CalCOFI Conference

12-14 December 2011

San Diego, CA

Hosted by:

Scripps Institution of Oceanography

CalCOFI Coordinator: John Heine
Symposium Convener: Tony Koslow

In association with:
California Department of Fish and Game
Southwest Fisheries Science Center, NOAA Fisheries

CalCOFI Conference 2011

Sumner Auditorium
Scripps Institution of Oceanography
University of California, San Diego
Dec. 12-14

Monday, 12 December

12:00-1:00	Registration – Sumner Auditorium Portico
1:00-1:15	**Opening of the Conference** Welcome: Tony Koslow, Scripps Institution of Oceanography
1:15-2:15	**Session I: Status of the California Current** Eric Bjorkstedt, Southwest Fisheries Science Center, NOAA
2:15-2:45	Break. Registration continues.
2:45-4:45	**Session II: Status of the Fisheries** Chair: Laura Rogers-Bennett, California Department of Fish and Game
2:45-3:00	Coastal pelagic species, Bill Miller
3:00-3:15	Squid, Bill Miller
3:15-3:30	Groundfish, Deb Wilson Vandenberg
3:30-3:45	Dungeness crab, Kristin Hubbard
3:45-4:00	Whelk, Kristin Hubbard
4:00-4:15	Sea cucumber, Derek Stein
4:15-4:30	Lobster, Kai Lampson
4:30-4:45	Sea bass, Kathryn Johnson

Poster Session: T-29, Scripps Institution of Oceanography

Beer, wine, and non-alcoholic beverages, hors d'oeuvres

Monday, 12 December (cont)

5:00-7:00 PM

P-1. A stable isotope-based perspective on the contribution of prey to Humboldt squid (*Dosidicus gigas*) in the northern California Current. Todd W. Miller[1], Richard D. Brodeur[2], Junya Shibata[1], Keith L. Bosley[2], Koji Omori[1], and Robert L. Emmett[2,3]. [1]Global Center of Excellence, Center for Marine Environmental Studies, Ehime University, 2-5 Bunkyo-cho, Matsuyama, 790-8577, Japan, [2]Northwest Fisheries Science Center, National Marine Fisheries Service, NOAA, Newport, Oregon, [3]Present address: Northwest Fisheries Science Center, National Marine Fisheries Service, Point Adams Research Station, 520 Heceta Place, Hammond, OR 97121 USA

P-2. Genetic corroboration of *Engraulis mordax* larvae distribution in the Upper Gulf of California. Noé Díaz-Viloria[1], Laura Sánchez-Velasco[1], S. Patricia A. Jiménez-Rosenberg[1], Ricardo Perez-Enriquez[2], [1]Plankton and Marine Ecology Department, Centro Interdisciplinario de Ciencias Marinas (CICIMAR-IPN), La Paz, B.C.S. 23096, Mexico. [2]Aquaculture Genetics Laboratory, Centro de Investigaciones Biológicas del Noroeste (CIBNOR), Mar Bermejo 195, Col. Playa Palo de Santa Rita, La Paz, B.C.S. 23090, Mexico.

P-3. Hypoxia condition in Todos Santos Bay area. Héctor Bustos-Serrano, Raúl Canino-Herrera, Héctor M. Atilano-Silva, Rafael Morales-Chávez, María E. Blanco-Cárdenas and Nadia L. López-Tejada, Universidad Autónoma de Baja California. Facultad de Ciencias Marinas, Ensenada, Baja California, México.

P-4. Community dynamics of juvenile fishes in coastal benthic habitats. Lorenzo Ciannelli, College of Oceanic and Atmospheric Sciences, Oregon State University, Corvallis OR, Angela Johnson, College of Oceanic and Atmospheric Sciences, Oregon State University, Corvallis OR, Waldo Wakefield, NOAA, Fisheries Resource Analysis and Monitoring Division, Northwest Fisheries Science Center, Newport OR, Sarah Henkel, Hatfield Marine Science Center, Oregon State University, Newport, OR.

P-5. ROV surveys of soft and rocky deep-water habitats along California's North Central Coast: MPA baseline data collection. James Lindholm[1], Dirk Rosen[2], DONNA KLINE[1], Mary Gleason[3], [1]Institute for Applied Marine Ecology at CSU Monterey Bay, [2]Marine Applied Research and Exploration, [3]The Nature Conservancy.

P-6. Shark-inflicted lesions on California sea lions (*Zalophus californianus*) at San Miguel Island, California: A new phenomenon. Jeffrey D. Harris, Sharon R. Melin, Robert L. DeLong, NOAA, National Marine Fisheries Service, Alaska Fisheries Science Center, National Marine Mammal Laboratory.

P-7. The SIO Pelagic Invertebrates Collection. Mark D. Ohman and Linsey Sala, Scripps Institution of Oceanography.

P-8. Spatial and temporal length distributions off California from daily egg production method surveys conducted 1986-2011. Beverly Macewicz, David Griffith, Nancy Lo, NOAA-NMFS-Southwest Fisheries Science Center.

Tuesday, 13 December

8:00-8:30 Registration – Sumner Auditorium Portico

8:30 **Session III: The Symposium of the Conference: Integrated Ecosystem Assessment and Ecosystem Modeling of the California Current**
Chair: Tony Koslow, Scripps Institution of Oceanography

8:30-8:40 Introduction and overview. Tony Koslow, Scripps Institution of Oceanography.

8:40-9:25 S-1. Overview of ecosystem-based management and integrated ecosystem assessments. Jason Link, NOAA NMFS NEFSC (Northeast Fisheries Science Center), Woods Hole, MA.

9:25-10:00 S-2. NOAA and the California Current integrated ecosystem assessment. Brian Wells[1], Phil Levin[2], Cisco Werner[3], John Stein[2], [1]NOAA Fisheries, SWFSC, Santa Cruz, CA, [2]NOAA Fisheries, NWFSC, Seattle, WA, [3]NOAA Fisheries, SWFSC, La Jolla, CA.

10:00-10:20 BREAK

10:20-10:55 S-3. Development of a climate-to-fish-to-fishers model: Implementation in the eastern Pacific Sardine and Anchovy system. Enrique N. Curchitser, Kenneth A. Rose, Kate Hedstrom, Jerome Fiechter, Shin-ichi Ito and Cisco Werner.

10:55-11:30 S-4. Ecosystem modeling for the California Current integrated ecosystem assessment. Isaac Kaplan, NOAA Fisheries, Northwest Fisheries Science Center.

11:30-12:05 S-5. An integrated ocean observation system for the California Current. Uwe Send and Tony Koslow, Scripps Institution of Oceanography, University of California, SD, La Jolla, CA.

12:05-1:00 Catered buffet lunch, Sumner Auditorium Portico

1:05-1:40 S-6. The Pacific Fishery Management Council process and the California Current integrated ecosystem assessment. Yvonne deReynier, NOAA Fisheries, Northwest Region.

1:45 **Session IV: Contributed Papers (15 minutes with 5 minutes for discussion).** Chair: Nancy Lo, Southwest Fisheries Science Center

1:45-2:05 C-1. Steps towards producing an integrated assessment of the status of the continental shelf and slope ecosystems of the Northern California Current. Bill Peterson[1], Jay Peterson[2], Cheryl Morgan[2] and Jennifer Fisher[2], [1] NOAA Fisheries, Northwest Fisheries Science Center, Hatfield Marine Science Center, Newport OR, [2]Cooperative Institute for Marine Resource Studies, Oregon State University, Hatfield Marine Science Center, Newport OR.

2:05-2:25 C-2. Anomalous ichthyoplankton distributions and concentrations in the northern California Current resulting from the 2010 El Niño and La Niña events. Toby Auth, Cooperative Institute for Marine Resources Studies, Oregon State University, Hatfield Marine Science Center, Newport, Oregon.

2:25-2:45 C-3. The ichthyoplankton of King Harbor, Redondo Beach, California 1974-2009. Daniel J. Pondella, II, Jonathan P. William, Vantuna Research Group, Occidental College, Los Angeles, CA, Eric F. Miller, MBC Applied Environmental Sciences, Costa Mesa, CA, and Jeremy T. Claisse, Vantuna Research Group, Occidental College, Los Angeles, CA.

2:45-3:05 C-4. A brief history of ichthyoplankton research in the Northern California Current Region: Contributions to integrated ecosystem assessments. Richard D. Brodeur, Northwest Fisheries Science Center, Newport, OR, Toby D. Auth, Cooperative Institute for Marine Resources Studies, OSU, Newport, OR, and Miriam J. Doyle, Joint Institute for the Study of the Atmosphere and Ocean, University of Washington, Seattle, WA.

3:05-3:30 BREAK

Session V: Contributed Papers (15 minutes with 5 minutes for discussion) Chair: Greg Cailliet, Moss Landing Marine Laboratories

3:30-3:50 C-5. Migration of juvenile Japanese sardine during the recent low biomass period. Atsushi Kawabata[1], Masayasu Nakagami[2], Satoshi Suyama[2], and Yasuhiro Ueno[1], [1]National Research Institute of Fisheries Science, Fisheries Research Agency, Yokohama, 236-8648 Japan, [2]Tohoku National Fisheries Research Institute, Fisheries Research Agency, Hachinohe, 031-0841 Japan.

3:50-4:10 C-6. Modeling the California Current ecosystem under the auspices of climate change: which path to take? Andrew W. Leising, NOAA-SWFSC-ERD, Pacific Grove, CA.

4:10-4:30 C-7. Decadal changes in the phenology of larval fishes in the southern California Current ecosystem. Rebecca G. Asch, Scripps Institution of Oceanography, Integrative Oceanography Division, La Jolla, CA.

4:30-4:50 C-8. Assessment of fisheries interactions in Bahia Magdalena-Almejas, Baja California Sur, Mexico. *Miguel Ángel Ojeda-Ruiz[1,2], Mauricio Ramírez-Rodríguez[1], Francisco Arreguín Sánchez[1], [1] CICIMAR-IPN, La Paz, Baja California Sur, 23000 México, [2]Universidad Autónoma de Baja California Sur, La Paz, Baja California Sur, 23050 México.

Reception

5:00-7:00 Terrace of Scripps Seaside Forum, just below Sumner Auditorium.

Wednesday, 14 December

8:30 **Session VI: Contributed Papers (15 minutes with 5 minutes for discussion)**
Chair: Laura Rogers-Bennett, California Department of Fish and Game

8:30-8:50 C-9. Temporal trends in southern California Bight demersal fishes and their indications of habitat value. Eric Miller, MBC Applied Environmental Sciences, Costa Mesa, CA, Ken Schiff, Southern California Coastal Water Research Project, Costa Mesa, CA.

8:50-9:10 C-10. Seabirds, salmon and groundfish: using predator diets to track shifts in the marine prey community in the Northern California current. Amanda J. Gladics[1,2], Robert M. Suryan[2], Richard D. Brodeur[3], Leah M. Segui[2,4], Laura Z. Filliger[2,5]. [1]Oregon State University, College of Oceanic and Atmospheric Sciences, Corvallis, Oregon, [2]Oregon State University, Hatfield Marine Science Center, Newport, Oregon, [3]Northwest Fisheries Science Center, National Oceanic and Atmospheric Administration, Newport, Oregon, [4]San Diego State University, San Diego, California, [5]Carnegie Mellon University, Pittsburgh, Pennsylvania.

9:10-9:30 C-11. California Grunion in San Francisco Bay: Temporary habitat or expanded range? Karen Martin, Pepperdine University, Kathy Hieb, California Department of Fish and Game, and Dale Roberts, NOAA- Cordell Bank National Marine Sanctuaries.

9:30-9:50 C-12. Rockfish assemblage structure in the southern California Bight as revealed through genetic identification of larvae. Andrew Thompson, Sharon Charter, William Watson, and John Hyde, Southwest Fisheries Science Center, La Jolla, CA.

10:10-10:30 C-13. An end-to-end model of the northern California Current upwelling system: Accounting for the propagation of lower trophic level variability and upper trophic level uncertainty. James J. Ruzicka[1], John H. Steele[2], William T. Peterson[3], Richard D. Brodeur[3], Thomas C. Wainwright[3], [1]Cooperative Institute for Marine Resources Studies, OSU, Hatfield Marine Science Center, 2030 Marine Science Dr., Newport, OR 97365. [2]Woods Hole Oceanographic Institute, Woods Hole, MA, [3]Northwest Fisheries Science Center, Newport, OR.

10:30-10:50 BREAK

10:50 **Session VII: Contributed Papers (15 minutes with 5 minutes for discussion)**
Chair: TBA

10:50-11:10 C-14. Annual variability in population parameters of California sea lions (*Zalophus californianus californianus*) at San Miguel Island related to oceanographic variability in the California Current. Sharon R. Melin[1], Anthony J. Orr[1], Jeffery D. Harris[1], Jeffery L. Laake[1], Robert L. DeLong[1], Shelbi Stoudt[2], Denise Greig[2], Frances M.D. Gulland[2], [1]National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center, National Marine Mammal Laboratory, [2]The Marine Mammal Center.

11:10-11:30 C-15. A broadscale ecosystem survey of the nearshore California Current. Baldo Marinovic[1], John Field[2], and Steve Ralston[2], [1]Institute of Marine Sciences, University of California Santa Cruz, [2]Fisheries Ecology Division, NMFS-SWFSC.

11:30-11:50 C-16. Inferring sub-structure of the Australian sardine (*Sardinops sagax*) population using multiple approaches: Implications for future stock assessment and management. T.M. Ward, C. Izzo, A.R. Ivey, and B.M. Gillanders.

11:50-12:10 C-17. Modeling trends in cetacean habitat use and density on the southern CalCOFI lines. Gregory S. Campbell[1], Cornelia S. Oedekoven[2], Dominique L. Camacho[3], Lisa M. Munger[1], Karlina A. Merkens[1], Andrea M. Havron[3], Annie B. Douglas[4], John Calambokidis[4] and John A. Hildebrand[1], [1]Marine Physical Laboratory, Scripps Institution of Oceanography, University of California San Diego, La Jolla, CA, [2]School of Mathematics and Statistics, University of St Andrews, St Andrews, UK, [3]Spatial Ecosystems, Olympia, WA, USA, [4]Cascadia Research Collective, Olympia, WA, USA.

12:10-12:30 C-18. Climate, biomass, and the trophic role of midwater fishes in the California Current. J.A. Koslow,[1] A. Lara-Lopez,[1] P. Davison[1] and W. Watson[2], [1]Scripps Institution of Oceanography, University of California, S.D., 9500 Gilman Drive, La Jolla, CA

92093-0218, USA. Email: jkoslow@ucsd.edu, [2]Southwest Fisheries Science Center, National Marine Fisheries Service/NOAA, La Jolla, CA 92037, USA.

12:30-12:50 C-19. Combining a trawl camera and hydroacoustics for species verification. George Cronkite, Ken Cooke, and Greg Workman, Fisheries and Oceans, Canada, Pacific Biological Station, Nanaimo, BC

12:50 Catered buffet lunch, Sumner Auditorium Portico

Conference adjourned.

SYMPOSIUM ABSTRACTS

S-1. Overview of Ecosystem-based Management and Integrated Ecosystem Assessments

Jason Link

NOAA NMFS NEFSC (Northeast Fisheries Science Center)
Woods Hole, MA

Adjunct Professor
UMass-Dartmouth SMAST
URI-GSO

The rationale, justification, and simple definition of ecosystem-based management (EBM) is noted. This EBM policy and technical background forms the context for a definition, delineation, and evaluation of Integrated Ecosystem Assessments (IEAs). The challenges associated with IEAs, particularly regarding their multiple roles or and overlap with other efforts, are duly noted. In lieu of specific technical details and examples for each element of an IEA, a conceptual treatment of each facet of the six step IEA process is instead provided. A "Mother-Goose" dominated schema is highlighted to denote the important principles of applying IEAs. The contribution of scientific endeavours (modelling, indicators, thresholds, assessment, risk analyses, and management simulation evaluations), stakeholder outreach, and monitoring are mapped to the IEA process, identifying key roles each can play in the success of an IEA. Important lessons-learned, affirmation from international arenas adopting this approach, as well as identification of important steps remaining describe what is still a nascent, but certainly a maturing development of IEAs.

S-2. NOAA and the California Current Integrated Ecosystem Assessment

Brian Wells[1], Phil Levin[2], Cisco Werner[3], John Stein[2]

[1]NOAA Fisheries, SWFSC, Santa Cruz, CA

[2]NOAA Fisheries, NWFSC, Seattle, WA

[3]NOAA Fisheries, SWFSC, La Jolla, CA

Central to the National Ocean Policy of the United States is a shift from single-sector/single species management toward comprehensive ecosystem-based management. Ecosystem-based management is an integrated approach to management that considers the entire ecosystem, including humans. Integrated ecosystem assessments are designed to fill a critical gap in achieving effective ecosystem-based management. An integrated ecosystem assessment is a formal synthesis and quantitative analysis of all relevant scientific information – biological, geological, physical, economic, and social – in relation to ecosystem management objectives. The goal of an integrated ecosystem assessment is to fully understand the web of interactions in an ecosystem and forecast how changing environmental conditions and management actions affect the status of the ecosystem. It brings together citizens, industry representatives, scientists, and policy makers through formal processes to evaluate a range of policy and/or management actions on particularly difficult environmental problems. In 2010, NOAA began a pilot study to lay the groundwork for an integrated ecosystem assessment for the California Current. This has been a collaborative effort between NOAA's Northwest and Southwest Fisheries Science Centers, NOAA regional offices, and NOAA Sanctuaries. Now, beginning our third year, we have made substantial progress in the design, development and implementation of the California Current integrated ecosystem assessment. By leveraging the strengths of the different NOAA offices and our academic partners, we have developed ecosystem health indicators as well as strategic and tactical decision support tools.

S-3. Development of a Climate-to-fish-to-fishers Model: Implementation in the Eastern Pacific Sardine and Anchovy System

Enrique N. Curchitser, Kenneth A. Rose, Kate Hedstrom, Jerome Fiechter,
Shin-ichi Ito and Cisco Werner

An ecosystem approach to understanding large-scale patterns in exploited systems caused by both climate change and human activity increasingly relies on the use of numerical models. In the past, physical, lower and higher trophic level models were developed, tested, and implemented independently of each other. Recently, the advances in physics and biology have created the needed pieces for a comprehensive (end-to-end) ecosystem model, including humans as a dynamical component. The challenge is to integrate all the components, and examples of fully-coupled end-to-end models are relatively rare. This is partly due to the perception that blending separate yet complex sub-models is impractical because of demanding computational requirements and partly due to the respective communities working independently. In this presentation, we present our progress to date on the development of an end-to-end model modeling framework within the widely-used ROMS (Regional Ocean Modeling System) circulation model. The NEMURO Nutrient-Phytoplankton-Zooplankton (NPZ) submodel provides the lower trophic level dynamics, and a multi-species individual-based submodel simulates fish population and community dynamics, including fishing fleets as one of the predator species. All of these models exist in various forms, but the individual sub-models have never been harmonized together into one integrated analysis tool useful for synthesis, integration, and prediction. This model framework was designed to investigate the effects of climate and fishing on marine ecosystems within one model that includes dynamical feedbacks among the different systems. We will present results of a test-bed application developed to study the low-frequency fluctuations of sardine and anchovy.

S-4. Ecosystem Modeling for the California Current Integrated Ecosystem Assessment

Isaac Kaplan

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Northwest Fisheries Science Center
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Marine ecosystem assessment is an ambitious goal that requires tools to synthesize a broad range of information related to ecological, fishery, and economic factors. Contributors to the California Current Integrated Ecosystem Assessment have applied a range of statistical and simulation approaches, including qualitative modeling, time series analysis, food web models, and end-to-end ecosystem models. End-to-end ecosystem models are one type of tool that allows strategic planning, evaluation of management actions, and risk assessment. Here I discuss the role of an Atlantis ecosystem model, the underpinnings of the model, and related biological and oceanographic data. I then present two case studies. The first case study quantifies the effects on ecosystem health that can be attributed to individual fishing fleets and gears, and their interactions. The second case study combines the Atlantis ecosystem model with an economic model (IO-PAC) to trace how changes in fishery management and seafood landings impact the broader economy. The analyses offer one way to sharpen the focus of ecosystem-based fisheries management in the California Current, illustrating trade-offs between policy options and interactions between system drivers. I conclude by discussing options for including global change and climate drivers in Atlantis models, and for extending the geography of the California Current model.

S-5. An Integrated Ocean Observation System for the California Current

Uwe Send and Tony Koslow

Scripps Institution of Oceanography, University of California, SD, La Jolla, CA

Various ocean observation programs now span the California Current, including CalCOFI and IMECOCAL; sampling lines off Monterey Bay and Newport, with incipient lines off Humboldt and Bodega Bays; several coastal ocean observation systems (OOS) (SCCOOS, CenCOOS, NanOOS); and surveys carried out by the Southwest and Northwest Fishery Science Centers. There are also several glider lines and moorings and a variety of additional coastal monitoring programs carried out by state and local agencies, as well as by academic and other non-government scientists. However, development of an integrated observation system for the California Current remains handicapped by two key factors: key gaps in observation coverage and lack of consistent data access. The addition of a few additional moorings and/or glider lines could dramatically improve coverage along the California Current. Adoption of a code of publicly-available web access to all primary data within 1-2 years of collection would substantially facilitate the scientific community's ability to synthesize, assess and model the California Current. Development of the IEA process should provide impetus to develop a more fully integrated ocean observation system for the region.

S-6. The Pacific Fishery Management Council Process and the California Current Integrated Ecosystem Assessment

Yvonne deReynier

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Seattle, WA 98115

Fishery management councils (FMCs) provide an unusual public process for discussing and developing management plans for living marine resources within the U.S. Exclusive Economic Zone (3-200 nm offshore). FMCs are authorized and bounded by the Magnuson-Stevens Fishery Conservation and Management Act , which has evolved significantly from its first iteration in 1976. Since 1996, the Act has spurred national conversations on ecosystem-based management (EBM) for marine fisheries, and has supported regional development of ecosystem science. National legislation, however, has provided little direction on what it is that FMCs are supposed to do to implement EBM, a situation that provides both opportunities and challenges.

The Pacific Fishery Management Council (PFMC,) like other FMCs, has found itself addressing a wide variety of EBM-related issues in recent years, ultimately spurring its interest in more organized EBM planning. Concurrent with increased PFMC work on EBM, the National Oceanic and Atmospheric Administration and its West Coast partners have initiated the California Current Integrated Ecosystem Assessment. These emerging science and policy processes are together shaping West Coast EBM for marine resource management. Ocean and fisheries scientists wishing to support EBM's development and implementation can do so by: evaluating their research agendas against the scientific needs expressed by the PFMC's advisory bodies; collaborating with scientists who serve on PFMC advisory bodies and within PFMC's partner agencies; and developing tools and methods to improve communication both across scientific disciplines and with non-scientists.

CONTRIBUTED ABSTRACTS

C-1. Steps Towards Producing an Integrated Assessment of the Status of the Continental Shelf and Slope Ecosystems of the Northern California Current

Bill Peterson[1], Jay Peterson[2], Cheryl Morgan[2] and Jennifer Fisher[2]

[1] NOAA Fisheries, Northwest Fisheries Science Center, Hatfield Marine Science Center, Newport OR
[2] Cooperative Institute for Marine Resource Studies, Oregon State University, Hatfield Marine Science Center, Newport OR

Integrated ecosystem assessments for the California Current seem to be taking on many forms. Some examine the state of a given fishery (e.g., hake, salmon), others assess the state of the ecosystem as represented by end-to-end and Ecopath with Ecosim (EwE) models, whereas other efforts (such as our own) use ocean observations in a bottom-up approach which assesses the status of physical forcing and biological response of lower trophic level organisms with qualitative comment on how ocean conditions might affect salmon and other local fisheries of the northern California Current. This talk will discuss various approaches to assessing the status of the northern California Current "ecosystem". The problems facing those of us interested in IEAs are at least three fold: (a) our efforts are not **i**ntegrated; (b) it is not clear what we are defining as an **e**cosystem, thus (c) it is not clear "who" or "what" we are assessing. Although the California Current is recognized as a single Large Marine Ecosystem, it is clearly not a single ecosystem; rather it contains many smaller "ecosystems" which are connected to varying degrees through physical transport processes, and each has very different physical forcing and biological responses. Thus we argue that a proper IEA must be regionally specific and must be able to capture the temporal dynamics of physical forcing at the seasonal, interannual and decadal scales. Furthermore, an integrated assessment of the California Current might be best described as a team effort that links assessment of the smaller ecosystems through models, oceanographic observations and fisheries survey and stock assessment data. Our talk will introduce some of the problems discussed above but then will provide an example of how one can use long-time series of physical and biological observations, primarily of lower trophic levels, to produce a web-based assessment of ocean conditions in the northern California Current, on a quarterly-to-seasonal time scale. We focus on this short time scale and this region because a massively high biomass of marine animals migrate to this portion of the Current in spring for a single purpose – to fatten up on the lipid-rich food chain that is found there in spring and summer. The list of migrators includes virtually all of the Pacific whiting in the California Current, along with sardines and mackerels, albacore tuna, pelagic seabirds (shearwaters and albatross), and whales (humpback, gray and blue).

C-2. Anomalous Ichthyoplankton Distributions and Concentrations in the Northern California Current Resulting from the 2010 El Niño and La Niña Events

Auth, T.D.

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In late spring of 2010, the northern California Current (NCC) experienced a transition from El Niño to La Niña conditions resulting in anomalous distributions and concentrations within the ichthyoplankton community. I analyzed larval fish data collected during the four months before and after this transition and compared them to data from four previous studies conducted in the NCC. Concentrations of larvae collected during winter from stations 1-25 nm offshore along the central Oregon coast were higher in 2010 than in any other year from 1998-2009. In a seasonal comparison of nearshore larvae collected during six periods (1971-1972, 1978, 1983, 1998, 1999-2002, and 2003-2005) from a previous study to those collected in 2010, concentrations of total larvae and most dominant larval taxa were higher during the winter/spring and lower during the summer/fall seasons in 2010 (corresponding to the shift from El Niño to La Niña conditions) than during similar seasons in any other annual period. Larvae collected from stations 10-55 nm offshore along the southern Washington to south-central Oregon coast in May 2010, at the end of the El Niño event, were found in higher concentrations than during any previous May from 2004-2009. In addition, larvae collected from stations 1-200 nm offshore along the southern Washington to northern California coasts during the El Niño period of 2010 had far more coastal distributions, and greater concentrations and diversity of offshore taxa found nearshore, than larvae collected between March and October in 2007-2008 or during the La Niña period of 2010. Also, several taxa normally found in the southern and central California Current region were collected in the NCC during the winter/spring (El Niño) period of 2010. These data will also be compared to recent larval collections in the NCC during May-September 2011.

C-3. The Ichthyoplankton of King Harbor, Redondo Beach, California 1974 – 2009

Daniel J. Pondella, II[1], Jonathan P. William[1], Eric F. Miller[2] and Jeremy T. Claisse[1]

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The Vantuna Research Group has been monitoring the ichthyoplankton of King Harbor, Redondo Beach on a monthly basis continually since 1974. In the southern California bight, this is the only long-term monitoring program of this nearshore larval fish assemblage. The assemblage varies significantly with macro scale environmental changes. Most notably the switch of the Pacific Decadal Oscillation in the late 1970's precipitated a dramatic decline of all larval taxa. During 1980's and 1990's elevated sea surface temperature (SST) was exacerbated by an increased frequency and strength of El Niño Southern Oscillation (ENSO) events. The first of which was the 1982-1984 ENSO, at that time the largest on record. Throughout the 1990's annual SST were at or above those during the 1982-84 event. Larval fish densities continued to decline significantly throughout the 1990's and were negatively correlated with SST for the major taxa. We found significantly different larval assemblages over this time series and an overall decline in larval catch was found. Major oceanic forcing processes and metrics explained some of this variation, however individual larval taxa responded differently over the time series. Certainly a critical criteria for the evaluation of our nearshore ecosystems is larval production and these analyses are strengthened by placing them in a long-term perspective.

C-4. A Brief History of Ichthyoplankton Research in the Northern California Current Region: Contributions to Integrated Ecosystem Assessments

Richard D. Brodeur[1], Toby D. Auth[2], and Miriam J. Doyle[3]

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[2]Cooperative Institute for Marine Resources Studies, OSU, Newport, OR
[3]Joint Institute for the Study of the Atmosphere and Ocean, University of Washington, Seattle, WA

We review the literature on the abundance and distribution patterns of ichthyoplankton in the northern California Current (NCC) north of Cape Mendocino, California to northern Washington. Although there were some extended CalCOFI cruises in the 1950s up to at least northern California, the first dedicated larval fish survey in this region was made by Ken Waldron of the Bureau of Commercial Fisheries in 1967. Extensive cruises were conducted starting in 1969 and continuing through the 1970s by William Pearcy at Oregon State University (OSU) and the ichthyoplankton were analyzed by Sally Richardson and her colleagues. Much new information on larval taxonomy, spatial and temporal distributions, and relationships to environmental conditions were generated as part of these studies. Nearshore studies continued in the early 1980s by OSU under the direction of George Boehlert, Doug Markle, and colleagues focusing on the recruitment and connections of mainly flatfish species to the local estuaries. At the same time, there were a series of 8 joint US-Soviet large-scale cruises covering the entire region organized by Art Kendall of NMFS, with the data analyzed primarily by Miriam Doyle. After a hiatus in the early to mid-1990s, sampling began anew by NMFS and OSU focusing initially off the Central Oregon Coast, but by the mid-2000s was expanded over a broader area of the NCC over multiple years and seasons to provide information to managers on the outlook for future recruitment. We discuss current gaps in our knowledge, applications of ichthyoplankton data to understand ecosystem processes and relationships to climate variability, and propose a new analytical method based on early life history exposure-response coupling that may inform management of potential trends in these important species.

C-5. Migration of Juvenile Japanese Sardine During the Recent Low Biomass Period

Atsushi Kawabata[1], Masayasu Nakagami[2], Satoshi Suyama[2], and Yasuhiro Ueno[1]

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Japanese sardine, *Sardinops melanostictus* biomass was very high level in 1980s in the Pacific Ocean, but rapidly declined after 1990s and became the low level in recent years. The spawning ground of Japanese sardine is in the southern Japanese coastal waters near Kuroshio during December–May. Young and adult sardines' (>age-1) summer feeding grounds have extended northeastward to 170°E in the high biomass period in 1980s but the recent feeding grounds in the low biomass period were only in Japanese coastal waters. Juvenile sardine (age-0) also has been thought to be distributed around the Japanese Islands in the recent low biomass period. However, it was found by our pelagic trawl and acoustic surveys during June–October in 2005–2011 that juvenile sardine migrate northeastward through the Kuroshio-Oyashio Transition area and use subarctic waters east off the Kuril Islands far from the spawning ground as the feeding ground. BL9–14 cm juvenile sardine hatched during March–May were distributed in the subarctic waters of SST10–15°C off the Kuril Islands in 146–170°E during summer–autumn though rarely occur around the Japanese Islands. Entrainment by the Kuroshio Extension and the northeastward quasi-stationary jets in the Transition area seems to play an important role for the long-distance feeding migration of juvenile sardine having less swimming ability. Juvenile sardine hatched before March did not occur (probably not survive) in these waters. This feeding ground of cold waters has abundant preys (such as copepods) and less warm water species predators (e.g. skipjack, albacore, and neon flying squid); it is thought to be effective in growth and survival of sardine. Annual abundance of juvenile sardine in this feeding ground greatly fluctuated owing to survival rate during larval stage and correlated to the richness of cohort. Acoustical estimate of juvenile sardine abundance in the waters of SST10–15°C in 146–170°E was 60 million individuals in 2006 at a minimum and was 16.6 billion individuals in 2010 at a maximum in September–October during 2005–2011. 2010 year-class was extra rich cohort in recent years and brings high catch to Japanese purse seiners in 2011 fishing season. Feasibility of the arrival of juvenile sardine to this feeding ground should determine a quantity of annual recruitment.

C-6. Modeling the California Current Ecosystem Under the Auspices of Climate Change: Which Path to Take?

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Coupled bio-physical models of the CCE face many challenges, particularly when attempting to forecast the effects of future climate change. One specific major challenge is how to include the effects of temperature change on the resulting physiological responses (e.g. growth, egg production rates, etc.) of the modeled organisms, be they single-celled microbes or large pelagic fish – such effects must be included if we expect these models to realistically respond to environmental variability. There are two (not necessarily mutually exclusive) approaches to including such effects. The first, and more commonly used, is to give the organisms some kind of relatively smooth temperature-response function, i.e. a "Q10" growth response. Such response functions are typically based upon laboratory experimentation, where batches of organisms are exposed to different temperature treatments, and the physiological rate of interest is then recorded over time. A second, less widely used yet no less valid option is to assume phenotypic variability in temperature response of the individuals within the population (as is known to exist naturally). For this approach, experiments must either be conducted on individuals or on batches of individuals from different locations(latitudes), where its assumed that the different locations represent different sub-populations with differing underlying phenotypes. Under this option, the model must include individual variability among organisms or populations and relies on phenotypic adaptation and differential survival so that the resulting population shows an appropriate response to climate change. The advantages and disadvantages of these two approaches and their impacts on model outcomes will be discussed. Consideration of how to include temperature effects in coupled bio-physical ecosystem models is a key step in our strategic planning as we engage in EBM and IEA efforts.

C-7. Decadal Changes in the Phenology of Larval Fishes in the Southern California Current Ecosystem

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Global warming has prompted an earlier arrival of spring in numerous ecosystems. It is uncertain whether such a change is occurring in the California Current Ecosystem, because this region is subject to decadal climate oscillations and regional climate models predict seasonal delays in upwelling. I investigated changes in larval phenology of 43 fish species sampled by California Cooperative Oceanic Fisheries Investigations from 1951-2008. Trends in monthly larval abundance were analyzed by decadally averaging data from quarterly surveys conducted in different months. Phenological shifts were quantified by anomalies in the central tendency of seasonal larval abundance. The first principal component of this dataset showed a progression towards the earlier appearance of larvae, which accelerated during the 1990s. 39% of species displayed increasingly early peaks in larval abundance, while 18% exhibited delayed phenology. These changes are best explained by a secular trend towards earlier warming of surface waters rather than by decadal climate cycles, such as the Pacific Decadal Oscillation and the North Pacific Gyre Oscillation. Species displaying either long-term advances or delays in phenology exhibited similar behavior at the interannual scale based on their reaction to El Niño. Generally, species that are spawning earlier are characterized by an offshore, epipelagic distribution and a spring or summer peak in larval abundance. Conversely, species with delayed phenology are more likely to be coastal, demersal fishes that spawn in winter or fall. While earlier spawning was linked solely to seasonal changes in sea surface temperature (SST), a combination of SST and upwelling were responsible for delays in spawning. The fish species that are spawning earlier may be subject to increasing mismatches with their prey, because these fishes have been unresponsive to fluctuations in the seasonal cycle of upwelling and zooplankton volume.

C-8. Assessment of Fisheries Interactions in Bahia Magdalena-Almejas, Baja California Sur, Mexico

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To provide information towards strengthening the implementation of ecosystem-based management, the dynamics of small-scale fisheries fleets in Bahia Magdalena–Almejas were analyzed based on official trip tickets data on catch per species, value and frequency of use. Fourteen fisheries were identified but scallop, shrimp and finfish, were the most important and were selected to estimate fishery performance indicators including spatial and temporal use of main species. Fishing maps were done, delimiting fishing zones related to physiographic characteristics, fishing gears, depth, and the historical distribution of catches. Complementary surveys on local knowledge were used to validate results and define types of conflicts. Direct interactions between fisheries occur when two or more overlaps in time and/or space and official regulations on fishing seasons, areas and quotas show different effects on fisher's behavior. The information is integrated in a conceptual model of fleet behavior useful to measure some conflicts between fleets.

C-9. Temporal Trends in Southern California Bight Demersal Fishes and Their Indications of Habitat Value

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The demersal fish communities throughout the Southern California Bight from the outer to inner continental shelf were sampled during the summers of 1994, 1998, 2003, and most recently in 2008 under a standardized methodology, inter-agency sampling plan. Summer water temperature at depth between 1950 and 2008 has remained relatively stable although temperatures in 1998 and 2008 were above the long-term mean while the 1994 and 2003 temperatures were at or below the mean. The demersal community recorded in each of the four regional surveys was relatively consistent based on percent similarity index analysis, with 1998 standing out as the most different sampling year. Conspicuous abundance declines were recorded in *Genyonemus lineatus* and *Seriphus politus* while increases were noted in *Citharichthys sordidus* and *C. stigmaeus*. These patterns were consistent with that observed in ichthyoplankton sampling throughout the area. Habitat valuation revealed a trend of increasing value with depth as greater densities and generally larger individuals were collected from trawls on the outer shelf and middle shelf, in comparison to the inner shelf. No significant differences were detected between the annual habitat value scores, suggesting the Southern California Bight's continental shelf fish community has changed little since 1994.

C-10. Seabirds, Salmon and Groundfish: Using Predator Diets to Track Shifts in the Marine Prey Community in the Northern California Current

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During the past decade, the northern California Current has experienced dramatic inter-annual variability in ocean conditions, including delayed and intensified upwelling, anomalous near-shore hypoxia, and decoupling of conditions between Northern and Southern regions. Managers require a better understanding of the impacts of such variability on marine ecosystems, yet it is not possible to monitor all ecosystem components. Predator diets may serve as a method to track the prey community, and the efforts of recreational and commercial fishermen can be leveraged to obtain high quality diet samples at low costs. We employed collaborative fisheries research techniques with synoptic observations of a major seabird colony to determine the diets of a suite of upper trophic level consumers on the central Oregon coast. Focal predators included common murres (*Uria aalge*) Chinook and coho salmon (*Oncorhynchus tshawyscha and O. kisutch),* black rockfish (*Sebastes melanops*), and Pacific halibut (*Hippoglossus stenolepis*). We report on the degree of dietary overlap among predators during two summers (2010 and 2011) of contrasting oceanographic conditions. The greatest degree of dietary overlap was observed in Chinook salmon and common murres, with both smelts (Osmeridae) and clupeids (primarily *Clupea pallasi*) observed as the dominant prey types. There were marked differences in the diets of several predators between the two sampling seasons, with a greater proportion of invertebrate prey in black rockfish diets and decreased importance of smelts in the common murre diets during 2011 compared to the previous year. The diets of predators, a source of information on prey availability that augments boat-based surveys, can contribute to more comprehensive ecosystem based management throughout the California Current.

C-11. California Grunion in San Francisco Bay: Temporary Habitat or Expanded Range?

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California Grunion *Leuresthes tenuis* provide a natural spectacle and unique recreational fishery during midnight spawning runs, as hundreds of fish emerge from ocean waves onto sandy beaches to spawn. Although this endemic marine fish is mostly found south of Pt. Conception, the single type specimen was purchased from a San Francisco market in 1859. No reports exist of *L. tenuis* in San Francisco Bay between 1860 and 2000. In 2000, a small number of *L. tenuis* were collected as dropped fish at the Alameda Tern Colony in San Francisco Bay. Over the next few years, larval, juvenile, and adult *L. tenuis* were collected in trawls and on shore, and multiple spawning sites within San Francisco Bay were identified. After the *Cosco Busan* fuel spill in November 2007, only a few *L. tenuis* have been found, and no spawning runs or nests have been observed since 2007 in San Francisco Bay. A small number of *L. tenuis* may have colonized San Francisco Bay in the late 1990's during an ENSO event. Additional protections are recommended for this unique endemic species in northern habitats.

C-12. Rockfish Assemblage Structure in the Southern California Bight as Revealed Through Genetic Identification of Larvae

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Rockfishes (*Sebastes* spp.) are important components of commercial and recreational fisheries as well as the coastal marine and terrestrial ecosystems of California. In response to fishery-induced declines of many rockfishes over the past half century managers established several rockfish conservation areas (RCA) throughout California. The goal of our research was to elucidate patterns of rockfish distribution within and around a large RCA, the Cowcod Conservation Area (CCA), following its inception in 2001. We used genetic sequencing to identify larvae that were collected in the winters of 2002 and 2005. We detected 26 rockfish species that were historically subjected to varying degrees of fishing pressure. In both years, however, the assemblage was dominated by smaller, non-targeted species such as shortbelly, squarespot, swordspine and pygmy rockfish. Cluster analysis characterized major differences in assemblage structure among stations in the eastern and western Santa Barbara basin (north of the CCA) and south of the Channel Islands (within the CCA) that largely reflected relatively high abundance of a targeted species, blue rockfish, in the western Santa Barbara basin but nowhere else. There was also a less pronounced but significant difference in assemblage structure among eastern and western banks within the CCA that was caused by higher abundances of almost all species on the western banks. The breaks in assemblage structure mirrored a long-term gradient in sea surface temperature characterized by cooler, southward flowing California Current waters in the west versus warmer inshore waters. These results demonstrate how small-scale environmental gradients can affect species distributions and stress the importance of considering underlying environmental conditions when assessing species distribution in relation to spatially static marine protected areas.

C-13. An End-to-end Model of the Northern California Current Upwelling System: Accounting for the Propagation of Lower Trophic Level Variability and Upper Trophic Level Uncertainty

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Predicting ecosystem response to future climate variability requires a mechanistic understanding of ecosystem dynamics. Food web models are useful platforms for estimating functional group response to structural changes among energy flow pathways. However, they do not themselves incorporate the physical processes that drive variability among bottom-up energy supply processes. Plankton productivity and community composition within the Northern California Current (NCC) vary on seasonal, inter-annual, and decadal time scales due to variable nutrient input via coastal upwelling and due to climate-scale processes that force changes of the local meso-zooplankton grazer community via large-scale water-mass transport. To study propagation of lower trophic level variability across all trophic levels, an NPZD model was used to drive an end-to-end food web model of the NCC ecosystem. The plankton model was coupled to a one-dimensional, cross-shelf Ekman transport and upwelling model. System production was balanced between new production supported by input of upwelled nutrients and the physical export of plankton production from the shelf domain via Ekman transport. The functional response parameters of the meso-zooplankton were varied seasonally as appropriate to time-series observations of the copepod community size composition off the central Oregon coast. Propagation of model error during alternate scenario runs was analyzed via Monte Carlo sampling of potential food webs drawn from biomass distributions as observed over a decade of pelagic trawl surveys off the Oregon and Washington coasts. Potential food webs were evaluated based upon their thermodynamic balance after allowing for seasonal biomass changes and variable migration of upper trophic level groups.

C-14. Annual Variability in Population Parameters of California Sea Lions (*Zalophus californianus californianus*) at San Miguel Island Related to Oceanographic Variability in the California Current

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We monitored pup production, pup mortality, and pup weight at 4 months of age of California sea lions at San Miguel Island, California between 1997 and 2011. We used upwelling (UWI), multi-variate El Niño Southern Oscillation (MEI) and sea surface temperature (SST) indices within the foraging range of lactating females to examine oceanographic variability during this time period. Annual variability in the pup mortality was best explained by periodic oceanographic perturbations in the California Current rather than a long-term trend related to population growth or oceanographic changes. Strandings of weaned pups and yearling along the central California coast showed a similar pattern. We examined various mixed-effects models to explore relationships between pup weight and the oceanographic indices. The best model demonstrated a declining trend in pup weight over the 15 years and a strong negative relationship with average SST anomaly between June and September. Food habits analysis based on prey remains in scats showed a consistent diet of six fish species and two cephalopod species but the frequency of occurrence of the species varied annually and showed marked differences in years when pup births were low, pup mortality was high or SST anomalies were warmer than normal. The greatest variability in population parameters and food habits occurred in years that coincided with the 1998, 2002, and 2009 El Niño events and the localized 2009 summer relaxation event that occurred along the central California coast.

C-15. A Broadscale Ecosystem Survey of the Nearshore California Current

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Effective management of marine resources greatly benefits from the use of ecosystem based models. This is particularly important when considering the potential impacts of climate change on the structure and function of the pelagic community. Krill (euphausiids) play a central role in the trophic dynamics of the coastal pelagic environment of the California Current Large Marine Ecosystem (CCLME) therefore an understanding of the processes that influence krill population dynamics is critical for any comprehensive effort to model and assess this ecosystem. For the last 25 years, the Fisheries Ecology Division at NMFS-SWFSC has been conducting annual springtime midwater trawl surveys within the nearshore region of the CCLME utilizing a modified Cobb Midwater Trawl. Since 2004, this annual effort has been expanded to include the region between San Diego and Cape Mendocino. Beginning in 2003, in partnership with the zooplankton ecology lab at UCSC, analysis of the krill bycatch in trawl samples has been sequentially expanded to included species composition, sex, and size structure, thereby providing a comprehensive and synoptic measure of adult krill throughout the California portion of the CCLME. Here we provide an overview of the data collected by the annual midwater trawl survey and present new data on the spatial coherence of krill stocks throughout the region from 2003-2010. In addition, examples of modeling efforts that incorporate krill data from the spring midwater trawl survey will be provided.

C-16. Inferring Sub-structure of the Australian Sardine (*Sardinops sagax*) Population Using Multiple Approaches: Implications for Future Stock Assessment and Management

T.M. Ward, C. Izzo, A.R. Ivey, and B.M. Gillanders

The Australian population of sardine, *Sardinops sagax* (Jenyns, 1842) supports smaller catches but covers a larger geographical range than other populations. Locally significant commercial fisheries occur in five separate jurisdictions (Commonwealth, Queensland, NSW, Vic, SA and WA). Information on stock structure is needed to assess the level of co-ordination that may be required for future stock assessment and fisheries management. This study used three complementary approaches to assess the level of sub-structuring of the Australian stock. Firstly, a semi-quantitative weight of evidence approach using similarity matrices of existing information was applied to infer patterns of stock structure. This approach suggested that there was a high degree of separation between the WA, SA and the east coast (Qld, NSW and eastern Vic) groups and some sub-structuring along the east coast. Sub-structuring off south-eastern Australia, was investigated using two approaches: 1) Fourier analysis of otolith shape and 2) otolith chemistry. The shape analysis findings suggested the existence of separate SA, western Victorian (Port Phillip Bay) and east coast groups, with potentially two to three partially separated sub-groups along the east coast. Otolith chemistry results suggested separate northern and southern sub-groups off the east coast and potential fine-scale structuring off SA. Overall, the two otolith-based techniques generally supported the population structure for south-eastern Australia suggested by the weight of evidence approach; i.e. separate SA, western Victorian and east coast groups, with some sub-structuring likely along the east coast and potentially off SA. Future stock assessment and management on the east coast may need to be coordinated among the Commonwealth, New South Wales and Victoria (eastern Lakes Entrance). In Victoria and South Australia, there may be a need to explore options for finer-scale spatial management to prevent potential reductions in local abundance.

C-17. Modeling Trends in Cetacean Habitat Use and Density on the Southern CalCOFI lines

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Elucidating cetacean habitat use and density patterns in the California current ecosystem requires modeling of how both spatial and temporal covariates influence cetacean distributions. Cetacean visual line-transect data collected on 24 quarterly California Cooperative Oceanic Fisheries Investigations (CalCOFI) cruises from summer 2004 - spring 2011 were incorporated into two analyses. Data on thermal front distribution and intensity acquired from satellite imagery were examined relative to cetacean distribution to determine if front activity can be used to predict areas of increased cetacean densities. The distribution of cetacean sightings, particularly baleen whales, was linked to the presence of thermal fronts, with sighting probabilities significantly greater in frontal boundary regions versus random points in the study area. Increased surface nutrients that support primary and secondary productivity characteristic of frontal boundaries are likely factors influencing the observed trends in cetacean distribution. The density of common dolphins was assessed using an innovative method for modeling trends in abundance via spatio-temporal models that include fixed effect covariates, such as sea-surface temperature or thermocline depth, as well as a random effect for the trend, allowing for spatial variation in trend that is not accounted for by covariates. Transect lines were broken up into smaller segments to allow appropriate allocation of spatial and habitat covariates to respective line segments. We assume that the trend at any given segment is normally distributed. Hence trend is estimated as a random effect at the segment level with a global mean, rather than assuming a fixed value for all segments. Such models allow for inference on trend of the overall population size within the study area as well as smaller-scale spatial variations.

C-18. Climate, Biomass, and the Trophic Role of Midwater Fishes in the California Current

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Recent analysis of the CalCOFI ichthyoplankton data set indicates that mesopelagic fishes in the California Current have fluctuated since 1951 by a factor of ~2.7, highly correlated (r = 0.75) with changes in deepwater oxygen concentration. What are the implications of such changes for regional marine food webs? Since 2010, multi-frequency acoustics and trawl sampling have been combined to assess the abundance and distribution of micronekton in the southern California Current (CC). Preliminary results indicate that the biomass of mesopelagic fishes in the CC is ~5-fold higher than previous estimates, based on sampling with small research trawls alone. Mesopelagic fishes tend to be distributed more broadly across the CC than the small coastal pelagic species, anchovy and sardine, and their overall biomass is substantially greater. However, they are less active and live at lower temperatures, so their metabolism and food consumption rates are substantially lower. Overall, their trophic impacts appear to be of the same order. Analysis of the CalCOFI ichthyoplankton time series indicates that mesopelagic fish populations, including migrators and non-migrators, planktivores and piscivores, tend to be highly inter-correlated and that there are often significant positive correlations between mesopelagic fishes, their epipelagic competitors (e.g. anchovy and the mackerels), and the hake. There are also generally significant correlations between time series for these fishes and environmental indices, such as ENSO and the Pacific Decadal and North Pacific Gyre Oscillations. These patterns suggest that these fish populations are generally most influenced 'bottom-up' by environmental factors rather than 'top-down' by predator-prey and competitor interactions. These results also open to question the hypothesis that upwelling systems, such as the CC, are 'wasp-waisted,' with only a few plankton feeders, such as anchovy and sardine, that regulate the flow of plankton production to higher predators.

C-19. Combining a Trawl Camera and Hydroacoustics for Species Verification

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We present a simple and portable self-contained underwater video camera system that can be used during trawl surveys to obtain non-destructive species composition information when the cod-end of the trawl is removed. This system allows commercially valued species such as hake to be assessed without capturing species of concern such as salmon, rockfish and marine mammals. The video camera records the layering of organisms in the water column and when combined with depth information from a trawl mounted CTD the images can be correlated with acoustic echograms to corroborate acoustic signatures. Experimental trawls with closed cod-end have shown good agreement between camera-based estimates of abundance and catches for species large enough to be easily observed. Parallel green lasers are used to estimate species size and these estimates compare favorably to catch information. Digital image recording allows extended or quickly repeated operation of the trawl nets. We recognize the value of developing real-time video imaging for trawling activities in the future, as currently the viewing of our images is delayed.

POSTER TITLES AND ABSTRACTS

P-1. A Stable Isotope-based Perspective on the Contribution of Prey to Humboldt Squid (*Dosidicus gigas*) in the Northern California Current

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Diet studies have shown Humboldt squid (*Dosidicus gigas*) to be aggressive opportunistic predators, although it is recognized for cephalopods tht this approach provides a limited and potentially biased view of their trophic behavior. As an alternative, we measured stable isotopes ($\delta^{13}C$ and $\delta^{15}N$) of Humboldt squid and their prey from the northern California Current ecosystem, and applied a Bayesian mixing model to assess the proportional contributions of prey groups to their diet. Cluster analysis of prey taxa by their respective $\delta^{13}C$ and $\delta^{15}N$ values was first applied to consolidate prey into prey groups, which was then incorporated into a stable isotope mixing model (SIAR) as source groups. Model results showed much lower trophic-level feeding by Humboldt squid relative to previous diet-based studies, with greatest contributions from macrozooplankton and ichthyoplankton (median 50% credibility interval contribution = 0.26-0.43), and nekton such as juvenile rockfish, market squid, sand lance, and juvenile hake (0.22). Groupings consisting of myctophids and other deep water benthic-pelagic species, yearling-adult hake, other squid species, sardine and anchovy, juvenile salmonids and other nekton all displayed negligible contributions ($\leq$ 0.01). Sensitivity analyses of the SIAR model based on varying isotopic fractionation factors of $\delta^{13}C$ (0, 0.39, 0.8, and 1.2‰) and $\delta^{15}N$ (2.6, 3.0, and 3.4‰) showed proportional contributions that were resilient to change. Analyses of size-specific shifts in $\delta^{13}C$ and $\delta^{15}N$ showed weak but significant relationships with increasing squid mantle length. Our results suggest that stable isotopes can provide an integrated measure of Humboldt squid feeding history.

P-2. Genetic Corroboration of *Engraulis mordax* Larvae Distribution in the Upper Gulf of California

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Over the past decade, the use o molecular tools for taxonomic identification have increased in response to limitations of morphological identification. Despite considerable efforts, larval identification remains one of the major factors limiting the answer to questions that can be addressed regarding ichthyoplankton studies, such as larval distribution, spawning locations and seasons. These limitations are especially acute within certain regions, for certain taxonomic groups and during the earliest stages of larval development. For fishes the techniques that have been most frequently used, involve the use of polymerase chain reaction (PCR), followed by sequencing or restriction fragment length polymorphism (RFLPs), or PCR of specific primers. In the present study the goal of using PCR-sequencing was to verify the identity of distinct larval types of Engraulidae. Plankton samples were collected at the Upper Gulf of California in March 2011. Zooplankton samples were collected with a surface net, which were fixed-preserved in 80% ethanol. Five *Engraulis mordax* and five *Cetengraulis mysticetus*-type larvae were identified using morphometric and meristic data. Adult specimens of seven Engraulidae species were also collected and identified. For molecular identification, genomic DNA was extracted, two mitochondrial DNA fractions, 16 S rRNA (~650 bp) and COI (~750 pb), were amplified using universal primers, and PCR products were sequenced in both directions. Sequences of larvae and adults were compared to estimate genetic distances among them, using the sequence of *Anchovia macrolepidota* as outgroup. Genetic distances and Neighbor-Joining trees corroborated that five *E. mordax*-type larvae were effectively such species, but the five *C. mysticetus*-type larvae were not that species, indicating a misidentification of these larvae within the Engraulidae family. In fact, three *C. mysticetus*-type larvae, showed the same sequence as *E. mordax*-type larvae. The other two larvae did not matched to any available sequence from our samples or from the GenBank. This is a first report of the presence of *E. mordax* larvae at the Upper Gulf of California during March, possibly indicating the expansion of its distribution range and/or reproductive period at the northern Gulf of California. The possible explanation of *E. mordax* larvae presence in this region is discussed.

P-3. Hypoxia Condition in Todos Santos Bay Area

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This work involved Todos Santos Bay and the surrounding area, which is located at the northwest of the Baja California Peninsula, Mexico. Dissolved Oxygen (DO) concentration in seawater is a very sensitive indicator of changes both physical and biological in the ocean; we estimated the apparent concentration of this variable, with CTD casts (SeaBird Electronic, Model 25). Six oceanographic cruises were carried out from October 2010 to October 2011. The results suggest that within the first 20 m of depth, maximum and minimum values of DO varies from 350 to 130 µmol/kg in March 2011. In terms of the distribution, low DO values were at the northeast part of the bay and southeast of the Peninsula de Punta Banda (in March). Higher DO values were found at the northwest side of Punta Banda Peninsula and around Todos Santos Islands. Since a high DO levels indicates a better water quality, concentrations from ~60 to 120 µmol/kg (hypoxic conditions) can lead to negative effects such as loss of suitable habitat for many marine organisms. In many profiles, the presence of hypoxic conditions began at a depth interval of ~ 27 to 125 m. The area located southwest of the Todos Santos Island, especially station B1 (Lat. 31.766°N; Long. 116.875º W) shows hypoxia at greater depth. Although hypoxia occurs naturally in oxygen minimum zones, deep basins near upwelling zones, among others, human activities can cause this condition. According to the above, the hypoxic condition southwest of the Todos Santos Islands corresponds to the point where we pour the dredging of the seaports of Ensenada and El Sauzal de Rodríguez. This activity can reduce the DO concentrations contributing to the hypoxia conditions in the area.

P-4. Community Dynamics of Juvenile Fishes in Coastal Benthic Habitats

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There is increasing need to consider spatial allocation of nearshore marine habitats in relation to human activities. These environments provide numerous societal and ecological services, being easily accessible, and being critical habitats for numerous fish and invertebrate species that are commercially and ecologically important. For example, several flatfish and rockfish species spend part of their life cycle as settled juveniles in coastal benthic habitats. Coastal benthic habitats are also highly dynamic, and can be seasonally affected by the expansion of low oxygen and low pH waters from depth, linked with intensification of upwelling strength. In this study, we present results of a four-year (2008-2011) sampling program, conducted along the central Oregon Coast (Newport hydrographic line), to assess the juvenile fish community and monitor its spatial and interannual dynamics. Each year, sampling was conducted at multiple locations from 30 to 80 m depth in soft-sediment areas, with a 2x0.5 m beam trawl. A video camera was mounted on the trawl to observe and quantify fish behavior including response to the approaching of the sampling gear. During these four years, we found high spatial and temporal variability in species composition and behavior. Some of the spatial dynamics are related to ontogentic distributional shifts of the dominant fish species and are therefore consistently observed in different years. However, we also document high interannual variability of species composition, which can be related to changes in environmental variables, such as variation of upwelling strength and the timing and extent of seasonal hypoxia. While based on a relatively short time series, our results underscore the importance of monitoring coastal benthic resources and provide synoptic metrics that can be used as indicators of fish community dynamics in nearshore waters.

P-5. ROV Surveys of Soft and Rocky Deep-water Habitats Along California's North Central Coast: MPA Baseline Data Collection

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The ultimate success of any management measure, spatial or otherwise, in the marine environment is predicated on a clear understanding of baseline conditions present at the time the measure is implemented. In 2010 the Marine Life Protection Act (MLPA) process resulted in designation of marine protected areas (MPAs) throughout the North Central Coast Region (Pt. Arena to Pillar Point, including the Gulf of the Farallones) as part of a state-wide network of MPAs. Baseline characterization and monitoring of both deep benthic rock and soft-sediment communities (20 m -120 m) is being undertaken by a unique partnership between California State University's Institute for Applied Marine Ecology (IfAME), Marine Applied Research and Exploration (MARE), and The Nature Conservancy (TNC), with the additional participation of commercial fishermen and scientific experts from other institutions. This study leverages the expertise and resources of multiple regional institutions, including public and private, academic and non-governmental, coupling data processing and analysis with education and training of the next generation of scientists in California. Researchers use a remotely operated vehicle (ROV) to collect videographic and still photographic imagery. Imagery is used to quantify landscape attributes on the seafloor, as well as the fish and invertebrate communities associated with those attributes. Five sites were selected at each location ─ inside and outside the No-Take Reserve (SMR), inside and outside the less-restrictive Conservation Area (SMCA), and a site relatively distant from both but of similar depth distribution and bottom habitat composition, considered a reference site. Results will provide a baseline against which future monitoring efforts can be compared to evaluate performance and inform adaptive management. In 2010 we sampled at four locations (listed from north to south) 1): Pt. Arena SMCA and SMR, 2) Bodega Head SMCA and SMR, 3) South Farallon Island SMCA and SMR, and 4) Montara SMR and Pillar Point SMCA. In 2011 we re-sampled each of those four locations and added the Point Reyes SMCA and SMR. Analysis of more than 20,000 still photographs and more than 300 hours of video is on-going. In advance of the completed analyses, we implemented a rapid assessment protocol for data collection and developed a graphical approach to visualize distributional data to provide quick summaries to managers in the near term.

P-6. Shark-inflicted Lesions on California Sea Lions (*Zalophus californianus*) at San Miguel Island, California: A New Phenomenon

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Shark-inflicted lesions on California sea lions (*Zalophus californianus*) were observed in unprecedented numbers on San Miguel Island (SMI), California, from February to September 2011. Prior to this time period (1972-2010), there was little observational evidence of shark predation on SMI sea lions. We documented 101 living animals with lesions, including 70 adult females, 29 juveniles and 2 adult males. Lesion condition (fresh, healing, scarred) was used to assess the peak period of shark predation; 88% of all freshly inflicted lesions occurred in June and July. Based on distinct bite patterns, 33 of the lesions could be assigned to the mako shark (*Isurus oxyrinchus*) and 13 to sub-adult great white sharks (*Carcharodon carcharias*). Shark predation on California sea lions at SMI is ecologically important and may signify the return of apex predators following two decades of commercial harvest in the Southern California Bight. Adult female and juvenile survival drives California sea lion population growth and if predation persists on these age classes it may emerge as a key factor in sea lion population dynamics.

P-7. The SIO Pelagic Invertebrates Collection

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The SIO Pelagic Invertebrates Collection (PIC) holds valuable zooplankton samples extending back to 1903, the years of Scripps' founding. The collection began growing rapidly in the post-WWII era of expeditionary oceanography, which generated a suite of plankton samples from extensive geographic coverage of different ocean basins that remain unparalleled today among plankton collections around the world. The advent of systematic CalCOFI sampling in 1949 led to the accumulation of a large number of samples that now constitute one of the world's preeminent ocean time series. All of those samples are housed and curated at SIO. Our holdings originating from CalCOFI, together with related sampling in the California Current System (CCS), now represent slightly over half (~55%) of the PIC samples. The PIC is now the repository for the mesozooplankton samples from the Hawaii Ocean Time Series program. In recent years, samples fixed or frozen for molecular genetics research have expanded significantly. The CCE-LTER program has contributed vertically stratified and fine mesh samples from the CCS region. The samples and specimens of the PIC are used extensively in research, teaching, public outreach, and assistance to government entities. Currently supported research projects pertain to climate change effects on pelagic communities, life histories of different holoplanktonic and meroplanktonic organisms, the effects of submesoscale ocean variability on pelagic production, the use of stable isotopes (both bulk and amino acid-specific) to infer changes in pelagic food web structure, digital ZooScan analysis of zooplankton size structure and vertical habitat use, molecular population genetics of oceanic plankton, and a suite of other programs. The PIC search engine (http://collections.ucsd.edu/pi/frm_search.php) provides a web-based portal to collection holdings.

P-8. Spatial and Temporal Length Distributions off California From Daily Egg Production Method Surveys Conducted 1986-2011

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Pacific sardine (*Sardinops sagax*) spawning biomass has been assessed using data from daily egg production method (DEPM) research surveys since 1986. Although eggs and larvae were sampled during 1986-1988 and 1994-2011 to estimate daily and total egg production, adults were collected, adult parameters calculated and spawning biomass was estimated in 1986-1988, 1994, 1997, 2002, and 2004-2011 (Table 1). All surveys collected sardines off California within the standard DEPM survey area. The standard DEPM area extends from CalCOFI line 95 (near San Diego) to CalCOFI line 60 (just north of San Francisco). A few DEPM surveys extended south into Mexico (in 1994) or north to Canada (in 2006, 2008, 2010, and 2011). We examined egg and trawl locations and sardine standard length distributions (SL in mm) (Figure 2 and 3). On closer examination of eight consecutive surveys (2004-2011) in the standard DEPM area we found a significant number of smaller sardines in the 2005, 2006, 2007, and 2011 surveys, an indication that some recruitment occurred. We found few small sardines during 2008-2010 coupled with decreasing biomass, indicating possible poor recruitment.