole may give insight as to species commonness or rarity and may help explain the variation in abundance in patchy environments. This study examines the recruitment strategy of three
amphipods that coexist on discrete benthic communities: the empty shells of *Atrina rigida* molluscs. The three amphipods, *Bemlos unicornis*, *Neomegamphopus hiatus*, and *Melita nitida*, are relatively common species within the pen shell community at St. Joe Bay, Florida. Their abundance tends to vary with successional stages, presenting an interesting comparison of how the dispersal phase may influence population dynamics. These species were compared in a series of experimental shell manipulations that varied the successional stage and the seasonal components of habitat availability. The moon phase was used as an environmental cue to compare recruitment patterns. These recruitment patterns and amphipod natural histories were related to their short- and long-term population dynamics. All three species dispersed at different life history stages, which affected the species abundance over time and across different shells. Incorporating dispersal strategies of different life stages may allow better understanding of population dynamics and community structure.

§ Mutz, Stephanie J. James Cook University. COMPARATIVE GROWTH DYNAMICS OF ACANTHURID FISHES; AN INTER-OCEAN COMPARISON

Understanding factors that influence longevity of fishes are important in population ecology and fisheries management. Recent reef fish studies have shown that many species are longer lived than previously believed, and Caribbean fishes have been thought to be shorter lived than Indo-Pacific fishes. However when comparing populations on regional scales it is critical that the comparisons are corrected for latitudinal position and habitat both of which have major effect on size and growth. To determine the effects of geographic distributions, I examined age-based demographic patterns in surgeonfish (genus *Acanthurus*) in two oceans. I studied algal grazers, *A. lineatus* from the Great Barrier Reef (GBR) and *A. coeruleus* from Bermuda and Ascension Island (Atlantic), and sediment grazers, *A. olivaceus* from the GBR and *A. chirurgus* from Bermuda and *A. bahianus* from Ascension Island using otolith growth increment measurements. Recent studies have suggested that surgeonfishes with similar population dynamics, size and diet have similar life spans and demographic characteristics regardless of geographic differences. I found that *A. lineatus* and *A. coeruleus* and *A. olivaceus* and *A. chirurgus*, illustrate similar growth patterns and life spans respectively. Growth patterns of *A. bahianus* and *A. coeruleus* from Ascension Island did not show any similarities with the other species suggesting the importance of comparing the demography of fish at similar latitudes. This study also indicates that longevity varies when compared at a local scale and regional scale within the same ocean basin. I found that in Bermuda *Acanthurus coeruleus* lives longer than *A. chirurgus*, but *A. chirurgus* achieves a larger terminal size. Terminal sizes among species will vary due to a range of factors, and I will seek an explanation by investigating diet population abundance and phylogenetic relationships. I did not find contrasts in life span or growth patterns of acanthurids between the different ocean basins.


Within the last few decades there has been an explosive growth of a very lucrative nearshore commercial fishery in California. The “live-fish fishery” targets the hardier shallow water species that can be maintained in captivity and sold live to buyers and retail consumers. The cabezon (*Scorpaenichthys marmoratus*) is a primary target species of the trap fishery and is the leading nearshore catch off South Central California. Initial exponential growth of the fishery and apparent reduction in average fish size resulted in a number of controversial closures and restrictions. These actions were exacerbated by a lack of useful biological information and robust catch data for cabezon. Through concerted facilitative efforts of a local public interest group [Marine Interests Group (MIG): Morro Bay, CA] and the cooperation within the commercial fishing industry, collaborative field projects on nearshore fisheries were conducted off the South Central California Coast. These efforts resulted in the acquisition of location specific, high resolution reproducible catch data previously unavailable to managers. This information provided a basis for the characterization of the cabezon trap fishery (e.g. Catch, CPUE, Size Composition) and served as a starting point for other important investigations abundance, movement, and site fidelity. These investigations are complementary with investigations on population genetics currently being conducted in the context of fisheries management. The latter include mtDNA and microsatellite based analysis derived from over 500 cabezon samples ranging from Puget Sound (WA) to San Diego (CA).

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High variability in the strength of species interactions is usually considered a source of unstable or unpredictable community patterns. However, recent theoretical work suggests that some types of variance in interaction strength may actually promote stability. Here we provide the first empirical evidence that highly variable, context-dependent species interaction strengths and resilient community patterns can be two sides of the same coin. Field experiments show that a persistent rocky intertidal seascape is remarkably resilient to multiple sources of environmental stochasticity largely because of scale-dependent and variable species interaction strengths. Biological interactions exert a stabilizing effect because their intensity varies systematically with changes in both physical sources of mortality of established species, as well as recruitment of new individuals. Strong variation in species interaction strengths with disturbance size and environmental conditions is ubiquitous in nature. Elucidating when this context-dependency will be stabilizing is critical to predict community-level responses to anthropogenic disturbances.

O’Connor, Nessa E. *, Jonathan H. Grabowski1 and John F. Bruno1. 1University of North Carolina at Chapel Hill, 2Gulf of Maine Research Institute. SPECIES LOSS AND ECOSYSTEM FUNCTIONING: EFFECTS OF SIMULATED PREDATOR EXTINCTIONS ON A FOUNDATION SPECIES

The effects of species loss on the functioning of ecosystems have not yet been fully tested. In addition, in marine ecology, little is known about the biotic factors that affect the recruitment of benthic invertebrates on sedimentary shores. We examined the effects of the removal of species of predator on a foundation species; the Eastern oyster *Crassostrea virginica*. We performed a field experiment with caged enclosures, manipulating the presence and abundance of three of the most common predatory crabs on oyster dominated shores in North Carolina (*Callinectus sapidus, Panopeus herbstii, Menippe mercenaria*). The aim of this experiment is to examine the effect of changing the number and identity of species of crabs present on the recruitment of oysters and subsequent effects on the overall habitat structure. Preliminary results suggest that the loss of blue crabs, *C. sapidus*, alone or in combination with either of the other two crabs affects the survival rate of juvenile oysters significantly. We also found tentative evidence that at increased densities other crabs had a similar effect on juvenile oysters, suggesting a level of redundancy in this system. The relationship between predators, prey and predator density is complex and the factorial design of this experiment permits examination of independent and interactive effects.

O’Donnell, M.J.* Hopkins Marine Station, Stanford University. REDUCTIONS OF WAVE-IMPACT FORCES WITHIN PATCHES IN MUSSEL BEDS

Mussels (*Mytilus spp.*) form extensive beds that can occupy much of the space on rocky, wave-swept shores. Using byssal threads to attach themselves firmly to the substratum, mussels are able to resist the hydrodynamic forces imposed by breaking waves. The matrix within a mussel bed provides refuge to numerous species that have less-tenacious attachments to the rock, and some of these organisms use the mussel bed as a refuge from which to graze algae of the surrounding rocks. Patches of bare space within mussel beds offer habitat for ephemeral species that quickly colonize after mussels are removed. Although investigators have speculated that mussels are providing protection from wave forces to objects nearby, the extent of such protections has not been quantified. I measured the forces experienced by objects 1 cm in diameter in the center of a patch within an artificial mussel bed and found that mussels do provide protection from wave forces. Such protection extended at least 10 cm from the edge of the mussel patch. These findings may provide a mechanism to explain grazing halos noted by previous investigators.

Olyarnik, S.V.* and J.J.Stachowicz. University of California Davis. UNDERSTANDING THE EFFECTS OF SEASONAL MACROALGAL BLOOMS ON THE SEAGRASS COMMUNITY: IMPLICATIONS FOR HABITAT STRUCTURE AND FISH FORAGING

Macroalgal blooms present a growing threat to coastal systems worldwide. By sequestering light and nutrients, reducing dissolved oxygen, and changing habitat structure, fast growing macroalgae can harm foundation species and alter trophic interactions in ecosystems ranging from estuaries to coral reefs. Other evidence shows some macroalgae contribute dissolved organic carbon and nutrients to adjacent plants and sediments that may benefit communities, so the net effect of these blooms over time can be unclear. Here we report results of ongoing experiments on the short- and long-term dynamics and consequences of seasonal green algal blooms (*Ulva* sp.) in the seagrass community of Bodega Bay, CA. In the field, we are manipulating *Ulva* biomass in 3-meter wide
enclosures to determine effects on seagrass density and epiphyte load, epifaunal diversity and abundance, and sediment organic content. There are four treatments: Ulva removal, ambient Ulva biomass, double ambient biomass, and a cage control. We have observed seasonal variation in Ulva ranging from 0 kg/m in winter to 14 kg/m in summer. During the summer, plots with Ulva have higher shoot density compared to plots without Ulva; this difference disappears in winter. There was no difference among treatments in epiphyte load on seagrasses, so these effects appear to be driven more by direct effects of Ulva on seagrass. In the lab, we conducted feeding trials to identify trophic interactions that affect Ulva abundance. Of the common invertebrates, amphipods consume the most Ulva; individuals ingested an average of 63 mg (wet mass) in a 24-hour period. Other species (isopods, crabs, sea hares) consumed negligible amounts. Mesocosm experiments show that amphipods suffer 60% less predation by fish in seagrass beds when Ulva is present. The predation refuge provided by Ulva may allow amphipods to reach the high densities we observed in the field in the late summer, which may eventually speed the decline of the bloom in the late fall months.

§ Ortiz, D.M.*1 and B.N. Tissot1 1Washington State University-Vancouver EVALUATING SPATIAL VARIATION IN HABITATS IN RELATION TO ONTOGENETIC VARIATION IN A REEF FISH IN AN MPA NETWORK IN HAWAI’I

Several studies have highlighted the role of habitat as an important component in structuring reef fish assemblages. Understanding the scale at which habitat characteristics influence spatial abundance and distribution of reef fish is important because processes that function at small scales may be different than those at larger spatial scales. Therefore, information on benthic habitats at a range of spatial scales is critical to the understanding and prediction of spatial distributions and abundances of reef fish. This study aims to examine patterns of ontogenetic shifts in habitat use in the Yellow tang (Zebrasoma flavescens), a commonly collect fish for the aquarium trade, at multiple spatial scales. Using NOAA’s archived remote-sensing data and in-situ geographically referenced underwater video surveys we examined ontogenetic variation in relation to the distribution of habitats in an existing MPA network on West Hawai’i. Seven years of monitoring in these areas has shown that the micro-habitat (1-10s of m) appears to be an important resource for the survival of juvenile yellow tangs. To date we have established 91 monitoring sites at four MPAs along the west Hawai’i coastline. Results reveal a significant ontogenetic shift in habitat use of Yellow tangs at all study sites. This shift indicates that multiple habitats are important for the life history of Yellow tangs and the distribution and abundance of these habitats may influence the effectiveness of MPAs to replenish depleted fish stocks. The results of this study and future research will allow us to examine the processes that may have been important in producing these patterns and ultimately identify the demographic factors influencing the effectiveness of MPAs.

§ Overstrom-Coleman, M.*, Greenley, A. and A. Alifano Moss Landing Marine Laboratories. IMPACTS OF A WINTER STORM SERIES ON THREE CENTRAL CALIFORNIA KELP ASSEMBLAGES

It is widely recognized that storms impact community structure of kelp-dominated ecosystems and it has been hypothesized that most assemblage change follows the first storms of the season, rather than subsequent storms of equal or greater magnitude. In March 2005, an uncharacteristically large late winter/early spring storm struck Monterey Bay, California from the west, with significant wave heights exceeding 5m and swell periods greater than 18 seconds. We opportunistically sampled kelp density, size and reproduction, as well as percent coverage of sessile invertebrates and algae immediately before (Feb) and after (April) this storm at three locations in central California: Hopkins Marine Station (HMS), Stillwater Cove (SWC), Point Lobos Marine Reserve (PTL). Percent cover of sessile invertebrate decreased significantly at HMS while fleshy red algae increased significantly over the same sampling period. Sessile invertebrate and non-geniculate coralline algae species percent cover decreased significantly at SWC. No significant changes in assemblage structure were observed at PTL. None of these differences are consistent with a negative impact of storms on assemblage structure, but in many cases suggest a trajectory of recovery from earlier storms. Overall, despite its uncharacteristically high magnitude, this late season storm had little impact on these kelp forest assemblages, supporting the hypothesis that following the first storms of the season, the remaining invertebrate and algal assemblages are less susceptible to increased water velocities.

§ Paddack, M.J.*, S. Sponaugle, R.K. Cowen. Rosenstiel School of Marine and Atmospheric Science, Division of Marine Biology and Fisheries. RECRUITMENT MICROHABITAT SELECTION OF A CORAL REEF FISH IN A CHANGED ECOSYSTEM
Many species of coral reef fish select specific microhabitats soon after settling on a reef. The spatial distribution of such habitats can be an important determinant of both the magnitude of recruitment and the distribution and structure of adult fish populations. Live scleractinian corals are a prime microhabitat for many juvenile reef fishes because they offer refuge from predation and access to readily available food sources. Live coral cover has declined drastically in recent decades however, and little is known about how this loss of habitat may affect recruiting fishes and the resulting adult populations. Previous work has shown that parrotfishes select specific species of coral for recruitment habitat and declines in parrotfish recruitment rates have been observed after loss of coral cover. However, increased numbers of juvenile parrotfishes have also been observed in connection with increased macroalgal abundance on reefs, suggesting that parrotfish may be capable of utilizing macroalgae as an alternate recruitment refuge. In order to test this hypothesis, recruitment rates of the stoplight parrotfish, Sparisoma viride, were monitored on reefs in the upper Florida Keys which have recently lost a majority of their coral cover. *Sparisoma viride* has been shown to strongly associate with the branching coral *Porites porites* on Caribbean reefs, but little is known about its ecology on low coral cover reefs. We found that on low coral cover reefs, *S. viride* recruited preferentially to areas of high macroalgal cover (*Dictyota* spp.) and that reefs with higher macroalgal cover supported larger numbers of juvenile parrotfish. These results indicate that newly settled stoplight parrotfish are able to utilize the increased macroalgal cover associated with loss of coral cover and that this microhabitat may provide an alternate refuge and/or enhanced food source.

Padilla, D.K.*1 and T. Klinger2. 1Stony Brook University, 2University of Washington. INVASION OF CRASSOSTREA GIGAS IN MARINE RESERVES: CAN THEY REPRODUCE IN COLD WATERS?

The Pacific oyster, *Crassostrea gigas*, has been an important aquaculture species in the Pacific Northwest for almost a century. Because this species requires waters warmer than 19-20°C for spawning, it has been considered a safe introduction, without the possibility of escape due to local reproduction limits. However, this species has been invading rocky shores in the San Juan Archipelago, Washington for almost a decade and these invaders are more abundant within marine reserves outside of reserves. The invasion of these oysters could be due to:1) changes in local water temperatures or warm waters in local bays such that they are warm enough to induce spawning, 2) thermal loading during low tide (which is mid-day) that allows oysters to spawn even though the water is not warm, 3) evolution for spawning at lower temperatures in the oysters, or 4) spawning elsewhere where waters are warmer and then dispersal of larvae into marine reserves and adjacent shores. We tested among these hypotheses by monitoring local water temperatures and direct experimental tests to determine if oysters collected from the field will spawn when held at ambient water temperatures or at ambient water temperatures when exposed to a tidal cycle. We also tested whether larvae produced by local *C. gigas* were capable of development in the cold waters typical of the San Juans. These oysters do not appear able to spawn at temperatures lower than 17-18°C, and larval development even at 15°C is slowed more than 3 times from development at 20°C. Even in quite bays, temperatures are not warm enough to induce spawning. These data suggest that larval production elsewhere must be responsible for this invasion.

Pardo, L.-M.1 and L.E. Johnson2.1Universidad Austral de Chile; 2Université Laval. GROWTH RATE, SIZE, AND FECUNDITY IN A MARINE SNAIL ACROSS AN ENVIRONMENTAL GRADIENT LACKING PREDATORS: EVIDENCE FOR COUNTER-GRADIENT SELECTION?

Intertidal habitats are ideal for examining the environmental control of life-history traits because of their sharp gradients in biological and physical factors, including wave action, temperature, food availability, and predation. However, the effect of a particular factor on ecological and evolutionary processes is difficult to separate when multiple factors vary simultaneously. We examined shifts in life-history traits in the intertidal gastropod *Littorina saxatilis* Olivi across an intertidal shoreline where predation appears to have little influence. We determined the density, size, fecundity and size at maturity of snails in four distinct zones across the shoreline and estimated growth rates in each zone. Size, fecundity, median size at maturity and growth rate all exhibited pronounced clines across the shoreline with higher values in the lower zones where food abundance was highest. Snail density, however, peaked in the mid-zones. The clines in life-history traits corresponded with food availability and environmental stress (wave forces and desiccation stress), and these factors were the likely determinants of the patterns observed. We also conducted a reciprocal transplant experiment between the extreme zones to assess if any differences in growth rate might have a genetic basis. Snails transplanted from the high zone to the low zone grew 7 times faster.
than snails that remained in the high zone and, more unexpectedly, 1.6 times greater than local snails from the low zone. Snails transplanted from the low zone to the high zone did not grow at all while local snails from the high zone had slow, although measurable, growth. These divergent responses of transplanted snails (i.e., counter-gradient variation) suggest that there may be differential size-dependent selection between the extreme zones with the greater wave forces of the low shore selecting against fast growth which would otherwise be supported by the abundance of food found there.

Pelc, R.A.*1 and M.L. Baskett 2. 1 University of California, Santa Barbara, 2 Princeton University.

THE EFFECTS OF MARINE RESERVES ON HARVESTED INTERTIDAL SPECIES IN SOUTH AFRICA

Fishing pressure has been shown to reduce the density and average size of harvested intertidal species in South Africa, including the mussel *Perna perna*, the limpets *Scutellastra longicosta* and *Cymbula oculus*, and the oyster *Crassostrea margaritacea*. Smaller sizes and reduced densities may lead to lower reproductive output and reduced larval recruitment in exploited areas. Marine reserves serve as a refuge for large individuals and may provide a source of larvae to replenish harvested areas. This project investigates differences in the density, size structure, and larval recruitment of populations of *P. perna*, *S. longicosta*, *Cymbula oculus*, and *Crassostrea margaritacea* inside and outside the Goukamma marine reserve on the south coast of South Africa. *P. perna* reached larger sizes and higher percent cover inside than outside the reserve, particularly on sandstone benches, the most suitable habitat for the species. Larval recruitment of mussels was higher inside the reserve and dropped off sharply at reserve boundaries. Limpet populations showed no differences inside versus outside the reserve. Oysters were larger inside the reserve but were most abundant outside reserve boundaries. The results suggest that these populations are influenced by the interplay of ecological factors and spatial protection from harvesting.

Petersen, C.W.*1,2, R. L. Preston2,3, and George W. Kidder III2. 1 College of the Atlantic, 2 Mount Desert Island Biological Laboratory, 3 Illinois State University, Normal. EGG SURVIVAL AND DEVELOPMENT RATES IN THE INTERTIDAL SPAWNER *FUNDULUS HETEROCLITUS*: A FIELD EXPERIMENT

Intertidal spawning is a widely used reproductive strategy in marine and estuarine fishes. To test the adaptive benefits of intertidal spawning, we measured the effects of tidal height and substrate type on egg survivorship and development rate in the wide-ranging estuarine fish, the mummichog *Fundulus heteroclitus*. Over most of their range (Florida – Newfoundland), mummichogs restrict spawning to extreme spring tides, but at our northern study site in a Maine salt marsh individuals spawn over the entire lunar month at a variety of tidal heights. We placed embryos into two different environments where spawning naturally occurs: salt hay (*Spartina patens*) mud flats and cobble-gravel slopes. Embryos were placed at 5 tidal heights, from the subtidal to the high intertidal, with half of the containers protected with mesh screens to exclude predation by fishes. Eggs were left in the field 3-7 days, and data were collected on egg survivorship and development rates of embryos. Despite the fact that natural spawning levels were much more intense in the cobble-gravel areas, we found that egg survivorship was typically lower in these areas than in the grass areas. The cobble-gravel area appeared more physically stressful for eggs, both because the sediments did not hold water as well as the mudflat and because the average surface temperature was much higher. Development rates varied tremendously over the season, with intertidal eggs developing at faster rates than subtidal eggs, supporting the hypothesis that intertidal oviposition increases development rate. We discuss how these and other results inform our understanding of oviposition site selection and reproductive behavior in this abundant estuarine species.

Petes, L.E.*, G.D. Murphy, and B.A. Menge. Oregon State University. EFFECTS OF THERMAL STRESS ON PARASITE LOADING AND REPRODUCTION IN NEW ZEALAND MUSSELS.

Biotic and environmental stressors can negatively affect the ability of an organism to reproduce. Pea crabs, *Pinnotheres novaeezelandiae*, reside within mussel shells and feed off of their host’s mucous food strings; this kleptoparasitic behavior can also have a negative effect on host growth and reproduction. To test the effects of thermal stress on mussel reproduction and parasite loading, reciprocal transplants were performed between the upper (high thermal stress) and lower (low thermal stress) edges of an intertidal mussel bed at Box Thumb, Christchurch, New Zealand in the austral summer of 2004. Two species, *Mytilus galloprovincialis* and *Perna canaliculus*, were transplanted together, as they are often found coexisting in mussel beds at this location. Monthly sampling was conducted, and shell growth, mass of reproductive and somatic tissues, presence of pea crabs, and size and mass of
pea crabs were assessed. Pea crab infestation was more prevalent in *M. galloprovincialis* than in *P. canaliculus*, and infestation rate was higher in the lower edge of the mussel bed than in the upper edge. This indicates that the upper edge of the mussel bed, an environment with high thermal stress and shorter immersion time for filter-feeding at high tide, may be unfavorable for these kleptoparasites. Presence of pea crabs did not have an effect on mass of mussel reproductive tissue or shell growth. Mussels transplanted to the upper edge of the mussel bed showed lower growth and lower mass of reproductive tissue, indicating that thermal and desiccation stress may impair the ability of an organism to allocate energy towards growth and reproduction.

Piotrowski, C.N.* San Francisco State University, California Academy of Sciences. CRYPTICS AND EXOTICS AMONG COSMOPOLITAN POLYCHAETES: SORTING THROUGH AN OPEN CAN OF WORMS

In recent years, many cosmopolitan marine taxa have been found to include multiple cryptic species. In this study, I present mitochondrial evidence (cytochrome c oxidase subunit I) for the presence of three reproductively isolated taxa within Eastern Pacific populations of the scaleworm *Harmothoe “imbricata”*. This cosmopolitan polychaete was first described from the North Atlantic by Linnaeus in 1767 and has since been reported from the coasts of five continents in an abnormally broad range of habitats. Populations from different continents are reported to employ varied reproductive strategies. The high likelihood of anthropogenic transport of members of this group and shared haplotypes among three highly invaded ports sampled in this study (San Francisco Bay, Tokyo Bay, and Sydney Harbor) raise suspicion about the native status of at least one of the proposed cryptic species. Population level molecular analyses provide some evidence for recent population expansion due to a possible founder effect in two out of three of these taxa. In addition to genetic evidence, I am currently examining novel morphological characters to confirm the delineation of these cryptic species of *Harmothoe* in the Eastern Pacific.

§ Pirtle, J.L. *1, B.N. Tissot 1, D.A. Roberts 2,3, D. Howard 2, 1 Washington State University, Vancouver, 2 NOAA Cordell Bank National Marine Sanctuary, 3 Point Reyes National Seashore. HABITAT-BASED ASSESSMENT OF STRUCTURE-FORMING MEGAFANAUL INVERTEBRATES AND FISHES ON CORDELL BANK, CALIFORNIA

Previous studies have identified the potential of megafaunal benthic invertebrates to provide structural relief to fishes by adding complexity to the habitat of continental shelf ecosystems. To better manage and protect areas impacted by fishing activities we need to understand the ecological relationships between fishes and structure-forming invertebrates. Cordell Bank is a submerged rocky island on the continental shelf northwest of San Francisco. Dives were made in 2002 using the submersible Delta to characterize the habitat and describe the distribution of fishes and invertebrates. Structure-forming invertebrates were identified and the associations with fishes were described to further characterize habitat and community composition. Cordell Bank was found to be composed of diverse substrates of which a total of sixty-seven taxa of megafaunal invertebrates and seventy-three fishes including twenty-five species of rockfish were associated. Unique community-level associations were formed between fish and structure-forming invertebrates across specific habitats and close interactions were observed. Structure-forming invertebrates were found to be important components of biological diversity in Cordell Bank communities and enhance the structural relief of the abiotic habitat for associated fishes.

§ Pister, B.A.* and K. Roy. University of California, San Diego. URBAN ECOLOGY IN A MARINE ECOSYSTEM: ARE JETTIES AND BREAKWATERS SUITABLE HABITAT FOR INTERTIDAL COMMUNITIES?

Artificial hard substrates cover over 50% of southern California shoreline. Jetties, breakwaters, and armored shorelines constructed of riprap comprise these artificial intertidal areas. Very few studies have evaluated the suitability of these structures as habitats for rocky intertidal species. Alternatively, the ecological consequences of these massive additions to coastal ecosystems remains unknown. Riprap usually consists of large quarried boulders, or concrete blocks, and is easily colonized by intertidal organisms. However, artifacts of their construction set them apart from natural rocky intertidal habitats. In this study I compare rocky intertidal community composition on riprap and neighboring rocky intertidal benches. These communities are significantly different from each other and evidence suggests that the riprap itself plays a role in these differences. As coastal human populations continue to grow we can expect the addition of even more artificial structures in marine environments. Differences among
communities on these artificial structures and natural habitats have profound ecological implications in space and time at both local and regional scales.

§ Preisler, R.K.*1,2 and Wasson, K.R.1,2. 1Elkhorn Slough National Estuarine Research Reserve, 2University of California Santa Cruz. ESTUARINE AND COASTAL INVERTEBRATE INVASIONS: A BIOGEOGRAPHIC COMPARISON

In order to optimize spending and effort in invasive species’ management, it is critical to gain a better understanding of which habitats are particularly vulnerable to invasions. However, little is known about how invasion rates vary among different habitats for entire species assemblages. This study compared estuarine and open coast invertebrate invasions at a global scale. One estuary in Central California, Elkhorn Slough, has considerably higher invasion rate than the open coast adjacent to Elkhorn Slough has. The goal of this study was to see whether the pattern of high estuarine invasion rates and low open coast invasion rates occurs at a global scale. We obtained four datasets, from three different continents, on both native and invasive invertebrates. Additionally, we obtained data from four additional sites on the same three continents on only alien species. We found higher proportions of alien invertebrates (alien/(alien + native)) for estuaries (12.0%) than for coasts (5.8%) on all three continents. Across all eight sites, we found the average percentage of alien species occurring in estuaries (82.5%) was and much higher than percentage of aliens occurring on open coasts (33.4%). For most regions, the majority of alien invertebrates occurred only in estuaries, with a few alien species present on the coast or both in the estuary and on the coast. The high invasion rates of estuaries may be accounted for by multiple factors, including high inoculation rates, low biotic resistance from native species, and a modification of selective regimes due to extensive human alteration of habitats.

§ Ramon, M.L.*1 University of California, Santa Cruz. THE POPULATION GENETIC STRUCTURE OF AN INTERTIDAL SCULPIN (Clinocottus analis)

The pelagic larval phase of marine fish is potentially dispersive and has major implications for reef fish populations at the evolutionary and ecological scale. Dispersal of temperate reef fishes occurs during the larval planktonic stage of their life cycle. After this phase, these fish recruit to the reef and remain sedentary. It is unclear whether larvae return to the same location they originated from (closed populations) or if they disperse to other locations (open populations). The recent advances of genetic molecular tools and statistical programs can estimate how much dispersal occurs between populations. This study focused on the intertidal wooly sculpin (Clinocottus analis). Samples were collected throughout its entire range from Northern California to Baja California. Mitochondrial DNA sequences, the 5’ end of the control region (376bp), were used to determine how much larval movement (estimated using gene flow levels) occurs between populations. Preliminary results indicate that there is very low migration between most populations. However, this low level of migration from central California to other locations results in very little genetic structure between populations. In addition, this study discovered a novel mitochondrial genome rearrangement for C.analis. The results of this research (dispersal and recruitment of larvae) can assist policy makers, fishery scientists and other decision makers in the design of Marine Protected Areas (MPAs) by providing information on the dispersal capabilities of the organisms throughout their respective ranges.

§ Rassweiler, A.* University of California, Santa Barbara. A MECHANISM THAT MAY MAINTAIN ALTERNATE STATES ON SUBTIDAL REEFS IN THE SANTA BARBARA CHANNEL

Pachythyone rubra, a filter feeding sea cucumber found at shallow depths in Southern California, can persist at very low levels or at densities of several thousand per square meter. These different densities often exist at neighboring sites with apparently similar abiotic conditions. Additionally, long term data show that several populations which had persisted for years in the low density phase switched into the high density phase during the late 1980s and have persisted at high densities for more than a decade. One explanation for these patterns is that some mechanism prevents P. rubra from increasing at low density but causes it to persist at high density, causing both states to be stable. Here I explore interactions between P. rubra and understory algae, focusing on a situation in which P. rubra is competing with adult algae for space, but also consuming algal spores before they settle. I present mathematical models demonstrating that if spore predation is strong, the combination of interactions can lead to two equilibrium densities of P. rubra. I also show experiments demonstrating that P. rubra substantially reduces the rate of algal
Although major stock collapses for rockfishes from commercial harvest have been reported there is evidence that recreational fishing has had a similar impact for some regions of California including the southern California Bight, Monterey, and San Francisco. Indicators of stress on rockfish stocks such as declining mean lengths and catch rates were reported from these regions in the CPFV fishery. Additionally fishing locations further from port began as early as the 1960’s. Here we report on the results of comparisons for individual species and fish assemblages between near port and distant locations for the CPFV fishery in the Morro Bay region from two ports, Morro Bay and Avila Beach. The fish assemblage from distant locations in Morro Bay is stable while only minor changes have occurred in near port locations. Surprisingly, the assemblage in distant locations from Avila Beach was unstable despite a lower fishing effort. Comparisons between locations revealed that assemblages between near port and distant locations from Morro Bay were similar, while the assemblage in distant locations from Avila Beach was remarkably different. Length comparisons between near and distant locations revealed 3 general trends: species that were always larger in distant locations, species whose lengths decreased from north to south, and those where no differences were detected. Exceptions were vermillion and olive rockfish. CPUE was similar between near and distant locations for all species except brown rockfish. Assemblage differences in species composition for the southernmost area probably reflect habitat differences and an abundance of brown rockfish, although it may be possible that southern species transgress Point Conception during El Nino episodes. Although large differences in mean length were found for some species between near and distant locations in 2003-2004, CPUE for most species remained fairly stable for near and distant locations over a 16 year period.

Recent models of coastal community function suggest that large-scale, oceanographically-driven processes result in a strong coupling of nutrients and prey supply (subsidies) with onshore predation intensity. These processes should thus produce high but relatively predictable variability in community structure and function among sites. However, recent findings suggest that these models still leave much of the observed variability among rocky shore sites unaccounted for. We demonstrate that very local-scale variability in larval supply and predation intensity, that is mostly seascape-depended, result in high variability in community structure among wave-exposed sites, and that predation intensity can be decoupled from prey supply. In New Zealand, subtidal predators (fish and crabs) exert intense predation pressure on small transplanted mussels during high tide on intertidal rocky benches with continuous subtidal reefs (Reef sites) even in sites where mussel supply is extremely low. On isolated rocky benches located in sandy beaches with no extensive subtidal reefs (Sand sites) subtidal predators are usually rare and predation pressure is lower. Mussel supply, however, can show an opposite trend with greater supply to mussel-settler collectors (tuffies) on Sand than on Reef sites. Such decoupling of predation intensity from prey supply may be responsible for the rarity of mussel beds on many wave-exposed sites in eastern New Zealand where predatory fish are abundant but mussel supply appears low. We argue that local, context-depended, processes can be accountable for just as much variability in community structures as large-scale processes, and much more detailed knowledge is required on local conditions before predictions of general models can become reliable.

Among the most important and threatened ecosystems of the coastal environment are estuaries, which constitute a transition zone between terrestrial and marine environments where fresh water mixes with sea water. Tidal flow and
Freshwater input into estuaries have often been restricted via the construction of dams, causeways, and dikes; a practice which can significantly alter the habitats and associated biotic communities of estuaries. Although estuaries are known to provide critical habitat for a variety of fish and crustacean species, very little research has focused on how manipulation of tidal regimes and freshwater input influences these organisms. This study investigated how assemblage structure and species distribution and abundance patterns of fishes and crabs are influenced by variation in tidal flow and freshwater input throughout shallow-water habitats in the Elkhorn Slough estuary. In April and August of 2005 we surveyed fish and crab abundance patterns throughout 18 locations in Elkhorn Slough fall into one of three categories: full tidal flow, muted tidal flow, very muted tidal flow/seasonally high freshwater input. At each of these locations we used three different methods of data collection, including beach seines and two types of minnow traps. Fish and crab abundance patterns varied across habitat types and across seasons depending upon which species were considered. The very muted/seasonally high freshwater input sites were most different in terms of species composition and abundance patterns compared to the other two flow regimes, but there were also differences between the full and the muted flow sites in regards to these factors. Overall, the results of this study suggest that if the management goals for estuarine habitats include maintaining high diversity of fish and crab species, appropriate management strategies should consider preserving a mosaic of habitat types that vary in tidal flow and freshwater input.

Rogers, L.K.*1 and R.T. Leaf2. 1CDFG and U.C. Bodega Marine Lab, 2Moss Landing Marine Labs. ELASTICITY ANALYSIS OF SIZE-BASED RED AND WHITE ABALONE MATRIX MODELS: MANAGEMENT AND CONSERVATION

Prospective elasticity analyses have been used to aid in the management of fished species and the conservation of endangered species. Elasticities were examined for deterministic size-based matrix models of red, Haliotis rufescens, and white abalone, H. sorenseni. In the red abalone matrix, growth transitions were determined from a tag-recapture study and grouped into 9 size classes. In the white matrix, abalone growth was determined from a laboratory study and grouped into 5 size classes. Survivorship was estimated from tag-recapture data for red abalone using a Jolly-Seber model with size as a covariate and used for both red and white abalone. Reproduction estimates for both pre-breeding models used averages of the number of mature eggs produced by female red and white abalone in each size class from four-year reproduction studies. Population growth rate (λ) was set to 1.0 and the first year survival (larval survival through to the first size class) was estimated by iteration. Survival elasticities were higher than fecundity elasticities in both the red and white matrix models. The sizes classes with the greatest survival elasticities, and therefore the most influence on population growth in the model, were the sub-legal red abalone (150-178mm) and the largest white abalone size class (140-175mm). For red abalone, the existing minimum legal size (178mm) protects the size class the model suggests is critical to population growth. Implementation of education programs for novice divers coupled with renewed enforcement may serve to minimize incidental mortality of the critical size class. These results suggest a white abalone conservation efforts directed at restoring adults may have more of an impact on population growth than focusing on juveniles. Our work is an example of how prospective elasticity analyses of size-structured matrix models can be used to quantitatively evaluate research priorities, fishery management strategies, and conservation options.

Rodriguez, Laura*, Section of Evolution and Ecology, 1 Shields Avenue, University of California, Davis, CA 95616. NON-INDIGENOUS AQUACULTURE CROPS AS PREY SOURCES FOR NATIVE PREDATORS

Commercial cultivation of non-indigenous species typically results in large, dense populations of monocultures, which can provide abundant and accessible prey for native predators. Bahia San Quintin, Baja California, Mexico, is a shallow bay, characterized by soft sediment habitats (mud and sandflats, and eelgrass beds). Since the 1970s this bay has been developed and heavily used for off-bottom (rack/rope) systems to cultivate the Pacific oyster, Crassostrea gigas. A native whelk, Macron aethiops, was found to prey on this very abundant, non-indigenous, prey source. I used this system to try to identify the impact of a native predator on a marine crop. First, because very little is known about this whelk species, I conducted observations to look at predatory behavior in response to different prey types. Unlike other whelks, this species does not make drill holes, but rather uses its shell to pry open bivalve prey. Then, guided by the results of a field survey looking at the pattern of whelk presence and oyster mortality, I ran experiments to determine per capita predation rates of whelks. Further, I conducted several lab and field experiments to identify variation in juvenile oyster mortality due to predator size and density, and prey size and density. Response variables measured included prey mortality rates and prey sizes consumed. From both field and lab results there appears to be a threshold size above which oysters are resistant to whelk predation. Results show
that prey mortality rates are dependent on the size of prey, but not on the size of the predator. Through continuing to work in this system I hope to both determine the impact oysters have on whelk population size and distribution, and estimate if the impact level of the native predator on the non-indigenous prey source warrants management actions.

§ Roman, Y.J.*, E.M. Gallardo and R.R. Wilson, Jr. California State University, Long Beach.

PHYLOGENETIC UTILITY OF mtDNA CONTROL REGIONS AMONG GOBIOIDS

The mtDNA control region of gobioid fishes, a non-coding region, has not been studied much interspecifically for its phylogenetic utility. Our continuing research on the genetic diversity of goby control regions among yellowfin goby led us to compare it with that of other gobies. However, only 4 full goby control region sequences appear in GenBank of the more than 2,000 named goby species in the world. Thus, we cloned and sequenced 4 more to study the phylogenetic utility of gobioid control regions. We cloned and sequenced the species Acanthogobius flavidus, Acentrogobius bifrenatus, Cristatogobius cristatus, and Gillichthys mirabilis. We aligned the 8 goby sequences with 8 sequences from lower fish orders present in GenBank, and performed maximum parsimony. The ClustalW alignment of 858 bp was generally conserved with few alignment gaps among the 16 species. Using a rockfish (Scorpaeniformes) as an outgroup root, the gobies appeared monophyletic. Interestingly, Asian yellowfin goby, Acanthogobius flavidus, and Californian longjaw mudsucker, Gillichthys mirabilis, were sister taxa despite other Asian gobies in the analysis. We also found that Rhacichthys aspro and Eleotris acanthopoma appeared ancestral to the other goby species; thus, our results agreed with earlier studies of goby molecular phylogeny based on mtDNA protein-coding genes. We have also cloned and sequenced a 5th Asian goby invasive to California, Tridentiger trigonocephalus. But due to long (75 bp) tandem repeats in the left domain, the sequence was not easily aligned and has not yet been included in our analysis.

§ Ruttenberg, B. I.*, A. Hearn2, L. R. Vinuesa3, S. Salazar4, S. Banks2, and V. Francisco5. 1University of California Santa Barbara, 2Charles Darwin Research Station, Galápagos 3Oregon State University, 4CICIMAR, La Paz, Baja California Sur, Mexico, 5CICESE, Ensenada, Baja California, Mexico. THE EFFECTS OF BOTTOM UP PROCESSES ON REGIONAL DEMOGRAPHIC PATTERNS IN THE GALÁPAGOS ISLANDS

Ecologists have long debated the relative importance of bottom-up and top-down processes on community structure. Evidence for the predominance of top-down processes is common in marine systems, and includes such well-known examples as keystone predation in the rocky intertidal and regime shifts resulting from overfishing on tropical reefs. Less attention has been paid to the impacts of bottom-up and top-down processes on demographic parameters, such as size or age structure of individual species. In many cases, teasing apart the effects of these processes on demography is difficult because demographic changes often occur over large spatial scales. In the Galápagos Islands, variation in bathymetrically driven upwelling results in strong temperature gradients across regions separated by no more than 150 km. These regional differences in temperature and upwelling result in regional differences in productivity (as measured by sea-surface chlorophyll a) and abundance of benthic algae. We surveyed the size structure of 5 disparate taxa, including the Galápagos sea lion (Zalophus wollebackii), the Galápagos marine iguana (Amblyrhynchus cristatus), the white-tailed damselfish (Stegastes beebei), a spiny lobster (Panulirus penicillatus), and a whelk (Thais melones), from all regions of the archipelago. For all taxa, we found that individuals were generally smallest in the warmest, least productive region and largest in the colder, more productive regions of the archipelago. The strong correlation between productivity and size structure of these different taxa suggest that bottom-up processes may be important in structuring populations over regional scales in this system, and also demonstrates that bottom-up processes can affect population parameters as well as community structure.

Saffo, M.B.* Marine Biological Laboratory, Woods Hole, MA. MOLGULID ASCIDIANS AS HABITAT: COEVOLUTION OF NEPHROMYCYES WITH ITS MOLGULID HOSTS

Molgulids are hosts to two microbial endosymbionts: a horizontally-transmitted protistan symbiont, Nephromycyes, in the molgulid “renal sac”; and vertically-transmitted, intracellular bacteria in Nephromycyes cytoplasm. Though formally classified by Giard (1888), as a chytridiomycete, Nephromycyes has nevertheless resisted definitive taxonomic identification. So peculiar, and peculiarly diverse, are the morphological features of Nephromycyes that mycologists later questioned Giard’s description, as well as the symbiont’s very existence. We have shown, however, that Nephromycyes does exist, that it infects all adult molgulids, and that its diverse cell types are
developmental stages of a single organism. And, finally, we now have a sense of its phylogenetic affinities: both ssu rDNA sequences, and particular structural features, especially of the infective stage of *Nephromyces*, indicate that *Nephromyces* is a distinct clade within the Apicomplexa. *Nephromyces* is unique among this group of obligate parasites and pathogens, both in its intracellular bacteria and its apparently mutualistic relationship with its molgulid hosts. By several measures, *Nephromyces* seems tightly adapted to its life inside the renal sac. In addition to the fact that it is found only in molgulids, *Nephromyces* also shows at least some host specificity within the Molgulidae. For instance, *Nephromyces* from *M. occidentalis* cannot infect aposymbiotic *M. manhattensis*; conversely, *Nephromyces* from *M. manhattensis* cannot infect aposymbiotic *M. occidentalis*. Our data so far suggest that the Molgulidae have coevolved with *Nephromyces*, and that several of the unusual features of molgulid biology are best explained in the context of the association of molgulids with their remarkable apicomplexan symbionts.

* Sagarin, R. D.*1, W. Gilly2, C. Baxter2, N. Burnett2. 1. Institute of the Environment, University of California, Los Angeles 2. Hopkins Marine Station of Stanford University. REMEMBERING THE GULF: CHANGES IN THE SEA OF CORTEZ SINCE STEINBECK AND RICKETTS

One of the most storied ecological expeditions is the 1940 journey of author John Steinbeck and biologist Edward F. Ricketts to the Gulf of California, or Sea of Cortez, on the *Western Flyer*, a sardine purse-seiner, out of Monterey, CA. Steinbeck and Ricketts collected extensively and made detailed notes on the fauna at each site and noted many ecologically relevant observations at and en route to19 intertidal sites (15 rocky, 3 sandy, 1 coral) from Cabo San Lucas, Baja California Sur, to Estero Agiabampo on the Sonoran coast of mainland Mexico. Since their expedition, large scale changes are to be expected in the general ecology of Baja California and the Sea of Cortez, potentially due to increased resident population, increased fishing intensity, massive development of tourism-related infrastructure, and climatic change. In an attempt to assess these changes from a historical ecology point-of-view, we repeated the 1940 expedition, to the same intertidal sites and at the same time of year. We illustrate and discuss the difficulties in attempting to repeat past ecological studies for gaining insight into ecological change, but we also demonstrate that, even lacking quantitative data taken with modern statistical approaches in mind, the record set forth by Steinbeck and Ricketts leaves little doubt that large ecological changes have occurred in the Sea of Cortez.

§ Samhouri, J.F.*1 and M.A. Steele2. 1UC Los Angeles, 2 UC Santa Barbara. THE INFLUENCE OF PREDATOR REFUGES ON SELECTIVE MORTALITY IN A CORAL REEF FISH

Many organisms, including amphibians, insects, and marine fishes and invertebrates have complex life cycles that consist of a larval phase and an adult phase occurring in two distinct habitats. Often, larval traits affect adult performance despite the fact that each life stage faces very different selective pressures. On coral reefs, predators cause intense mortality of juvenile fish during and after their transition from larval to adult habitat (i.e. settlement). We collected goldspot goby (*Gnatholepis thompsoni*) juveniles that had yet to experience this critical period, along with surviving older gobies from the same settlement cohort, from two sites in the Bahamas. We also directly manipulated goby shelter availability at each site to determine if the strength of predator-induced selective mortality was altered by the structural complexity of the reef habitat. By comparing the otolith-derived larval traits of the initial group to the larval traits of the survivors, we show that in this prey species intense juvenile mortality represents a selective bottleneck. In unmanipulated, “ambient shelter” habitat, gobies that were small at the time of settlement were most likely to survive reef-based predation as juveniles. Although this same type of size-selective mortality occurred in habitats with an experimentally-increased abundance of predator refuges, the effect was much weaker. This study represents one of the first experimental tests of the linkage between larval traits and selective mortality in coral reef fishes.

Sandin, S.A.*1, J.F. Samhouri2, and S.L. Hamilton3. 1 Scripps Institution of Oceanography, 2University of California, Los Angeles, 3University of California, Santa Barbara. HABITAT CHARACTERISTICS CHANGE DENSITY DEPENDENT MORTALITY FROM DIRECT TO INVERSE

Predation is known to severely affect the population dynamics of many marine organisms, in particular of juvenile benthic fish. In many settings, predominantly in patchy habitats, predation causes directly density-dependent mortality with fish in larger groups experiencing higher per capita risk of mortality than fish in smaller groups. Such mortality has been viewed as a potential form of population regulation. However, a growing body of evidence demonstrates for similar species in continuous habitats that the form of mortality is inversely density-dependent, i.e.,
that fish in larger groups suffer lower per capita risk of mortality than fish in smaller groups. Such results parallel some predictions of behavioral ecology, in particular that aggregation or shoaling can dilute the risk of mortality for individuals in a group. Here we present a model of competition for refuges that addresses the observed shift in the form of density dependence in patchy versus continuous habitats. When patch size is on the same order as the home range size of individuals in a group, strong competition for limiting refuges can result in directly density-dependent mortality from predation. When patch size is large relative to home range size (as in continuous settings), competition for refuges becomes weaker, leading to inversely density-dependent mortality. We explore conditions for such a dynamic change of mortality and fit these results into the context of available data.

§ Sandoval, E.J. Moss Landing Marine Laboratories. HABITAT MAPPING AND TOPOGRAPHIC COMPLEXITY: IMPLICATIONS FOR PREDICTING KELP FOREST COMMUNITY COMPOSITION

By understanding species/habitat associations, predictions of species composition can be made about a benthic community based on available habitat. In a kelp forest, topographic complexity does not directly affect an organism, but has indirect effects such as modifying flow, altering food availability, or altering light availability and may provide refuges and barriers that fragment the habitat, resulting in more heterogeneous assemblages. There are many qualitative ways to evaluate topographic complexity. Rugosity is a quantitative measure and is defined as the ratio of surface area and planar area. Using habitat maps developed in GIS from multibeam bathymetry data, regions of varying rugosity were mapped. Associated communities were examined to elucidate spatial patterns and similarities in community composition. In addition, direct measures of transect rugosity, significant wave height ($H_s$), depth, the number of edges, the number of walls and the number of crevices were used to compare environmental spatial patterns with biological spatial patterns. Results from non-metric multidimensional scaling (MDS) plots and Analysis of Similarity (ANOSIM) indicate no differences among high, medium or low rugosity classes, but did indicate significant sample site differences. Results from the BIOENV analysis suggest that $H_s$, transect rugosity and depth correlate best with community composition variation, but only explain up to 0.35 of the variation. The development of spatial statistics, GIS and remote sensing has created a tremendous opportunity for researchers to quantify and explain patterns in marine ecosystems, but these new tools must be used with caution. It is apparent that benthic kelp forest communities are difficult to predict with remote sensing techniques due to the multidimensional aspect of numerous species and environmental variables.

Sanford, E.¹, S.B. Holzman², R.A. Haney², D.M. Rand², and M.D. Bertness²,¹University of California Davis and Bodega Marine Laboratory, ²Brown University. LARVAL TOLERANCE, ADAPTATION, AND THE MAINTENANCE OF GEOGRAPHIC RANGE LIMITS

Despite growing interest in species’ range shifts, little is known about the ecological and evolutionary factors that regulate geographic range boundaries. We investigated the processes that maintain the northern range limit of the mud fiddler crab (*Uca pugnax*) at North Scituate, Massachusetts (42º14’N, just north of Cape Cod). We reared zoea under controlled temperatures to test whether colder water at the edge of this species range inhibits larval development. All larvae died at temperatures $\leq$14ºC and <6% of larvae reached the settling (megalopal) stage at 16ºC, requiring 52-82 days. In contrast, >65% of larvae reached the megalopal stage at 18ºC, requiring only 33-51 days. Thus, few larvae completed development at temperatures <18ºC, a threshold that larvae would regularly encounter north of Cape Cod. Transplant experiments using enclosures confirmed that benthic fiddler crabs would survive well in northern marshes if larvae were able to settle north of their current range limit. Surprisingly, larvae produced near the range edge had intrinsically faster growth rates than those from the south side of Cape Cod (reaching the megalopal stage 1 to 5.5 days faster at 18ºC). These results may reflect an adaptation to development in colder water (i.e., countergradient selection). However, our analyses of mitochondrial DNA sequences (COI) suggest high gene flow among populations with little differentiation across Cape Cod. In the face of this gene flow, we hypothesize that recurrent selection in the plankton for faster development times may lead to an unexpected accumulation of favorable adaptations in populations at the edge of the range. As a result, edge populations may play a dominant and unrecognized role in future range extensions.

Schaaf, J.A.*¹, D.A. Ebert¹,², and G.H. Burgess³,¹Moss Landing Marine Laboratories, Pacific Shark Research Center, ²Florida Museum of Natural History, University of Florida. THE DESCRIPTION OF A NEW SPECIES OF LANTERN-SHARK OF THE GENUS ETMOPTERUS (SQUALOIDEA: ETMOPTERIDAE) FROM TAIWAN
A new species of Squaloid shark of the genus *Etmopterus* is described from Taiwanese waters of the Western Pacific Ocean. *Etmopterus sp. nov.* is known from only one specimen collected in deepwater off Ta-chi, Taiwan and closely resembles other lantern-sharks of the “*Etmopterus lucifer* group” in having longitudinal rows of dermal denticles. The *E. lucifer* group includes *E. brachyurus* Smith & Radcliffe, *E. molleri* (Whitley), *E. splendidus* Yano, and *E. lucifer* Jordan and Snyder for which the group name was coined. The new species of lanternshark is identified as unique and separate from the aforementioned species based on the following characters; the length of the gill slits, body proportions and fin placement, the height of the 2nd dorsal fin and spine, the arrangement of flank and caudal markings, tooth morphology, and the presence or absence of dermal denticles on key areas of the body. Specifically, the gill lengths are longer on *E. sp. nov.* than any other species in the group when analyzed proportionally. In observing the body proportions, *E. sp. nov.* has a much shorter caudal peduncle, and a longer pectoral-to-pelvic distance than other members of the group. Relatively, the 2nd dorsal fine spine is medium sized, but the fin height is large. The dermal denticles on the ventral side of the snout are uniquely conspicuous in *E. sp. nov.* as other members largely lack denticles in this region. Finally, the most distinguishing characters of *E. sp. nov.* are the flank and caudal markings which resemble *E. lucifer*, but have a wider base.

**Schiel, David R.**  Marine Ecology Research Group, School of biological Sciences, University of Canterbury, Private Bag 4800, Christchurch, New Zealand. RIVETS OR BOLTS? WHEN SINGLE SPECIES COUNT IN THE FUNCTION OF TEMPERATE ROCKY REEF COMMUNITIES

There is considerable controversy about the role of individual species in ecosystem functioning. Most models stress the role of diversity in ecosystem function, but it is also recognised that individual species or functionally similar species can play prominent roles in assessments of function. In this talk, I discuss some of the necessary conditions for functional replacement and some aspects of function with respect to trophic relationships and species’ interactions with biogenic and physical habitats, with examples from rocky reefs in southern New Zealand and elsewhere.

**Sebens, K.P.**  Friday Harbor Laboratories, University of Washington. CAN CORALS COPE? LIMITS TO GROWTH IN A CHANGING ENVIRONMENT

Scleractinian corals use diverse resources to grow and calcify in habitats with scarce and potentially limiting resources. On shallow reefs, zooxanthellae translocate more than enough photosynthate to meet metabolic demands, yet nutrients needed for tissue growth can still be scarce. In deep reef habitats and other light limited reef locations, photosynthesis does not meet energetic needs. Zooplankton and other particulate material can be important sources of nutrients and energy to reef corals, and dissolved nutrient uptake can also be significant. Experimental results show that plankton capture rate can control calcification and tissue growth in several coral species. The effect of feeding on growth and calcification is often greater than that of other known controls, such as available bicarbonate concentrations, calcium saturation state, and water flow. The growth response of corals to simultaneously modified prey and irradiance indicates that zooplankton capture can control coral calcification even when irradiance is high. Comparisons of respiration and photosynthesis, with chlorophyll and zooxanthellae density/size, demonstrate changes occurring within the symbiosis with increased zooplankton capture. Allocation of energy and materials to tissue versus skeleton affects how corals grow, and may set limits on growth rates. Understanding interspecific differences in utilization of these diverse resources can help explain patterns of coral diversity, zonation, and abundance on reefs. Such information can be useful in interpreting changes in growth rate, and survivorship, with modifications of habitat quality and temperature.

**§ Selgrath, J.C.,1* Hovel, K.A.,1 Wahle, R.A.2** 1 San Diego State University. 2 Bigelow Laboratory for Ocean Sciences. EDGE EFFECTS ON AMERICAN LOBSTER (*Homarus americanus*) SURVIVAL AND ABUNDANCE

For species that are habitat specialists, the distribution and quality of habitat patches within a landscape can influence interactions such as predation and competition. These interactions may in turn influence populations and communities. In coastal waters, cobble substrate is a vital habitat for many marine organisms. Cobble is patchy at multiple spatial scales, but little is known about the influence of cobble patchiness on benthic organisms. Within patches, an organism’s distribution and predation risk may vary with distance from the patch edge. Inhabiting the edge may be beneficial if that species forages within the surrounding matrix, but may have negative consequences if the risk of predation is high near the edge. The American lobster (*Homarus americanus*) forms the most valuable
single species fishery in New England and depends on nearshore cobble habitat. To determine how proximity to edges influences the abundance and size of juvenile lobsters in shallow cobble patches, lobsters were surveyed in patches that bordered high and low quality matrix habitat (seagrass and sand respectively). Variation in relative predation rates between patches bordering high and low quality matrix habitat was compared to ascertain the influence of edge effects on juvenile lobster survival. Both experiments were conducted in natural cobble patches and in artificial cobble reefs of a standard size. Preliminary analyses indicate that juvenile lobster size distribution was random in relation to distance from the edge, that survival was highest in seagrass beds and edges adjacent to seagrass, and lowest in cobble patches and edges bordering sand. Determining the effect of Essential Fish Habitat on the survival and distribution of this species is critical for their effective conservation and management.

Shanks, A.L.1 and Roegner2, G.C. 1Oregon Institute of Marine Biology, University of Oregon, 2NOAA Fisheries, Point Adams Biological Field Station. THE COMMERCIAL CATCH OF CANCER MAGISTER VARIES WITH THE ABUNDANCE OF THEIR MEGALOPAE AND THE ABUNDANCE OF MEGALOPAE VARIES WITH THE TIMING OF THE SPRING TRANSITION

Over five-years, we collected daily samples of Cancer magister megalopae. Annual catch varied from <1000 to >79,000 megalopae. We found strong positive correlations between annual catch of megalopae and commercial catch of adults four years later from Coos Bay (r² = 0.979, P < 0.001, n=5) and Oregon (r² = 0.925, P < 0.009, n=5) suggesting that adult population size varies with the relative strength of larval recruitment and that mortality after recruitment had little affect on adult population size. At the end of larval development, C. magister larvae are generally found far from shore and off the continental shelf. Recruitment occurs in the spring and daily variation in megalopal abundance suggests that shoreward transport is due to currents over the shelf (e.g., internal tides and upwelling relaxation). For megalopae to return to shore, it appears they must first be transported onto the shelf. We hypothesized that this shoreward transport step is due to cross-shelf currents that occur during the seasonal“spring transition”. We correlated the timing of the spring transition with the size of the annual catch of megalopae and found a significant inverse relation (r² = -0.977, P < 0.001, n=5); when the spring transition was late catch of megalopae was small. If commercial catch varies with the annual abundance of megalopae and the annual abundance of megalopae varies with the timing of the spring transition then commercial catch should vary with the timing of the spring transition. We tested this by cross-correlating the Oregon commercial catch with the timing of spring transition. We found a significant cross-correlation at 4 years lag; nearly 50% of the annual variation in the commercial catch was due to the timing of the spring transition 4 years earlier. These data strongly suggest Cancer magister populations are limited by larval supply.

§ Shinen, J.L. * University of California Davis. ARE PISASTER AND NUCELLA CONDITIONAL KEYSTONE PREDATORS? SCALING UP FROM CAGES IN THE ROCKY INTERTIDAL

Classic studies in marine ecology have demonstrated that certain “keystone” predators, such as Pisaster ochraceous and Nucella ostra, can indirectly enhance community diversity through direct consumption of numerically dominant prey. Most of these studies, however, are conducted at limited scales, utilizing replicates of small exclusion or inclusion structures. Moreover, it is relatively unknown, how Pisaster and Nucella interact as competitors or as predator and prey. In this study, the interguild interactions between Pisaster and Nucella are examined in both laboratory and field settings. Factorial manipulations of Nucella, Pisaster, and shared prey, Mytilus californianus were conducted in sea water tanks. Results indicate a strong trait mediated indirect effect of Pisaster on the predation of Mytilus by Nucella. In addition, Pisaster only consumes Nucella when Mytilus is absent. Pisaster feeding and behavior, on the other hand, are unaffected by the presence of Nucella. To assess the direct and indirect effects of multi-tropic interactions of Pisaster and Nucella in a natural setting, whelks and sea stars were removed factorially from a series of intertidal boulders. Relatively isolated by sand and cobble, large boulders approximate discrete replicates of rocky intertidal communities where movement of predators among boulders is limited. Recruitment and changes in community structure are monitored monthly. Surprisingly, after approximately one year, results indicate that the removal of Pisaster and/or Nucella has no direct effect on the distribution and abundance of numerically dominant prey species. However, trends suggest that in the absence of predators, species diversity and macroalgal abundance declines whereas the abundance of grazers increases. Furthermore, these trends are conditional upon the westward and southward faces of the boulders. These initial results suggest that Nucella and Pisaster are affecting communities primarily through trait mediated indirect effects, but only under specific environmental or physical settings.
Small, S.T.* and J.P. Wares. University of Georgia. IS GENETIC DIVERSTIY A CONCERN WITH MARINE MANAGEMENT?

Genetic diversity can be thought of as the evolutionary potential of a species and an important component of species persistence in a changing environment. Genetic diversity has recently been shown to be highly linked with biodiversity and important in species resilience to disturbances (Vellend 2003, Hughes and Stachowicz 2004). In this study we focus on genetic diversity within marine communities. Within communities, species are exposed to numerous evolutionary pressures, and genetic variation is fundamental for long-term species survival and community interaction. With this in mind, we considered whether the selection of areas for marine management reflects patterns of higher localized genetic diversity associated with clines or other phylogeographic transitions (Bradshaw 1991, Endler 1977).

Smith, J. E. * and E. J. Conklin. National Center for Ecological Analysis and Synthesis, University of California Santa Barbara, University of Hawaii, Manoa. DIVERSITY AND INVASIBILITY IN A CORAL REEF ECOSYSTEM: EFFECTS OF DIVERSITY ON INVISIBILITY AND THE EFFECTS OF INVASION ON EMERGENT ECOSYSTEM PROPERTIES

Understanding the role of diversity on invasion success has been the topic of many recent studies in both terrestrial and marine systems. While some studies show a negative relationship between diversity and invasibility others show a positive relationship. Where diversity and invasibility are positively correlated it has been suggested that factors that co-vary with diversity may actually be driving invader success. In this study we tested the effects of benthic diversity on the success of an invasive marine macroalga (Eucheuma denticulatum) in a coral reef ecosystem in the Hawaiian Islands. We found that invasion success was positively correlated with diversity in this system and that habitat complexity (three-dimensionality) covaried with diversity and hence invasion success. Further not only were more diverse and more structurally complex plots more readily invaded in this system but one year after invasion both diversity and complexity were significantly reduced in invaded plots; sometimes by over half. By denuding three dimensional complexity, this invader likely reduces benthic diversity through a reduction in overall habitable space. These results have significant negative implications for the overall structure and subsequent function of reefs following invasion by this macroalga.

Smith, J.R. California State University, Fullerton. DRAMATIC DECLINES IN MUSSEL (MYTILUS) BED COMMUNITY DIVERSITY ALONG THE WAVE EXPOSED COAST OF CALIFORNIA: RESPONSE TO CLIMATE CHANGE?

The crisis of biodiversity loss is of great concern. Mussel beds along the wave-exposed coast of the eastern North Pacific serve as an important habitat harboring a high diversity of species with richness exceeding 170 species at some sites in the past. A comparison of California mussel bed community diversity in 2002 to historic data (1960s-1970s) revealed large declines (mean loss 58.9%), including some declines exceeding 141 species (~80% loss). These declines were observed at sites in all sampled regions including southern, central, and northern California. Concurrent work revealed inconsistent changes in mussel populations along the California coast. Mussel cover and biomass in southern California declined markedly over the past few decades with mean losses between 40-50 % that of historic data. Changes in mussel bed thickness were not as strong as cover and biomass, but also appeared to be reduced. Declines were limited to the southern California region, since mussel cover, biomass, and bed thickness remained unchanged or increased at sites in central and northern California. Patterns of mussel bed change limited to the southern California region, while diversity reduction was observed along the entire California coast, suggests that diversity declines may be related to large-scale processes rather than local habitat destruction. Potential factors causing declines in mussel community diversity were considered with support suggesting that climate change and climate change induced alterations of ecological interactions and biological processes are likely the cause. Although extensive literature has predicted the potential effects of climate change on global diversity, this study is one of the few examples of declines attributed to climate change.

Spalding*, H.L., Ross, M., Okano, R. and K. Peyton. University of Hawaii at Manoa, Botany Department. DEMOGRAPHY AND GROWTH OF HALIMEDA MEADOWS IN HAWAII: MAKING SAND IN PARADISE
The calcified green alga, *Halimeda kanaloana*, is an endemic species in Hawaii forming expansive meadows in sand from 1 to 90 m depths. Recent surveys have revealed large populations of this alga covering hundreds of square kilometers around Maui, Moloka‘i, Kaho‘olawe, and Lana‘i (Maui Nui island complex). The distribution and abundance of this species suggest that it may be an important ecological foundation species and CaCO₃-producer in this region. Given that the majority of the population occurs at depths greater than 20 m, an understanding of variability in demography with depth is crucial for determining its contribution to CaCO₃ production. The objectives of this study were to elucidate patterns of growth, abundance, and nutrient status across a broad depth gradient to develop a rough estimate of CaCO₃ production. Growth, abundance, and morphometrics were measured for plants at 10, 15, 20, and 30 m depths at Kahekili, west Maui and compared with other collections throughout Maui Nui. The photosynthetic efficiencies of plants with and without nutrient manipulations were measured at similar depths with a diving Pulse Amplitude Modulated (PAM) fluorometer. Plant height and densities generally increased with depth, although the number of segments per plant was greater at shallower depths. A large cyanobacterial bloom and urchin recruitment event caused a ~10-20% plant mortality over the course of the growth period. Despite the effect of these natural disturbances, plants averaged 15% new growth (newly grown segments to existing segments) over a 7 day period, with similar growth rates across all depths. *Halimeda kanaloana* appears to be a highly productive and fast-growing species across a wide depth gradient, likely contributing to its success and high densities across Maui Nui. Additional studies over a larger spatial and temporal scale will contribute towards the development of a CaCO₃ production model for this species in Hawaii.

§ Stallings, C.S. Oregon State University. FISHING OUT DIVERSITY: NON-TARGETED PREDATORS REDUCE RECRUITMENT OF CORAL-REEF FISHES

Changes in the relative abundance of top predators may have strong “top-down” effects on the abundances of other species within a community. Throughout the greater Caribbean, intense fishing has depleted populations of Nassau grouper (*Epinephelus striatus*), while populations of the un-fished coney grouper (*Cephalopholis fulva*) have proliferated, possibly due to decreased ecological interactions between the two grouper species. I experimentally tested the effect different groupers had on recruitment of other coral reef fishes to spatially isolated reefs in the Bahamas. Each of 18 reefs was subjected to one of three grouper treatments: Nassau grouper only, coney grouper only, and control (no grouper present). I then conducted complete fish community censuses over an eight-week period. Fish recruitment to reefs occupied by Nassau grouper was similar to that on control reefs, and both were over 2.6 times the recruitment to reefs occupied by coney grouper. Among the most common species observed, significantly higher recruitment of beaugregory damselfish (*Stegastes leucostictus*), rosy blenny (*Malacoctenus macropus*), striped parrotfish (*Scarus iserti*), and stoplight parrotfish (*Sparisoma viride*) occurred on Nassau grouper and control reefs. These results show that different species of top predator can have substantially different effects on lower trophic levels. Shifts in dominance of predatory species may therefore lead to dramatic changes in abundance and diversity of entire communities. To strengthen marine conservation efforts and increase the sustainability of fished populations, fisheries management should address both the direct and indirect effects of fishing on marine communities.

Steele*, M.A., S.C. Schroeter, H.M. Page, and D.C. Reed. University of California, Santa Barbara. AN EXPERIMENTAL EVALUATION OF BIASES ASSOCIATED WITH SAMPLING ESTUARINE FISH WITH SEINES

Seines are among the gear most commonly used to estimate the density and species richness of fishes in estuaries, yet their biases and the causes of those biases are not well understood. Without knowledge of the causes and magnitudes of potential biases, it is difficult to account for them and make valid comparisons among studies that use different methods. In this study we evaluated biases and their causes associated with the use of beach seines and purse seines to sample fish. For both types of seines, we found that net length had large effects on estimates of density. Net length did not affect estimates of species richness from beach seines; but a larger purse seine provided higher estimates of species richness per sample and per unit effort, but not per area, than did a smaller one. Beach seining conducted in segments of waterways that were blocked with other nets produced estimates of density and species richness that were significantly higher than those from seining in unblocked areas. The number of times a beach seine was hauled through a blocked area also had major effects on estimates of density and richness because many fish initially evaded capture. Underestimates were more pronounced for demersal fish, which evaded capture better than midwater species. Thus, estimates of community structure (e.g., relative abundance) were biased, but...
could be corrected since we measured the degree of bias. We found that seines are excellent tools for sampling many estuarine fishes, provided that their biases are quantified and accounted for.

Jason Stier, A.C. 1, Dahlgren C.P. 2 Caribbean Marine Research Center, Perry Institute for Marine Science. RATES OF PREDATION ON JUVENILE QUEEN CONCH (Strombus gigas): HOW DENSITY AND SUBSTRATE AFFECT THE SURVIVORSHIP OF JUVENILES

Experimental manipulations have shown predation to be one of the key factors governing patterns in population dynamics. In this study, predation rates on juvenile conch were investigated using tethering in order to determine if predation is a limiting factor in juvenile conch nursery distribution. Regular observations of each site were made over a span of 7 weeks. Two hundred conch were divided into 20 different sites along Lee Stocking Island and Norman’s Pond Cay, Bahamas. Conch were placed at both high and low densities into 4 previously categorized habitat suitabilities, and attached to a 1-m-long piece of monofilament, which was secured to the bottom by a metal stake. Total length of conch ranged from 100-150 mm, and growth was measured at all sites. True Tulip snails were observed (Fasciolaria tulipa) preying upon conch. Other potential predators were observed at one or more sites including: Caribbean Spiny Lobsters (Panulirus argus), Southern Sting Rays (Dasyatis americana), and Giant Hermit Crabs (Petrochirus diogenes) (Marshall, 1988). Low survivorship was recorded in hard bottom areas in comparison to seagrass sites. Data suggests that predation is a limiting factor for conch nursery distribution. Results of a survival analysis will be discussed.

Robert Studebaker, R.S.*, Mulligan, T.J., Cox, K.N. Humboldt State University. USE OF ROCKY INTERTIDAL AREAS BY JUVENILE BLACK ROCKFISH, SEBASTES MELANOPS

Juvenile black rockfish, Sebastes melanops, primarily recruit to the nearshore waters of northern California and Oregon. However, their temporary residence in rocky intertidal areas has received little attention. This study examined recruitment and feeding habits of juvenile black rockfish at three rocky intertidal locations in northern California from 2003 to 2005. Juveniles were noted in the rocky intertidal from May through August with peak abundances occurring in May or June. Residency time within the rocky intertidal ranged from 29 to 100 days, depending on location. Interannual variation in recruitment was strongly evident. Abundances in 2004 were four and nine times greater than the abundances observed in 2003 and 2005, respectively. Variation in fish abundance among sites was also observed over the three year period. For example, abundances at our central location in 2004 were eight times greater than they were at our most southern site. A feeding study showed that juvenile black rockfish consume a wide variety of prey items while in the rocky intertidal. However, Index of Relative Importance values suggest that Harpacticoid copepods and Gammaridean amphipods are the prey most often taken. To further examine the geographical range of rocky intertidal use, by this species, sites ranging from Bodega Bay, CA to Ecola State Park, OR were sampled in 2005. These data show that juvenile black rockfish recruit to rocky intertidal habitats from at least Mendocino County, CA northward to the Oregon/Washington border with peaks of abundance occurring in southern Oregon. These investigations suggest that rocky intertidal areas are important nursery habitats for juvenile black rockfishes throughout Oregon and northern California.

Stephanie Talmage, Stephanie C.*, and R.C. Carpenter. Department of Biology, California State University Northridge. PATTERNS OF ABUNDANCE OF SARGASSUM MANGAREVENSE ACROSS HYDRODYNAMIC AND HERBIVORY GRADIENTS IN MOOREA, FRENCH POLYNESIA

The development of optimal resource allocation under particular environmental conditions can determine the distribution of aquatic organisms. In response to local environmental conditions, macroalgae have been shown to apportion resources differentially. Macrocystis can alter material properties, growth rates, and levels of chemical defenses to resist herbivory and increase their population size. This study considers how the combined effects of water motion and herbivory can alter the distribution and responses of a macroalgal species across a reef ecosystem in Moorea, French Polynesia. Maximum water flow was estimated in three reef habitats (reef crest, backreef, and fringing reef) using dynamometers. Sargassum mangarevense abundance, growth rates, herbivore abundances, and grazing intensity were estimated in each reef habitat. Both the abundance and growth rates of S. mangarevense were highest in the high flow habitat (reef crest) where herbivore abundance and grazing intensity are reduced. However, holdfast tenacity and stipe strength were greatest in the backreef. A lab feeding assay using a common echinoid suggests that algal thalli from the reef crest are preferred over those from the other reef habitats and may indicate
that chemical defenses are reduced in reef crest thalli and indicating a trade-off between allocation to growth and chemical defenses. Allocation to material properties that influence biomechanical performance may be related more closely to forces experienced by thalli that are density-dependent. The continued quantification of these patterns will help elucidate how gradients in abiotic and biotic factors influence resource allocation and ultimately patterns of distribution and abundance in this common coral reef seaweed.

§ terHorst, C.P.* and P. Munguia. Florida State University. BIOMASS AND PRODUCTIVITY RELATIONSHIPS ARE LIKE A BOX OF CHOCOLATES…

In theory, a positive relationship between biomass and productivity should exist, unless other processes reduce biomass. In natural systems though, many forces, including herbivory, senescence, and abiotic stress, constantly remove biomass from the system. As a result, the relationship between biomass and productivity is highly context-dependent. Although this is well documented, recent community and ecosystem studies have continued to assume a strong positive relationship between productivity and biomass. The practical reason for this is that it is much easier to measure biomass than to monitor productivity over time. We tested the assumption of a positive relationship in seagrass beds at St. Joe Bay, Florida in the Gulf of Mexico. Growth of Thalassia testudinum was measured over a short time period to avoid losing seagrass biomass during the study period. Growth was used as a measure of productivity (defined as biomass produced per unit time). Epiphytes were removed from all blades and dry weights were measured. We found that the relationship between biomass and productivity is not always positive, and when it is, the amount of variance explained is often low. Additionally, biomass-productivity relationships in seagrass beds are scale-dependent. Correlations within beds were varied and ranged from positive, to no relationship, to negative. When beds were pooled into a regional scale, there was no relationship between biomass and productivity. Differences between beds may be due to differential herbivory, exposure to wave action, the percent cover of epiphytes, or genetic differences. We stress that biomass is a static measure and does not reflect the dynamic nature of productivity or other forces over time. The relationship between biomass and productivity is not consistently predictable and each serves as a poor proxy for the other.

Thiel, Martin* 1,2 and Lars Gutow3. 1Facultad Ciencias del Mar, Universidad Católica del Norte, 2Centro de Estudios Avanzados en Zonas Áridas (CEAZA) Coquimbo, Chile; 3Alfred Wegener Institute for Polar and Marine Research, Germany. NOT EVERYBODY CAN PARTICIPATE IN THE RAFTING ROULETTE – THE BIOLOGY OF ORGANISMS TRAVELING ON FLOATING ITEMS

Dispersal processes in the sea depend to a large extent on marine currents. In species that are dispersed via particular agents (birds, fish, humans or floating items) the characteristics of the transport medium also play an important role. Herein we will focus on dispersal on floating items, i.e. rafting. A wide diversity of organisms has been reported as rafters on floating items in the sea, primarily on floating macroalgae, wood, plastics and pumice. Different selective pressures on these main types of rafts may affect the assemblage of species that are successfully dispersed by this mechanism. We hypothesized that (i) species with certain reproductive characteristics (asexual reproduction, self-fertilization, direct development) will dominate among rafters, and that (ii) feeding biology and mobility of rafters is affected by the characteristics of floating substrata. In order to test these hypotheses we evaluated an extensive database, containing reports on 1205 rafters ranging from microalgae to terrestrial mammals. The most abundant phyla were arthropods (410 species, 34.0% of the total), molluscs (186 species, 15.4%), and cnidarians (131 species, 10.9%). More than 50% of the reported species, for which information of reproductive biology was available, feature direct development. There was also a relatively high number of asexually reproducing rafters and some self-fertilizing hermaphrodites. Most feeding types were represented, and suspension-feeders were most common on abiotic substrata (plastics and pumice), while grazers abounded on biotic substrata (macroalgae and wood). Sessile species dominated on abiotic substrata while many species on biotic substrata are mobile. It is concluded that the species more prone to become dispersed over long distances are those that feed on allochthonous food sources (leaving rafts intact) and that have direct development, because these traits facilitate species persistence on floating items. Funding source: FONDECYT 1010356

§ Thomas, Oliver* and Steve Palumbi. Hopkins Marine Station, Stanford University. A MULTI-LOCUS APPROACH TO THE STUDY OF THE FUNCTIONAL DIVERSITY OF CORAL ZOOXANTHELLAE – EARLY EXAMPLES FROM THE PACIFIC
Coral bleaching events are strongly correlated with local ocean heating events. These breakdowns of symbiosis between reef-building corals and their dinoflagellate endosymbionts (Symbiodinium spp. – dubbed zooxanthellae), often lead to high coral mortalities and represent ecosystem-wide disturbances. Previous research has established the existence of Symbiodinium strains that are relatively more and less susceptible to temperature stress, but genetic descriptions of these strains have been very coarse. Generally researchers use a single neutral locus to classify a given strain as belonging to one of a handful of deeply divergent clades, each of which has a large degree of within-clade diversity. We are currently using genomic techniques to develop and test new markers that will allow us to more accurately genotype these symbionts, build more resolute phylogenies, and provide information about the critically important functional divergence in Symbiodinium. This talk presents our approach and some early data from two islands in the Pacific –Palmyra Atoll, and Ofu Island, American Samoa. Samples of the table-top corals Acropora hyacinthus and A. cytherea were collected from similar depths in both locations. For the nuclear gene Chloroplast Ferredoxin, Palmyra corals host only two functionally identical genotypes while Samoan corals host a wide diversity of genotypes. Much of this nucleotide diversity in Samoa is non-synonymous, meaning that these substitutions change the amino acid sequence of the encoded protein. The protein in question is a member of the photosynthetic electron transport chain and mediates the electron transfer that results in the greatest generation of radical oxygen species (ROS), toxic agents causally linked to bleaching. Functional diversity or lack thereof at such a gene may argue for distinct population-level responses to climate change. By using our emerging understanding of functional diversity we may be able to provide a local conservation means for addressing the global problem of climate change.


NOW AND THEN: MITOCHONDRIAL AND MICROSATellite MARKERS REVEAL PATTERNS OF HISTORIC AND CONTEMPORARY GENE FLOW IN A CORAL REEF FISH

Genetic markers can provide insight towards the dispersal dynamics of marine species. Due to variability in rates of mutation among genes, however, some markers are more likely to resolve historic dispersal whereas others have greater potential to expose contemporary movement. To investigate movement of a coral reef lagoon fish at both long (10^5-years) and short (10^1-years) time scales, we examined genetic structure of the fierce shrimpgoby, Ctenogobiops feroculus, using relatively slowly (mitochondrial cytochrome b) and rapidly (9 microsatellite loci) evolving genes. We collected gobies from 11 islands (Okinawa, Fiji, Cook Islands, Society Islands, and Tuamotu Islands) that are separated from each other by 5 orders of magnitude (10^0 – 10^5 km). The degree of genetic structure differed between markers as the smallest scale at which isolation-by-distance was detected was 10^5-km (Fijian to Tuamotu Islands) with cytochrome b, but 10^1-km (within the Society Islands) with microsatellites. Next, analyses using mitochondrial DNA indicated that gobies in French Polynesia had experienced a bottleneck followed by sudden population expansion. Microsatellites, however, failed to detect a bottleneck or rapid population growth. These disparate results can be explained in part by the geological history of Pacific Islands. Due to sea level fluctuation associated with global climate change, many shallow lagoons (in which C. feroculus resides) were destroyed during the last glacial maximum (~11 kybp). As sea levels rose to present levels (~6 kybp) and lagoons were reestablished, gobies probably invaded via incidents of rare, long-distance dispersal from habitats that remained intact during periods of low sea level. Following initial colonization, however, it is likely that inter-island movement was more restricted. Hence, cytochrome b results probably reflect historic colonization events and subsequent population expansion associated with major changes in climate. Microsatellites, by contrast, probably depict more restricted movement and stable population sizes that typify present-day conditions.

§ Thompson, S. A.* and K.J. Nielsen. Sonoma State University. ASSESSING THE IMPACT OF COMMERCIAL COLLECTING ON POSTELSIAS PALMAEFORMIS

The Sea Palm (Postelsia palmaeformis) is a highly recognizable rocky intertidal organism endemic to the West Coast of North America and an increasingly popular commercial product for local seaweed collectors. It is also a signature menu item in several Mendocino county establishments. However, little is known about the impact of commercial collecting on Postelsia populations. Current regulations for commercial collection of edible seaweeds do not take a precautionary approach, nor do they require reporting of species or location specific information on landing reports. Postelsia is vulnerable to commercial over-exploitation because of its annual life history and limited dispersal. Commercial collecting techniques vary but many collectors claim to use methods that ensure sustainable use of the resource. We are studying the effects of different collection methods on Postelsia populations by mimicking collection methods in controlled field experiments. Here we report on the results of an experiment. 
initiated this summer to examine the impact of one collection technique (cutting fronds below the meristem in May prior to reproductive maturity) on frond re-growth, reproductive output and density of individuals in treatment plots. The experiment was replicated at two sites in northern California. Fronds re-grew after clipping but were more ruffled in their morphology and remained shorter than unclipped fronds through mid-September. Stipe lengths, frond widths and density of individuals in plots did not vary between treatments. However, the appearance of sori was delayed on clipped fronds relative to unclipped fronds, and reproductive output (measured as sorus area) was reduced. Changes in timing of reproduction and reproductive output may have important consequences for local population dynamics.

§ Thurber, A.T. Scripps Institution of Oceanography. THE GUTLESS LINK BETWEEN THE PELAGIC MICROBIAL LOOP AND BENTHIC METAZOAN FOOD WEB: FATTY ACIDS AND STABLE ISOTOPES IN ANTARCTIC SPONGES

The Antarctic is an ecosystem where the pelagic microbial loop may be utilized by benthic suspension feeders to survive through the food poor winter. This study used three techniques, fatty acid analysis, stable isotope concentrations, and a laboratory based feeding study, to address the role of the microbial loop in four species of Antarctic sponge: Homaxinella balfourensis, Isodictya setifera, Kirkpatrickia variolosa, and Sphaerotylus antarcticus. Sponges were sampled at distances between 115 and 840 m from the McMurdo station sewage outfall to provide diet variability. The sewage effluent acted as a tracer for particulates larger than bacteria. Sponge diet ranged from primarily bacteria in the case of I. setifera, to larger particles for H. balfourensis. The diet of K. variolosa was intermediate between these. The diet of S. antarcticus was not completely resolved by this study; fatty acid analysis supported its similarity to K. variolosa yet the isotopic analysis and feeding study separated it from other sponges studied, suggesting that symbionts were abundant enough to confound the results. This study is the first application of fatty acid analysis to determine diet composition of sponges, the first stable isotopic analysis of Antarctic sponges identified to species, and the first conclusive evidence of differential utilization of microbial loop components by co-occurring sponges.

Tissot, B. N.*; W. J. Walsh2, and L. E. Hallacher3. 1 Washington State University Vancouver, 2 Hawaii Division of Aquatic Resources, 3 University of Hawaii Hilo. EVALUATING THE ECONOMIC, SOCIAL AND ECOLOGICAL EFFECTIVENESS OF A MARINE PROTECTED AREA NETWORK IN HAWAI’I

A network of nine marine protected areas was established on the west coast of the island of Hawai’i in 2000 in response to declines of reef fishes taken by aquarium collectors. In 1999, we established 23 study sites in MPA areas, areas open to fishing, and control areas (existing protected areas) to collect data both prior to and after the closure of the network in 2000. Five years after closure of the FRAs, 7 of the 10 most heavily collected fish species have increased overall. Yellow tangs which constitute 84% of all harvested fish increased 49% and chevron tangs increased 141%. Overall 7 of 9 showed a positive effectiveness for yellow tangs with four having statistically significant increases in abundance. The effect of the FRAs has also been positive on the fishery and have reduced social conflicts. The average number of commercial aquarium collectors, total catch, price per fish, and CPUE during the four years after FRA establishment is higher than the comparable period before FRA establishment and the total economic value of the of the aquarium fishery has reached new heights. Effective replenishment has been linked to high levels of newly recruiting aquarium fishes observed in 2001-03. Previous work also indicates that habitat characteristics, FRA size, and density of adult fishes are important factors influencing the effectiveness of FRAs. The widespread occurrence of increases of aquarium fishes in FRAs, combined with a large and significant increase in the yellow tang, indicates that the FRAs are effectively replenishing aquarium fish stocks in Hawai`i after five years of closure.

Tran, C.*, B. L. Sanderson, H. Coe, K. Macneale, and V. Pelekis. Northwest Fisheries Science Center, NOAA Fisheries. NUTRIENT LIMITATION ACROSS MULTIPLE ANADRAMOUS STREAMS IN IDAHO

Spawning adult salmonids deliver marine-derived nutrients vital to the ecology of inherently oligotrophic streams throughout the Pacific Northwest. The Salmon River basin in Idaho is an area where low ambient concentrations of lotic nitrogen (N), declining salmon stocks, and previous nutrient studies imply N-limited streams. Our study includes 12 anadramous chinook-dominated tributaries in this basin. To determine the magnitude and mechanisms of nutrient limitation we conducted in-stream nutrient diffusing substrate experiments between July and September in 2003-2005 to measure algal biomass accrual (chlorophyll a) in control, N, P, and N+P treatments over 30-day
periods. [0.5]M of NH₄NO₃ and [0.2]M KH₂PO₄ were used for N and P treatments respectively, and those were combined for N+P treatments. Our results indicate primary N limitation and N+P co-limitation in most surveyed streams. In 19 of 32 experiments, chlorophyll a levels increased from two- to nine-fold in N+P treatments relative to controls. N treatments showed a two- to four-fold increase in 12 experiments. Interestingly, in 25 experiments P treatments yielded significantly lower levels of chlorophyll a than in control treatments. In 2005, we explored this inhibitory algal growth response seen in P treatments, which is also documented in other studies but not yet explained, by using an aqueous medium for nutrient diffusion (versus agar) and a lower P concentration. Identifying patterns of nutrient limitation is a critical first step in assessing whether nutrient additions are appropriate restoration measures for streams with declining numbers of returning adult salmon.

§ Vega Thurber, R.L. and Epel, D. Hopkins Marine Station, Stanford University. POTENTIATION OF GENOTOXINS VIA INHIBITION OF EFFLUX TRANSPORTERS IN VIVO

Hypothesized to be a first responder system to eliminate toxins, efflux transporters exhibit broad specificity for natural and anthropogenic pollutants. This broad specificity can be both a blessing and a curse for organisms attempting to combat the dynamic and extensive range of potentially harmful chemicals in their environments. Complex mixtures can lead to activation of this stress defense system but can also overwhelm it through competitive binding and direct inactivation. How this dynamic system works is still debatable, but we demonstrate here that when embryos are exposed to inhibitors of the transporters and non-lethal doses of transporter substrates in vivo there are dramatic adverse effects on development and survival. Using larvae of the sea urchin, Strongylocentrotus purpuratus, we show that while low doses of the genotoxin etoposide (1 M) are ineffective at producing DNA damage, cellular apoptosis, and embryo death, double exposure to inhibitors of the MRP and P-pg type transporters, increases the intracellular concentration of etoposide and ultimately induces irreparable amounts of DNA damage, including but not limited to: chromosome bridges, aneuploidy, and cytokinesis abnormalities. In addition, double exposure to non-toxic levels of both etoposide and the transporter inhibitors verapamil and reversin 205 leads to as much as a 4 fold increase in developmental apoptosis and consequentially 100% embryo mortality. Therefore, inhibition of efflux transporters ultimately can reduce the effective dose or potency of etoposide by several orders of magnitude which demonstrates that while single low doses of chemicals alone may have no toxic effects, co-exposure to the transporter inhibitors can potentiate the detrimental effects of seemingly benign natural and anthropogenic toxins in the environment.

Wahle1*, R.A., M. Gibson 2 and K.A. Hovel3. 1Bigelow Laboratory for Ocean Sciences, 2Rhode Island Division of Fish & Wildlife, 3San Diego State University. IMPACT OF SHELL DISEASE ON LOCAL RECRUITMENT DYNAMICS OF NEW ENGLAND LOBSTERS

Understanding the relative importance of pre- and post-settlement processes to the dynamics of marine open populations remains a central issue in marine ecology. One of the most practical applications of this knowledge is in forecasting recruitment trends in fisheries, a goal that has been particularly elusive for the American lobster (Homarus americanus). Here we describe the first demonstration of a predictive relationship between a post-larval settlement index and the resultant abundance of older “pre-recruit” lobsters near harvestable size. This analysis includes the 1990 to 2004 year classes in coastal Rhode Island, where since 1996 epizootic shell disease has been increasing dramatically, and now affects about one-third of the near-shore population. We discuss the impact of this disease event in the context of larger scale geographic patterns of lobster abundance and sources of post-settlement mortality along the steep environmental gradients characteristic of coastal New England. For Rhode Island, settlement alone accurately predicted pre-recruit abundance, for all cohorts up through 1996. As shell disease became increasingly prevalent among older juvenile and adult lobsters in this region, an additional disease severity term was necessary to continue to predict pre-recruit trends with reasonable accuracy. Shell disease appears to have increased rates of natural mortality sufficiently to obscure the simple settler-to pre-recruit relationship. Despite this local collapse of the lobster fishery, settlement densities have remained relatively high, suggesting a considerable larval subsidy from healthy populations offshore, which may bode well for recovery if and when the disease abates.


In between pure salt marsh and pure upland vegetation lies a narrow band of transitional habitat, the salt marsh-upland ecotone. While much attention has been focused on threats to salt marsh habitats and on restoration of
degraded marshes, little is known about the ecotone that lies just above it. The goal of our investigation was 1) to characterize this transition zone, and 2) to examine the effects of human disturbances on it. We carried out transects sampling vegetation and soil parameters at 18 locations around Elkhorn Slough, central California. Overall, we found that the ecotone represents a very narrow zone, just a few meters wide, yet harbors many plant species – at all our sites combined, we found a total of about 70 species (8 native saline-dependent species, 3 non-native saline species, 24 native upland species, and 34 non-native upland species). We found that sites with cattle had more than 50% bare ground, while those without had less than 5%, but assemblages and soil parameters were otherwise similar in these two regimes. Tidal flow levels had minor effects on plant assemblages and soil parameters, but had dramatic effects on ecotone width. In particular, sites with muted flow (lagoons connected to tidal areas by culverts or tidegates allowing for regular but limited exchange) had extremely narrow ecotones and thus this transitional habitat was virtually absent from these managed areas. Biological invasions by upland plants were conspicuous in the ecotone; about 15% of the cover was by non-native upland plants (e.g., poison hemlock, sickle grass, sowthistles). Cover by native saline-dependent species increased with soil salinity and moisture, while cover by non-native upland plants decreased. The salt marsh ecotone us thus a rich, but extremely rare estuarine habitat type, that is affected by anthropogenic disturbances such as cattle grazing, tidal restriction, and biological invasions.

§ Weng, Kevin C. ¹, Andre Boustany¹, Scot Anderson², Adam Brown², Peter Pyle², John O’Sullivan³, Christopher G. Lowe³, Chuck Winkler⁵ and Barbara A. Block¹
¹Hopkins Marine Station of Stanford University, ²PRBO Conservation Science, ³Monterey Bay Aquarium, ⁴California State University, Long Beach, ⁵Southern California Marine Institute. HABITAT, MIGRATION AND ONTOGENETIC NICHE SEPARATION IN WHITE SHARKS IN THE EASTERN NORTH PACIFIC

White sharks (Carcharodon carcharias) were tracked in the North Pacific Ocean using satellite tags, revealing the contrasting habitats and migratory behaviors of adult and juvenile white sharks. Adult white sharks showed both coastal and pelagic phases, moving between northern California waters and the oligotrophic subtropical gyre between Baja and Hawaii, with one shark reaching Hawaiian waters. Juvenile white sharks moved along the continental margin from southern California to Baja, suggesting a large nursery region spanning US and Mexican waters. The habitat of the white shark in the Eastern Pacific appears to change dramatically with age, and the movements of sub-adult age classes remain poorly known.

§ Whitcraft, C.R.* ¹, Crooks, J.A², Demopoulos, A. ¹, Levin, L.A.¹, and Talley, D.M.³
¹Scripps Institution of Oceanography, ²Tijuana River National Estuarine Research Reserve, ³UC Davis. INVASIVE TAMARISK ALTERS THE PHYSICAL ENVIRONMENT AND SEDIMENT FOOD WEB IN A SALT MARSH ECOSYSTEM

Tamarisk is an invasive plant native to Asia that has become established in many freshwater systems in the Western United States, often with disastrous effects. I am studying the first-documented occurrence of tamarisk in a salt marsh in Tijuana Estuary. The goal of my research is to determine the effect of tamarisk on benthic invertebrate and algal communities and on the sediment food web. Stable isotope analyses offer a powerful approach for addressing questions of trophic structure. One approach involves natural abundance stable isotopic analyses. Isotopic enrichment experiments can also be used to create an unambiguous marker that can be tracked through food chains. Comparisons between natural- and tamarisk-invaded habitat patches demonstrate that tamarisk significantly decreases light, humidity, and temperature at the sediment surface, decreases snail abundance, increases Chl a biomass, and decreases organic matter content. Litter dynamic observations demonstrate that tamarisk detritus is not lingering under trees; the detritus is either being exported out of the area, decomposing quickly, or being rapidly consumed. Enrichment experiments induced a positive behavioral response of Melampus olivaceus to N-enriched tamarisk detritus. Results of natural abundance and enrichment experiments as well as Melampus feeding experiments indicate that N derived from tamarisk detritus is entering the sediment food web and potentially altering the trophic structure of the underlying natural community. This research will help characterize the impact of tamarisk into salt marsh environments in both an ecological and management context.

White, J.S.† Department of Zoology, University of Florida. DIRECT AND INDIRECT EFFECTS OF A MARINE ECOSYSTEM ENGINEER ON CORAL GROWTH AND SURVIVAL
Territorial damselfish occupy defined areas which they actively defend from competitors and egg predators. Within this diverse group, only territorial algal “farmerfish” stimulate physical state changes in the benthic structure of coral reefs. These farmerfish develop and maintain conspicuous filamentous algal mats (hereafter, turf) through two behavioral adaptations: (1) territorial defense to reduce herbivory and (2) active farming (e.g., preparing substrata by killing coral, “weeding” by removing unpalatable algae, and fertilization through defecation). The consequences of these behaviors for benthic algal biomass, diversity, and productivity have been well-documented; however, the relative effect of these behaviors on coral community structure is unknown. For example, some studies report turf can overgrow or increase sedimentation on hermatypic corals and coral spat, thereby decreasing survival; while others document increased recruitment and survivorship of juvenile corals within farmerfish territories. I conducted a fully factorial experiment to determine the relative effects of farming turf and territorial aggression on the growth and survival of four common species of coral. I manipulated the presence of the farmerfish Stegastes nigricans and turf on isolated patch reefs with an additional positive control consisting of homogeneous reefs never colonized by S. nigricans (yielding five treatments). I used the buoyant weight technique and digital photographs to determine the survival and growth of 480 coral transplants. Sub-treatments (cage, cage control, open) were applied within each treatment to tease apart the effects of S. nigricans vs. transient fishes. Fish assemblages changed with the removal of S. nigricans yielding concurrent changes in reef composition. The strength and direction of survival and growth effects varied with coral species; for example, two species exhibited higher survival due to an indirect positive effect of territorial behavioral. Future directions include exploring the effects of such engineered spatial refuges on coral community structure using lagoon-scale habitat data.

§ White, J. W.* and C. J. Grigsby. University of California, Santa Barbara. CLEANING BEHAVIOR: A HIGH-RISK FORAGING STRATEGY

The removal of ectoparasites from large, often piscivorous, client fish by small cleaner fish is a conspicuous and well-studied phenomenon on coral reefs. The fitness benefits of this mutualism for the cleaners are seemingly clear-cut: access to high-quality ectoparasite prey and immunity from predation by their clients during cleaning bouts. Indeed, clients are rarely observed preying upon their cleaners. However, predation by clients is not the only potential source of cleaner mortality, and the actual mortality risk incurred by cleaners has never been quantified. We examined the mortality costs of cleaning behavior in the sharknose goby (Gobiosoma evelynae), which pursues two distinct ecological strategies: some individuals maintain active cleaning stations on coral heads while other individuals reside in and on sponges, where they feed on zooplankton and benthic invertebrates. We tagged individuals from both habitats and found that coral-dwelling gobies had a higher mortality rate over 1 month than sponge-dwelling gobies. The higher mortality of cleaners may reflect predation by non-client species or morbidity from parasite infestation. Behavioral observations and gut contents analysis confirmed that coral-dwellers cleaned more frequently and were more likely to have large, profitable items in their guts than their sponge-dwelling conspecifics. Thus participation in cleaning mutualisms may represent a classic foraging trade-off: higher mortality risk in return for more profitable food.

§ White, L.F. The University of British Columbia. DIVERSITY VERSUS INVASION: INVESTIGATING EFFECTS OF NATIVE MACROALGAL DIVERSITY ON INVASION SUCCESS OF THE INVASIVE JAPANESE ALGA SARGASSUM MUTICUM (YENDO) FENSHOLT

The effects of native macroalgal diversity on invasion success of the introduced alga, Sargassum muticum (YENDO) Fensholt (Phaeophyceae: Fucales) were investigated. To determine the slope of the diversity-invasion relationship in intertidal macroalgal communities, diversity gradients were constructed. These treatments varied in species richness and composition, representing one, three and four algal species. Factors other than diversity influence invasions, for example species richness in natural plant communities may be affected by changes in species identity or adaptive history of the regional species pool. To control for such confounding underlying mechanisms, in addition to offering a uniform study area where species number and underlying mechanisms such as environmental conditions could be controlled, experimental boards were used rather than natural community manipulations. The range of diversity treatments chosen was representative of undisturbed areas in the intertidal zone, equal in size to the experimental boards, being mostly occupied by three to four algal species. S. muticum is known to release germlings over a three day tidal cycle following the lowest neap cycle in July. Germlings typically settle within ~ 3 m of sporophytes, where conditions are likely favourable. For maximum recruitment, boards were placed directly within the S. muticum canopy in the sub-littoral zone. To minimize disturbance, once boards were
deployed, communities were not interfered with. Changes in canopy cover, basal utilization of the substratum, species number and recruitment were recorded bimonthly from July to September, 2005. Results will be discussed.

§ Whiteside, K.E. *, A.M. Bullard, and S.N. Murray. California State University, Fullerton. DISTRIBUTION, HABITAT UTILIZATION, PRODUCTIVITY, AND REPRODUCTIVE PATTERNS IN CAULACANTHUS USTULATUS (CAULACANTHACEAE, GIGARTINALES), A NEWLY ESTABLISHED SEAWEED ON SOUTHERN CALIFORNIA SHORES

The intertidal red alga Caulacanthus ustulatus was first observed on southern California shores in 1999; previously it had been reported in the Eastern North Pacific only from Baja California, San Francisco Bay, Washington, and British Columbia. Molecular studies indicate that eastern North Pacific specimens from Washington and southern California are identical to material from Asia and a population from northern France believed to be introduced from Asia. This suggests that southern California populations of C. ustulatus may not be indigenous. The goals of this study were to determine for southern California populations of C. ustulatus: 1) its distribution along the southern California mainland, 2) its abundance, habitat utilization, and contributions to local intertidal productivity, and 3) its phenology. Our surveys and specimens obtained from colleagues reveal that C. ustulatus is now widespread along the southern California mainland and also has established populations on Santa Catalina Island. Abundance sampling at Dana Point and Corona del Mar over the last three years has shown that C. ustulatus is confined to mid and upper intertidal habitats and is a persistent, cover dominant in mid-shore algal turf communities. C. ustulatus grows on a variety of substrata including rock, the surfaces of Mytilus californianus shells, Chthalamus spp., and Balanus glandula plates, turf-forming macro-algae such as Corallina pinnatifoli, and basal portions of the rockweed Silvetia compressa. Measurement of primary productivity rates show that C. ustulatus is an important primary producer at Corona del Mar and Dana Point, contributing between 167.3 and 350.5 mg C m\(^{-2}\) h\(^{-1}\) depending on the shore and season. Examination of thalli collected from local sites revealed that the majority of C. ustulatus specimens are sterile but that tetrasporangial plants exist, suggesting that both vegetative and spore recruitment are likely mechanisms for dispersal.

Wilder, R.M. U.S. Fish & Wildlife Service, Stockton, CA. LONG TERM MONITORING OF JUVENILE FISHES IN THE SAN FRANCISCO BAY DELTA ESTUARY

The Stockton Fish & Wildlife Office has monitored populations of juvenile fishes at over 50 sites throughout the San Francisco Bay Delta Estuary since the early 1970’s. The program began as a means of gaining information on the potential adverse effects on fish populations of water pumping by the Central Valley Project (CVP) and the State Water Project (SWP). The original goals of the program were: (1) to define the impacts of water exports on estuarine populations of juvenile chinook salmon, and (2) to document water quality requirements (including flow standards) needed to sustain and enhance salmon production. The goals have broadened since inception of the monitoring program to reflect an overall desire to gain information on what management actions can be taken to improve survival of juvenile salmon rearing in and migrating through the Delta towards the ocean, as well as to document temporal and spatial distributions of non-salmonid species. Here I present an overview of our program and document some of our major findings over the past 30 years. In particular, I will discuss the relationships between abundance and survival of salmon and water flow and pumping by CVP and SWP.

Wilson, R.R., Jr., Department of Biological Sciences, California State University, Long Beach MARINE BIOLOGY FROM THE BOTTOM UP: A REPORT OF THE MIR DIVES TO THE CHARLIE-GIBBS FRACTURE ZONE, CENTRAL NORTH ATLANTIC OCEAN

In June 2003, 4 dives of opportunity were made in the Charlie-Gibbs Fracture Zone (CGFZ) between 3100 and 4500 m to survey the fauna as part of the international MAR-ECO program. I was a science observer for two of the dives. The 1st dive on June 11 was to the base of a ridge lying at 3150 m in the complex topography of the CGFZ, followed by vertical ascent of the ridge to 1760 m, spending 8 h on the bottom. The deep portion of the transect was a sedimentary area broken up with basalt/volcanic rocks densely packed in places. Rising to near 2000 m we encountered a series of “stepped areas”-- a steep rocky area followed by a level sedimentary area followed by another steep area. Among the fishes seen mostly over sediment were 3 species of grenadier (Coryphaenoides armatus, Coryphaenoides leptolepis, and Coryphaenoides rupestris), a halosaur (Halosauropsis macrochir), a bathysaur (Bathysurus mollis), a morid cod (Antimora rostrata), an ophidioid, and several slickheads. The grenadiers were abundantly represented between about 3000 and 2000 m by small individuals holding near 2 m over
the bottom. The 2nd dive on June 13 was into a depression of 4481 m with a transect to the rim of the depression lying near 4000 m, spending 5 ½ h on the bottom. Among the fishes seen in the depression were two species of grenadier, *C. armatus* and *C. leptolepis*, and the bathysaur *B. mollis*. We saw large (> 1 m) *C. armatus* swimming actively, in some instances approaching *Mir* and swimming about it. Findings: the abyssal ichthyofauna in the CGFZ is not different from that reported from similar depths in the western North Atlantic; the expected high scavenging activity of large *C. armatus* at great depths is confirmed.

§ Wood, Spencer1, Amber Tews2, and Roland Russell3. 1University of British Columbia, Biodiversity Research Centre, 2Idaho State University, Department of Anthropology, 3The Earth Institute at Columbia University.

COMPARING ANCIENT MIDDEN AND PRESENT DAY MARINE COMMUNITIES TO DETECT LONG TERM CHANGES IN INTERTIDAL COMMUNITY COMPOSITION

Have intertidal communities changed over the last few millennia? It is hypothesized that subsistence harvesting can dramatically alter both species composition and population structures of intertidal ecosystems. Here we use the united insight of prehistoric midden and contemporary intertidal composition to analyze temporal changes in intertidal communities of Sanak Island, Alaska. We demonstrate that some massive discrepancies exist between the relative abundances of species harvested prehistorically and today, and that middens imply an urchin-rich intertidal biological community existed in the past: a structurally and functionally distinct type of ecosystem in comparison to the algal-dominated communities that are present today.

§ Wormald, C.L.4, M.A. Steele2, and G.E. Forrester1. 1University of Rhode Island, 2University of California, Santa Barbara.

TESTING ASSUMPTIONS OF MARK RECAPTURE THEORY: AN EXAMPLE WITH A TROPICAL SNAPPER

Mark-recapture methods are widely used by field ecologists and wildlife and fisheries scientists to provide estimates of population size and demographic rates, such as growth or mortality. Several methods have been developed to analyze data collected in mark-recapture studies, but all have some critical assumptions that are seldom adequately tested. We tested assumptions of the Cormack-Jolly-Seber model in a population of tropical snappers in the central Bahamas using a combination of laboratory and field studies. We tested whether all fish were equally catchable, whether all fish had an equal probability of surviving the interval between samples, whether marks were lost, and whether marking affected the mortality or growth rates of marked individuals. We found that the capture method – fish trapping – generally provided representative samples of the population, though in some instances the size distributions of fish captured differed significantly from the size distribution of the population at large. Though statistically significant, these differences were generally small and there was no consistent direction of bias. Analysis of our mark-recapture data with the program MARK indicated that the assumption of equal probability of survival of fish between sampling periods was met. We also estimated the loss rate of three different types of tags. Internal passive integrated transponder (PIT) tags were not lost, but two external tags (spaghetti type plastic tags and pressure-injected paint marks) were usually lost within weeks. PIT and injected paint tags had no effects on rates of growth or survival. We recommend that the assumptions of mark-recapture theory be tested routinely to avoid reaching inaccurate conclusions about the populations being studied.

§ Zahn, E.F.* California State University, Long Beach.

INVASIVE CAPABILITIES AND POPULATION DISTRIBUTION OF EXOTIC ICE PLANT IN SOUTHERN CALIFORNIAN COASTAL SALT MARSHES

Southern California’s coastal salt marsh plant communities have been invaded by several species of the family Aizoaceae. This invasion is believed to be aided by urban pressure and habitat fragmentation. We have conducted two controlled greenhouse experiments testing the establishment capabilities of several species of ice plant, as well as surveyed marshes throughout southern California to determine the extent and severity of this invasion. The first investigation found that seeds of the endemic, upper salt marsh dominant *Salicornia subterminalis* appear to be better adapted, than seeds of three exotic ice plants *Carpobrotus edulis*, *Mesembryanthemum crystallinum*, and *Mesembryanthemum nodiflorum*, at becoming established in a dry and hypersaline edaphic environment. However, all of the eighteen southern Californian salt marshes surveyed, thus far, support populations of at least 1 and as many as 6 species of exotic ice plant. The locations of these invasive populations were documented using a GPS and were observed threatening a majority of southern California’s native salt marsh plant species. Preliminary GIS analysis indicates that the number and size of invasive populations appear to be associated with the amount of habitat.
disturbance and urban proximity present at each salt marsh. These surveys led to an investigation into the ability of ice plant to regenerate from vegetative fragments. This study found that fragments of two ice plant species, *C. edulis* and *Malephora crocea*, will establish root growth after only 12 days when exposed to soil salinities as high as 35 ppt. Based on these findings, salt marsh managers should pay close attention to invasive ice plant populations and implement proper restoration techniques of invaded areas to ensure the complete removal of exotics and eventual succession of native plants.

**CONTRIBUTED POSTER ABSTRACTS**

§ Adams, M.M.¹, Somero, G.N.¹, and Francis, C.A.². ¹Hopkins Marine Station, and ²Geological and Environmental Sciences, Stanford University. **ADAPTATION ON THE MICRO-SCALE: CHARACTERIZATION OF MICROBIAL DIVERSITY IN THE ROCKY INTERTIDAL ENVIRONMENT**

Marine bacteria and archaea account for most oceanic biomass and metabolism, are the most abundant primary producers in the ocean, and are crucial players in the carbon and nitrogen cycles. Although great advances have been made in the past two-three decades in describing microbial life in pelagic waters, relatively little is known about the microbes that live attached to shoreline surfaces. Our research is aimed to elucidate the taxonomic composition and physiological adaptations of microbes in the rocky intertidal environment, where organisms face alternating periods of immersion and emersion. Tidal rhythms thus expose organisms to a suite of environmental stresses, including variations in temperature, oxygen availability, and nutrient concentrations. In these preliminary studies of eubacteria in the rocky intertidal, we utilized phylogenetic anchor methodology to delineate bacterial community profiles. Microbial biofilm samples were collected during high tide from rocks at the Hopkins Marine Station of Stanford University in Pacific Grove, California (36°36′N 121°54′W), followed by construction of 16S ribosomal DNA (rDNA) libraries from total community DNA. By employing this phylogenetic anchor approach, we are beginning to obtain a picture of the types of bacteria that occur in this environment, a necessary first step in characterizing their adaptations to the unique constellation of stresses found in rocky intertidal habitats.

§ Batchelor-Rivers, Anne-Marie* and Christopher L. Kitting.  California State University East Bay, Hayward, California. **HEALTH AND CHANGES IN DISTRIBUTION AND ABUNDANCE OF CALIFORNIA SEA LIONS (ZALOPHUS CALIFORNIANUS) AT PIER 39 IN SAN FRANCISCO BAY**

Within the past decade, the California sea lion (*Zalophus californianus*), CSL, has reached a recovery level from their once low abundance in the early 19th century, due in large part to the Marine Mammal Protection Act of 1972. Additionally, based on their annual breeding and mating cycle and success, it appears California sea lions (CSL) will continue to become more densely populated, with the exception of El Niño years. The expanding population may need to seek out new habitats to accommodate the growing population, increasingly closer to human populations, for example Pier 39 in San Francisco Bay. There, our monitoring found that as the local CSL population reaches an apparent maximum of 800-1,000 CSLs, they do not seek out additional space in a particular area. Health of human populations, directly effected by marine mammal disease management, also will be important as organizations/agencies appropriately protect marine mammals. Pier 39 CSL management should take two different approaches dependent upon the number of CSLs that return over the next six months. If the abundance returns to that pre-2004 (greater than 600-800 CSLs at peak) and continues to increase, agencies will not need to add more floats to accommodate the growing population. In addition, CSLs should be closely monitored for symptoms of prevalent diseases such as leptospira, domoic acid and hookworm as their increasing prominence may threaten long-term CSL health and survival. If CSLs do not exceed 800, a recommendation is to collaborate with diverse environmental management agencies throughout California, Oregon, Washington and Alaska, where breeding, haulout sites, and analogous sites probably will be colonized, with and without many humans nearby. Sharing information on amounts of area for expanding CSL populations and how best to protect perimeters (with fences, etc.) will better manage health and sustainability of a population increasingly expanding geographically.

§ Bell, T. M.*¹, Wares, J.P.¹, and Sanford. E.² ¹University of Georgia. ²University of California, Davis. **ESTIMATES OF THE HERITABILITY OF FEEDING BEHAVIOR IN THE PREDATORY GASTROPOD, NUCELLA CANALICULATA**
Geographic variation in a potentially heritable feeding behavior has been documented in *Nucella canaliculata*, an intertidal snail species that inhabits 1500 km of the Eastern Pacific coastline. Sanford et al. (2003) found feeding behavior in *N. canaliculata* varied along a north to south gradient in primary prey (*Mytilus trossulus* and *Mytilus californianus*) distribution. Following common garden experiments (Sanford et al. 2003), it appears that feeding behavior in *N. canaliculata* is a heritable trait. While mitochondrial COI sequence data has demonstrated isolation by distance among these populations and therefore the potential for local adaptation, we sequenced mtCO1 of ~300 individuals that were hand-reared in the laboratory and monitored for prey preference. We are also beginning to compare the degree of population genetic differentiation between northern and southern subpopulations utilizing several nuclear markers, in order to not only give broader depth to the genealogical sampling but also to test the use of different genealogical methods to infer levels of trait heritability. We will use these inferences to further understand the evolution of feeding behavior in intertidal predators.

Bodensteiner, S.M.1, M.J. Wiechmann 2, M.E. Zinkl 1, J.M. McCloskey 1 F.C. Innocenti 1 J.Q. Word 1, and S.M. Brander*1. 1MEC - Weston Solutions, Inc. Tiburon CA ; 2 U.S. Army Corps of Engineers, San Francisco District San Francisco CA. EFFECTS OF TOTAL ORGANIC CARBON (TOC) LEVELS AND GRAIN SIZE DISTRIBUTIONS ON SEDIMENT DDT ANALYSIS AND BIOACCUMULATION POTENTIAL

As an ecologically persistent pesticide, DDT continues to pose a threat to various aquatic ecosystems within the U.S. despite the 32-year ban on its use. In many cases, large-scale clean-up efforts have mitigated the extent and magnitude of ecological impairment caused by DDT contamination in affected coastal areas. However, clean-up efforts are typically unsuccessful in complete elimination of the presence or threat of DDT in contaminated sediments. Many sites are left with sediment DDT concentrations near the threshold for eliciting adverse biological effects, including bioaccumulation. Therefore, it is critical to understand how common sediment characteristics can influence DDT uptake in aquatic organism tissues when this pesticide is present at reduced but not assuredly innocuous concentrations. It is also critical to understand the significance of analytical precision when measuring sediment DDT concentrations within this range. The study objectives were to 1) evaluate the effect of varying TOC levels and grain size distributions on bioaccumulation potential of DDT present in moderately contaminated sediments, and 2) assess the analytical variability expected when measuring DDT concentrations. Sediment samples were collected from Moss Landing Harbor, a site with wide variations in TOC and grain size distributions, and DDT concentrations previously measured up to 303 ppb dry weight. Four samples exhibiting the greatest variation in TOC and grain size were selected for steady-state bioaccumulation testing using the clam *Macoma nasuta* and polychaete *Nephys caecoides*. Samples were also split three ways and submitted to three chemistry labs certified for pesticide analysis (EPA 8081). Bioaccumulation results showed significant correlations between tissue uptake and both TOC and grain size distributions. Results of sediment DDT analysis submitted by the laboratories showed significant intra-sample variability (12 to 43% CV). Data normalization based on surrogate spike recoveries allowed for an accurate estimation of the variability that can be expected with sediment DDT analysis.

Boyer, K. E.* and L. K. Reynolds. Romberg Tiburon Center for Environmental Studies. San Francisco State University. INVASION OF PEPPERWEED IN SAN FRANCISCO ESTUARY: CHANGES TO SEDIMENT CHARACTERISTICS AND EFFECTS ON GERMINATION OF NATIVES

Invasion and spread of the non-native, broad-leafed, perennial pepperweed (*Lepidium latifolium*) in brackish and saline marshes of San Francisco Estuary prompted our study of the plant’s alterations to these habitats. In one year of quarterly field surveys at three sites representing the north, central, and southern portions of the estuary, we sampled within monocultures of pepperweed and adjacent pickleweed (*Salicornia virginica*) stands at similar elevations. In all seasons and across sites, we found significantly lower soil moisture and organic content in pepperweed stands than in pickleweed. While others have hypothesized that pepperweed concentrates salts in surface sediments, perhaps to the detriment of native plants, we found significantly lower soil salinity in surface and deeper sediments within pepperweed stands, up to 5 x lower than in adjacent pickleweed stands. However, a growth chamber experiment provided evidence that pepperweed thatch has an allelopathic effect on germinating native species. Two natives had lower germination in the presence of pepperweed thatch, or an exudate produced from it, than in controls. Our results suggest that pepperweed is altering physicochemical features of marshes in the San
Francisco Estuary, and may limit re-establishment of natives through changes to sediment that could persist after the invader is removed.

§ Brady, B.C.*1,2, D. Sweetnam1, V. Taylor1, and T. Tanaka1. 1California Department of Fish and Game, 2Moss Landing Marine Laboratories. SPATIAL AND TEMPORAL PATTERNS IN THE MARKET SQUID (LOLIGO OPALESCENS) FISHERY

For fisheries management to be effective, long-term biological trends must be identified and the causes for those changes investigated. In the market squid (Loligo opalescens) fishery, in which management is based on a seasonal catch limit and the amount of eggs released by females, monitoring biological changes that affect fecundity is critical for maintaining the economic and ecologic health of the fishery. For example, changes in body size of squid caught by the fishery may result in an increase or decrease in egg production thereby causing a need for different management strategies. The market squid fishery began in Monterey in the mid 1800s and expanded to southern CA in the mid 1900s, growing to be one of California's most valuable in quantity and volume by the mid 1990s. Currently, the California Department of Fish and Game (DFG) samples fishery landings from ports in the Monterey, Santa Barbara/Ventura, and Los Angeles areas to collect biological data and corresponding fishery information. The DFG study, which began in 1998, focuses on measuring changes in landings, length, weight, and sex ratios over time and across different geographic locations. Data from this monitoring program are compared with results from similar historical studies that range from the 1940s to the early 1990s. Preliminary analysis of these data shows that there have been changes in catch amounts, mean length and weight, and sex ratios observed in the fishery over time. Results from this study will provide valuable insight into the status of the market squid fishery and provide information for sustainable fisheries management.

Breen, Bob. San Francisco State University. MORE THAN JUST MOSQUITOS AND MUD; PRELIMINARY RESULTS FROM A STUDY ON THE RELATIONSHIP OF HABITAT, SEDIMENT TYPE AND BIOTURBATORS TO THE MANGROVE JELLY, CASSIOPEA SPP.

Mangroves grow on protected coasts throughout the tropics and host a diverse assemblage of marine organisms that colonize prop roots and adjacent subtidal substrates. In the Caribbean, the red mangrove Rhizophora mangle produces an extensive network of prop roots that harbor a diverse assemblage of fish, invertebrates and algae. The muddy and sandy subtidal benthic substrates adjacent to these mangrove stands are less diverse with common species such as alpheid shrimp found in burrows, while on the surface occur the mangrove jellyfish, Cassiopea xamachana and C. frondosa. These scyphozoans are found on a variety of substrates; sand, silt, mud, carbonate sands and in some seagrass beds. This study seeks to examine the relationship between the jellyfish and bioturbators and establish the physical conditions that both may occur in. So far, this study has found a significant difference in Cassiopea spp. and alpheid shrimp populations that is dependent upon the physical characteristics of the substrate that both are found in. Other patterns that have been encountered is a significant difference in the presence of Mycosporine like Amino Acids (MMA’s) in jellyfish found in benthic habitats where irradiance is more scalar such as coarse, light colored, carbonate sands as compared to those benthic habitats that have a dark background such as organic rich silts that are found in backwater lagoons. Further studies may suggest that there is a correlation between Cassiopea spp. populations and bioturbators. If this true so do bioturbators maintain ecosystem function by efflux of nutrients to the jellyfish and its zooxanthellae symbionts?

§ Carlisle, A.B.*1, R.M. Starr2, G.M. Cailliet1, and D.A. Ebert1. 1Pacific Shark Research Center, Moss Landing Marine Laboratories. 2University of California Sea Grant Extension Program. PATTERNS OF MOVEMENT AND HABITAT UTILIZATION OF FEMALE LEOPARD SHARKS IN ELKHORN SLOUGH, CALIFORNIA

The leopard shark (Triakis semifasciata) is one of the most abundant nearshore sharks in California and is commonly found in bays and estuaries. Elkhorn Slough is a shallow tidal embayment at the edge of Monterey Bay that is extensively utilized by leopard sharks of all ages, for which it is believed to function as a nursery ground. Since much of the life history of leopard sharks occurs in the slough, understanding how sharks utilize this habitat is important. Patterns of movement and habitat use of female leopard sharks in Elkhorn Slough were examined using acoustic tags and a combination of manual tracking and passive monitoring techniques between May 2003 and February 2005. Ten leopard sharks (91-132 cm TL) were tagged and manually tracked for 20-71.5 hours. An
additional 13 leopard sharks (78-140 cm TL) were tagged and monitored for 4-443 days using an array of acoustic receivers. Analyses done to date indicate that the Elkhorn Slough National Estuarine Research Reserve marsh restoration site (ESNERR) is important for leopard sharks and may serve as a nursery ground for them. Shark movements and habitat use were tidally influenced, and in terms of large scale movements, they generally moved with the tides. In the ESNERR they moved up onto intertidal mudflats at higher tides and were restricted to deeper channels during low tides. While in the main channel of Elkhorn Slough they exhibited a highly periodic pattern of movement, during which they were in the upper slough during higher tidal levels and would move up and down the length of the slough during periods of large tidal change. There also was a seasonal pattern of general habitat use, where sharks spent most of their time in the ESNERR during the spring and summer, and more time in the main channel during the fall.

§ Catton, C.* Scripps Institution of Oceanography, University of California – San Diego. TEMPERATURE EFFECTS ON THE LARVAL ECOLOGY OF THE WAVY TURBAN SNAIL, MEGASTRAEA UNDOSA (WOOD, 1828) (GASTROPODA: TURBINIDAE) NEAR SAN DIEGO, CALIFORNIA

_Megastraea undosa_ is a large herbivorous gastropod, reaching basal diameters up to 150 mm, making it a prime target for commercial and recreational harvesting. Its range is limited to the region between Pt. Conception and southern Baja California, where it is common from the low intertidal zone to depths of approximately 35 m. Fertilized eggs of _M. undosa_ are negatively buoyant. Therefore, subtidal temperatures recorded near the substrate may represent the environment experienced by a newly spawned egg. In the San Diego region, the larvae may experience an average temperature between 10 and 15°C. However, the larvae may experience pulses of temperatures ranging between 10 and 23°C, depending on when the spawning occurred in relation to local upwelling or downwelling events. In order to test the effects of this broad temperature range on the larval development and settlement, larvae were reared in four different temperature treatments: 10, 15, 20, and 25 degrees Celsius. The results of this study suggest that increased ambient temperature increases development times and settlement rates in response to a coralline algal cue. The results also showed a lethal effect of water colder than 10°C, in that eggs did not properly develop beyond the first cleavage. This effect is particularly important for eggs spawned from animals deeper than 23 m, where the water temperature hovers between 10 and 11°C much of the time during the spawning season. Many authors have noted a distinct depth gradient in this size of individuals, such that larger animals are found in deeper water. Since large individuals are more fecund and could contribute more to the reproductive potential of the population, the water temperature at the time of spawning in deeper waters is critical to understanding the potential impact on the population recruitment for that year.

Christiansen, N.A. Grosholz E.D. and Mahl, U.H. Department of Environmental Science and Policy. University of California, Davis. INVASIVE SPARTINA HAS FACILITATING EFFECTS ON LOCATION AND ABUNDANCE OF BIVALVE COMMUNITIES IN SAN FRANCISCO BAY

In San Francisco Bay, the hybrid smooth cord grass (_Spartina alterniflora X foliosa_) is an aggressive invasive species that can affect the composition of the infaunal community in complex ways. While the dense root-mat in established _Spartina_ meadows can reduce the diversity and abundance of the benthic community, the root-mat at the edge of the expanding meadow is not yet dense enough to cause the same effect. At the same time, above ground plant structure can facilitate benthic abundance through shading and moderating temperature as well as providing a refuge from predation. Here we show that some introduced bivalves appear to be more abundant in the expanding _Spartina_ edge than in either the adjacent mudflat or meadow. To assess the role of _Spartina_ in creating a refuge from predation, we measured the abundance of small bivalves at two sites in San Francisco Bay, one with extensive predation by bat rays (_Myliobatis californica_) and one with little or no bat ray activity. Bat rays are know to be efficient bivalve predators, but generally avoid foraging in vegetated habitats. At each site, we compared the abundances of three invasive clams _Macoma petalum_, _Mya arenaria_ and _Gemma gemma_ 1 m inside the newly colonized edge of the _Spartina_ meadow with abundances in adjacent unvegetated tidal flats. At the site with a high density of ray pits, we found significantly higher bivalve abundance within the growing edge of the _Spartina_ meadow compared with the unvegetated tidal flats. At the site with few if any ray pits, there were no differences in bivalve abundance between the _Spartina_ edge and the mudflat. These data suggest that the _Spartina_ structure excludes an important intertidal predator, with positive effects on the abundance of introduced clams. These results suggest another mechanism by which invasive _Spartina_ may facilitate other invasions.
Kelp forests are among the world’s most productive ecosystems and serve as a key source of food and shelter for a wide range of species. They are also of economical importance, generating millions in annual revenue and contribute to numerous marine fisheries. Therefore, there is immense interest in the sustainability and propagation of these natural resources. Presently, the widely accepted theory of kelp propagation is that reproductive spores are passively dispersed towards the benthos via advective and diffusive transport. However, it is possible that these spores can also be dispersed vertically towards the surface and away from an existing kelp stand. The aim of this study is to address the effects of vertical distribution on dispersal potential of kelp spores. To investigate this theory, we developed a novel technique employing a vertical spore profiler (VSP) to collect settled spores at various depths. Our preliminary data has shown that in addition to being dispersed within the first meter above the substrate, spores are able to disperse as high as 8 meters from the benthos. To our knowledge, this is the first report of its kind. Also under investigation are the hydrodynamic forces and physical barriers (e.g., kelp blades, stipes, rocks, etc.) that may facilitate the dispersal capabilities of kelp species by establishing turbulent forces necessary for vertical transport. Information gained from this research may help elucidate the methods of vertical dispersal and the recovery of kelp populations, thereby contributing to the proper management of these natural ecosystems, and the understory communities that rely upon them.

Dennis Cocherell¹, Ayako Kawabata², Z.Q. Richard Chen¹, Daniel Kratville², Leslie Kanemoto³, Jason Webber², Emily K. Anderson¹, H. Bandeh¹, Kara Carr¹, M.Cayar¹, I. Haltas¹, Christopher Wilkinson³, Maureen McGee Rotondo¹, Roger Padilla², Roger Churchwell³, M.L. Kavvas¹, Joseph J. Cech, Jr.². ¹UC Davis Department of Civil and Environmental Engineering, ²UC Davis Department of Wildlife, Fish, and Conservation Biology, ³California Department of Water Resources.

IS A “STURGEON-FRIENDLY” FISH LADDER POSSIBLE? PRELIMINARY RESULTS (A): HYDRAULICS AND PASSAGE EFFICIENCY

Upstream passage of anadromous fishes, particularly non-salmonid species such as sturgeon, migratory routes are blocked or impeded by a variety of water-management-related structures such as dams and weirs in the Sacramento-San Joaquin watershed. Many existing passage structures (e.g., fish ladders) are designed for salmonid species and are known to be ineffective for sturgeon passage considering these species’ size and physiology (primarily benthic cruising, “non-jumping” species). The inaccessibility to suitable spawning grounds is likely the leading factor in the decline of many sturgeon populations. To assist in the design of “sturgeon-friendly” ladder we undertook an ambitious sturgeon study. The swimming performance of 117 wild-caught adult white sturgeon (*Acipenser transmontanus*) were tested for passage performance in several types of fish ladder structures, including vertical and horizontal barriers of various heights, widths, and slopes (0, 4, and 8%), a submerged 60-cm-diameter orifice. This work lead to a 24.4-m-long sturgeon ladder with 5 vertical-energy-dissipating baffles at a 4% bed slope, constructed at the University of California, Davis’ J. Amorocho Hydraulics Lab in 2005. Successful sturgeon passage was achievable in both high and low-tailwater conditions (>50% reached upstream-end), only when fish were in healthy condition prior to the experiments. Poor sturgeon pre-experiment health condition resulted in reduced passage success (13% reached upstream-end). A pilot design demonstrated increased sturgeon passage success with further design improvements of the baffle system, by reducing water turbulence.
Many conventional fish ladder designs are inefficient regarding sturgeon passage. To assist in the design of “sturgeon-friendly” passage structures, we designed, built, and tested a laboratory fish ladder with 5 energy-dissipation baffles, having vertical slots and horizontal side weirs. We measured blood hematocrit, plasma pH, cortisol, lactate, and glucose concentrations to assess physiological stress responses during passage. Changes in plasma cortisol levels provide direct assessments of the severity and duration of the primary stress response; while changes in hematocrit, plasma pH, glucose, and lactate (secondary stress responses) characterize the severity of stress, the time needed for recovery, and possible metabolic or respiratory acid-base imbalances. Hematocrit and plasma glucose measurements define within-fish or fish-environment fluid shifts (e.g. osmoregulatory dysfunction).

Blood samples were collected from 5 adult white sturgeon (*Acipenser transmontanus*) via in-dwelling cannulae, implanted 24 h prior to an experiment. Samples (3 ml) were taken at four time periods: holding tank resting, post-acclimation, 15 min post-experiment, and 24 h post-experiment. Our preliminary results showed a mild stress response to the pre-test handling and a more severe one after exercise of the fish. Overall the physiological responses showed significant stress associated with passage. From a bioenergetics point of view, transient stress responses are adaptive but a prolonged stress response can decrease energy allocations to reproduction, and immunoregulation. Minimizing stress during ladder passage should be a concern for managers when constructing and operating fish-friendly ladder systems.

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**Substratum Preference of the Introduced Bioeroding Isopod, *Sphaeroma quoianum*, in Coos Bay, Oregon**

The introduced Australasian burrowing isopod, *Sphaeroma quoianum*, is a common mid to high intertidal inhabitant of Coos Bay, Oregon. *S. quoianum* are prodigious burrowers and inhabit a variety of substrata including: mud and peat banks, decaying wood, sandstone, styrene plastic floats (Styrofoam) and more. When abundant, *S. quoianum* create anastomizing networks of burrows, which appear to exacerbate the rate of marsh and sandstone shoreline erosion in some areas and may damage Styrofoam floating docks and some wooden structures. Preliminary surveys of the most commonly invaded intertidal substrata indicate the burrow density is highest in Styrofoam substratum followed in descending order by sandstone, decaying wood, and mud. To investigate the relative substratum preference of *S. quoianum*, a field experiment is currently underway. Replicates of four types of substrata of equal size have been placed in the high intertidal adjacent to existing populations of *S. quoianum*. The number of burrows created in each substratum per week indicates the relative preference. Initial results indicate *S. quoianum* prefer mud and decaying wood substrata over both Styrofoam and sandstone. These results likely reflect the relative ease of creating burrows in the mud and decaying wood substrata. Although mud and wood substrata appear to be the most preferred, the strength and longevity of these substrata within the intertidal appear relatively low. Future work will examine how burrow densities change over time.

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**Effects of Off-Highway Vehicle Activity on the Mojave Desert Biota**

The frequent use of off-highway vehicles (OHV) within the eastern Mojave Desert may lead to the destruction of plant and animal habitats. The effects of OHV activity on the eastern Mojave Desert community were investigated by measuring the percent coverage of perennial plants and vehicle tracks, and the abundance of lizards and ant nests. OHV active areas were compared with protected National Park Services (NPS) land, which is closed to OHV activity. Measurements were taken over two days at two separate sites along an access road that divides protected land from land open to OHV activity. Community composition on both sides of the road was similar, validating a comparison between the sites. Six line transects (300 m in length) at each site were used to measure the percent coverage of vehicle tracks and perennial plants. The abundance of lizards and ant nests was measured with belt transects (5 m wide and 300 m long). All two tailed t-tests between open and closed sites showed no significant differences for the measurements taken. The NPS land is recovering from past OHV use; the land has been protected since 1994, making the measured NPS and OHV sites both disturbed communities. The data were in the predicted
direction yet no significance could be determined. However, future studies of broader regions may show an effect of OHV activity on the desert biota.

§ Ellingson, R. A.* and P. J. Krug. California State University, Los Angeles. SPECIATION AND TRANSARCTIC MIGRATION IN AN ESTUARINE GASTROPOD: EVOLUTIONARY HISTORY OF THE SEA SLUG GENUS ALDERIA

Climate can strongly affect phylogeography and speciation in temperate gastropods if conditions lead to transient allopatry. Climate change can lead to peripheral isolation as a species' range expands and contracts along the coastline, while trans-Arctic migration can be interrupted during glacial maxima. The sacoglossan genus Alderia was recognized as monospecific throughout the North Pacific and Atlantic, but recent molecular, morphological and developmental data indicate Alderia comprises two species. A. modesta is strictly planktotrophic, occurring in the Atlantic and north of Bodega, CA in the Pacific. Its congener Alderia sp. is restricted to California south of Bodega and is poecilogonous, seasonally switching from planktotrophy to lecithotrophy. DNA sequence analyses of the mitochondrial COI and 16S genes revealed no population structure along the west coast of North America in either species, indicating widespread dispersal of planktotrophic larvae. Atlantic and Pacific specimens did not differ in internal or external morphology or development, but formed reciprocally monophyletic clades based on COI (10-12% divergent) & 16S (1% divergent) sequences. Interspecific comparisons indicate the COI gene rapidly saturates in sacoglossans, thus estimates of divergence time were based on the 16S gene. Sequence divergence between A. modesta and Alderia sp. was approximately 3 times greater than the genetic distance between Atlantic and Pacific A. modesta. A rate of 2.4% change per Ma for 16S was estimated from germinate sacoglossan species, suggesting divergence times of 400,000 and 1.6 Ma, respectively, for intra- versus interspecific comparisons. The geological history of the North Pacific is more consistent with 1.5 Ma and ~4.5 Ma divergence times, suggesting our rate may be an overestimate. Mismatch distribution of COI haplotypes indicates an historical bottleneck in Alderia sp., but not in Alderia modesta. Physiological constraints that limit the range of Alderia sp. to southern California may contribute to its vulnerability to bottlenecks.

Frasier, K.E.* and E.F. Granek. Oregon State University. LARVAL PRESENCE IN MANGROVES: A COMPARISON OF THE LARVAL POPULATIONS IN INTACT AND CLEARED MANGROVE AREAS IN BOCAS DEL TORO, PANAMA

Mangroves are becoming increasingly recognized as important nursery habitats for many juvenile fish and macroinvertebrate species, however little is known about their importance for larval and zooplankton communities. The complex structure of mangrove environments may provide invertebrate zooplankton populations with shelter and established, spawning adult populations, as well as potential substrate, food, and protection from predation. These factors could impact survival and retention, as well as potential habitat selection, by invertebrate larvae and might result in differences in the composition of larval communities between types of coastal ecosystems. We compared larval invertebrate populations in intact mangrove environments to those found in areas from which mangroves had been cleared by human activity, to determine whether populations vary between the two habitat types on a very local scale (100s of meters). This study focused on variation in larval abundance, species diversity, and numbers of individuals representing different developmental stages in the two types of environments. Sampling was conducted in 6 pairs of neighboring areas of cleared and intact red mangrove forest off of the Caribbean coast of Panama. Each sampling involved twocollection methods - larval light traps and plankton tows. All individuals in each sample were counted and identified to phylogenetic order when possible. Decapods were further identified to suborder and infraorders (Anomura and Brachyura, Dendrobranchiata and Pleocyemata, or Astacidea) and by larval life stage. Results indicate a marked increase in the total number of individuals in cleared mangrove areas, but greater diversity in intact areas.

Genovese, Sal, Three Seas Program, Northeastern University. THE THREE SEAS PROGRAM: TRAINING THE NEXT GENERATION OF MARINE SCIENTISTS FOR OVER 20 YEARS

The Three Seas Program (a.k.a. East West Marine Biology) provides students who wish to move beyond the confines of the traditional classroom, the opportunity to spend a year studying marine biology in three different marine environments: New England, the South Pacific, and the California Pacific Coast. This program is unique in that no other college program in marine biology offers the opportunity to learn in three diverse locations, explore the field in such depth, and enroll in a variety of marine biology courses. The Three Seas Program is ideal for advanced undergraduates
and first-year graduate students with a strong interest in marine biology. Many of our students have recently completed an undergraduate degree and find the Three Seas Program helps narrow their focus and provides valuable contacts for graduate school or a new Professional MS in Marine Biology program, offered in conjunction with the Three Seas Program. It is ideal for graduate students wishing to gain the skill set required to pursue a career in marine science without completing a formal thesis. Our new website can be found at www.threeseas.neu.edu.

Goodwin, Lindsay1, Theresa Talley1,2, Lyra Pierotti1, Demetrius Lewis3, Kim-Chi Nguyen3, Jared Ocampo3, Angel Soria3, Terry Singleton3, Shara Fisler1, Drew Talley1,2,4 1Aquatic Adventures Science Education Foundation, San Diego, 2University of California, Davis, 3Hoover High School, San Diego, 4San Francisco Bay National Estuarine Research Reserve. A DESCRIPTION OF COMMUNITY STRUCTURE OF WETLANDS IN BAHÍA DE LOS ANGELES, BAJA CALIFORNIA, MEXICO

As part of a broad innovative research and education program, a group of scientists, educators, and secondary-school students performed some of the first-ever community analyses of the wetlands in Bahía de los Angeles, Baja California, Mexico. Four wetlands were surveyed for epifauna, plants, fish, and various sediment characteristics in order to broadly characterize habitat and community structure. We found that faunal species diversity was higher at the largest sites and in mangrove habitats, while abundance was higher in salt marsh (Salicornia-dominated) habitats. Both resident and non-resident fishes were found within the wetlands, with patterns consistent with the hypothesis of a strong nursery function for these habitats. Further, each individual wetland had a distinct faunal assemblage. These data not only support the important role of these wetlands in providing ecosystem functions such as increasing biodiversity and providing nursery and foraging habitat for fishes and birds, but also demonstrate that the loss of even a small wetland would potentially decrease (beta) biodiversity in the larger bay ecosystem. Further studies in the region are made even more urgent by numerous pending development plans in the bay, which will undoubtedly increase the anthropogenic disturbance of these sensitive habitats. This study is an example of how combining science, education, and outreach can create powerful results for conservation and communities alike.

§ Green, D.H.* and P.J. Edmunds. Department of Biology, California State University, Northridge. HAS A WEEDY SPECIES OF CORAL BECOME MORE ABUNDANT IN THE CARIBBEAN?

Total scleractinian coral cover has undergone widespread decline throughout the Caribbean over the last thirty years and as a result, weedy species of coral with brooding life history strategies appear to be increasing in relative abundance. The apparent increased abundance of such weedy corals may be due to their preferential survivorship during adverse conditions, which has been documented in the fossil record during the early Miocene. One species of coral that appears to exhibit such an increase in abundance is Porites astreoides. In this study, six locations spanning 4100 km across the Caribbean were used to assess Porites astreoides population density and colony size structure in 2003 and 2004; photo-quadrats were used to determine the population density, colony size-frequency distribution, and percent cover. The analysis of community structure shows that most sites were characterized by low coral cover (<15%), but that relative Porites astreoides cover ranged from 16% to 72% of the total living coral cover. Population density and colony size-frequency data show that there were relatively few (<3 colonies) colonies per quadrat, with most (85%) < 100 cm² in size. Because Porites astreoides does not reach sexual maturity until >125 cm², the current populations primarily consist of sexually immature colonies which would be expected to have high mortality rates. Well-known historical data from the 1970’s, 1980’s, and the early 1990’s reveal an unequivocal decline in absolute coral percent cover throughout the region, but also provides some evidence that the percent cover of Porites astreoides, relative to the cover of all scleractinians, has increased from <20% to a mean of ~50% as reported here. This study provides some of the first evidence that Porites astreoides has increased in relative abundance on shallow reefs throughout the region, despite a decline of overall coral cover.

§ Grupe, B.M.* Oregon Institute of Marine Biology, University of Oregon. THE INFLUENCE OF PIT-DWELLING ON THE BIOLOGY AND ECOLOGY OF THE PURPLE SEA URCHIN STRONGYLOCENTROTUS PURPURATUS

The purple sea urchin Strongylocentrotus purpuratus is a common inhabitant of exposed rocky intertidal areas on the Pacific coast of North America. Where the substrate is sufficiently soft, urchins can excavate and live inside pits in the rock. These pits do not seem to be a requirement for survival because in some tidepools urchins may be found both inside and outside pits. I am investigating whether microhabitat (inside or outside pits) might be associated
with differences in the morphology, growth, and population structure of purple urchins. I have measured a number of morphological characteristics of “pit urchins” and “non-pit urchins” cohabiting tidepools at several sites in Oregon. The mean diameter of non-pit urchins is consistently larger than that of pit urchins, even though the size range may vary between tidepools and sites. This size-frequency distribution could be explained by several factors including the emigration of urchins out of pits or differential growth rates. With digital photos I carefully monitored 21 plots between June and August of 2005 at Cape Arago and observed very little urchin movement. Although non-pit urchins tend to be slightly larger than their sheltered counterparts, pit urchins have a larger mean jaw length and lantern index (lantern mass/total mass), which may be indicative of older age. These results suggest lower growth rates in pit urchins compared to non-pit urchins. In the spring of 2006 growth data will be collected from tetracycline-labeled urchins and will be used to test this hypothesis.

§ L.L. Hamady*, S.E. Lester, B.P. Kinlan, G.E. Hofmann, and S.D. Gaines. University of California, Santa Barbara. IS IT HOT IN HERE OR IS IT JUST YOU?: THERMAL STRESS AND RANGE BOUNDARIES OF TWO BARNACLE SPECIES ON THE EAST COAST OF SOUTH AFRICA

Range boundaries are interesting and dynamic regions due to the myriad of possible factors influencing their occurrence. Along the east coast of South Africa, two barnacle species in the genus *Tetraclita* overlap at a known biogeographic break. Both species are found in the mid rocky intertidal and have overlapping geographic ranges in the region of Cape Vidal. Morphologically, both species appear to be superficially similar except that *T. squamosa rufotincta* has pink/red plates, and *T. serrata* has grey/black plates. Due to their similarity, we hypothesize that shell color may influence thermal stress, thereby playing a role in determining their range boundaries along the east coast. This study seeks to examine possible physiological tolerance differences between the two species that may explain the relatively abrupt range transition. We will present data regarding *in situ* temperature, reproductive output, size structure and abundance of both species, as well as preliminary data from small temperature loggers deployed in “mock” barnacles (empty barnacle shells filled with silicone) in the intertidal. Future work will include examining samples for heat shock protein expression and additional temperature measurements using mock barnacles.

§ Hammond, L.M.* and G.E. Hofmann. University of California, Santa Barbara. THE EFFECTS OF TEMPERATURE AND MATERNAL HISTORY ON HSP70 GENE EXPRESSION IN S.PURPURATUS LARVAE ACROSS ITS BIOGEOGRAPHICAL RANGE

In my project the heat shock response will be investigated from the sea urchin, *Strongylocentrotus purpuratus*, across its biogeographical range. Urchins will be collected from 6 sites between Baja California to Friday Harbor, WA. Thermotolerance experiments will be carried out on the gastrula and 4-arm pluteus stages to determine the LD50 temperatures for larvae from each site. Previous experiments in the lab have successfully yielded LD50s for purple urchin 4-arm pluteus larvae from sites in southern California and Washington. Once the LD50s are determined, heat shock experiments will be performed on the two stages of larvae from each site. Heat shock temperatures will be midway between ambient and the LD50 temperature for larvae at each site. Larvae will be heat shocked for one hour followed by RNA extraction. Quantitative PCR will be performed to determine the expression of the heat shock gene, *hsp70*. qPCR conducted in our lab on adult purple urchins from Oregon and southern California revealed a significant difference in *hsp70* expression, with urchins from southern California having a higher induction temperature of *hsp70* than urchins from Oregon. Also, qPCR revealed a much greater amount of induction of *hsp70* mRNA than northern analysis due to qPCR’s high sensitivity to low levels of mRNA. For this reason westerns will also be run to obtain qualitative information about the relative amounts of *hsp70* protein produced relative to each developmental stage being tested (gastrula and 4-arm pluteus). This approach will provide information on how much *hsp70* mRNA is being translated as compared to the amount of *hsp70* mRNA being transcribed during a period of heat shock. Future experiments will also compare thermotolerance profiles of adult females with larvae and the role of thermal history of females in determining the genetic response in the larvae.

§ Hatch, M.B.A.*1 and Naish, K.A. 2. 1Scripps Institution of Oceanography and Samish Indian Nation Center for the Study of Coast-Salish Environments, 2School of Aquatic and Fishery Sciences, University of Washington. IDENTIFICATION OF ARCHAEOLOGICAL SOCKEYE SALMON REMAINS AS A PROXY FOR DETECTING THE INITIATION OF REEF-NET FISHING
The Coast-Salish people of the North Puget Sound / San Juan Islands developed reef-net technologies between 300 and 2000 years before present (ybp). The reef-net allowed Coast Salish tribes to harvest thousands of sockeye salmon (*Oncorhynchus nerka*) per day in open water. Prior to the invention of reef-net fishing, Coast-Salish tribes harvested salmon using less efficient technologies such as hook and line, spearing, and gillnets. The commencement date of sockeye salmon reef-net fishing could be determined by measuring an increase in sockeye salmon remains relative to other salmonids (*Oncorhynchus* spp.), because this species was the primary target of reef nets. At present, recovered salmon vertebrae can only be identified the genus level, prohibiting accurate species identification. Molecular technologies could overcome this limitation if DNA could be extracted, amplified, and identified from archeological salmon remains. The purpose of this study was to identify salmon remains from the Watmough Bay Lopez Island archeological shell midden to the species level, using molecular technologies. To accomplish this DNA was extracted and the 16s region mtDNA was amplified using PCR. Species identification was attempted by examining restriction site length polymorphisms (RFLPs) and sequencing, comparing unknown samples to known Genebank sequences. DNA was reliably amplified from vertebrae older than 780-950ybp. Using RFLPs to identify unknown archeological samples was successful. However, the practicality of using RFLP exclusively was limited, due to few base pair differences between RFLP fragments and it is clear that sequencing will be the method of preference in future studies. Aside from minor technical difficulties, extracting DNA from salmon bones that were harvested over 1000 years ago proved to be a rather novel undertaking. Studies such as this highlight mutually beneficial collaborative research efforts between ecologists and archeologists.

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**§ Henkel, S.K.* Hofmann, G.E. and A.C. Whitmer** University of California, Santa Barbara. MOLECULAR CHARACTERISTICS OF INVASIVE AND NATIVE KELP SPECIES

To date, much research has been conducted at the organism level on non-native algal species; however, little physiological work has been done on invasive seaweeds. I have employed molecular techniques to identify physiological characters that may facilitate or limit the invasion of a particular species. In physiological ecology, an established index of thermotolerance is the up-regulation of heat shock genes (termed the heat shock response) by which heat shock proteins (Hsps) are rapidly synthesized. The goal of this study was to examine the up-regulation of Hsps as a means to assess the physiological plasticity and tolerances of the Eastern Pacific invasive kelp, *Undaria pinnatifida*, as compared to a potentially competing native kelp, *Egregia menziesii*. This work is being carried out on both sporophyte and gametophyte tissue to assess tolerance levels at different life history stages that may be important for competition between native and invasive species. Temperature is thought to be one of the primary factors determining the geographic boundaries of seaweeds; thus, this study will elucidate a possible mechanism for how seaweeds cope with temperature stress and what affects their ability to expand their range. Knowledge of the potential for *Undaria pinnatifida* to expand beyond its current level of invasion is important for assessing where to focus prevention efforts as well as for establishing methods to control transmission. If global temperatures rise and disturbance of the coastal zone continues to increase, information on how species will respond to changes in temperature and other stressors such as pollution will become important not only for predicting invasions but for conservation of native species.

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**§ Hermann, C.R. and D.S. Janiak.** Humboldt State University. RESOURCE QUANTITY AND QUALITY IN RELATION TO PHENOTYPIC PLASTICITY OF THE PURPLE SEA URCHIN, *Strongylocentrotus purpuratus* (STIMPSON)

Regular echinoids can alter the size of various body components in response to variability in food availability, temperature, chemicals, and the density of conspecifics. This phenotypic plasticity is a commonly observed phenomenon in sea urchins. By feeding the purple sea urchin, *Strongylocentrotus purpuratus*, four different algae (*Alaria marginata*, *Egregia menziesii*, *Ahnfeltiopsis linearis*, and *Porphyra* sp.) we examined diet related changes in test weight, gonad weight, and jaw length. Two different feeding regimes were used: (1) an ad libitum supply, or (2) a limited supply (ad libitum food for 3 days followed by no food for 9 days), for a period of 9 weeks. Increased growth in mean gonad weight, test weight, and jaw length, were observed from weeks 3 to 6 for all algal diets except *A. marginata*, which led to a decrease in the size of these organs for both food regimes. *Porphyra* was the only alga to lead to a net loss in mean test weight (ad libitum only), gonad weight and jaw length over the entire study. In contrast, an ad libitum diet of the brown alga, *E. menziesii*, resulted in the largest growth for all organs measured, although urchins ate primarily the tubercles and sporophylls of this alga. The general trend observed through time was an increase in organ size over the first six weeks, followed by a decline in the remainder of the
study. Jaw length typically increased when gonad and test weights were at their highest, in contrast to previous evidence that starved urchins have larger jaws relative to other body proportions. These results suggest that an ad libitum diet, comprised solely of the alga *E. menziesii*, is likely to lead to the highest growth in jaw length, test weight, and gonad weight.

§ Hewson, W.E.* California State University, Fullerton, Dept. of Biological Science, CA 92834. TEMPORAL SEGREGATION OF JUVENILES AND ADULTS IN TWO SOUTHERN CALIFORNIAN BEACH HOPPER SPECIES (*MEGALORCHESTIA CORNICULATA* AND *M. CALIFORNIANA*)

Numerous studies have observed that diel surface activity patterns of juvenile Talitrid Amphipods differ from the patterns exhibited by adults. Generally, evidence indicates that juveniles are less strictly nocturnal than adults of the same species. Two species of Talitrid Amphipods (*Megorchestia corniculata* and *M. californiana*) found on Southern California sandy beaches may display this pattern of temporally segregated surface activity. This study measured the relative juvenile and adult abundances of *M. corniculata* and *M. californiana*. A crepuscular activity pattern was observed for *M. corniculata* juveniles and a similar, but less clear pattern was observed for *M. californiana* juveniles. In contrast, adults of both species displayed almost entirely nocturnal patterns of surface activity. An additional comparison was made between the activity patterns of adults of both species. This comparison suggested a nighttime surface activity dominated by *M. corniculata* at the study site.

§ Holden, W.H.* University of Washington. EFFECTS OF CATTLE GRAZING ON INVERTEBRATE INPUT INTO STREAMS AND JUVENILE SALMONID DIETS

Invertebrate input response to cattle grazing in an interior stream of Idaho was evaluated. The study included two reaches (grazing and non-grazing) containing six sample sites and were separated by a 3 km buffer zone between the reaches. Six habitat variables were collected in each of the reaches to assess the differences between the reaches. Sticky traps were used to sample input of terrestrial invertebrates, and stomach contents from young-of-the-year (Y0Y) juvenile salmonids were sampled to assess differences in diet between reaches. Sticky traps in the non-grazed reaches showed significantly higher densities of all taxa, but there were significantly higher densities of chironomids in the grazed reaches. From the stomach contents of the fish it was found that there were no significant differences between the abundances of invertebrates in the grazed and non-grazed reaches. However there was a slightly higher biomass of the invertebrates found in the stomach contents of fish from the non-grazed reach that was mostly from a terrestrial source.

§ Huerta de Garcia E.¹* & S. Williams². ¹Department of Plant Biology, ²Bodega Marine Laboratory, University of California Davis: FLORAL PATHOGEN ATTACKS: EFFECTS OF FLORAL PATHOGEN ON SEED GERMINATION AND SEEDLING GROWTH OF NATIVE AND INTRODUCED GRASSES IN A NORTHERN CALIFORNIAN COASTAL PRAIRIE

We investigated the effects of floral pathogens on native and introduced grass species at Bodega Head. Our main objective was to investigate if the pathogens are responsible for slowing or speeding invasion by plants. The affected plants present symptoms including inflorescences that are uniformly straw-colored instead of having mauve, red, or brown colors, and black spots on the glumes or lemmas. We collected inflorescences of most of the common grasses within the reserve, and placed the seeds in Petri dishes in order to test the effects of apparent attack by floral pathogens on seed germination. We found that seeds from highly attacked inflorescences were still viable; furthermore we found no evidence that seeds from highly attacked inflorescences had lower proportion of germination than the ones from less attacked ones. We also tested how the pathogen affects the growth performance of *Bromus diandrus* (introduced), and found that the significant difference in growth performance between highly attacked and moderately attacked inflorescences of *B. diandrus* is largely due to the differences in seed mass between the two different levels of attack. Seedlings from highly attacked inflorescences had an overall lower growth performance than those from moderately attacked inflorescences. Finally, we compared highly attacked inflorescences of *Bromus carinatus* and *B. diandrus*, and we found that the floral pathogens attack the two species to different degrees. For the two *Bromus* species that we studied, *Bromus carinatus* was more affected by the floral pathogens. Even though it had an earlier emergence, it still presented a lower growth rate which can be explained by
having a lower seed mass. We conclude that the pathogen causes inflorescences to produce smaller seeds, which will have a slower growth rate, and in turn will lower their chances of survival and successful reproduction.

§ Karr, Kendra1, Mike Beck2. UC Santa Cruz1, The Nature Conservancy2. CONSERVATION LEASING AND OWNERSHIP OF MARINE RIGHTS AND THEIR APPLICATION IN THE MONTEREY BAY SANCTUARY: A LOOK INTO THE POTENTIAL NURSERY ROLE OF MACROCYSTIS CANOPY

It has been commonly assumed that strategies for marine conservation must be substantially different than those for terrestrial conservation, in part because it is not possible to “buy the bottom” of the publicly owned oceans. This is an unfortunate misconception. There is significant submerged land available for lease and ownership in the USA for a diverse array of ecosystems. With this in mind, The Nature Conservancy has explored the leasing and ownership of submerged lands as a tool for marine conservation and examined some of the benefits, considerations and strategies for the conservation and restoration of these lands. To examine the concept in depth, The Nature Conservancy, PISCO and ISP Alginates have developed a partnership to examine how kelp canopy habitat loss may affect biodiversity within the Monterey Bay National Marine Sanctuary. The Nature Conservancy is leasing 1,700 acres of California’s kelp forests within the MBNMS, the leased beds will be monitored for 3 years to assess the biodiversity supported by kelp canopy habitats, and the potential impacts of harvesting on that diversity. After an initial 3 month investigation period, surveys have demonstrated that after kelp canopy removal the numbers of settled and newly settling juvenile rockfish and invertebrates decrease significantly. This study of the role of kelp beds as nurseries for juvenile rockfish and invertebrates can illuminate some of the key factors that control populations of nearshore rockfish and other kelp diversity and suggest best management practices. It is our hope that leasing and ownership of submerged lands will become a viable tool for other conservation groups to link their work to the sea.

§ Keber, R.J.* and S.A. Banack. Southern California Ecosystems Research Program, California State University, Fullerton. THE INFLUENCE OF ARTICHOKE THISTLE ON HUMMINGBIRD POPULATIONS.

Artichoke thistle (Cynara cardunculus L.), an invasive species of plant plaguing coastal southern California, has been endangering the rare, native plants of the area. At Starr Ranch Audubon Sanctuary in Orange County, California, eradication efforts are underway. However, the artichoke thistle may or may not be a problem for the avian community. Hummingbirds feed on the artichoke thistle’s inflorescences, but preliminary observations have suggested that hummingbird nests built on these plants often fail. It was hypothesized that hummingbird nesting success on live artichoke thistles would be lower than on native vegetation, mainly due to plant strength. Nest searches and data collection in both thistle-invaded sites and native vegetation were carried out from April to June 2004 and May to July 2005. A total of 59 active nests were found, all on artichoke thistle. Species using the nests were Costa’s hummingbirds (Calypte costae), Anna’s hummingbirds (Calypte anna), Black-chinned hummingbirds (Archilochus alexandri), and Calliope hummingbirds (Stellula calliope). Thirty-eight nests were built on the dead stalks or inflorescences of artichoke thistle, and twenty-one nests were built on live artichoke thistle leaves. Approximately 24% of all nests were successful, which was normal compared with previous publications. Leaf and stem strength tests revealed that live leaves were weakest, and dead stalks strongest. Failure of nests built on dead thistle was thought to be mainly due to predation, or other causes, but not to plant strength alone. Failure of nests built on live thistle was hypothesized to be mainly due to plant strength and structure combined with nest placement and structure, as well as predation and extreme temperature. Although artichoke thistle disturbs native plant species, it may provide a benefit for hummingbirds as both a nectar and nesting source.

Kerr, H. M.*1 and E. W. Burkett.1 California State University, Northridge, 2 University of Wisconsin-Superior. THE RELATIVE IMPORTANCE OF DISTURBANCE AGENTS ON THE CORAL COMMUNITY OF A PRISTINE LOCATION

Environmental stress, such as disease, damages coral reefs by killing the scleractinian coral architects of the community. Coral diseases are of growing concern because of the rapid increase in frequency of coral mortality attributed to these agents in both disturbed areas as well as more pristine locations. In developing countries with tropical coasts, such as Belize, the health of coral reefs is of particular interest because the economy is based to a great extent on coastal resources. We predicted that if coral disease were increasing regionally in frequency, pathogenic diseases would also be affecting a reef in a relatively pristine location, perhaps to an even greater extent
than mechanical lesions (i.e. coral predation) or bleaching. To explore this possibility, we quantified the coral community structure and the frequency of coral diseases, mechanical lesions, and bleaching on the patch reefs of the Caye Caulker Marine Reserve (CCMR), Belize. To quantify the community structure, scleractinian corals >10 cm in diameter were counted in 19 circular survey areas of 113 m$^2$ haphazardly located throughout the reserve. The major reef building corals were *Montastraea annularis*, *Porites astreoides*, and *M. faveolata* (70%, 10% and 5% of 11,306 coral colonies, respectively). The most frequently encountered sources of potential coral mortality were not due to coral disease, but instead were a result of mechanical lesions and coral bleaching, although coral disease varied in relative frequency among the coral taxa. Contrary to our prediction, in this pristine location two of the three numerically dominant corals had lower frequencies of disturbances caused by pathogenic agents than disturbances attributable to mechanical lesions and bleaching. The patch reefs of CCMR reveal that diseases are less important than alternative potential sources of mortality for reef corals, at least in terms of number of colonies affected.


NaGISA is the nearshore component of the Census of Marine Life Program. Its primary goal is to conduct a global biodiversity survey of macroalgal rocky bottom communities. Methods utilized are a standardized protocol developed under the Census of Marine Life. This poster will present an example of NaGISA data for the Gulf of Alaska (including Prince William Sound, Kachemak Bay, and Kodiak Island sampled in 2003 and 2004). The specific outcomes of this sampling include species lists for each area and replicate sites and various biodiversity analyses. A total of 242 invertebrate species/higher taxa groups and 237 macroalgal species/higher taxa groups were analyzed for abundance and/or biomass. Analyses of invertebrate and macroalgal groups showed that each area and depth stratum had unique descriptive genera/groups. Analyses also showed that intertidal communities differ in composition, biomass, and diversity from subtidal communities and as such, intertidal communities can not be used as indicators for subtidal communities. These data are currently being entered into the OBIS (Ocean Biogeographic Information System) database so that they will be publicly accessible. Datasets such as these should be used for current regional and global comparisons and future long-term monitoring programs.

**§ Kreamer, K.A.*, E.A. Vlahovich*1,2, C.R. Hargens1.** 1Evergreen State College, Olympia, WA; 2Horn Point Laboratory, Univ. Maryland. AUTECOLOGY AND HOMING OF THE NORTHERN KELP CRAB, *PUGETTIA PRODUCTA*, IN A SOUTHERN PUGET SOUND MARINA

This study examined the autecology of *Pugettia producta* living on the pilings within Boston Harbor Marina in southern Puget Sound, Washington, USA. Homing and piling choice was explored using displacement trials. Specimens were observed and counted using an underwater video camera. *Pugettia producta* did not home when displaced 2, 4, 8, or 20 m from the initial capture site. Crab density on pilings did not affect homing or piling choice of displaced individuals. The population of *P. producta* on Boston Harbor pilings was estimated to be 1043-1230 +/- 11% individuals. The population was compared to a population studied in a California kelp forest (Hines, 1982); differences in density, sexual dimorphism, diet, and predation were found. Both populations lacked small individuals. Artificial habitats and differences with populations in kelp forests are discussed.

**§ Krigsman, L.M* and R. Larson.** San Francisco State University. GEOGRAPHIC VARIATION IN AGE COMPOSITION OF KELP ROCKFISH (*SEBASTES ATROVIRENS*)

Geographic variation in the temporal patterns of recruitment occur in many marine populations. Some of this variation can be a result of interannual events such as El Niño and La Niña's, or from interdecadal events like the Pacific Decadal Oscillation. There are also marine populations that demonstrate geographical differences in timing and frequency of strong and weak year classes, which could be a result of variation in larval survival. A challenge facing fisheries biologists is determining what directs these variations, is it climate or fishing pressure? Understanding how these patterns effect populations could be important for the effective management of exploited populations. To investigate this issue I selected the kelp rockfish, *Sebastes atrovirens*, a fish that is minimally impacted by the fishing community. Here I present results to date of collections from the distribution of kelp rockfish along the California coast from Monterey Bay to San Diego. Monterey Bay is closely examined because not only do I demonstrate recent patterns of recruitment in relation to climate but I also show patterns for the same
area during the early 1980s. The main question answered is, have the conditions for strong year classes remained the same?

§ Kurze, E.M.,* N.L Adams, and J.M. Kershner. Cal Poly, San Luis Obispo, CA. NATURAL ULTRAVIOLET RADIATION DELAYS EARLY DEVELOPMENT OF PURPLE SEA URCHIN EMBRYOS (Strongylocentrotus purpuratus)

Ultraviolet radiation (UVR) causes delays in cell division and abnormal development of sea urchin embryos. We examined effects of solar UVR on development of embryos of the purple sea urchin Strongylocentrotus purpuratus. Experiments were conducted by exposing embryos to natural sunlight at two ocean depths (surface and 0.5 meters) to vary UV-levels and to test effects of UVR in-situ at Cal Poly’s Center for Coastal Marine Sciences pier in San Luis Obispo Bay, California. Freshly fertilized embryos were placed in Whirl-pak bags and exposed to or protected from natural sunlight in seawater at both depths for 30 minutes. After exposure, embryos were sampled and fixed every 10 minutes until all had reached the first cell division of mitosis. The percentage of embryos that had completed the first cell division was determined for each sample and the percentage of delay experienced was calculated for each sample. In surface waters, UVR levels were highest and caused a substantial delay in cleavage (21.43% ± 5.40). UVR levels were much lower at a depth of 0.5 m, and delays in division were significantly lower (P=0.035) than those from embryos irradiated in surface waters, but still detectable (9.74% ± 5.01). This indicates that even at 0.5 meters, where UVR levels are much lower than at the surface, embryonic development is still negatively affected by natural UVR. There was a significant relationship between amount of damage, as measured by percentage cleavage delay, and UVB dose (P=0.026), but not between the amount of damage and UVA dose (P=0.052). Further exploration of the relationship between penetration of UVR into the ocean and damage to embryos are needed to more fully understand the effects of natural UVR on marine organisms.

§ Lewallen, E.A.*, Bohonak, A.J. and T.W. Anderson. San Diego State University. POPULATION STRUCTURE AND DISPERSAL OF LEOPARD SHARKS INFERRED FROM GENETIC AND GEOSPATIAL DATA

The leopard shark (Triakis semifasciata) is one of several cartilaginous fishes commonly found in the coastal waters of California. Despite its relative abundance, very little is known about the movement, dispersal and population structure of this species. Due to commercial exploitation and life history traits, leopard sharks are susceptible to stock depletion. Cartilaginous fishes evolve slowly and have extraordinarily large amounts of genomic DNA which allow for the implementation of powerful genetic techniques that may reveal relative dispersal capabilities and general movement patterns. The focus of this study concerns two questions: (1) What is the genetic population structure of leopard sharks?, and (2) What molecular markers can be used to assess population structure? Preliminary research has shown that inter simple sequence repeats (ISSRs) are useful for “screening” large amounts of genetic material for polymorphic loci within this species. This technique may prove to be broadly applicable and useful for other population genetic investigations involving little-studied vertebrate species. By sequencing mtDNA and genotyping multiple inter simple sequence repeats (ISSRs), we hope to understand the processes that influence the exchange of genes across the range of this species. Preliminary results show that gene flow is limited along the west coast of California, and that an offshore island population is not especially isolated. By integrating genetic and geospatial data (GIS), future analyses will focus on potential ecological and physical barriers to dispersal in leopard sharks.

Lloyd, D.C. *, Paradis, G.*, Warner, R.R., and D.C. Zacherl1 1California State University, Fullerton. 2University of California, Santa Barbara. EFFECTS OF TEMPERATURE, SITE AND SEAWATER CHEMISTRY ON STATOLITH ELEMENT INCORPORATION IN KELLETTIA KELLETTII LARVAE

Statolith elemental signatures have become useful for tracking larval dispersal trajectories with the assumption that these signatures reflect the physicochemical properties of the surrounding seawater. Indeed, seawater barium concentration and temperature affect barium incorporation in Kelletia kelletii larval statoliths. Here we examine effects of these factors on incorporation of a larger suite of elements including magnesium, strontium, cerium, lead, manganese, and zinc. Further, via reciprocal field and laboratory transplants, we validate whether statolith element composition is primarily influenced by physicochemical parameters versus site effects. In the field, we transplanted egg cases among three open-coast southern California sites (Pt. Fermin, Los Angeles Harbor, Salta Verde) to test for
site effects (possibly due to yolk contributions) and to attempt to correlate physicochemical factors with statolith element concentration. In laboratory cultures, we tested these effects using ambient seawater from the three sites and temperatures that spanned the range experienced by *K. kelletii*. Seawater, statolith and yolk element analyses were via inductively coupled plasma mass spectrometry. Barring significant interactions among factors, we hope to identify the key factor causing differences in element signatures among the sites. I will discuss the results of this study and its applications to larval tracking.

Lonhart, S.I. Monterey Bay National Marine Sanctuary. IDENTIFYING INVERTEBRATES FROM THE COAST OF BIG SUR, CALIFORNIA: PLAYING “I SPY” WITH ECOLOGISTS

The Monterey Bay National Marine Sanctuary is working closely with the California Department of Transportation (CalTrans) and several other local, state, and federal agencies to develop a Big Sur Coast Highway Management Plan (CHMP) along 70 miles of coastal highway, stretching from Point Lobos southward to Ragged Point. This section of Highway 1 is often subject to delays and closures due to storms, washouts, and landslides. In September 2003, MBNMS staff and researchers from the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) at UC Santa Cruz began a marine resources survey to characterize intertidal and nearshore subtidal sites, focusing on areas of coastline that have in the past or may in the future be affected by landslides. During qualitative subtidal surveys, several species were observed that could not be identified on site. This was especially true for sponges and compound tunicates, two groups that, unlike mollusks and fishes, have no easily accessible field guides to aide in identification. The purpose of this poster is simple: if you think you can identify one of the photographed organisms, simply write in the genus and species on the space provided. On future surveys, voucher specimens will be photographed in the field, collected, and sent to taxonomic experts when necessary. The Sanctuary Integrated Monitoring Network (SIMoN) is committed to characterizing the diverse biological resources that contribute to the unique nature of the Sanctuary. As part of this commitment, SIMoN staff is developing an on-line resource to include species descriptions, natural history, and multiple photographs capturing phenotypic variation, available to the public in summer 2006 at www.mbnms-simon.org.

Mahl, U.H.*, Grosholz, E. D., Christiansen, N. C., Sorte, C. J. University of California, Davis. TROPHIC MECHANISMS FOR ALTERATION OF INFAUNAL COMMUNITY COMPOSITION BY INVASIVE PLANTS

Invasion of coastal wetlands by vascular plants is increasing globally, with potentially profound consequences for ecosystem structure. While research has shown that shifts in trophic structure and community composition of benthic invertebrates frequently follow invasion, the mechanisms driving this change are often unclear. Previous work from San Francisco Bay, where hybrid cordgrass (*Spartina alterniflora x foliosa*) is invading open mudflats, demonstrated that subsurface detritovores replaced surface feeding infauna in invaded areas. Stable isotope studies using both 15N and 13C tracers indicated a trophic basis for this change: infauna in hybrid areas consumed more labeled detritus while infauna on mudflats consumed more labeled microalgae. To determine if the invasion of *Spartina alterniflora* in Willapa Bay is resulting in similar trophic changes, we conducted a parallel dual tracer study. Here the previously open mudflat areas are largely covered by invasive eelgrass (*Zostera japonica*). In replicated plots, we added N15-labeled *Spartina* and *Zostera* litter to treatments, both above and below the sediment surface, and labeled surficial algae with C13. We sampled isotopic signatures of infauna at several time points. This data generally follows the findings from San Francisco Bay, however we observed a greater uptake of labeled detritus by a wider range of surface feeders. Our results suggest that changes in the quality of the detritus as well as shifts in detrital abundance may influence its usage and ultimately the impact of the invasive plant on infaunal communities.

§ Mireles, C.*, R. Nakamura, D. E. Wendt. Biological Sciences Department and Center for Coastal Marine Sciences, Cal Poly State University, San Luis Obispo. SITE FIDELITY, HOME RANGE, AND HOMING BEHAVIOR OF CABEZON (*SCORPAENICHTHYS MARMORATUS*) ON THE SOUTH CENTRAL COAST OF CALIFORNIA

Our work sought to determine the site fidelity, home range, and homing behavior of the cabezon (*Scorpaenichthys marmoratus*), which is a commercially important species in the live-fish fishery based out of Morro Bay, California. Our research utilized a conventional multiple mark and recapture approach to conduct the first comprehensive analyses of cabezon in this region. A total of 1239 cabezon ranging in lengths from 17.5-56 cm, were tagged between September 9, 2004 and December 15, 2004. We have recaptured 235 individuals to date. The average
distance that cabezon were recaptured from their initial capture location was 147.3 meters. Our results indicate that
the distances between capture events increases with fish size, suggesting that larger fish have larger home ranges.
Average home range estimates are 833 m² using the minimum convex polygon method. We also investigated
homing behavior by translocating forty-one fish away from their original capture sites distances that ranged from
1,580 meters to 5,346 meters. Ten of the translocated fish have returned to within 166 meters of their initial capture
location. The average proximity distance of translocated recaptured-fish was 59.6 meters to their initial capture
location. Results of this study suggest that cabezon display high degrees of site fidelity, relatively small
neighborhoods, and high levels of homing behavior. These data provide the first assessment of cabezon movements
and behavior in the south central coast and they will be useful in managing the cabezon fishery.

§ Navarro, M.O.¹, Paradis, G.², Lea, D.W.², Sheehy, M.², Warner, R.R.², Gaines, S.D.² and D.C. Zacherl¹
¹California State University Fullerton. ²University of California Santa Barbara. LINKING THE STATOLITH
CHEMISTRY OF APYLSIA CALIFORNICA TO WATERSHED DISCHARGE ENVIRONMENTS ALONG THE
OPEN COAST

Scientists must identify the larval trajectories of marine organisms inhabiting marine protected areas (MPAs) in
order to understand recruitment variability and population connectivity. Currently, larval trajectories among
populations inhabiting southern Californian MPAs, typically 2 – 3 km in length, remain unknown. However,
environmental tagging of fish otoliths and invertebrate statoliths has enabled tracking of some marine larvae. Prior
research indicates tags along the open coast might exist at spatial scales of 10s of kilometers. We propose to test if
watershed discharge generates detectable site-specific tags at a spatial scale relevant for tracking larvae among
MPAs populations. The amount of exposure time to watershed discharge necessary to create detectable tags, and the
temporal stability and site-specificity of tags forming at these locations are unknown. In laboratory culturing
experiments, larval statoliths of a model species, the sea hare, Aplysia californica, will be exposed to discharge for
varied times to pinpoint the time necessary to generate watershed-specific tags. In addition, we will out-plant egg-
masses at three watershed discharge sites along the open coast of southern California twice from October through
December 2005 to test for unique statolith chemistry among sites and temporal stability of statolith chemistry at
each site. Concurrently, seawater chemistry, temperature and salinity will be sampled to correlate statolith
chemistry to seawater characteristics. We will analyze statoliths and seawater samples for elemental concentrations
by inductively coupled plasma-mass spectrometry (ICP-MS). We predict that exposure to watershed discharge
plumes for time spans as short as two to four days will generate site-specific tags and expect A. californica statoliths
out-planted during November - December (rainy season) to have detectable tags among locations. If detectable tags
are found, A. californica could be used as a model species to track larval dispersal among MPAs influenced by
watershed discharge along the open coast of Southern California.

§ Nicol, S.D.*¹ and J.S. Rosenfeld². ¹University of British Columbia, ²British Columbia Ministry of Environment.
COST-BENEFIT ANALYSIS OF PHYSICAL AND BIOLOGICAL HABITAT VARIABLES USED IN
HABITAT CAPACITY MODELING FOR JUVENILE SALMONIDS

Habitat capacity models are used for several purposes, including predicting changes in species' densities in response
to disturbance and prioritizing restoration activities. The objective of this study was to improve the efficiency of
capacity models used for juvenile salmonid habitat monitoring and restoration projects by determining the benefits
(contribution of the variable to the R² of the multiple regression model) and costs (time required to measure the
variable) of selected stream habitat variables. A suite of physical and biological variables were measured at 23 sites
in southwestern British Columbia. Some of the selected variables are commonly and others rarely used for capacity
modeling (e.g. pool area and invertebrate drift density, respectively). Fish density at the sites was estimated using
triple-pass depletion electrofishing data. These measurements will be used to construct a capacity model for
juvenile salmonids. Results of the model and cost-benefit analysis will be discussed.

§ Parker, M.E.* and N.L. Adams. California Polytechnic University, San Luis Obispo. ULTRAVIOLET
RADIATION DELAYS DIVISION AND ACTIVATION OF CDC2 IN SEA URCHIN EMBRYOS,
STRONGYLOCENTROTUS PURPURATUS

Ultraviolet (UV) radiation has many adverse effects on cells, including delaying or inhibiting cell division. We
tested whether UV radiation affects Cdc2, a cyclin dependent kinase that is part of the mitosis promoting factor
(MPF) and which controls cell division. There are three primary phosphorylation sites that control the activity of Cdc2. Cdc2 is first phosphorylated at two inhibitory sites (tyrosine 15 (Tyr15) and threonine 14 (Thr 14)) and is subsequently phosphorylated at threonine 161 (Thr 161), an activating site. Subsequent dephosphorylation of Cdc2 at Tyr 15 and Thr 14 allows the MPF to become active and cells to divide. We have demonstrated that UVR-irradiation delays dephosphorylation of Tyr 15 (and presumably Cdc2 activity) in embryos of the purple sea urchin Strongylocentrotus purpuratus. UV-irradiation does not appear to directly affect activation of Thr 161 in these embryos.

§ Polson*, M.P. and D.C. Zacherl. California State University, Fullerton. THE BIOGEOGRAPHY AND PHYLOGEOGRAPHY OF THE NATIVE WEST COAST OYSTER, OSTREA CONCHAPHILA

The native west coast oyster, Ostrea conchaphila, was once abundant throughout its range from Sitka, AK, USA to Cabo San Lucas, Mexico, but populations were over-harvested and depleted by the 1930s. In recent years, there has been a renewed interest in restoring O. conchaphila populations since it is the only oyster native to the west coast. Yet, little is known about its ecology and there is no comprehensive information on the current status of natural populations. We surveyed natural intertidal populations at 25 historical sites across the entire range during the spring and summer 2005, using a 2 hour timed search. We quantified maximal densities using 10 replicate quadrants per site. From sites where presence was established, we collected 10 samples and plan to analyze two mtDNA genes (COI and COIII) to assess phylogeographic structure. Preliminary results from the biogeographic survey indicate that O. conchaphila is absent from intertidal sites in Sitka, AK and Cabo San Lucas, the two end points of its distribution. It is also absent at two CA sites, Morro Bay and Big Lagoon. Average maximal densities are highest in Bahia de San Quintin, Mexico and Point San Quentin, San Francisco Bay. This study represents the first comprehensive biogeographic survey of populations of the native oyster, Ostrea conchaphila. Both the biogeographic survey and the population genetics study will provide baseline data for future projects in genetics and larval tracking that will examine population connectivity.

§ Reynolds, P.L.* University of California, Davis, Bodega Marine Laboratory. MAINTENANCE OF COLOR POLYMORPHISM IN THE BENT BACK SHRIMP: HEPTACARPUS PALUDICOLA

Selection for the optimum coloration within a specific habitat may occur if crypsis is an important mechanism for avoiding predation. Selection for multiple color morphs may lead to color polymorphism within a species if there is variable habitat coloration. Color polymorphism is common in arthropod species, specifically crustaceans. Within the Zostera beds of Campbell Cove, Bodega Bay, California, I observed intraspecific color polymorphism of the small bent back shrimp, Heptacarpus paludicola. The presence of a seasonally persistent brown-colored epiphyte Smithora naidum at Campbell Cove creates a mixed color habitat with both brown and green substrate. To assess how color polymorphism may be maintained at this site, I conducted microhabitat preference and predation experiments in the lab using green and brown color morphs of H. paludicola. Although there was a slight increase in the incidence of green shrimp on the bare eelgrass blades, both brown and green shrimp showed a preference for eelgrass blades with the epiphyte compared to bare eelgrass blades. Thus, microhabitat choice does not appear to be a strong selective force driving color polymorphism in H. paludicola. To test if predation is variable depending on whether a shrimp matches its background color, I tethered green and brown shrimp to bare eelgrass and eelgrass with epiphyte and exposed them to fish predators. Results show that brown color morphs were 4 times more likely than greens to be eaten on the bare eelgrass, while green color morphs were 5.7 times more likely than browns to be eaten on the eelgrass with epiphyte. In addition, subsequent predation trials with free-swimming shrimp indicate that green color morphs are 3 times more likely to be consumed in eelgrass with epiphyte than in bare eelgrass habitats. These results suggest that predation may be a strong selective force maintaining color polymorphism in Heptacarpus paludicola.


The longnose skate, Raja rhina, is one of the most important incidental species landed in central and northern California demersal fisheries. However, life history information is extremely limited for this species and aspects of its diet and feeding habits are unknown. Feeding ecology studies can provide researchers with important insights
towards understanding potential fishery impacts on marine systems. The primary objective of this study was to analyze the feeding ecology of *R. rhina* off the coast of central California. Specimens of *R. rhina* were collected between September 2002 and August 2003 from fisheries-independent trawl surveys conducted by the National Marine Fisheries Service, Santa Cruz Lab (NMFS-SCL). Of 1,193 longnose skates caught, 527 were female and 666 were male. To date, 300 *R. rhina* stomach samples have been processed, and all prey items identified to lowest possible taxa. For every stomach, the percentage of each prey item by number (%N) and weight (%W) were calculated and averaged to obtain a mean value. These measures were combined with the overall percent frequency occurrence (%FO) to determine the Index of Relative Importance (IRI), represented as %IRI. Preliminary results indicate that the five most important prey items are unidentified teleosts (23.4% IRI), unidentified euphausiids (22.4% IRI), *Neocrangon resima* (14.5% IRI), Crangonidae (8.1% IRI), and *Octopus rubescens* (8.0% IRI). *Raja rhina* diet will be further analyzed through comparison of the following intraspecific variables: gender (male/female), depth (shelf/slope), and size class (<600 mm/>600 mm).

§ Rodriguez, Albert*1, Ryan P. Kelly2, Douglas J. Eernisse1 1Department of Biological Science, California State Univ., Fullerton CA 92834; 2Columbia Univ. and American Museum of Natural History, New York NY WHO SAYS IT’S NOT EASY TO GET AROUND IN L.A.: PALOS VERDES PENINSULA IS AN INEFFECTIVE GENETIC BARRIER FOR CHITONS AND LIMPETS

The comparative phylogeography of selected chiton and limpet species was analyzed in order to test a recent hypothesis that Palos Verdes Peninsula, California, is an unsubstantiated biogeographic boundary. In California, the cold temperate Oregonian and warm temperate Californian provinces are separated at Pt. Conception, which has long been considered a potential barrier for larval dispersal. Recent authors have found phylogenetic breaks that are not concordant with Pt. Conception and its strength as a biogeographic boundary has been questioned. In fact, Dawson (2001; J. Biogeogr. 28:723-736) reviewed available phylogeographic comparisons of various marine animals that have planktonic larvae, including fishes, snails, and clams, and he found more general patterns of genetic separation further south near Los Angeles, California. He argued that the area around Palos Verdes Peninsula might represent a more significant dispersal barrier than Pt. Conception. This hypothesis has been tested by looking for congruent patterns of phylogeographic breaks for multiple chiton and limpet species common to southern California. All have similar ecology and relatively brief pelagic dispersal, especially compared to marine invertebrates with feeding larval stages. Specimens were collected from up to three populations on either side of the peninsula. 16S rDNA and COI (or cox-1) mitochondrial gene regions have been amplified and sequenced. Preliminary data sets show some species to have little to no genetic structure from sample locations from Ventura to San Diego Counties, which is indicative of gene flow among populations. Other species have been shown to have genetic structure with no consistent separation with respect to Palos Verdes. Thus, the Palos Verdes Peninsula has not emerged as a particularly effective or persistent barrier to gene flow for chitons and limpets sampled to date.

Romero, Melissa* and D. Zacherl. California State University, Fullerton. TEMPERATURE EFFECTS ON GROWTH RATE AND DIEL VERTICAL MIGRATION OF *KELLETTIA KELLETTII* (FORBES, 1852) LARVAE

*Kelletia kelletii* recently expanded its range into the colder waters of central California past its historical northern range limit at Point Conception. This shift to colder water can have profound implications for northern populations on larval life-history traits such as planktonic larval duration (PLD), growth rate, and behavior. This study examines temperature effects on growth rate and behavior of *K. kelletii* larvae. To examine the effect of temperature on larval growth rate, larvae were reared at 12°C, 15°C, and 18°C, their shell size was measured twice weekly, and their weekly growth rate calculated for at least one month. A second study investigated whether *K. kelletii* larvae undergo diel vertical migration (DVM) and if a change in DVM occurs as a function of age or temperature (12°C, 15°C) or both. Larval shell size increased with increasing temperature. *K. kelletii* larvae exhibited DVM, with more pelagic larvae during the night and more demersal larvae during the day, but this behavior changed as a function of temperature and age. In general, larvae exhibited more demersal behavior at 15°C and in the first week compared to subsequent weeks. These results suggest that *K. kelletii* larvae developing in colder water might have longer PLD, spend more time in dispersive surface currents, and thus might have the potential to disperse further than larvae developing in warmer water.

Schneider, Jessica1, Heidi Weiskel1,2, Drew Talley1,2. 1San Francisco Bay National Estuarine Research Reserve, 2UC Davis. CRAB MONITORING IN THE SAN FRANCISCO BAY NATIONAL ESTUARINE RESEARCH RESERVE – A PILOT STUDY
Monitoring data from estuaries can provide us with important insights into ecosystem functioning and community trends that might otherwise go undetected. The San Francisco Bay National Estuarine Research Reserve (NERR) is one of a few reserves piloting a long-term biomonitoring project to assess estuarine crab communities across the U.S. Following the protocol developed at the Elkhorn Slough NERR, we are sampling quarterly across the estuarine gradient in China Camp State Park and Rush Ranch, two reserves that cover a range of San Francisco Estuary’s salinity gradient. We are interested in detecting novel invaders and changing abiotic conditions that may affect estuarine communities. Preliminary data from China Camp indicate that the invasive European green crab *Carcinus maenas* (Linnaeus, 1758) represented 28-50% of the catch per transect by biomass and 5-12% by number of individuals. The native mud crab *Hemigrapsus oregonensis* (Dana, 1851) represented the vast majority of the remaining catch. By monitoring abundance, sex, and size of the native and invasive crabs over time, and coupling these data with the NERR water-quality monitoring program, we will not only be provided with an “early warning” indicator of new invasions, but will test hypotheses about invasive species and their relationship to environmental and biotic parameters. Over time, the results will allow us to observe abundance trends and changes in other characteristics such as intra-site distribution and aggregation patterns. As this monitoring program is adopted system-wide across the NERRs, it will enable geographic comparisons of the dynamics of these invasions.

§ Seale, Erin* and D. Zacherl. California State University, Fullerton. THE EFFECTS OF CONSPECIFIC DENSITY AND SEASON ON SETTLEMENT OF THE NATIVE OYSTER, *OSTREA CONCHAPHILA*

Declines in populations of the native oyster, *Ostrea conchaphila*, has peaked recent interest in restoring its populations. Local population dynamics and persistence are influenced by the magnitude and timing of larval settlement. Thus, we examined factors that may influence larval settlement and examined settlement as a function of season. *O. conchaphila* settlement is thought to peak in the spring and fall months in California and Baja. Previous studies of related oyster species demonstrate that conspecific chemical cues encourage larval settlement. A higher concentration of chemical cues might result in greater larval settlement relative to areas with lower conspecific density. To test this prediction, artificial substrate tiles were placed in two separate estuarine locations, upper Newport Bay and Aqua Hedionda in Carlsbad, CA. Each estuary contained separate high and low density *O. conchaphila* populations. Tiles were collected and oyster settlers counted every two weeks during spring tides to pinpoint pulses in settlement. Preliminary results indicate that conspecific density does not affect larval settlement, settlement is significantly higher at Newport Bay than at Aqua Hedionda, and larval settlement is variable among months.

§ Smith, J. and L.A. Sam*. California State University, Fullerton. TRACING WATER SOURCE OF *QUERCUS AGRIFOLIA* NEAR A SOUTHERN CALIFORNIA STREAM USING STABLE ISOTOPES

This study determined whether riparian woodland plants, such as *Quercus agrifolia*, use nearby streams as a main source of water. Tick creek traverses Starr Ranch Audubon Sanctuary in Orange County, California. Runoff from a nearby housing development and a golf course provides continuous water to this stream throughout the year. Without this supplemental water, most small streams in southern California flow only during the winter and spring. In the near future, this supplemental flow will be returned to a more seasonal pattern. The objective of this study was to determine if the *Q. agrifolia* could be affected by this change. The sample site was an 80 m elevated gradient along a north-facing slope near Tick creek. It was hypothesized that *Q. agrifolia* sampled along this gradient do not use Tick Creek as a permanent source of water. Stable oxygen can be used as a signature to trace water source in plants. Water was obtained from the samples of *Q. agrifolia*, their surrounding soil, and Tick creek. It was found that the young *Q. agrifolia* in the area within 10m the creek, use the creek as a direct source of water. *Q. agrifolia* further than 10 meters from the creek use a water source other than the creek. The remaining *Q. agrifolia* sampled appeared to be tapping into an alternative source of water based on the fact that the isotopic ratios did not match those of the creek. Analysis of these data revealed that young *Q. agrifolia* within 10m. may be adversely affected by the future control of Tick creek.

§ Szoboszlai, A.I.*. Moss Landing Marine Labs, San Jose State University. FLUID DYNAMICS OF INTERTIDAL MACROALGAL CANOPIES: FLOW MODIFICATION AND MACROALGAL RECRUITMENT
Accelerating loss of biodiversity due to human activities has renewed interest in what the functional consequences of diversity might be. This study addresses how different levels of biogenic diversity (in this case diversity of algal forms or morphologies) affects water flow, and in turn, algal recruitment and species distributions in marine ecosystems. One of the most conspicuous aspects of intertidal habitats in California is the high diversity of algal morphologies. It is becoming increasingly clear in ecological studies that biogenic habitats including macroalgae have a primary role in modifying hydrodynamics, especially at scales of millimeters to tens of meters. These small-scale flow dynamics are key to the recruitment and survival of intertidal marine organisms, but the effects of variable algal morphology on flow-mediated recruitment are unknown. This project is designed to address two questions: (1) How does macroalgal morphology affect water flow and algal recruitment? and (2) How does a diverse canopy (i.e. comprised of multiple species vs. a single-species canopy) affect water flow and algal recruitment? I will be investigating these questions from two perspectives: a lab study of flow velocities above different types of algal canopies, and a field-based study of algal recruitment into different types of algal canopies. Results from this study will contribute to management of Marine Protected Areas, emphasizing the contribution of morphological diversity to diversity at higher trophic levels.

§ Tanner, C.A.* Gaines, S.D. Kinlan, B.P. Lester, S.E. University of California, Santa Barbara

LINKING ROCK TYPE, MICROALGAL ABUNDANCE, AND INTERTIDAL GRAZER SIZE STRUCTURE AND DENSITY WITH NEARSHORE OCEANOGRAPHY AND WAVE EXPOSURE

In coastal upwelling ecosystems, recent studies emphasize tight linkages between nearshore oceanography and benthic ecological processes. When benthic-pelagic coupling is strong, spatial patterns of variation in oceanographic processes adjacent to the coast may be useful in predicting among-site variation in community structure. However, wave exposure and geology are other physical factors that vary along coastlines. Also, species interactions may complicate effects of nearshore oceanography. On rocky shores of South Africa, a strong quantitative relationship exists between community structure and coastal topography. This relationship may be due to topographic effects on upwelling and circulation, or correlated variation in other environmental variables. Wave exposure, for example, exhibits strong gradients across and within sites, and has shown to exert strong effects on growth and abundance of invertebrate grazers. In July and August of 2005, we examined the interaction between geology, wave exposure, microalgal standing stock, and grazer populations at 20 rocky intertidal sites spanning >3000 km of South African coast. Rock chip samples were taken along a wave exposure gradient within each site, and epilithic microalgal standing stock was determined by chlorophyll extraction and spectrophotometry. Other measurements include size structure, density and gonadal index of a common grazing limpet, Scutellastra granularis. Preliminary analyses suggest correlations between microalgal standing stock, rock type, wave exposure, and grazer populations. Further analyses will attempt to quantify relative impacts of geology and wave exposure on grazer-algal interactions in the context of broader regional patterns of oceanography such as upwelling and phytoplankton abundance. In addition, a thorough analysis of rock chip petrography will be conducted to compare microalgal productivity and limpet data both among sites and within sites.

§ Valentovich, Tracy* and Darren Sandquist. California State University, Fullerton. Fullerton, CA, 92831.

VARIATION OF JOSHUA TREE MORPHOLOGY AMONG POPULATIONS IN THE MOJAVE DESERT

The current distribution of Yucca brevifolia Engelmann (Joshua Tree) is restricted to higher elevation habitats in the Mojave Desert. This distribution warrants investigation because it may represent the result of post-glacial migration, which could have restricted gene flow. The overall objective of our study is to reconstruct the phylogeography of Y. brevifolia based on morphological and genetic variances of populations in the Mojave Desert. Some taxonomic treatments of this species define more than one variety based on morphology. This includes Y. brevifolia var. jaegeriana, a variety of the Eastern Mojave defined by short, stout stems and short leaf lengths. In a preliminary study we examined the morphology of four populations in this region. The morphological variance of these populations was expected to be minimal, because they occurred relatively close to one another and within the described jaegeriana distribution. Trunk sizes and leaf lengths were compared among populations using ANOVA, and a broader evaluation was based on multivariate analyses of 13 tree and leaf traits. Tree sizes and leaf characteristics of three populations always conformed to the classification of var. jaegeriana; the fourth population (Garnet Mountain, AZ) showed characteristics of var. jaegeriana for leaf traits but not for trunk size. Principle components analysis revealed significant scatter among plants of all populations, but clearly separated the Garnet...
Mountain population from the rest. These results bring into question the varietal classifications of *Y. brevifolia* and suggest that environmental factors may cause closely related populations to show notable morphological differences.

§ Wenzel, Brian. California Polytechnic University at San Luis Obispo. ANALYSIS OF BREEDING SITE FIDELITY AMONG NORTHERN ELEPHANT SEALS, *MIROUNGA ANGUSTIROSTRIS*, AT PIEDRAS BLANCAS ROOKERY

Piedras Blancas lighthouse, along the central coast of California, is home to a rookery of northern elephant seals, *Mirounga angustirostris*. Seals have been hauling out at the beaches surrounding this lighthouse since late 1990. Every year seals return to bear pups, mate and then return to the ocean. Female seals, as well as newborn pups, have been tagged on these beaches each season since 1994. This study examined the beach site fidelity of returning female seals each season after they are tagged. Tag re-sight history showed that 85% of re-sighted, locally tagged seals have returned to the area for two seasons or more. Of these, 71% have pupped at the same beach site during two breeding seasons or more. These data suggest that seals tagged at Piedras Blancas exhibit some level of beach site fidelity between seasons, but the extent is not known. Patterns suggest that rookery site fidelity exists, but that beach site selection is a complex cognitive process that requires further study.