



CalCOFI Conference

14-16 December 2015

Monterey Bay Aquarium Research Institute (MBARI)
Moss Landing, CA

Hosted by:

California Department of Fish and Wildlife

CalCOFI Coordinator: John Heine
Symposium Conveners: Laura Rogers-Bennett and Julia Coates

In association with:
Southwest Fisheries Science Center, NOAA
Scripps Institution of Oceanography



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Monterey Bay Aquarium Research Institute (MBARI)
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Dec. 14-16

Monday, 14 December

- 12:30-1:30 Registration - MBARI
- 1:30-1:45 **Opening of the Conference**
Welcome: Laura Rogers-Bennett, California Department of Fish and Wildlife
- 1:45-2:45 **Session I: State of the California Current 2014-2015: El Niño vs the "Blob"**, Andrew W. Leising, Environmental Research Division, National Marine Fisheries Service.
- 2:45-3:45 **Session II: Status of the California Fisheries: Warm Water from the "Blob" and now El Niño**, Laura Rogers-Bennett, California Department of Fish and Wildlife.
- 3:45-4:00 Break
- 4:00 **Session III: Contributed Papers (15 minutes with 5 minutes for discussion)**. Chair: Sam McClatchie, Southwest Fisheries Science Center, NOAA.
- 4:00-4:20 **C-1. Warm anomaly effects on subtropical NE Pacific Ocean phytoplankton.** Eliana Gómez-Ocampo¹, Gilberto Gaxiola-Castro^{1*}, and Emilio Beier², ¹Departamento de Oceanografía Biológica, Centro de Investigación Científica y de Educación Superior de Ensenada. Ensenada, Baja California, México, ² Unidad La Paz, Centro de Investigación Científica y de Educación Superior de Ensenada, La Paz, BCS, México.
- 4:20-4:40 **C-2. Patterns of movement of Pacific Bluefin tuna (*Thunnus orientalis*) obtained using archival electronic tags.** Tim Baumgartner¹, Oscar Esparza¹ and Barbara Block², ¹CICESE, Ensenada, Baja California Mexico, ²Hopkins Marine Station, Stanford University, Pacific Grove, CA.
- 4:40-5:00 **C-3. Anomalous patterns in California Current pelagic micronekton distribution and abundance in 2015.** Keith M. Sakuma,¹ John C. Field,¹ Baldo B. Marinovic,² Cynthia N. Carrion² and Nathan J. Mantua¹, ¹SWFSC, NOAA Fisheries Ecology Division, Santa Cruz, California, USA. ²Institute for Marine Sciences, University of California Santa Cruz, Santa Cruz CA, USA.

- 5:00-5:20 **C-4. Tracking geomorphological processes of the sandy seafloor and associated effects on the spatial patterns of inhabitants, including market squid, *Doryteuthis opalescens*.** Navarro, Michael O.¹, Jesirae M. Collins¹, Chelsea Burgess^{1,2}, Nicole Barbour¹, Corey Garza^{1,3}, ¹ Science and Environmental Policy Division, California State University Monterey Bay, ² Department of Natural Sciences, Haskell Indian Nations University, ³ Monterey Bay Regional Ocean Science REU, California State University Monterey Bay.
- 5:20-5:40 **C-5. Larval production and habitat distribution of Jack mackerel *Trachurus symmetricus* in the Southern California Bight.** Edward D. Weber, Southwest Fisheries Science Center, NMFS/NOAA La Jolla.

Tuesday, 15 December

- 8:00-8:30 Registration - MBARI
- 8:30 **Session IV: The Symposium of the Conference: What can animal telemetry tell us about fisheries, MPAs and nearshore oceanography in the California Current?** Co-chairs: Julia Coates and Laura Rogers-Bennett, California Department of Fish and Wildlife.
- 8:30-8:40 Introduction and overview: Julia Coates and Laura Rogers-Bennett.
- 8:40-9:20 **S-1. Movement of cabezon and several nearshore rockfish species based on tagging studies from collaborative fisheries research.** Dean Wendt, Cal Poly State University, San Luis Obispo.
- 9:20-10:00 **S-2. Integrating cooperative fisheries research and the La Jolla acoustic array: Population analyses of two species in the genus *Paralabrax*.** Lyall Bellquist, Brice Semmens, Scripps Institution of Oceanography, La Jolla.
- 10:00-10:40 **S-3. Swim or stay: Residence times and movements of tagged fishes in an acoustic array in Carmel Bay.** Rick Starr¹, Ashley Greenley², Kristen Green³, ¹California Sea Grant and Moss Landing Marine Laboratories, Moss Landing, ²Fish Wise, Santa Cruz, ³Alaska Department of Fish and Game, Sitka.
- 10:40-11:00 Break
- 11:00-11:40 **S-4. Tracking California spiny lobsters: behavior, survival, and implications for protection in MPAs.** Kevin A. Hovel, Department of Biology and Coastal & Marine Institute, San Diego State University.

- 11:40-12:20 **S-5. Movement and home range of pink abalone (*Haliotis corrugata*): implications for restoration and population recovery.** Julia H. Coates¹, Kevin A. Hovel¹, John L. Butler², A. Peter Klimley³, Steven G. Morgan³,
¹Department of Biology, San Diego State University, ²National Marine Fisheries Service, Southwest Fisheries Science Center, ³Graduate Group in Ecology, University of California, Davis.
- 12:20-1:20 **Lunch**
- 1:20-2:00 **S-6. Movement patterns of the California two spot octopus, *Octopus bimaculatus*, using acoustic telemetry.** Jennifer Hofmeister¹ and Kelley Voss², ¹ Department of Integrative Biology, UC Berkeley, ² Department of Environmental Science, Alaska Pacific University, Anchorage.
- 2:00-2:40 **S-7. Using high resolution GPS to measure behavior in foraging seabirds: predictions of foraging events are possible using random forests.** Gabrielle Nevitt, Grant W. Humphries and Chris Tyson, Department of Neurobiology, Physiology and Behavior, University of California, Davis.
- 2:40-3:20 **S-8. Quantifying the movements and behavior of juvenile white sharks in southern California using different electronic tags.** Christopher G Lowe¹, Connor White¹, Ryan Logan¹, Armand Barilotti¹, Kady Lyons¹, Chuck Winkler², Sal Jorgensen³, John O'Sullivan³, ¹Shark Lab, California State University Long Beach, ²Southern California Marine Institute, Terminal Island, ³Monterey Bay Aquarium, Monterey.
- 3:20-3:40 **Break**
- 3:40 **Session V: Contributed Papers (15 minutes with 5 minutes for discussion).** Chair: Dave Checkley, Scripps Institution of Oceanography
- 3:40-4:00 **C-6. Dynamics of the rockfish community in Southern California: a new time series derived from CalCOFI data.** Andrew Thompson¹, John Hyde¹, John Field², Jameal Samhoury³, Lian Guo⁴, Dustin Chen⁵, and William Watson¹, ¹ Southwest Fisheries Science Center, NMFS/NOAA, La Jolla, ² Southwest Fisheries Science Center, NMFS/NOAA, Santa Cruz, ³ Northwest Fisheries Science Center, NMFS/NOAA, Seattle, ⁴ Dept. of Organismic and Evolutionary Biology, University of Massachusetts Amherst, Amherst, MA, ⁵ Marine Science Program, University of San Diego, San Diego.

- 4:00-4:20 **C-7. Ontogenetic vertical distribution of mesopelagic fishes and the development of diel migration.** Noelle M. Bowlin^{1,2}, Andrew R. Thompson¹, William Watson¹, Philip A. Hastings², ¹Southwest Fisheries Science Center, NMFS/NOAA, La Jolla, ²Scripps Institution of Oceanography, La Jolla.
- 4:20-4:40 **C-8. The Rewilding of the California Current: Marine mammal forage requirements and implications for forage fish management.** Russ Vetter, Sam McClatchie, Southwest Fisheries Science Center, NMFS/NOAA, La Jolla.
- 4:40-5:00 **C-9. Fish diversity and corrosive Pacific Equatorial Water in the southern California Current System.** Sam McClatchie¹, Andrew R. Thompson¹, Steven J. Bograd², Samantha Siedlecki³, Simone R. Alin⁴, Noelle Bowlin¹ and William Watson¹, ¹Southwest Fisheries Science Center, NMFS/NOAA La Jolla, ²Southwest Fisheries Science Center, NMFS/NOAA, Pacific Grove, ³JISAO, University of Washington, Seattle, ⁴PMEL, OAR/NOAA, Seattle.

Poster Session

- 5:15-7:15 **Seminar Room, Moss Landing Marine Laboratories.** Beer, wine, and non-alcoholic beverages, hors d'oeuvres, and dessert.
- P-1. Three-dimensional Distribution of Copepods Species in Cyclonic Eddy in the Gulf of California.** Javier Cruz-Hernández¹, Laura Sánchez-Velasco¹, Emilio Beier², and Ricardo¹ Palomares-García, ¹Centro Interdisciplinario de Ciencias Marinas-IPN (CICIMAR), ²Centro de Investigación Científica y de Educación Superior de Ensenada. CICESE, Unidad La Paz.
- P-2. Identifying anomalous climate conditions in the Northeastern Pacific Ocean.** Benigno Hernández-de la Torre¹, Gilberto Gaxiola-Castro^{2,4}, Rafael Hernández-Walls³, ¹Geographer Consultant, Ensenada, B. C. México, ²CICESE, Ensenada, Baja California, México, ³Universidad Autónoma de Baja California, Ensenada, B. C. México, ⁴Monterey Bay Aquarium Research Institute. Moss Landing, California (Sabbatical).
- P-3. Monitoring of planktonic communities in the Guerrero Negro lagoon, Baja California in two seasons during El Niño 2015.** Cota-Meza M.S.,* Sánchez -González, A., Garate Lizárraga, I. A., Pacheco Chávez, R., Zarate Villafranco. Departamento de Plancton CICIMAR-IPN.
- P-4. Rippled scour depressions (RSDs) and their impacts on a dominant marine organism of the continental shelf.** Jesirae M. Collins, Michael O.

Navarro, Corey Garza Marine Landscape Ecology Lab, CSU Monterey Bay, Seaside.

P-5. On the anomalous hydrographic conditions off Baja California. Reginaldo Durazo¹, Gilberto Gaxiola-Castro^{2,3}, Luis E. Miranda², ¹ UABC-Facultad de Ciencias Marinas, Ensenada, México, ² Centro de Investigación Científica y Educación Superior de Ensenada, Ensenada, México, ³ Monterey Bay Aquarium Research Institute, Moss Landing, California (sabbatical).

P-6. Influence of Nutrients and Temperature on Pelagic Ecosystem Microbial Networks in the Southern California Current Ecosystem. Andrew E. Allen^{1,2}, Kelly Goodwin³, Ralf Goericke¹, Margot Bohan³, Shonna Dovel¹, Ariel Rabines², Megan Roadman¹, Hong Zheng², Dave Checkley¹
¹Scripps Institution of Oceanography, ²J.Craig Venter Institute, ³NOAA SWFSC.

P-7. Monterey Bay Marine Biodiversity Observation Network (MBON): Integrating multidisciplinary regional data to track biodiversity and inform resource management. Jennifer A. Brown¹, Steven J. Bograd², Francisco Chavez³, Andrew DeVogelaere¹, John C. Field⁴, Elliott L. Hazen², Jaime Jahncke⁵, Maria T. Kavanaugh⁶, Jarrod A. Santora⁷, Isaac D. Schroeder^{2,1}, ¹ Monterey Bay National Marine Sanctuary, ² Southwest Fisheries Science Center, Environmental Research Division, Monterey, ³ Monterey Bay Aquarium Research Institute, ⁴ Southwest Fisheries Science Center, Fisheries Ecology Division, Santa Cruz, ⁵ Point Blue Conservation Science, ⁶ Woods Hole Oceanographic Institution, ⁷ University of California Santa Cruz.

P-8. Fishing For Answers: Results from both Recreation Fisheries Data Analysis and Tagging of Yellowtail (*Seriola lalandi*) in the Southern California Bight. Noah Ben-Aderet, Ph.D. Candidate, Center for Marine Biodiversity and Conservation, Scripps Institution of Oceanography.

P-9. Moss Landing: A Humpback whale hotspot? J.T. Pennington*, N. Black**, M. Salisbury*, R.P. Michisaki*, J. Sevadjian*, F.P. Chavez*,
*Monterey Bay Aquarium Research Institute, Moss Landing, CA, **Monterey Bay Whale Watch.

P-10. Variability of organic carbon and biogenic opal from Soledad Basin, during the last 150 years. Juárez-Fonseca, M.¹, Sánchez, A.^{1,*}, González-Yajimovich, O.², ¹ Centro Interdisciplinario de Ciencias Marinas, Instituto Politécnico Nacional, La Paz, Baja California Sur, México, ² Facultad de Ciencias Marinas, Universidad Autónoma de Baja California, Mexico.

- P-11. Biogeography of Ichthyoplankton Assemblages from British Columbia to Baja California.** Chargualaf, D. N.^{1*}, Thompson, A. R.¹, and Hastings, P. A.²
¹NOAA Fisheries Service, Southwest Fisheries Science Center
²Scripps Institution of Oceanography
- P-12. Diapycnal Mixing in the Atlantic Equatorial Undercurrent.** Á. Rodríguez-Santana¹, J.L. Pelegrí², M. Emelianov², ¹Universidad de Las Palmas de Gran Canaria, Spain, ²Instituto de Ciencias del Mar- CMIMA-CSIC, Oceanografía Física, Barcelona, Spain.
- P-13. Nonlinear dependence of Diel Vertical Migration behavior on copepod body size and water column transparency.** Mark D. Ohman¹ and Jean-Baptiste Romagnan², ¹Scripps Institution of Oceanography, ²Laboratoire d'Océanographie de Villefranche-sur-mer, France.
- P-14. A Shifted Baseline in the California Current Ecosystem from Ocean Warming.** David B. Field¹, John Barron², Manuel Bringué³, David Bukry², Vicente Ferriera-Batrina⁴, Bruce Finney⁵, Vera Pospelova³, Kimberly Rose¹, Patricia Ziveri⁶, Tim Baumgartner⁴, ¹Hawaii Pacific University, ²United States Geological Service (Menlo Park), ³University of Victoria, ⁴Centro de Investigaciones Científicas y Educación Superior de Ensenada, ⁵Idaho State University, ⁶Universitat Autònoma de Barcelona.
- P-15. Central and Northern California Ocean Observing System Data Portal: Access to real-time observations, nowcasts, and forecasts.** David M. Anderson¹, Fred L. Bahr¹, Aric Bickel¹, Robert Bochenek²; Jennifer L. Patterson¹, and Leslie K. Rosenfeld¹, ¹Central and Northern California Ocean Observing System (CeNCOOS), Monterey Bay Aquarium Research Institute, Moss Landing, CA, ²Axiom Data Science, Anchorage, AK.
- P-16. Tracking Three-Dimensional Fish Behavior With A New Marine Acoustic Telemetry System.** Ian G. Brosnan¹, Louise P. McGarry², Charles H. Greene², Tracey W. Steig³, Samuel V. Johnston³, John E. Ehrenberg³, ¹NASA Ames Research Center, Mountain View, CA, ²Cornell University, Ithaca NY, ³Hydroacoustic Technology Inc. (HTI), Seattle, WA.
- P-17. A review of California's commercial market squid fishery and its response to a warming ocean.** Laura Ryley, California Department of Fish and Wildlife.
- P-18. Responses of copepod and euphausiid communities off northern California to the warming event of 2014-2015.** Eric P. Bjorkstedt¹, Roxanne R. Robertson², William T. Peterson³, ¹NOAA National Marine

Fisheries Service, Southwest Fisheries Science Center and Humboldt State University, ²CIMEC, Humboldt State University, ³NOAA National Marine Fisheries Service, Northwest Fisheries Science Center.

Wednesday, 16 December

8:30-3:00 El Nino Workshop. Hosted by Center for Ocean Solutions. Chairs: Dr. Larry Crowder and Dr. Laura Rogers-Bennett.

8:30-11:00 Presentations.

11:00-12:00 Discussion.

12:00-1:00 Working lunch (provided).

1:00-3:00 Research and Monitoring Plans.

3:00 Conference adjourned.

SYMPOSIUM ABSTRACTS

Session IV: What can animal telemetry tell us about fisheries, MPAs and nearshore oceanography in the California Current?

Co-chairs: Dr. Julia Coates and Dr. Laura Rogers-Bennett

The movement patterns of marine species in the nearshore have broad implications for fisheries, reproduction, habitat use, and adaptation to disturbance or long-term climate change. Recent advances in tracking animal movements now make it possible to identify critical habitats, spawning aggregations and oceanographic features. Movement also has implications for the efficacy of Marine Protected Areas (MPAs). The amount of protection afforded by MPAs to fished species will vary with the frequency they cross protected borders. Promotion of ecosystem integrity through protection of whole communities may be compromised by variable protection afforded to the component species. Tracking the movements of nearshore species however, presents particular challenges relative to studies of species in more open pelagic habitats. Presentations for the 2015 CalCOFI symposium will explore the movement patterns of nearshore species of southern California, their uncertainty, and the mechanisms driving these patterns as well as discuss their implications for ecosystem based management, MPA function and learning about the nearshore physical environment.

S-1. Movement of cabezon and several nearshore rockfish species based on tagging studies from collaborative fisheries research

Dean Wendt
Cal Poly State University, San Luis Obispo

The California Collaborative Fisheries Research Program has been working for 10 years to better understand the status of nearshore groundfish on the Central Coast of California. As part of the effort, scientists, working with commercial and recreational fishermen, have been tagging and releasing fish inside and outside of four marine protected areas and co-located reference sites. This seminar will report on: 1) a focused study with commercial-trap fishermen to understand the home range, site fidelity, and homing behavior of the Cabezon, *Scorpaenichthys marmoratus*; and, 2) working with the commercial passenger fishing vessel industry, a report on the movement of several species of rockfish, *Sebastes* spp. The results of the tagging work will be discussed in the context of the size and spacing of California's marine protected areas.

S-2. Integrating cooperative fisheries research and the La Jolla acoustic array: Population analyses of two species in the genus *Paralabrax*

Lyall Bellquist, Brice Semmens
Scripps Institution of Oceanography, La Jolla

Cooperative approaches to fisheries science can yield vastly improved data quantity and quality, significantly help disseminate information beyond just the scientific community, and ultimately provide more informed fisheries management decisions. The effectiveness of these management decisions is partially dependent upon accounting for fish behavior, especially given that spatial management approaches have become common in recent years. One of the necessary components of spatial management is knowledge of species movement patterns because harvest control rules can ultimately be ineffective if spatial regulations are implemented without accounting for spatially mediated life history characteristics (e.g., spawning sites). The state of California recently implemented an extensive network of coastal marine protected areas (MPAs) that cover approximately 16% of state waters. Understanding the movements and behaviors of fishes relative to these reserve boundaries affords the opportunity to quantify the extent of fishing protections (or conversely, spill-over) associated with an MPA or a network of MPAs. The fishing community is eager to learn more about fish movements in all contexts, which creates the potential for cooperative research that can inform both the design and assessment of MPAs. We conducted a cooperative fishing community-based tagging study, and integrated both tag-recapture and acoustic telemetry methods to measure movement patterns of three species of *Paralabrax* on multiple spatial scales. We externally tagged a total of 12,581 Kelp Bass (*P. clathratus*), 1079 Barred Sand Bass (*P. nebulifer*), and 2353 Spotted Sand Bass (*P. maculatofasciatus*), with recapture rates of 10.8% (1362), 4.5% (49), and 3.8% (90), respectively. We also internally tagged 41 Kelp Bass and 25 Barred Sand Bass with Vemco coded acoustic transmitters to measure more detailed behavioral patterns. These fish were detected with a fixed subsurface array of 43 acoustic receivers located throughout three sites within the La Jolla kelp bed off San Diego, California. Both species showed both daily and seasonal depth migrations and activity levels, as well as daily and seasonal horizontal migrations. However, seasonal horizontal movements were more prominent for Barred Sand Bass, which showed a southward migration to a previously undescribed aggregation site off south La Jolla. Only 12% of acoustically tagged Kelp Bass were regularly detected across multiple La Jolla sites, while the remaining 88% were primarily detected at a single site. However, 48% of Barred Sand Bass were regularly detected at two or all three La Jolla sites, and the apparent local spawning site for this species spans the southern boundary of the South La Jolla State Marine Reserve. None the five previously known primary spawning aggregation sites for Barred Sand Bass are located within any of the new southern California MPAs, so this newly documented south La Jolla aggregation site is likely the first to be afforded at least partial protection by an MPA. Increased spatial protection of this spawning aggregation could be achieved by shifting the southern boundary farther south. However, greater conservational benefits for Barred Sand Bass would likely be achieved through seasonal protection during the spawning season. This is an issue that should be discussed given 1) severe declines in CPUE for this species since 2004, 2) recent breakdowns in traditional spawning aggregation behavior, and 3) agreement from the fishing community that barred sand bass stocks are less healthy than in the past.

S-3. Swim or stay: Residence times and movements of tagged fishes in an acoustic array in Carmel Bay

Rick Starr¹, Ashley Greenley², Kristen Green³

¹California Sea Grant and Moss Landing Marine Laboratories, Moss Landing

²Fish Wise, Santa Cruz

³Alaska Department of Fish and Game, Sitka

Marine protected areas (MPAs) have been shown to increase the numbers and sizes of fishes within reserve boundaries and may enhance fisheries yields via movements of fishes to areas outside reserve boundaries. The conservation benefits afforded by no-take MPAs, however, are primarily accrued for fish that stay within reserve boundaries, i.e. fishes with home ranges that are smaller than the reserve. To date, most information used to design MPAs has been based on the net movements of adult fishes. Without information about daily and seasonal movements of immature as well as mature fishes, it is difficult to evaluate the performance of a MPA in achieving an expected level of protection. We placed sonic transmitters in Lingcod, Cabezon, and several species of rockfishes and tracked their movements from 2006-2008 using an array of 31 moored acoustic receivers in Carmel Bay.

The specific objectives of the present study were to: (1) describe the daily and seasonal movement patterns of fishes and (2) quantify the home range and residence times of juvenile and adults. Each tagged species displayed different movement patterns; however, movements of most tagged fishes were correlated with environmental variables such as atmospheric pressure, wind speed, upwelling, and wave height.

S-4. Tracking California spiny lobsters: behavior, survival, and implications for protection in MPAs

Kevin A. Hovel, Department of Biology and Coastal & Marine Institute,
San Diego State University

The California spiny lobster *Panulirus interruptus* supports valuable commercial and recreational fisheries in Southern California, as well as a much larger fishery in Baja California. Though there is renewed interest in lobster population dynamics, behavior, and the predatory role of lobsters in coastal ecosystems, much remains to be learned about the ecology of this species. In California, intense fishing for over 100 years has contributed to reductions in *P. interruptus* density and body size, which has strong implications for interactions between lobsters, their predators, and their herbivorous prey. Nonetheless, lobster habitat requirements, patterns of behavior, and community-level interactions are not well known. I will highlight research on California spiny lobster behavior in kelp forest and soft-sediment ecosystems in Southern California, focusing on telemetry and habitat use studies and their implications for lobster use of, and protection within, marine protected areas (MPAs). Combining short-term (nightly) and long-term (months to years) lobster tracking and survey data reveals clear patterns of lobster movement behavior that depend heavily on habitat availability, food availability, conspecific density, and predation risk. Lobsters are highly residential in areas with adequate food and shelter, whereas habitats with more diffuse resources, and perhaps lower predator abundance, promote long-distance movement and use of multiple habitats. Recent experiments conducted in areas of high predator density reveal strong effects of shelter size and conspecific density on lobster predation risk, which correspond to patterns of lobster shelter selection and movement. Overall, lobsters maintain small home ranges which bode well for protection of lobster populations by MPAs.

S-5. Movement and home range of pink abalone (*Haliotis corrugata*): implications for restoration and population recovery

Julia H. Coates¹, Kevin A. Hovel¹, John L. Butler²,
A. Peter Klimley³, Steven G. Morgan³

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Densities of abalone in southern California have been dramatically reduced by overfishing and disease and low fertilization rates may be hindering population recovery. However, movement may produce clustered distributions that promote fertilization success in broadcast spawners, such as abalone, even at low regional densities. We used acoustic telemetry and an individual-based model to investigate the effects that pink abalone (*Haliotis corrugata*) movement may have on the success of aggregation as a restoration technique and expectations for fertilization success. We translocated wild, adult pink abalone to an existing abalone patch to create a high-density aggregation, and then monitored movement and aggregation maintenance for a period of 14 mo in the Point Loma kelp forest near San Diego, California. Abalone showed a minimal flight response to handling and most individuals exhibited small home ranges (median area 183 m²) with homing behavior consisting of regular back-and-forth movement to a single point. Though site fidelity may help maintain aggregations, abalone density decreased, and nearest neighbor distances increased at our site to near initial levels after 18 mo via a combination of mortality, large movements of a few individuals, and small, incremental movements of most individuals. Translocation of wild abalone to produce aggregations may not result in high rates of fertilization success that promote population recovery. However, the observed homing behavior suggested the potential for more opportunities to mate than expectations based on static density and aggregation state commonly used in fertilization success models. Our model incorporated asynchrony in spawning spread over a reproductive season, movement rules based on the telemetry data, and realistic densities and aggregation states for the Point Loma kelp forest. Movement was capable of compensating for the fertilization drawbacks to asynchronous spawning. However, fertilization success rates based on movement and spawning asynchrony were comparable to success rates assuming no movement and complete synchrony and declined similarly with decreasing population density. When combined with reproductive asynchrony, movement may not mitigate density decline.

S-6. Movement patterns of the California two spot octopus, *Octopus bimaculatus*, using acoustic telemetry

Jennifer Hofmeister¹ and Kelley Voss²

¹ Department of Integrative Biology, UC Berkeley, Berkeley, CA, USA, email: jenkkhof@gmail.com

² Department of Environmental Science, Alaska Pacific University, Anchorage, AK, USA

Octopuses have significant ecological roles and predatory impacts on prey populations, yet their movement and activity patterns are very rarely included in studies of community interactions or assessment of ecosystem function. During August 2014 on Catalina Island, CA, USA, nine *Octopus bimaculatus* were caught on SCUBA and tagged with continuous transmitters. Of the nine tags, six stayed on for the duration of the tags' battery lives; two tags fell off immediately, and one fell off after five days. Six of the octopuses were actively tracked for a 24 h period, and daily GPS locations were recorded for all individuals. *O. bimaculatus* is a very mobile octopus compared to other octopus species of equivalent size. On average, octopuses inhabited an activity space of 6000 m² over the course of the study. Octopus movement was highly variable between individuals. There was no difference in movement between day, night, or crepuscular time periods, or between sexes. Larger octopuses moved more, and individuals changed den locations every other day on average. The success of this tracking method on a relatively small (< 2 kg) octopus species lays the groundwork for expanding this type of research into wider a variety of habitats where octopus predation is a key limiting factor on invertebrate populations. Understanding octopus movement will provide insight to habitat choice and the intersection of octopuses and anthropogenic activity, especially with conservation and restoration of benthic invertebrates.

S-7. Using high resolution GPS to measure behavior in foraging seabirds: predictions of foraging events are possible using random forests

Gabrielle Nevitt, Grant W. Humphries and Chris Tyson

Department of Neurobiology, Physiology and Behavior, One Shields Avenue, University of California, Davis, California, 95616

Recently, high resolution GPS has been used in conjunction with stomach temperature recorders to explore the sensory bases of prey capture, but automated methods for accurately identifying and categorizing foraging events without stomach temperature data have not yet been developed. My presentation will review previous work published from our lab that has used this combination of technologies to test hypotheses about the sensory basis for foraging in albatross species. I will then introduce a tool that my lab is developing that draws on the predictive power of a ‘random forest’ machine learning algorithm to quantify, describe and predict foraging events using information derived from GPS tracks alone for situations where stomach temperature data are not available. This tool predicts an event by quantifying parameters (e.g., tortuosity, speed, and acceleration) of GPS tracks at varying distances from an identified foraging event. Using this random forest clustering algorithm, we can now identify two distinct foraging behavior types for Black-browed albatross (*Thalassarche melanophris*) and three distinct behavioral types for Wandering albatross (*Diomedea exulans*), which are the focal species for our current sub-Antarctic studies. However, variations on this tool may be useful to study the foraging ecology of procellariiforms and perhaps other seabirds operating within the California current system. Moreover, these tools could help drive other hypotheses that explain foraging behavior and tactics by drawing on the *a priori* nature of machine learning algorithms.

S-8. Quantifying the movements and behavior of juvenile white sharks in southern California using different electronic tags

Christopher G Lowe¹, Connor White¹, Ryan Logan¹, Armand Barilotti¹, Kady Lyons¹,
Chuck Winkler², Sal Jorgensen³, John O'Sullivan³

¹Shark Lab, California State University Long Beach, Long Beach

²Southern California Marine Institute, Terminal Island

³Monterey Bay Aquarium, Monterey

The evolution of electronic tags and remote environmental sensing technology over the last 20 years has allowed for a better understanding of the movements and behavior of highly mobile coastal marine organisms. We used combinations of electronic tags and telemetry technologies on young-of-the-year (YOY) and juvenile white sharks in southern California to determine movement patterns, site fidelity, migration patterns, habitat use and fishery interactions. Thirty-seven sharks have been tagged with coded acoustic transmitter (1-10 year battery life), 33 with PAT, and 20 with SPOT tags since 2006. Some individuals were fitted with all three transmitter types to allow for higher spatial and temporal monitoring of movements. Sharks have shown relatively high site fidelity to shallow coastal habitat during summer months, using areas off Ventura, Santa Monica Bay, Huntington Beach, and San Clemente. Depth distributions vary among individuals, but most activity is in shallow beach habitats or upper mixed layer when in offshore habitats. Sharks have shown consistency in seasonal migratory patterns, leaving southern California in early winter months when SST go below 15°C, rapidly migrating and overwintering in lagoon habitats off western Baja. Approximately, 25% of the individuals that have migrated to Baja have returned to CA the following summer. None of the 5 sharks tagged in summer 2014 or 2015 were observed to migrate to Baja in the winter, presumably due to warmer El Nino-like conditions. New technology (Smart-tags and customized tracking AUVs) are being developed for active tracking of YOY white sharks to better characterize fine-scale habitat use.

CONTRIBUTED ABSTRACTS

C-1. Warm Anomaly Effects on Subtropical NE Pacific Ocean Phytoplankton

Eliana Gómez-Ocampo¹, Gilberto Gaxiola-Castro^{1*}, and Emilio Beier²

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Sea surface positive temperature anomalies were evident at NE Pacific Ocean since the boreal winter of 2013–2014. Previous studies revealed that these anomalies were caused by lower than normal rates of heat loss from the ocean to the atmosphere, and by relatively weak cold water advection to the upper ocean. Anomalous high Sea Surface Temperature (SST), high Absolute Dynamic Topography (ADT), and low Chlorophyll-a (CHL) obtained from monthly remote sensing data were registered off the Baja California Peninsula during August 2014. Anomalies appeared around the coastal waters and oceanic zone, particularly between Punta Eugenia and off Magdalena Bay. High SST anomalous values up to 4°C above the monthly mean, ~ 15 cm in ADT, and less of 4.5 mg m⁻³ of CHL were registered off Baja California Peninsula. ADT 10 cm increase is equivalent to ~25 m thermocline deepening, which in turn influenced the availability of nutrients and light for phytoplankton growth in the euphotic zone. For searching the influence of the warm water anomaly on phytoplankton production, we fitted with Generalized Additive Models the relationship between monthly primary production and ADT 1997-2010 satellite data. Primary production during August 2014 inferred from the model showed high negative anomalies (up to 0.6 gC m⁻² d⁻¹) in the coastal zone between Punta Eugenia and off Magdalena Bay. Preliminary conclusions showed that warm anomaly affected negatively to phytoplankton organisms during August 2014, being this evident by low biomass and negative anomalies in primary production as result of pycnocline deepens.

C-2. Patterns of movement of Pacific Bluefin tuna (*Thunnus orientalis*) obtained using archival electronic tags

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Electronic tagging of marine fish has been used for tracking movements, feeding and collecting high resolution data at all time and spatial scales. This information indicates their preferences in oceanic conditions, where they are feeding and reveals their corridors of migration. The period of observation was from August, 2002 through August, 2004. We selected 7 fish with archival tags implanted in their abdominal cavity. The objective was to relate movements to that of the Pacific sardine considered to be their preferred prey.

During the spring of 2003, roughly 45% of the locations observed were found within latitudes 25-30°N. During April of that year the presence of sardine eggs collected by both the CalCOFI and the IMECOCAL programs indicate that the tuna were foraging on adult sardines. The external tag examined from one of the fish shows that the dives were relatively shallow (< 100m) down, with temperatures only the range of 20 down to 16°C. Comparison between the difference in the external and internal temperatures suggests this fish undertook four feeding events determined by immediate cooling due to ingestion of cold water and subsequent increases in metabolic activity.

Variation in the latitudinal movements among the tagged fish is related to their physiology that linked to their size; differences between seasons are likely due to changes in oceanographic conditions. Although the number of eggs is significantly greater in the CalCOFI region the preference for range of latitudes between 25-30° indicates the optimal conditions that would reduce the metabolic cost. We believe that the Bluefin make several dives after finding prey to continue their searching and to increase their internal temperature to accelerate their digestion.

C-3. Anomalous patterns in California Current pelagic micronekton distribution and abundance in 2015

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We report on the unusual distribution and abundance patterns of pelagic micronekton during the late spring upwelling season in the coastal waters off California in 2015 relative to a 33 year time series off central California and a shorter time series in northern and southern California. Data are collected from a midwater trawl survey primarily conducted to examine the abundance of young-of-the-year (YOY) rockfish (*Sebastes spp.*) and other groundfish to develop indices of year class strength for stock assessments. Throughout the duration of these time series we have tended to see three generalized patterns of community dominance. For example, in years of strong upwelling and/or southward transport, we see productive conditions associated with high numbers of YOY rockfish, market squid and other key elements of the food web. In contrast, in years of lower upwelling and transport (such as El Niño years), we often see greater localized abundance coastal pelagic species such as Pacific sardine (*Sardinops sagax*) and northern anchovy (*Engraulis mordax*), and an increase in the occurrence of typically subtropical species, such as pelagic red crabs (*Pleuroncodes planipes*). Finally, in some years the community is dominated by gelatinous zooplankton, such as salps, pyrosomes and heteropods. The 2015 survey was unusual in that species characteristic of all three of these nominal states were encountered in high abundance throughout this region. We will discuss the results of the 2015 survey relative to past trends.

C-4. Tracking geomorphological processes of the sandy seafloor and associated effects on the spatial patterns of inhabitants, including market squid, *Doryteuthis opalescens*

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Sandy plains constitute ~80% of the continental shelf in the north-eastern Pacific. The current paradigm is that these habitats are structurally homogenous and that the spatial patterns of associated species within sandy plains, including fishery species, are largely unrelated to structure. However, recent studies are challenging this paradigm providing evidence consistent with sandy plains being more heterogeneous than previously thought. In Monterey Bay, USA, this study analyzed the geomorphological dynamics of the upper shelf (0-40 m depth) repeating surveys in July and October 2015 using sidescan sonar (SWATHplus 400 kHz) and underwater video (SeaBotix LBV200 remotely-operated vehicle). Spatial models and analysis were conducted using GIS ArcMap v. 10.2.2 software. In addition to flat habitat types, rippled scour depressions (RSDs) were detected. Dominant species such as sand dollars, *Dendraster excentricus*, were near and within RSDs whereas other organisms were found primarily in flat habitat including the commercially important market squid, *Doryteuthis opalescens*. Additional surveys of flat and RSD habitats will be taken in winter and spring 2016. These added surveys will be used to study short term dynamics (persistence) of flat and RSD habitats through storm events and to study associated impacts on epifaunal spatial patterns.

C-5. Larval production and habitat distribution of Jack mackerel *Trachurus symmetricus* in the Southern California Bight

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Time series of egg and larval production are commonly used as indices of fish population size. Such indices have been developed using CalCOFI data for several coastal pelagic species in the California Current System. However, a limitation of such indices for mobile species with broad geographical ranges such as Jack Mackerel is that the range of the species is larger than the core CalCOFI area surveyed. I calculated a time series of larval production of Jack mackerel in the core CalCOFI sampling area and a model of spawning habitat as an indicator of habitat suitability. The model was used to test if the relation between habitat conditions and larval production could be used to correct larval production estimates for changes in the proportion of the mackerel population present in the survey area. Jack mackerel did not use the available habitat consistently. When larval production was relatively high and habitat conditions were good, most larval production occurred in the best habitat as expected. However, when larval production was relatively low and habitat conditions were below average, larval production occurred in areas with both good and poor habitat. These results suggest that larval production in the core CalCOFI sampling area may not reflect larval production for the population as a whole when habitat quality in the survey area is poor because the small fraction of the mackerel population present behaves differently than the population as a whole. When larval production is high and habitat quality is good, additional data from outside of the core area is needed to estimate the contribution of larval production in the survey area relative to that of the population.

C-6. Dynamics of the rockfish community in southern California: a new time series derived from CalCOFI data

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Rockfish are ecologically and economically important members of the fish assemblage in southern California. Due to historic overfishing, however, populations of many of the larger, targeted species were decimated and are now actively managed by the NMFS. Management measures include implementing areas where fishing is restricted, limiting or prohibiting take of certain species, and seasonally closing fisheries. In addition, formal stock assessments are mandated for several species.

Assessing the status of the rockfish assemblage in southern California has been difficult, however, due to a lack of data on population dynamics. Although rockfish larvae have been systematically collected in southern California for decades, the larvae of most rockfishes are morphologically indistinguishable to species. Here, we present for the first time a time-series (1998-2013) for larval rockfishes collected during winter CalCOFI cruises that were genetically identified to species.

Genetic analysis identified 40 species of rockfish, 35 of which were previously identified only to genus. Of the 40 species, 19 were targeted by fishers at some point over the past 50 years.

Overall, the assemblage was consistently dominated by untargeted species although there was a weak, positive trend in the proportion of larvae that were from targeted species. The overall abundance (9 targeted and 10 untargeted species) and proportion of stations occupied (10 targeted and 10 untargeted species) increased significantly between 1998 and 2013. Mean species richness also increased significantly with a 5-fold difference between 1998 and 2013.

Spatially, the center of abundance for both fished and unfished species was consistently located near the Santa Rosa-Cortes Ridge that connects Santa Rosa and San Nicolas Islands (although unfished species tended to be found somewhat southeast of the fished species). Similarly, centers of distribution of species richness were found on or near the Santa Rosa-Cortes Ridge. There was no systematic directional change in the location of centers of distribution through time.

Our findings suggest that the spawning stock of many rockfish species have significantly increased over the past 15 years and identify locations that are likely on or near important spawning habitats. Further analysis will help identify the factors that are driving these trends (e.g., oceanography, human actions) and evaluate the suitability of this data for stock assessment and integrated ecosystem assessment.

C-7. Ontogenetic vertical distribution of mesopelagic fishes and the development of diel migration

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The mesopelagic zone is one of earth's largest habitats and contains the highest abundance of marine vertebrates in the world. These fishes carry out all of their life stages in the water column. Typical of broadcast spawners, they generally have buoyant eggs that hatch into larvae which inhabit the productive epipelagic zone, but move into deeper habitats as they mature. While a variety of studies have described the vertical distribution and diel migration of juvenile and adult mesopelagic fishes, relatively few have focused on stage-specific vertical distribution of early life history stages. Given the need to choose a habitat that optimizes the balance between foraging and predation, it is plausible that larval fishes, not just juveniles and adults, partition themselves in the water column. Here we analyze depth-specific ontogeny in mesopelagic fishes in the central and southern California current with goals of better defining depth-specific niches and the development of diel vertical migratory patterns.

C-8. The Rewilding of the California Current: Marine mammal forage requirements and implications for forage fish management

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Landmark legislation passed in the mid 1970s led to the implementation of the Magnuson-Stevens Fishery Conservation and Management Act, the Marine Mammal Protection Act and the Endangered Species Act. Now, 40 years later we examine the relative magnitude of forage fish harvests and the increased demands of marine mammals for forage within the US west coast EEZ. In general exploited populations of pinnipeds and great whales have increased at near theoretical maximum demographic rates since the 1970's. Small cetacean populations were rarely targeted for direct harvest, and demographic impacts of bycatch and harassment mortality are poorly known. However, in some cases, small cetacean populations have also shown remarkable increases within the EEZ during this 40 year period. These increases may be due to migration into the EEZ due to direct and indirect effects of climate and forage distribution, as well as changes in local survivorship. Broad-scale surveys of marine mammals and fishery-independent forage surveys, coupled with high resolution physiological ecology studies of the bio-energetic demands of marine mammals, shed new light on the changing natural mortality (M) versus fishing mortality (F) of forage fish populations. Increasing numbers of pinnipeds and cetaceans has increased natural mortality of forage fishes in the last 40 years, but is not explicitly accounted for in current or anticipated forage fish assessments. We attempt a first order quantification of pinniped and cetacean forage fish predation, and compare its magnitude to estimates of forage fish catches.

C-9. Fish diversity and corrosive Pacific Equatorial Water in the southern California Current System

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The presence of Pacific Equatorial Water off southern California has been increasing over the last three decades, associated with strengthening of the California Undercurrent. Pacific Equatorial Water properties include warmer temperatures and higher salinities (higher spiciness), with lower oxygen and lower pH, and their higher acidity makes them a source of corrosive waters in this region where upwelling has less importance. The CalCOFI program has sampled the southern California region since 1951, identifying the ichthyoplankton assemblages to species. The mesopelagic fish larvae are the best represented group in these samples. We use the mesopelagic and the broader ichthyoplankton assemblages collected by CalCOFI near two locations representative of the core of the California Current and the core of the California Undercurrent to determine whether increasing Pacific Equatorial Water influenced fish diversity. Although Pacific Equatorial Water presence as measured by mean spiciness on the 26.25-26.75 isopycnal increased after 1995 we found fish diversity to be stable over the decades 1985-1995 and 1999-2014. In contrast diversity was reduced and warm water species dominants appeared during the 1997/99 ENSO event, after which the ichthyoplankton assemblage reverted to its former structure. The reversion indicates fish diversity is resilient and is not showing signs of stress despite increased presence of Pacific Equatorial Water off southern California. We discuss this result in relation to reported declines in cool-water associated fish species off southern California.

POSTER TITLES AND ABSTRACTS

P-1. Three-dimensional distribution of copepods species in cyclonic eddy in the Gulf of California

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The three-dimensional distribution of the copepods community in a cyclonic eddy observed in July 2011 in the Gulf of California was analyzed. In each station of a selected transect (19 sampling stations), CTD data and zooplankton samples were obtained; the zooplankton was collected during day and night using opening-closing conical hauls (505 µm), in six depth strata: three above of the thermocline (45 m depth), and three bellow it (up to 200 m). Geostrophic velocities show that the eddy extended ~600 m in depth and 140-16 km in diameter. Copepods abundance defined three habitats in relation to the structure of water column. First habitat, located close to surface (0-17 m depth), with mean abundance of 10,884 individuals and specific richness of 35. This was dominated by *Temora discaudata*, *Copilia miriabilis*, *Subeucalanus subtenuis* and *Undinula vulgaris*, who contributed with 27.29%. Their abundance was higher nearshore than in the eddy center. The second habitat, located in the thermocline (51-17 m depth), had the highest mean abundance of 18,139 individuals and specific richness 37. The dominant species were *Nannocalanus minor* and *Scolecithrix danae*, with a contributed of 18.77 %. Their distribution was homogeneous along the thermocline. A third habitat was located below the thermocline (200-100m depth) with the lowest copepods abundant of 3,566 individuals and specific richness 39. The dominant species were *Nannocalanus minor* and *Rhincalanus nasutus* with a contributed of 16.36%. The results suggest that the stratification of the water column had major influence in the distribution of the copepod habitats more than the eddy dynamic.

P-2. Identifying anomalous climate conditions in the Northeastern Pacific Ocean

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In this work, the increase of positive anomalies in monthly surface atmospheric pressure (SPL; station level) between Anchorage, Alaska and San Diego, California, from September 1959 to September 2015 are showing. Trends are revealing long-term atmospheric pressure changes in the northeastern Pacific Ocean, mainly occurring during the late 2013, 2014, and 2015. Atmospheric pressure anomalies at San Diego have been remaining positive since 1999. In order to keep a reference about climate variability in the northeastern Pacific region, a new climate index for the North America west coast is proposed, named North Eastern Index (NEI), as a tool for understanding some trends in small, meso, and long-term temporal scales. The index was drawn as differences in SLP between San Diego, CA/Ensenada, Baja California and Anchorage, Alaska, obtained from 1960-2015. The NEI captures signals from high latitudes and larger scales at central and southern portions of the California Current, strongly diminished during the last two years. In relation with ocean physical dynamics, Ekman transport (Ekty, north-south component) from January 1986 to September 2015 in three locations off the North America coastal regions are shown. Ekty trend is northward since 2010, not just at one point, but apparently all along the northeastern Pacific coast. This condition has been occurred before, but the northward component had been not stayed so long. This may reflect the tendency of warm subtropical conditions over temperate and subpolar regions, resulting in an increase of surface air temperature and SST.

P-3. Monitoring of planktonic communities in the Guerrero Negro lagoon, Baja California in two seasons during El Niño 2015

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Guerrero Negro lagoon is located in 27°56'24" and 28°06'16" N, and 114°02' and 114°09'10"W and is identified as a Type IIIA lagoon with large sand barriers, runoff from arroyos is absent or very local, morphology and bathymetry is modified by the action of the tides. Studies of plankton in the lagoon are scarce, despite being a marine protected area. This study aims to determine the species of phytoplankton, zooplankton and ictiplankton and its relation to environmental factors and the occurrence of floods caused by Hurricane Linda. The collection of biological material and environmental data were performed by conventional methods. In winter, the lagoon showed a sea surface temperature of 18-20 ° C. Phytoplankton was identified by diatoms, dinoflagellates and cyanobacteria. The zooplankton was dominated by the abundance of copepods (67%) and larval decapod crustaceans (31%). Concerning fish larvae identified these species correspond to *Hermosilla azurea* and *Quietula y-cauda*. In the summer, the sea surface temperature showed values of 24 and 25 ° C. The cyanobacterium *Trichodesmium* was dominant with 90% of total phytoplankton.

P-4. Rippled scour depressions (RSDs) and their impacts on a dominant marine organism of the continental shelf

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High resolution seafloor mapping has revealed that rippled scour depressions (RSDs) are a persistent and prominent sediment feature on the inner continental shelf of western North America. Yet, the degree to which they are persistent and their associated impacts on inhabitants remains unclear. In this study, an acoustical survey was used to identify RSDs in shallow waters, 10-30 m, at two sites (San Carlos Beach and Del Monte Beach) in southern Monterey Bay, CA. Consecutively, a tow camera survey was completed to acquire epifaunal data. Of these species, the Pacific sand dollar, *Dendraster excentricus*, is a dominant competitor that forms densely packed beds of up to several hundred individuals m^{-2} and has been observed to associate with RSDs. In this study, *D. excentricus* is used as a model species to test how RSD dynamics impact inhabitants. Spatial models were created using ArcGIS software and were used to quantify the distribution of RSDs and sand dollars across the study sites. No RSDs or sand dollars were found at San Carlos Beach (1.78 km^{-2} surveyed). However, of the 1.00 km^{-2} area surveyed at Del Monte Beach, 8.6% was covered by RSDs. In flat bedforms adjacent to RSDs, sand dollar densities were 5 times higher ($290.5 m^{-2} \pm 39.6$, $n = 139$) than they were within the RSDs ($59.2 m^{-2} \pm 6.7$, $n=20$). Future work will evaluate the persistence of RSDs by comparing these summer results with a recently completed fall survey, as well as two future surveys scheduled for winter and spring, 2016.

P-5. On the anomalous hydrographic conditions off Baja California

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Based on data from seven surveys conducted between 2012 and 2015 by the IMECOCAL program, current hydrographic conditions off Baja California are described. Mixed-layer temperature and salinity anomalies indicate an upper layer warming during 2014 (~ 4 °C) linked to saltier than normal (~ 0.2 – 0.4) near-surface waters. A trend towards fresher conditions was observed during September 2015. In the summers of 2014 and 2015 the cross-shore hydrographic structure depicted a thick (~ 60 – 100 m) warm upper layer and a deepening of the relative salinity minimum indicative of the California Current core. This deepening caused large negative subsurface salinity anomalies (~ -0.4) at depths where the upper California Undercurrent is usually found (100 – 150 m). The reduced cross-shore isopycnal slopes suggested a decreasing and/or stopping of coastal upwelling. Monthly anomalies of the altimeter absolute dynamic topography (ADT) showed the largest positive anomalies near-shore, which indicated the development of alongshore poleward surface flows. The first mode of the non-seasonal Empirical Orthogonal Functions of ADT, which was identified as the El Niño-La Niña mode, indicated this poleward flow during summer of 2015 to be consistent with the transport of tropical and subtropical surface waters typical of a canonical El Niño, as occurred during 1997–1998.

P-6. Influence of Nutrients and Temperature on Pelagic Ecosystem Microbial Networks in the Southern California Current Ecosystem

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Microbial diversity and function represent one of the great data gaps in marine observations, despite their large diversity and prominent role in biogeochemical cycling. Additionally, increasing evidence indicates that interconnected networks of microbial species, most of which have not yet been cultured in the laboratory, are largely responsible for regulating marine food web dynamics and associated carbon, nitrogen, silica and other key ocean ecosystem nutrient cycles. In early 2014, we initiated quarterly collection of samples suitable for DNA and RNA analyses to examine the diversity, biogeography, and activity of planktonic microbes in the CalCOFI Southern California Bight grid. Our goal is to develop a mechanistic understanding of the role of biotic and abiotic factors in shaping the flow of carbon via the photosynthetic base of marine food webs. Samples are collected at the primary productivity and cardinal stations at the mixed layer chlorophyll max and at 515 m, as well as at two bathypelagic samples (3500m) from the northern and southern regions of the grid, and filtered onto 0.22 μm Sterivex filters. We have used the MiSeq platform (Illumina) to saturate total diversity for bacterioplankton and pelagic protists across 159 samples from four 2014 cruises. Analyses related to regional biogeography and associated patterns of diversity of abundant and rare bacterioplankton and phytoplankton will be presented. Statistical analyses related to the influence temperature, nutrients and mixed layer depth on specific groups of microbes will be reported. One of our long term goals is construction and analyses of a Southern California Current Ecosystem (CCE) pelagic plankton interactome, which depicts (and predicts) patterns of co-occurrence between various microbial groups within and between different Southern CCE regions. We are interested in elucidating interactions and relationships between major groups of photosynthetic marine phytoplankton and other microbes.

Long term trends in temperature, chlorophyll, and nutrients in the Southern CCE indicate the highly anomalous nature of 2014, relative to the past 15 years, with regard to warm temperatures, low nutrients and deep nitracline depths. Despite this, although atypically low throughout 2014, phytoplankton biomass as assessed by chlorophyll *a* has remained relatively consistent relative to anomalies in other biotic and abiotic variables. This suggests a potentially intriguing and unknown relationship between nitracline depth and phytoplankton community structure. We aim to utilize microbial diversity and co-occurrence data generated and analyzed through this project to provide new insights into this paradox.

**P-7. Monterey Bay Marine Biodiversity Observation Network (MBON):
Integrating multidisciplinary regional data to track biodiversity
and inform resource management**

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In late 2014 the National Ocean Partnership Program (NOPP) funded a project to utilize the Florida Keys and Monterey Bay National Marine Sanctuaries as sentinel sites for demonstration Marine Biodiversity Observation Networks (MBONs). Two goals of MBONs in Sanctuaries are to: 1) integrate, synthesize and augment information from on-going monitoring programs to improve understanding of patterns in marine biodiversity and 2) to provide MBON information rapidly to National Marine Sanctuaries to improve resource characterization and management. Monterey Bay MBON has shown strong success in bringing together investigators from various disciplines to integrate long-term monitoring data, characterize spatial and temporal patterns in biodiversity, and explore drivers of those patterns. We will showcase some of the data being integrated to characterize alternate states of biodiversity in the pelagic environment of the sanctuary, and contrast them with the unusual biodiversity observed in 2014-2015. New data products resulting from the MBON effort will help sanctuary managers answer key questions on the current status and recent changes in condition of resources, ranging from microbes to seabirds. This information will help sanctuary managers determine if recent changes are natural or human-caused, and whether management action is needed to improve resource condition.

P-8. Fishing For Answers: Results from both Recreation Fisheries Data Analysis and Tagging of Yellowtail (*Seriola lalandi*) in the Southern California Bight

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Yellowtail (*Seriola lalandi*) are intensely targeted recreationally throughout their eastern Pacific range. They have long been thought to move north into the Southern California Bight (SCB) during May-October and abundance appears to be correlated to sea-surface temperature. However, analysis of fisheries-dependent data suggests the largest (≥ 13 kg) individuals inhabit near-shore waters of the SCB year-round. These observations suggest a structured pattern of space-use based upon physiological constraints and ontogenetic movements.

To examine spatial and temporal trends in the fishery, recreational yellowtail capture in southern California between 1936-2013 from all existing databases were analyzed by size, season, location, and sea-surface temperature. Catch was bi-modal with peaks at both immature and mature sizes, larger fish were caught inshore (< 3 mi) while smaller fish were predominantly offshore (> 3 mi). These trends varied predictably depending on season. Fish caught during winter were significantly larger than those caught during the remainder of the year. This defined spatial and temporal size segregation provided the motivation for a comprehensive tagging effort utilizing both conventional and acoustic tags within the southern SCB.

Currently, the recapture rate is above 20%, with time at liberty ranging from 24 hours to 24 months and recapture distance from 0-400km; smaller fish demonstrated higher vagility as compared to larger fish. These results suggest a pattern of shifting space use (habitat and mobility) with age, revealing novel evidence of ontogenetic changes in movement for a coastal marine fish. Currently, passive telemetry detections seem to confirm these results within the La Jolla kelp forest and adjacent inshore areas. This work is the first broad examination of California yellowtail since 1960.

P-9. Moss Landing: A Humpback whale hotspot?

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**Monterey Bay Whale Watch

In 1995 the MBARI science building was completed and staffed on the site of a historical whaling station in Moss Landing, California. Through 2012, whales were only occasionally observed from the building. However, in 2013, 2014 and 2015, large numbers of humpbacks (20-50 whales) began feeding near shore, easily visible from the building. The whales have been almost continuously present for many months each summer.

This poster begins an exploration of the Moss Landing whale phenomenon. Is Moss Landing a humpback hotspot? Were these whales present during historical whaling? Why do the whales congregate at this location? How did the ocean change after 2012, attracting the whales? What human interactions are associated with this nearshore congregation? Is it likely to continue?

P-10. Variability of organic carbon and biogenic opal from Soledad Basin, during the last 150 years

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The southwestern margin of the Baja California peninsula display intense coastal upwelling, which promotes high primary productivity. The presence of an oxygen minimum zone help to conserve the exported organic matter and can be used to infer changes in productivity in different time scales. Here we present proxies of Biogenic Opal (OB) and Organic Carbon (CO) to estimates changes in primary productivity for the last 150 years in Soledad Basin, Mexico. The OB and CO showed the maximum increment to the period from 100 to 140 years suggesting permanent upwelling conditions and a change in the species succession dominated by diatoms. For the past 80 years all proxies showed little variability with a productivity increment trend to the recent.

P-11. Biogeography of Ichthyoplankton Assemblages from British Columbia to Baja California

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Natural environmental fluctuation due to El Niño/Southern Oscillation (ENSO) episodes can induce change to assemblage structure of fishes. Responses of assemblages to natural environmental fluctuation and anthropogenic effects can be expressed as latitudinal shifts in species richness, abundance, and distribution. Explicating fish assemblage dynamics while assessing environmental factors is necessary when conducting ecosystem-based approaches to fisheries management. To assist ecosystem-based management (EBM) plans, this study assessed latitudinal patterns of diversity and community structure of larval fish assemblages comprised of a total of 126 fish taxa collected from British Columbia (~48.5°N) to Baja California (~30°N). Based on previously identified biogeographic barriers and potential ecological boundaries, this study area was separated into seven regions. Assemblages were compared between spring 2006 and 2008, which were a weak El Niño year and a strong La Niña year, respectively, and shifts in centers of distribution were detected for species residing in coastal and oceanic, but not coastal-oceanic habitats. Significant variation in species richness and diversity between regions was found. This research shows that shifting oceanic conditions can have large impacts on fish assemblages and that studying such shifts can provide tools for assessing the potential impacts of anthropogenic-induced climate change.

P-12. Diapycnal Mixing in the Atlantic Equatorial Undercurrent

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From 11 to 18 April 2010, during the first part of MOC2-Ecuatorial cruise (project MOC2), microstructure vertical profiles (turboMAP-L) were done with the objective to study diapycnal mixing in the Atlantic Equatorial Undercurrent (EUC). This cruise was carried out with R/V Hespérides and were collected data from several stations of CTD (conductivity-temperature-depth) with ADCP (Acoustic Doppler Current Profiler). The EUC maximum velocity was near 70 m in most cases and we found high values of mean turbulent kinetic energy dissipation rates, ϵ , on $5 \cdot 10^{-7} \text{ m}^2 \text{ s}^{-3}$ between 20 and 60 m, low values on $4 \cdot 10^{-9} \text{ m}^2 \text{ s}^{-3}$ between 60 and 120 m through the EUC core, and moderate values on $6 \cdot 10^{-8} \text{ m}^2 \text{ s}^{-3}$ below the core. We also found differences between western and eastern stations along EUC. A western station on $38,5^\circ \text{ W}$ shown a maximum velocity on $0,64 \text{ m s}^{-1}$ with an irregular vertical salinity profile below the core with various steps while an eastern station on 33° W shown a maximum velocity on $0,96 \text{ m s}^{-1}$ with an vertical salinity profile less irregular. The estimations of density ratio, R_ρ , and the gradient Richardson number, Ri , suggest that the sources of the diapycnal mixing are the vertical shear instabilities above and below the EUC and salt fingers below it. Using for the vertical diffusivity parameterizations of Ri and R_ρ jointly with observations of ϵ , we can estimate the diapycnal fluxes of different properties through the EU and its dynamic evolution.

P-13. Nonlinear dependence of Diel Vertical Migration behavior on copepod body size and water column transparency

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Zooplankton body size is a trait that co-varies with a spectrum of different fitness-related variables, including swimming velocity, feeding rate, metabolic rate, visual conspicuousness, and susceptibility to different guilds of predators. Here we illustrate a fundamental trade-off associated with body size, since both predation risk - due to visual predators - and predator avoidance behavior are a positive function of body size. There is not a single optimum balance between size-related risk and predator avoidance, expressed as diel vertical migration (DVM) behavior. Instead, this balance changes with body size in a nonlinear manner. Empirical support for a size-dependent trade-off comes from the California Current Ecosystem LTER site, which includes waters of widely disparate optical characteristics. Encounter rates with visually-hunting predators are dependent upon zooplankton body size and are therefore sensitive to variations in optical transparency. Our results show that the amplitude of DVM behavior varies widely with copepod body size: smaller-bodied copepods in this region tend to show no DVM response, remaining in near-surface waters day and night; intermediate body-sized copepods exhibit strong DVM behavior; and the very largest-bodied copepods also no DVM behavior, but remain continuously in deeper waters. For the intermediate size classes of copepods that show DVM, we found that the amplitude of copepod DVM is directly proportional to the optical transparency of the water column. Therefore, the long-term decrease in optical transparency that we have previously documented in the CCE region appears to have shifted the vertical distributions of planktonic copepods, with implications for prey-predator interactions and biogeochemical fluxes.

P-14. A Shifted Baseline in the California Current Ecosystem from Ocean Warming

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Recent ecosystem perturbations, such as strandings of sea lion pups (due to prey that migrated north) and extensive blooms of *Pseudonitzschia*, highlight the importance of understanding the role of ocean warming on the California Current ecosystem. We present a meta-analysis of microfossils and an updated record of fish debris to juxtapose recent changes in the CalCOFI domain with historical changes since ~1740. Approximately 50 different time series of plankton microfossils, including planktonic foraminifera, diatoms, silicoflagellates, coccolithophorids, and dinoflagellate cysts were grouped into six different categories. A trend of increasing numbers of the uncommon southern and warmer plankton began to exceed historical variations by the 1930s and continues throughout the 20th century, and is associated with a decline in the uncommon northern and colder species. An increase (decline) in the more common species associated with warmer (cooler) but moderately productive conditions also begins around the 1930s, but is more dramatic after the mid-1970s. While the pattern from species associated with high productivity is unclear, a lack of change in the oceanic cosmopolitan species indicates that long term changes from ocean warming are more driven by changes in species assemblage than productivity. Scales from 3 of the 4 major fish taxa present (sardines, anchovies, and hake) show persistently low values after the 1930s, indicating some combination of reduced biomass and a more northward distribution. The decline in scales of myctophids and fish skeletal debris after the mid-1970s indicates that forage fish have been substantially impacted by the ocean warming trend in the late 20th century. However, given that the trends began decades before CalCOFI monitoring began, we have been using a shifted baseline to evaluate impacts of ocean warming on marine populations.

**P-15. Central and Northern California Ocean Observing System Data Portal:
Access to real-time observations, nowcasts, and forecasts**

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The Central and Northern California Ocean Observing System collaborative transitioned to a new data portal in 2013, expanding access to a diverse collection of ocean observations, now-casts, and forecasts for the Central and Northern California Coast. The data portal (data.cencoos.org) provides catalog and map based access to real-time and historical observations, with data visualization and sub-set/ download capabilities. Observations from twenty two sensor types from 835 stations are streamed continuously and made available via the portal along with seven satellite data sets. The newest data streams are the Trinidad glider line (11/2014) and the Hog Island ocean acidification sensor (12/2014). Collaboration with biodiversity and ocean acidification projects are expanding the collection. Now-casts and forecasts from regional ocean circulation and atmospheric model simulations are also provided. The observations and simulations available from the portal are used by scientists, ocean industries including fishing and marine transportation, and the public, and are used for search and rescue, environmental response and restoration, and environmental monitoring and assessment. The portal data visualization interface reveals the increase in salinity in California's estuaries related to ongoing drought, the unusually warm waters circulating in the north Pacific in 2014-15 (nicknamed 'the blob') and the harmful algal bloom in June 2015 that resulted in mariculture warnings and closures in central California.

P-16. Tracking Three-Dimensional Fish Behavior With A New Marine Acoustic Telemetry System

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The persistent monitoring capability provided by acoustic telemetry systems allows us to study behavior, movement, and resource selection of mobile marine animals. Current marine acoustic telemetry systems are challenged by localization errors and limits in the number of animals that can be tracked simultaneously. We designed a new system to provide detection ranges of up to 1 km, to reduce localization errors to less than 1 m, and to increase to 500 the number of unique tags simultaneously tracked. The design builds on HTI's experience of more than a decade developing acoustic telemetry systems for freshwater environments. A field trial of the prototype system was conducted at the University of Washington's Friday Harbor Marine Laboratory (Friday Harbor, WA). Copper rockfish (*Sebastes caurinus*) were selected for field trials of this new system because their high site-fidelity and small home ranges provide ample opportunity to track individual fish behavior while testing our ability to characterize the movements of a species of interest to management authorities.

**P-17. A review of California's commercial market squid fishery
and its response to a warming ocean**

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Market squid (*Loligo (Doryteuthis) opalescens*) is among the highest grossing and highest volume commercial fisheries in the state of California. Market squid are harvested for human consumption and as bait in recreational fisheries. The market squid resource is also an important forage item for other fish taken for commercial and recreational purposes as well as seabirds, and marine mammals. The fishery is a federally monitored species and is actively managed by the State as directed by the Market Squid Fishery Management Plan, which has been in effect since 2005.

An overview of the commercial fishery will be given. Topics discussed will include history of the fishery, market squid life cycle, economics, management, and recent trends. Details of the spatial and temporal distribution of catch comparing the recent fishing seasons will be presented. Biological sample data from this same time period will also be presented. Landings data will be mapped alongside sea surface temperature data to show how commercial squid landings have responded to increases in temperature with the onset of El Niño.

P-18. Responses of copepod and euphausiid communities off northern California to the warming event of 2014-2015

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Analysis of zooplankton samples along the Trinidad Head Line have revealed several concurrent changes in the copepod and euphausiid communities off northern California related to changes in hydrographic conditions associated with the unusual warming observed in the northeast Pacific during 2014. The biomass of copepods with northern biogeographical affinities exhibited an unusual decline in mid- to late summer as upwelling weakened and mid-shelf bottom waters began to warm and freshen, and dropped dramatically in Fall 2014 with the cessation of upwelling and strong warming of shelf waters associated with the arrival of 'blob' waters. Conversely, the biomass of southern copepods increased during the late summer and fall and remained consistently high. This pattern has persisted through Spring and into Summer 2015. The decline of northern taxa is especially apparent when northern neritic species (including the normally abundant *Pseudocalanus mimus*) are considered separately, with strong negative biomass anomalies persisting into and through Spring 2015. Copepod species richness has been consistently high relative to previous years during summer and fall 2014, and again in early 2015, enhanced by several species of southern or offshore copepods that have been observed for the first time in the Trinidad Head Line record. The euphausiid community also showed marked changes in response to the 2014 warming event. Adult and larval stages of the sub-tropical krill *Euphausia recurva* (previously unobserved in our samples) were observed at low densities from January until March 2015. Concurrently, biomass of *T. spinifera* declined and remained low through summer 2015. This shift in the euphausiid community was partly countered by high abundances of *E. pacifica* and increased abundance of immature *E. pacifica* and *N. difficilis*, yet we have observed a decline in individuals' sizes relative to past years, suggesting poorer growth conditions for euphausiids off northern California during this period. These observations suggest a variety of responses to the warming event, ranging from patterns dominated by transport and changes in water masses off northern California (*E. recurva*) to those that may also reflect different responses to changes in local productivity or other ecological conditions (e.g., the contrasting patterns observed for *T. spinifera* and *E. pacifica* and changes in individual size).