CalCOFI Conference

26-28 November 2007

San Diego, CA

Hosted by:

Southwest Fisheries Science Center, NOAA Fisheries
CalCOFI Coordinator: John Heine
Symposium Convener: John Field

In association with:
Scripps Institution of Oceanography
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CalCOFI Conference 2007

Shedd Auditorium
Hubbs-SeaWorld Research Institute
San Diego, CA
Nov. 26-28

Monday, 26 November

1:00-1:15	**Opening of the Conference** **Welcome: Dr. Roger Hewitt, Fisheries Resources Division, Southwest Fisheries Science Center, NOAA**
1:15-2:00	**Session I: Status of the California Current** **Chair: Ralf Goericke, Scripps Institution of Oceanography**
2:00-2:30	Break. DeMotte Center, Hubbs.
2:30-4:30	**Session II: Status of the Fisheries** **Chair: Dale Sweetnam, California Dept. of Fish and Game**
2:30-2:45	Sonia Torres, Coastal pelagic finfish
2:45-3:00	Dianna Porzio, Market squid
3:00-3:15	Tom Mason, Leopard shark
3:15-3:30	Scott Lucas, Cabezon
3:30-3:45	Brian Owens, California halibut
3:45-4:00	Kim Penttilla, Surfperches
4:00-4:15	Jennifer Simon, Ocean salmon
4:15-4:30	Brooke McVeigh, Dungeness crab

Dinner

5:15-7:15	**Banquet, DeMotte Center, Hubbs.**

Tuesday, 27 November

8:15-8:30 **The Symposium of the Conference: Jumbo Squid Invasions in the Eastern Pacific Ocean**
Introduction - Dr. John Field, NOAA

Jumbo squid (*Dosidicus gigas*) have been occasional visitors to the northern California Current over the last century, and frequent visitors since the 1997-1998 El Niño. Since 2003, these large, subtropical predators have sporadically been very abundant throughout the coastal waters of the California Current, and have also been observed in large numbers as far north as British Columbia and Alaska. A comparable range expansion appears to be taking place in the Southern hemisphere. Like most cephalopods, jumbo squid are very fast growing predators with high metabolic demands and population turnover rates, which facilitate a rapid response time to perturbations in the environment. Food habits studies demonstrate that these animals prey on a number of stocks of commercial and ecological importance in the California Current, including Pacific hake, rockfish, sardines, anchovies and market squid. Throughout their range they likely play a major role in structuring the pelagic and mesopelagic ecosystems, and changing climate conditions will likely lead to further alterations to their distribution, and to their relationships to fishes, seabirds, marine mammals, and humans. This Symposium will explore historical and ongoing jumbo squid invasions throughout their range in the Eastern Pacific, including habitat interactions, movement patterns, and trophic interactions, with the overarching goal of better understanding the causes and consequences of these invasions.

8:30 **Session III: Symposium (35 minutes with 5 minutes for discussion).**
Chair: Dr. John Field, NOAA

8:30-9:10 S-1. *Dosidicus gigas*: northern range expansion events. E.M.C. Hatfield and F.G. Hochberg, Santa Barbara Natural History Museum.

9:10-9:50 S-2. Distribution and abundance of jumbo squid (*Dosidicus gigas*) off Peruvian coasts and their relationships to environmental conditions. Carmen Yamashiro*, Ramiro Castillo, Noel Domínguez, Carlos Paulino, Luis Vásquez, Luis Mariátegui, Instituto del Mar del Perú, Friedemann Keyl, Centre for Tropical Marine Ecology, Bremen, Germany.
* Corresponding author, e-mail: cyamashiro@imarpe.gob.pe

9:50-10:10 BREAK

10:10-10:50 S-3. Relationship between jumbo squid population expansion northward & climate variability. C.A. Salinas-Zavala and M.M. Manzano-Sarabia, Centro de Investigaciones Biológicas del Noroeste, México.

10:50-11:30	S-4. Large-scale range expansion and variability in cephalopod populations. Paul G Rodhouse, British Antarctic Survey.
11:30-12:10	S-5. Food and feeding habits of jumbo squid *Dosidicus gigas* in the Gulf of California and Pacific Ocean. Unai Markaida, El Colegio de la Frontera Sur, Unidad Campeche, ECOSUR, William Gilly, Hopkins Marine Station, Stanford University, Gastón Bazzino, Rigo Rosas, César Salinas Zavala, Centro de Investigaciones Biológicas del Noroeste, México.
12:10-1:00	LUNCH
1:00-1:40	S-6. *Dosidicus* in the context of mesopelagic community structure and ecology. Bruce H. Robison, MBARI.
1:40-2:20	S-7. An overview of the present state of common hake (*Merluccius gayi*) stock with a forecast of its biomass including jumbo squid (*Dosidicus gigas*) prey-predator relationship in central Chile (33°S – 39°S). Arancibia, Hugo, Universidad de Concepción, Chile, and Sergio Neira, University of Cape Town, South Africa.
2:20-3:00	S-8. Vertical Distribution of *Dosidicus gigas* in the Pacific Ocean off Baja California. William Gilly, Hopkins Marine Station, Stanford University, Unai Markaida, El Colegio de la Frontera Sur, Unidad Campeche, ECOSUR, Gastón Bazzino, Jorge Ramos, and César Salinas Zavala, Centro de Investigaciones Biológicas del Noroeste, México.
3:00-3:20	BREAK
3:20	**Session IV: Contributed Papers on Squid Theme (15 minutes with 5 minutes for discussion).** **Chair: Dr. John Field, NOAA**
3:20-3:40	C-1. Pictures from the edge: Interactions between Humboldt squid (*Dosidicus gigas*) and Pacific hake (*Merluccius productus*) observed in the northern California Current during joint Canada-US hake acoustic-trawl surveys. Ken Cooke, George Cronkite, John Holmes, Fisheries and Oceans Canada, Pacific Biological Station, Nanaimo, BC, Canada, V9T 6N7; Steve de Blois, and Lawrence Hufnagle, NOAA, National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, WA, USA, 98112.
3:40-4:00	C-2. Behavior of *Dosidicus gigas* in different pelagic environments. Louis D. Zeidberg, William F. Gilly, Ashley Booth, Hopkins Marine Station, Stanford University, Pacific Grove, CA 93950.
4:00-4:20	C-3. Feeding description of squid *Dosidicus gigas* d´ Orbigny, 1835 in the western coast of Baja California and Baja California Sur, Mexico. Rosas-Luis, Salinas-Zavala C., Markaida-Aburto U. y Abitia-Cardenas A., Centro de Investigaciones Biológicas del Noroeste S. C.Apdo. Postal 128, La Paz, B.C.S. 23000, MEXICO e-mail: rrluis@cibnor.mx

4:20-4:40 C-4. Predatory interactions between Mako shark, *Isurus oxyrinchus*, and jumbo squid, *Dosidicus gigas,* in the California Current. Russ Vetter, Suzanne Kohin, Antonella Preti, Sam McClatchie, and Heidi Dewar. Fisheries Resources Division, Southwest Fisheries Science Center, La Jolla, CA.

4:40-5:00 C-5. A conceptual scheme on life strategies and stock dynamics of *Dosidicus gigas* in the Eastern Pacific. Friedemann Keyl, Centre for Tropical Marine Ecology, Fahrenheitstr. 6, 28359 Bremen, Germany; Juan Argüelles, Ana Alegre, Luís Mariátegui, Ricardo Tafur, Instituto del Mar del Perú (IMARPE), Chucuito, Callao, Perú; Matthias Wolff, Centre for Tropical Marine Ecology, Fahrenheitstr. 6, 28359 Bremen, Germany; Carmen Yamashiro, Instituto del Mar del Perú (IMARPE), Chucuito, Callao, Perú.

5:00-7:00 PM **Poster Session:** West Room, Hubbs-SeaWorld Research Institute
Beer, wine, and non-alcoholic beverages, hors d'oeuvres

P-1 Fecundity, maturity index and oocyte quality on maximum size females of jumbo squid *Dosidicus gigas* (d' Orbigny, 1835) in Gulf of California, México. B.M. Claudia Alexandra Parra Méndez.

P-2 Spatial and temporal variations in albacore habitat in the northeast Pacific using remotely-sensed environmental data. R.D. Brodeur, Northwest Fisheries Science Center, 2030 S. Marine Science Dr., Newport, OR 97365, USA; E. Howell, J. Polovina, Pacific Islands Fisheries Science Center, 2570 Dole St., Honolulu, HI 96822, USA; L. Ciannelli, W.G. Pearcy, College of Ocean and Atmospheric Sciences, Oregon State University, Corvallis, OR 97331, USA; R.M.Laurs, Southwest Fisheries Science Center, PFEL, Pacific Grove, CA, USA; and J. Childers, Southwest Fisheries Science Center, P.O. Box 271, La Jolla, CA 92038, USA.

P-3 Trophic ecology of dominant micronektonic fish species in the northern California Current. Andrey V. Suntsov and Richard D. Brodeur, Hatfield Marine Science Center, Northwest Fisheries Science Center, NOAA, Oregon, USA.

P-4 The rockfish we have known: A summary of rockfish species encountered during 20 years of environmental monitoring off San Diego County. A.K. Groce, R. Gartman, W. Storms, D. Olson, A. Fiet, R. Duggan. City of San Diego Marine Biology Laboratory, Environmental Monitoring & Technical Services Division, Metropolitan Wastewater Department, San Diego, CA.

P-5 Vertical associations of chaetognaths and their relation to the water column in the main mouth of Bahía de La Paz (Gulf of California). Maria Soledad Cota Meza and Laura Sanchez Velasco, CICIMAR-IPN. Depto. del Plancton y Ecol. Marina. La Paz, Baja Calif. Sur. Mex.

P-6 Results of the 2004-2005 SWFSC ichthyoplankton survey of shallow coastal waters in the Southern California Bight. William Watson, Richard Charter, NOAA Southwest Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, CA 92037; James Rounds, and Curtis Cash, City of Los Angeles, Department of Public Works, Bureau of Sanitation, Hyperion Treatment Plant, 12000 Vista Del Mar, Playa Del Mar, CA 92093.

P-7 CalCOFI Gazetteer: Towards a geographic dictionary. Robert Thombley and Karen Baker, Scripps Institution of Oceanography, La Jolla, CA 92093-0218. E-mail: kbaker@ucsd.edu, rthomble@ucsd.edu.

P-8 Trace metal concentrations in the zooplankton from the northern and central Gulf of California in August 2003. Margarita Renteria-Cano, Laura Sánchez-Velasco and Evgueni Shumilin, Centro Interdisciplinario de Ciencias Marinas, AV. IPN s/n., Col. Playa Palo de Santa Rita, Apartado postal 592, La Paz, Baja California Sur, 23093, Mexico. E-mail: maggi_renteria@hotmail.com.

P-9 Morphological and genetical analysis of rhynchoteuthion paralarvae of Humboldt squid *Dosidicus gigas* (d'Orbigny, 1835) and purple squid *Sthenoteuthis oualaniensis* (Lesson, 1830). Jorge Ramos, César A. Salinas-Zavala, Susana Camarillo-Coop, Centro de Investigaciones Biológicas del Noroeste. Mar Bermejo # 195. Col. Playa Palo de Santa Rita. La Paz, B.C.S. C.P. 23090. e-mail: jeramosc@yahoo.com.mx, and Luis Enríquez-Paredes, Facultad de Ciencias Marinas - Universidad Autónoma de Baja California Km. 103 Carretera Tijuana- Ensenada. Ensenada, B.C. 22800.

P-10 Spatial and temporal variation of red spiny lobster *Panulirus interruptus* (Randall, 1840) phyllosoma larvae, in relation with oceanographic conditions during 2000-2001 period. Itzel García-Kauffman, María del Carmen Peñaloza-Mayorazgo, Alejandro Hinojosa-Medina, Martín Hernández-Rivas, Centro Interdisciplinario de Ciencias Marinas - Instituto Politécnico Nacional, Av. Instituto Politécnico Nacional s/n, Col. Playa Palo de Santa Rita Apdo. Postal 592, La Paz, B.C.S. 23096 México; e-mail: itzelgk@hotmail.com, igarciak@ipn.mx; and Reginaldo Durazo, UABC-Facultad de Ciencias Marinas, Apartado Postal 453, Ensenada, B.C. México.

P-11 CalCOFI Data Management: Developing Working Standards. Karen Baker, Scripps Institution of Oceanography, Jim Wilkinson, Scripps Institution of Oceanography, and Rich Charters, Southwest Fisheries Science Center, La Jolla, CA.

P-12 Ocean Informatics Datazoo: A Multi-Project Data Publishing System. Karen Baker, Mason Kortz, and James Conners, Scripps Institution of Oceanography.

P-13 Metadata Standards: Augmenting the Ecological Metadata Language. Lynn Yarmey and Karen Baker, Scripps Institution of Oceanography.

P-14 Jumbo squid (*Dosidicus gigas*) occurrences and distributions in Pacific Northwest waters during 2004-2007. A. Jason Phillips, Cooperative Institute for Marine Resources Studies, Oregon State University, 2030 SE Marine Science Dr., Newport, OR 97365, and Richard D. Brodeur, NOAA Fisheries, Northwest Fisheries Science Center, 2030 SE Marine Science Dr., Newport, OR 97365.

P-15 A subsurface warm-eddy off Northern Baja California in July 2004. Gilberto Jerónimo, gjeronim@cicese.mx and José Gómez-Valdés, jgomez@cicese.mx, Departamento de Oceanografía Física Centro de Investigacion Cientifica y de Educacion Superior de Ensenada, Km 107 Carretera Tijuana-Ensenada, Ensenada, BC, 22860, Mexico.

P-16 A summary of the Northwest Survey in June 2007: Sardines Revisited. David Griffith and Beverly Macewicz, Southwest Fisheries Science Center, 8604 La Jolla Shores Dr., La Jolla CA 92037, U.S.A. Dave.Griffith@noaa.gov.

P-17 Reproductive aspects of jumbo squid *Dosidicus gigas* d'Orbigny, 1835 caught along the west coast of the peninsula of Baja California in 2004-2006. C.A. Salinas-Zavala, A. Mejía-Rebollo, R. Rosas-Luis, R. Ramírez-Rojo, Centro de Investigaciones Biológicas del Noroeste, S.C., P.O. Box 128, La Paz BCS, México, csalinas@cibnor.mx.

P-18 Evidence of spawning of jumbo squid along the Gulf of California. S. Camarillo-Coop and C.A Salinas Zavala, Centro de Investigaciones Biológicas del Noroeste, S.C., P.O. Box 128, La Paz BCS, México, scoop04@cibnor.mx, csalinas@cibnor.mx.

P-19 Interannual variability in the population structure of jumbo squid (*Dosidicus gigas*) in Santa Rosalía, central Gulf of California. Gastón Bazzino, César Salinas Zavala, [1]Centro de Investigaciones Biológicas del Noroeste (CIBNOR), Mar Bermejo N° 195, Col. Playa Palo de Santa Rita, La Paz, BCS 23090, México; gbazzino04@cibnor.mx and Unai Markaida, Departamento de Aprovechamiento y Manejo de Recursos Acuáticos, El Colegio de la Frontera Sur (ECOSUR), Calle 10 # 264, Col. Centro, 24000 Campeche, México.

P-20 Is diel vertical migration important to oceanic carbon export flux? Pete Davison, David M. Checkley, Jr., and Tony Koslow, Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA 92093, USA.

P-21 The importance of hake in the diet of the jumbo squid *Dosidicus gigas* in the north of the Peruvian zone (2005-2007). Verónica Blaskovic´, Ana Alegre, Ricardo Tafur, Instituto del Mar del Perú, Callao, Perú. Correspondence: vblasko@imarpe.gob.pe.

P-22 A taxonomic revision of the eastern pacific swell shark, genus *Cephaloscyllium* Gill 1862 (Chondrichthyes, Carcharhiniformes, Scyliorhinidae), with comments on the status of *C. uter* (Jordan & Gilbert 1896). Jayna A. Schaaf-Da Silva & David A. Ebert, Pacific Shark Research Center, Moss Landing Marine Laboratories, 8272 Moss Landing Road, Moss Landing, CA 95039.

P-23 Assessment of *Dosidicus gigas* sperm longevity using fluorescence microscopy. Christine L. Huffard, Kurt Buck, and Bruce Robison. MBARI, 7700 Sandholdt Rd., Moss Landing, CA, 95039.

P-24 The potential application of molecular methods for improving the taxonomic resolution of jumbo squid predation on rockfish off of Central California. Devon Pearse and John C. Field , Fisheries Ecology Division, Southwest Fisheries Science Center, 110 Shaffer Road, Santa Cruz, CA 95060, Email: Devon.Pearse@noaa.gov, John.Field@noaa.gov

P-25 Larval dynamics of *Panulirus interruptus* during the 1997-1999 ENSO event in the west coast of Baja California, Mexico. [1,2]Peñaloza-Mayorazgo, Ma. del Carmen, [1]Hernández-Rivas, Martín E., [3]Durazo, Reginaldo, and [1]González-Armas, R. 1 Centro Interdisciplinario de Ciencias Marinas. Departamento de Plancton y Ecología Marina. Apdo. Postal 592. La Paz, BCS, México. 2 PIFI, CONACYT grant recipient, 3 UABC Facultad de Ciencias Marinas. Apdo. Postal 453. Ensenada, BC, México. email: mpenalozam0500@ipn.mx

Wednesday, 28 November

8:30 **Session V: Contributed Papers (15 minutes with 5 minutes for discussion). Chair: Dr. Tony Koslow, Scripps Institution of Oceanography**

8:30-8:50 C-6. Age and growth of the jumbo squid *Dosidicus gigas* d'Orbigny, 1835 from the West coast of the peninsula of Baja California. Arminda Mejía-Rebollo, Centro de Investigaciones Biológicas del Noroeste, S.A. La Paz B. C. S.; Casimiro Quiñónez-Velázquez, Centro Interdisciplinario de Ciencias Marinas, IPN. La Paz B. C. S., 23096; César A. Salinas-Zavala, Centro de Investigaciones Biológicas del Noroeste, S.A. La Paz B. C. S.; Unai Markaida, El Colegio de la Frontera sur, 24000 Campeche.

8:50-9:10 C-7. Swimming behavior of *Dosidicus gigas* paralarvae. Shulman, D.J. and Gilly, W.F. Hopkins Marine Station, 120 Oceanview Blvd., Pacific Grove, CA.

9:10-9:30 C-8. Population structure, somatic and reproductive condition of *Dosidicus gigas* before, during and after ENSO events in the Humboldt Current System. J. Argüelles*, R. Tafur, A., Instituto del Mar del Perú, Callao, Perú. Corresponding author, email: jarguelles@imarpe.gob.pe

9:30-9:50 C-9. Estimation of the biomass of *Dosidicus gigas* off central Chile and its impact on Chilean hake (*Merluccius gayi*). Ruben Alarcón, Biologist, M.Sc. Fisheries Instituto de Investigación Pesquera, Talcahuano, Chile. www.inpesca.cl

9:50-10:15 BREAK

10:15 **Session VI: Contributed Papers (15 minutes with 5 minutes for discussion). Chair: Paul Smith, Scripps Institution of Oceanography, IOD and Visiting Scientist Southwest Fisheries Science Center, La Jolla, CA**

10:15-10:35 C-10. Marine Protected Area Monitoring: Prospective (*a priori*) power analysis for detecting changes in density of fish on rocky reefs. Konstantin A. Karpov, Department (DFG), 19160 So. Harbor Drive, Fort Bragg, CA. 95437, kkarpov@dfg.ca.gov; Mary Bergen, Ojai, CA, mary_bergen@adelphia.net; John J. Geibel, DFG, Menlo Park, CA. geibel@sbcglobal.net; Phil M. Law, DFG, 350 Harbor Blvd., Belmont, CA. 94002, plaw@dfg.ca.gov; Charles F. Valle, DFG, 4665 Lampson Ave., Suite C, CA. 90720, cvalle@dfg.ca.gov; and David S. Fox, Oregon Department of Fish and Wildlife, 2040 SE Marine Science Dr., Newport OR. 97365, David.S.Fox@state.or.us.

10:35-10:55	C-11. Pelagic ecology of a Northern Boundary Current System: overview of a collaborative multi-disciplinary marine research program off southern Australia. Dr Tim Ward, Principal Scientist (Wild Fisheries), SARDI (Aquatic Sciences), PO Box 120, Henley Beach SA 5022, ward.tim@saugov.sa.gov.au, Ph: 61 8 82075401; Fax: 08 8207 5480.
10:55-11:15	C-12. Changes in the spawning habitat of Sardine (*Sardinops sagax*) off California between 1951 and 2005. Sam McClatchie, Sam.McClatchie@noaa.gov, Nancy Lo, Nancy.Lo@noaa.gov, Southwest Fisheries Science Center, NOAA NMFS, 8604 La Jolla Shores Dr, La Jolla, CA 92037-1508, USA; Steven Bograd, Steven.Bograd@noaa.gov Pacific Fisheries Environmental Laboratory, 1352 Lighthouse Avenue, Pacific Grove, California 93950-2097; Richard Charter, Richard.Charter@noaa.gov Southwest Fisheries Science Center, NOAA NMFS, 8604 La Jolla Shores Dr, La Jolla, CA 92037-1508, USA.
11:15-11:35	C-13. Comparisons of emergent red abalone densities between San Miguel Island (southern California) and northern California based on SCUBA surveys. Ian K. Taniguchi, itaniguchi@dfg.ca.gov, Department of Fish and Game (DFG), 4665 Lampson Ave., Suite C, CA. 90720; Jerry V. Kashiwada, jkashiwada@dfg.ca.gov, DFG, 19160 So. Harbor Drive, Fort Bragg, CA. 95437; Konstantin A. Karpov, kkarpov@dfg.ca.gov, DFG, 19160 So. Harbor Drive, Fort Bragg, CA. 95437; and Derek M. Stein, dstein@dfg.ca.gov, DFG, 1933 Cliff Drive, Suite 9,Santa Barbara, CA 93109.
11:35-11:55	C-14. Effects of ocean climate on transboundary movement of the Pacific Sardine between the EEZs of Mexico and the United States. Tim Baumgartner, Joaquín García, Cristina Sanchez, Division de Oceanología, CICESE, Ensenada, Baja California, Mexico; Nancy C.H. Lo and Richard Charter, Southwest Fishery Science Center, NMFS/NOAA, La Jolla, California, USA.
11:55-1:00	LUNCH
1:00	**Session VII: Contributed Papers (15 minutes with 5 minutes for discussion)** **Chair: Ian K. Taniguchi, California Department of Fish and Game**
1:00-1:20	C-15. Age-specific migration and availability of Pacific sardine (*Sardinops sagax*) off west the coast of the American continent. Nancy C. H. Lo, Beverly Macewicz and David Griffith, Southwest Fisheries Science Center, 8604 La Jolla Shores Dr., La Jolla CA 92037, U.S.A. Nancy.Lo@noaa.gov
1:20-1:40	C-16. Not enough ado about nothing. Paul E. Smith, Scripps Institution of Oceanography, IOD and Visiting Scientist Southwest Fisheries Science Center, La Jolla, CA.
1:40-2:00	C-17. Using top predators to assess the efficacy of the Vandenberg State Marine Reserve. Dan P. Robinette*, Nadav Nur, Adam Brown, Julie Howar, PRBO Conservation Science, 3820 Cypress Drive #11, Petaluma, CA 94954, and William J. Sydeman, Farallon Institute for Advanced Ecosystem Research, P.O. Box 750756, Petaluma, California 94975.

2:00-2:20 C-18. Catch strategies for the California Sardine. Rögnvaldur Hannesson, Norwegian School of Economics and Business Administration, Bergen, Norway, E-mail: rognvaldur.hannesson@nhh.no; Sam Herrick, Southwest Fisheries Science Center, La Jolla, CA, E-mail: sam.herrick@noaa.gov.

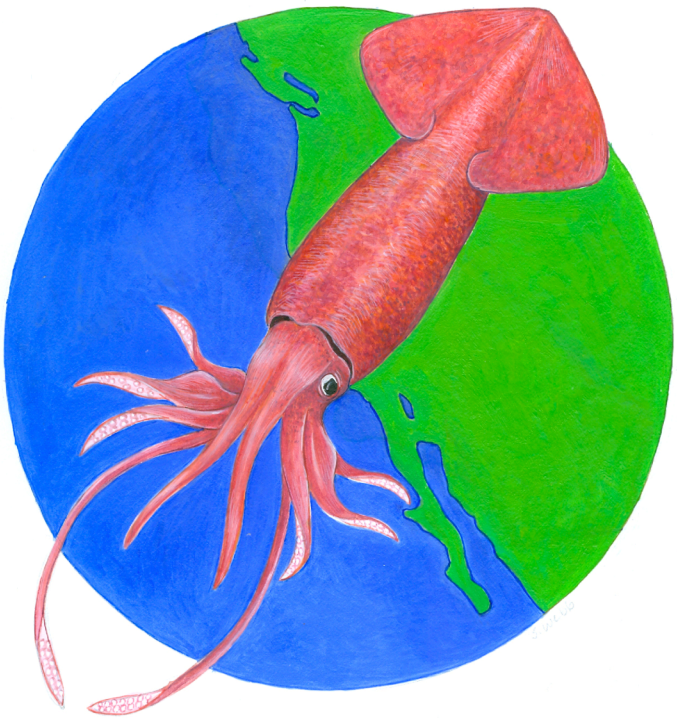
2:20-2:40 BREAK

2:40 **Session VIII: Contributed Papers (15 minutes with 5 minutes for discussion)**
Chair: Dr. Roger Hewitt, Fisheries Resources Division, Southwest Fisheries Science Center, NOAA

2:40-3:00 C-19. Anomalies in the cross-shelf plankton community off the central Oregon coast during spring 2007. Toby D. Auth, Hatfield Marine Science Center, Oregon State University, 2030 SE Marine Science Drive, Newport, OR, 97365, U.S.A. E-mail: toby.auth@noaa.gov; and William T. Peterson, Hatfield Marine Science Center, NOAA Fisheries, 2030 SE Marine Science Drive, Newport, OR, 97365, U.S.A.

3:00-3:20 C-20. Relationships between diver and commercial fishing gear surveys of nearshore fishes. Richard M. Starr, UC Sea Grant Cooperative Extension; Mark Carr, UC Santa Cruz, PISCO; Ashley Greenley, Moss Landing Marine Labs; Dan Malone, PISCO.

3:20-3:40 C-21. Ommastrephid paralarvae during 1997-1999 IMECOCAL cruises. M. E. Hernández-Rivas, E-mail: mrivas@ipn.mx, R. De Silva-Dávila, CICIMAR-IPN. Depto de Plancton y Ecología Marina. Apdo. Postal 592, CP 23000. La Paz, BCS, México; S. Camarillo-Coop, CIBNOR, La Paz, BCS, México; J. Granados-Amores, CICIMAR-IPN. Depto de Plancton y Ecología Marina. Apdo. Postal 592, CP 23000. La Paz, BCS, México, PIFI, CONACYT; and R. Durazo, UABC Facultad de Ciencias Marinas. Apdo. Postal 453. Ensenada, BC, México.



SYMPOSIUM ABSTRACTS

S-1. *Dosidicus gigas*: northern range expansion events

E.M.C. Hatfield[1] and F.G. Hochberg[2]

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[2]Santa Barbara Museum of Natural History, 2559 Puesta del Sol, Santa Barbara, California 93105, USA

In the north- and southeastern Pacific Ocean the jumbo squid, *Dosidicus gigas*, supports large-scale commercial fisheries principally in Peru and Mexico. The species typically lives in areas of high productivity and populations, most often, are concentrated in coastal waters from 25-30ºN to 25-30ºS. The limits of distribution to the west are not well known. Northern range expansions into California, and further north, have been documented since 1858. In 2004 jumbo squid were confirmed to have been caught as far north as Alaska (57ºN). Additional unconfirmed reports indicate that *Dosidicus* likely ranged northward to Alaska during some of the major, multi-year, incursion events in 1997-99, 1974-76, 1934-36, and 1910-13. In this paper we review records of sightings, strandings, and catches to document the periodic presence of *D. gigas* in waters north of Mexico. Where specimens are available we show the sizes of squid associated with strandings or catches, and present sex and maturity data for these specimens. We also explore temperature and upwelling patterns to determine if oceanographic conditions are associated with northern incursions.

S-2. Distribution and abundance of jumbo squid (*Dosidicus gigas*) off Peruvian coasts and their relationships to environmental conditions

Carmen Yamashiro[1]*, Ramiro Castillo[1], Noel Domínguez[1], Carlos Paulino[1], Luis Vásquez[1], Luis Mariátegui[1], Friedemann Keyl[2]

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The fishery data of jumbo squid (*Dosidicus gigas*) in Peruvian waters during 1991 to 2007 is analyzed and related to environmental data from pelagic research cruises realized by IMARPE during the same period, sea surface temperature anomalies (SSTA), Southern Oscillation Index (SOI) and Multivariate ENSO Index (MEI).

Annual landings of *D. gigas* ranged between 56 t in 1998 and 291 269 t in 2006. Two periods of high availability were observed, one in 1991-1995 and the other in 2000-2007, and one of low availability in 1996-1998 and these were reflected in both the artisanal and industrial fisheries.

The average catch per unit effort (CPUE) varied between 1.99 and 3.10 t/trip in the artisanal fishery, and from 0.8 to 3 t/h in the industrial fishery. The relation of SSTA to CPUE showed that the availability of the jumbo squid is affected by the strong thermal variations during the 1996 La Niña event and the extraordinary 1997-1998 El Niño event. Other cold or warm events of lower intensity did not appear to affect the availability of the resource.

D.gigas was widely distributed along the Peruvian coast, and the highest concentrations were observed between 4º to 9º S and 13º to 17º S up to 100 nm offshore. During the study period high concentrations were associated with zones of mixed subtropical surface and cold coastal water masses. An inverse relationship between the SOI and CPUE was observed and this is consistent with the earlier observation of a negative correlation between *D. gigas* abundance and the SOI of the previous February (Waluda et al. 2004). On the other hand, moderate values of the MEI Index are related with high CPUE values.

Nevertheless these relations between the abiotic environmental variables and jumbo squid abundance appear not to be able to explain the whole period from 1991 to 2007, but require partition into periods before and after 1999 to obtain two different relevant relationships. Therefore it is assumed that a second, indirect effect via the trophic system is of similar importance for the control of the abundance of *D. gigas* and subsequently its fishery yields.

The oceanographic characteristics during moderate cold and moderate warm events off the Peruvian coast enhance growth of *D. gigas*, because of greater food availability and better development of the early life stages, which contribute to recruitment success and additionally size-at-maturity. During intense cold or warm events, recruitment is probably affected by lower survival of paralarvae and/or migration of spawning adults to other areas. Abundance of *D. gigas* is apparently strongly influenced by mesoscale oceanographic conditions linked to ENSO, with low levels of upwelling leading to low catches of squid off Peru, so the variability in upwelling is likely to be a key factor for the abundance of *D. gigas* in the Eastern Pacific (Waluda and Rodhouse, 2006).

Keywords: *Dosidicus gigas*, Distribution, Fisheries, Jumbo Squid, Peru

S-3. Relationship between jumbo squid population expansion northward & climate variability

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RESUMEN

La información recopilada por más de una década sobre el calamar gigante lo coloca como un organismo euritérmico con un amplio espectro alimenticio que le confiere un carácter de depredador activo y voraz. Su corto ciclo de vida y su amplia plasticidad ecológica hacen de éste un organismo oportunista que se adapta rápidamente a las condiciones ambientales, manteniendo un éxito reproductivo alto en condiciones óptimas del hábitat. El margen oriental de la cuenca del Océano Pacifico se caracteriza por presentar amplias áreas de alta actividad biológica que han sido denominadas como BAC´s. En este trabajo se plantea la hipótesis de que el calamar gigante además de tener menor presión por depredación ha encontrado mejores condiciones ambientales particularmente en los BAC´s que le han permitido aumentar su rango de distribución hacia latitudes mayores y permanecer como organismo residente en la zona de transición templado-tropical al menos en el hemisferio norte.

Se analizaron datos ambientales que provienen de observaciones satelitales mensuales para diez áreas localizadas desde el Ecuador hasta el Golfo de Alaska. Se estimaron series de tiempo mensuales y anomalías de clorofila a (SeaWiFS: 1997-2006), TSM y frecuencia de frentes oceánicos (AVHRR: 1985-2006). También se realizó un análisis mensual de los sitios de pesca de la flota artesanal del estado de Baja California Sur 1997-2006. El análisis del conjunto de estas variables sugiere que la expansión del calamar gigante hacia el norte en la corriente de California tiene un componente ambiental que lo favorece.

ABSTRACT

The information compiled by more than one decade about the jumbo squid places it like an eurithermic organism with a broad food range that confers it an active and voracious predator character. Their short life cycle and broad ecological plasticity make of this one an opportunistic organism that adapts quickly to the environmental conditions maintaining a high reproductive success in optimal conditions of the habitat. The eastern margin of the Pacific basin is characterized by big areas of high biological activities denominated as BAC´s. In this work we propose the hypothesis of jumbo squid has a lesser pressure of predation besides has found better environmental conditions particularly in BAC´s areas which allow them to increase their distributional range forward high latitudes, and remain like resident organisms in the template-tropical transition zone at least in the north hemisphere.

Environmental data from satellite monthly observations were analyzed for ten areas localized from the Ecuador to Gulf of Alaska. Monthly time series and anomalies of Chlorophyll a (SeaWiFS: 1997-2006), SST and oceanic front frequency (AVHRR: 1985-2006) were estimated. Also a monthly analysis of the artisan fleet fishing sites in Baja California Sur 1997-2006 was made. All this variables indicates that the expansion of jumbo squid to the north within de California current has a favourable environmental component.

S-4. Large-scale range expansion and variability in cephalopod populations

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Cephalopod plagues, invasions and range expansions have been documented throughout history. The early teuthologist, D'Orbigny (1835 – 43), describes large strandings of *Dosidicus gigas* on the Chilean coast in the early 19th century and similar phenomena may explain the late Minoan octopus culture in the eastern Mediterranean in ancient times. Over the last four decades, several ommastrephid squid stocks have expanded and contracted, driving highly variable and sometimes boom and bust fisheries. These include *Illex illecebrosus* in the northwest Atlantic, *I. argentinus* in the southwest Atlantic, *Todarodes pacificus* in the northwest pacific, *T. sagittatus* in the Norwegian fjords and *D. gigas* in the Peru and Californian Current systems. Explanations for this behaviour of squid populations include: 1) direct effects of environmental variability; 2) indirect effects manifested as changes in prey availability, and 3) the effects of overfishing, on groundfish which reduces predation pressure and creates vacant niches into which the short-lived, ecologically opportunistic squid can expand. Apart from *D. gigas*, which is associated with the coastal upwelling systems of the Pacific Ocean's eastern boundary currents, the ommastrephid fisheries are pursued in the high energy, western boundary current systems. Environmental variability driving changes in population size will differ between these environments. The recent range expansion of *D.gigas* in the eastern Pacific has resulted in increased predation pressure on commercially exploited groundfish stocks, notably hake. The El Niño Southern Ocillation system in the Pacific is one of the better understood highly variable oceanographic systems in the world, and the fisheries along the western seaboard of North and South America are among the best documented. The case of the *D. gigas* range expansion over the last decade may provide an opportunity to explore the interacting effects on a squid population of environmental variability and ecological change caused by fishing.

S-5. Food and feeding habits of jumbo squid *Dosidicus gigas* in the Gulf of California and Pacific Ocean

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The jumbo squid, *Dosidicus gigas*, is an abundant and voracious predator of the eastern Pacific Ocean. It mainly preys on mesopelagic micronekton, principally myctophids and squid, in the Gulf of California and oceanic waters off Peru. We present here data on stomach contents of jumbo squid collected from the Pacific Ocean off Magdalena Bay, western Baja California, in 2005, as well as from several locations in the Gulf of California from 2005 to 2007.

Jumbo squid collected off Magdalena Bay had been feeding primarily on pelagic red crabs (*Pleuroncodes planipes*), the most important micronektonic component of the area, as well as on several species of neritic fishes. Prey remains were fresh, indicating recent feeding. In contrast, squid from the Gulf of California invariably showed the pattern of feeding described above. In this case, remains were generally highly digested, indicating feeding had occurred substantially before the time of collection.

Dosidicus typically spends most nighttime hours at depths of <100m and daytime hours at depths of >250 m, but it also shows complex movements between these depths during both time periods. Jumbo squid thus appear to be capable of feeding on any abundant prey that is encountered at any time of day in the water column covered by its vertical migrations. Plasticity in foraging behavior and prey preference are thus likely to be important factors in allowing this short-lived predator to rapidly respond to environmental perturbations and invade different pelagic habitats.

S-6. *Dosidicus* in the context of mesopelagic community structure and ecology

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Dosidicus gigas inhabits a dynamic, 3-dimensional habitat that ranges vertically from upper bathypelagic depths to near-surface waters of the epipelagic. The daily ambit of an individual can easily cover 1000 m in the vertical plane. This range encompasses a number of prey types and predators, some with as much vertical mobility as *Dosidicus*, others with far less. Food sources concentrate near the surface at night then disperse downward during the day, although *Dosidicus* apparently feeds throughout the diel cycle. Significant changes also occur in the vertical profiles of two physiologically important hydrographic parameters – temperature and oxygen content. Within this envelope, *Dosidicus* appears to range freely, using visual cues to capture prey that range in size from a few millimeters to a meter or more. Many of the prey species occur in aggregations, while the largest prey are more likely to be solitary. Within a geographical range from the Gulf of California to Monterey Bay, *Dosidicus*' habitat also shows considerable variability. In offshore waters the vertical extent of the oxygen minimum layer diminishes with increasing latitude, as does the temperature of the upper layers. While the species composition of prey changes as well, the size range and relative abundance of prey types does not. Behavioral changes in the activity levels of prey are correlated with the extent of local oxygen minimum layers and these factors influence the behavior of *Dosidicus*, which exhibits a variety of feeding patterns in response to differing prey types and hydrographic conditions.

S-7. An overview of the present state of common hake (*Merluccius gayi*) stock with a forecast of its biomass including jumbo squid (*Dosidicus gigas*) prey-predator relationship in central Chile (33°S – 39°S)

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At present, in Chile there is a great controversy to explain the cuasi-collapse of the fishery of hake, with total landings (artisanal + industrial) likely declining to lower than 40,000 tons at the end of 2007, which is *ca.* 1/4 of landings in 2004. There are mixed interpretations about whether the proximate causes are overfishing or squid predation, however estimates of predation mortality (M2) suggest that cannibalism represents a much greater proportion of hake mortality than squid predation. Moreover, indicators of both hake stock (mean gonado-somatic index) and fishery (mean length at landing, CPUE) show they were going down from the last quarter of 2000, more than two years before the heavy presence of jumbo squid in central Chile, with its highest annual landing occurring in year 2003, declining quickly from year 2005. A forecast for common hake biomass until year 2010 was carried out using the routine Ecosim included in the software Ecopath. Under the hypothetical scenario of no fishing ($F=0$ year^{-1}), constant M2 and constant recruitment, hake biomass increases only 30% in relation to that of year 2004.

S-8. Vertical distribution of *Dosidicus gigas* in the Pacific Ocean off Baja California

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Although *Dosidicus gigas* is a highly migratory predator, direct assessments of its movement patterns are limited to studies in the Gulf of California. We report here on complementary data from the Pacific Ocean. Pop-up satellite tags were deployed on 4 adult squid in June of 2005 in shallow water (~100 m depth) outside Magdalena Bay. Squid appeared to remain in this area for about 5 days before moving offshore into deeper water. Two squid migrated in a southerly direction, while another remained offshore of the tag deployment site. All squid showed a diel change in vertical distribution (deeper in daytime). Nighttime was generally spent in the upper 50 m, whereas daytime depths were more variable regardless of whether the squid was over shallow or deep water. Temperature over the full depth range (6-450 m) varied from 20 to 8 20°C, respectively. The fourth tag did not successfully pop-up but was recovered from a beach 175 km south of the deployment site. Patterns of vertical distribution were similar to those revealed by the other tags. Distributions of vertical velocities (0.2 Hz sampling) showed no obvious dependence on depth or time of day, despite depths >125 m being seriously hypoxic (<20 μM ≈ 0.5 ml/l dissolved oxygen). These results concur with those from the Gulf of California. In both locations D. *gigas* displays complex vertical migrations that span a large range of temperature and oxygen concentration, and repetitive diving behavior, presumably associated with foraging, is well maintained at hypoxic depths.

CONTRIBUTED ABSTRACTS

C-1. Pictures from the edge: Interactions between jumbo squid (*Dosidicus gigas*) and Pacific hake (*Merluccius productus*) observed in the northern California Current during joint Canada-US hake acoustic-trawl surveys

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Jumbo squid (*Dosidicus gigas*) occur in eastern Pacific Ocean waters from Chile to Alaska, but have only been caught incidentally over continental shelf waters of the northern California Current by the joint Canada-US Pacific hake (*Merluccius productus*) acoustic-trawl survey and other programs since 2003. These incidental catches were attributed to summer range extensions linked to warm ocean conditions, but trophic impacts associated with these extensions were not assessed. Robison and Zeidberg (2006: EOS, Trans. Am. Geophys. Union, 87: 36) recently reported changes in Pacific hake distributions and abundance in Monterey Bay that may have been caused by expansion of jumbo squid into the area. During the 2007 coastwide acoustic survey of Pacific hake, jumbo squid were captured at depths exceeding 300 m offshore of the continental shelf along Vancouver Island and the Queen Charlotte Islands. Since ocean conditions were somewhat cooler than normal during the 2007 survey period, we suggest that the range extensions observed in previous years may be less dependent upon warm water intrusion than previously thought and we hypothesize that predatory activity of jumbo squid is altering the normal day-time aggregation behaviour of hake and may impact on hake commercial fishing strategies. Unusual acoustic sign observed in 2007 led us to compare echograms collected during trawls in which jumbo squid and hake were caught with those from nearby trawls in which only hake were caught. The jumbo squid-hake echograms show evidence of a disruption in normal hake aggregation behaviour that is not evident visually in the pure hake echograms.

C-2. Behavior of *Dosidicus gigas* in different pelagic environments

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Tagging studies of *Dosidicus gigas* have revealed that this squid performs vertical diel migrations, preferring to remain between a range of 50% and 10% surface oxygen concentrations. In the Gulf of California, these behaviors lead to night-time depths of 50-100m and daytime depths of 200-300m, although the squids are occasionally observed to migrate into deep basins, to depths of 1400m. On a daily basis, *Dosidicus* undergoes temperature and oxygen ranges as large as recorded in the ocean. The effects of this varied environment will be compared to video recordings of behavior and analysis of high frequency tag data.

C-3. Feeding description of squid *Dosidicus gigas* d´Orbigny, 1835 in the western coast of Baja California and Baja California Sur, Mexico

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D. gigas squid has been catalogued as a mayor important species in the marine ecosystems due to its depredator-prey interactions. In the Gulf of California its study is extensive including feeding description, fisheries and ecosystem impact because of its fishery importance in the Gulf. There are less studies on the western Pacific coast of the Baja California peninsula than on the Gulf of California coast. Papers on cephalopods in the Pacific have reported that *D. gigas* is present in the zone. Fishery prospections made in 1989 for Japanese ships give indications on high abundance of squid from Bahía Ballenas to Cabo San Lucas, which has raised the question: What is the impact of high abundance of this organism in the area due to the importance of fisheries in an upwelling zone? One solution is to understand the trophic flow that describes the organism's feeding habits. In this study, it has been observed that *D. gigas* feeds on groups such as fish (Importance Relative Index IRI 3800.74) mainly myctophids, crustaceans (IRI 7919.15) mainly *Pleuroncodes planipes* red crabs; both integrate the mayor part of its feeding without discarding other groups such as mollusks, algae and even marine grass, which in comparison with the first two the IRI is <1000. At seasonal level feeding is variable in the months of January and February when the frequency of occurrence is more for fish (FO% 82.98) and in July crustaceans are the most important in their feeding (%FO 62). Observing these variations at seasonal level we can infer the dynamics that squid can develop in the region. This is why squid is feeding on preys that are the basis for the development of higher trophic levels.

C-4. Predatory interactions between mako shark, *Isurus oxyrinchus*, and jumbo squid, *Dosidicus gigas,* in the California Current

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Within the California Current Large Marine Ecosystem (CCLME) mako shark, *Isurus oxyrinchus,* is an abundant species managed under the Pacific Council's Highly Migratory Species (HMS) Fisheries Management Plan. Data on the abundance, life history, and diet of makos are gathered from fishery-dependent sources (e.g. monitoring of the California Drift Gillnet Fishery) and fishery-independent sources (e.g. the annual NMFS Juvenile Shark Longline Abundance Survey). The recent expansion of the distribution of jumbo squid into the CCLME provides the potential for makos to exploit them as a new prey source. Information on the horizontal and vertical movements of makos within the CCLME is gathered by Pop-off Archival Tag (PAT) and Satellite Position Only Tag (SPOT) deployments conducted in cooperation with the Tracking of Pacific Predators (TOPP) program. Physical and biological oceanographic measurements within the CCLME are taken via CTD casts and shipboard instrumentation. The Juvenile Shark Longline Survey and the California Drift Gillnet fishery overlap the CalCOFI transects, and analysis of the ecology of mako sharks based on the survey and fishery data benefits from the biophysical oceanographic measurements collected through CalCOFI. In this paper we will summarize observations regarding the foraging niche of mako sharks and an apparent increase in interactions between mako sharks and jumbo squid. These data include: 1) the historical and present day location of the upper edge of the oxygen minimum zone (a preferred habitat of jumbo squid in the Gulf of California); 2) swimming-depth profiles (feeding excursions?) of mako sharks; 3) the pattern of occurrence of jumbo squid beaks in mako stomach contents; and 4) the incidence of jumbo squid scars on the bodies of mako sharks. The ultimate goal is to combine previously published energetic requirements of mako sharks with caloric values of jumbo squid, diet composition measurements, and mako abundance estimates to develop a better understanding of the trophic relationships between the mako shark and jumbo squid.

C-5. A conceptual scheme on life strategies and stock dynamics of *Dosidicus gigas* in the Eastern Pacific

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The Humboldt squid is a highly migratory, fast growing predator of the Eastern Pacific Rim with a high-energy demand, known for its spasmodic population behaviour and greatly varying catches of its fishery. Around the beginning of the new millennia coinciding with a regime shift from warm to cold in the Pacific an apparently more abundant jumbo squid population started to invade waters beyond its known northern and southern distribution limits in the South and North Pacific and provided great catches to the Chilean fishery. At the same time specimens in the southern hemisphere were observed to reach maturity at significantly enlarged sizes. As a hypothesis we postulate that spatio-temporal differences in temperature and food abundance may explain the observed population responses through influencing processes of the triad maturation-growth-migration. In our hypothetical model, size and age at maturity may be largely a function of environmental temperature (day-degrees) resulting in smaller and possibly younger mature specimens under conditions of warmer waters. This mechanism would imply shorter migration cycles under warmer conditions and longer periods of growth and migration during colder periods, through which the distributional range of the population is enlarged. If the cold regime also provides enhanced food availability (as seems to be the present situation of the cold regime) specimens not only migrate longer routes, grow larger and mature later, but a greater number of migrating specimen will survive which may lead to additional relevant spawning aggregations in higher latitudes serving as basis for further invasion of uninhabited areas in subsequent years. It is thus assumed that the present invasion of *Dosidicus gigas* into formerly uninhabited areas is the result of such a combination of conditions of the abiotic (temperature) and biotic (food) environment in their original areas. In addition, the (possibly unprecedented) occurrence of a regime shift from warm to cold around the turn of the millennium with a preceding strong warm pulse as observed during the El Niño of 1997/98 may have opened a wide environmental window for the Humboldt squid following this El Niño. The intense fishery on competing predatory species and species preying upon *Dosidicus gigas* may have added to the favourable biotic conditions allowing for the present increased stocks and its spatial expansion.

C-6. Age and growth of the jumbo squid *Dosidicus gigas* d'Orbigny, 1835 from the west coast of the peninsula of Baja California

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We used statolith increment analysis to determine the age and growth of the jumbo squid for the western coast of the BC, in order to improve management of the jumbo squid in the Mexican northwest. A total of 197 females and 63 males were caught in the west coast of BC, in January, April, July and October at 2004. The Mantle Length (ML$\pm$5 mm) and Total Weight (TW$\pm$25 g) of the squids were measured, sex was determinate and, according to the maturity stages proposed in the literature, their reproductive condition was evaluated. Two size groups were present in both sexes, with two modes of 340 and 660 mm ML in females and 280 and 680 mm ML in males. The maturity stage confirmed the two groups of females <440 mm ML and >600 mm ML. Statoliths were processed by following of daily rhythm of statolith deposition. The counts of the increment growing were made independently by two readers. The higher longevity in males was of 391 days and 433 days in females. Seven individual growth models were evaluated; the best was selected according to the higher coefficient of determination (R^2) and the lower coefficient of variation (CV). A comparison between the growth curves of both sexes was made, using the F test with Df_p degrees of freedom. Relative growth (G) and daily growth rates (DGR) by sex were calculated, and we found that the integral logistic model ($R^2 \geq 0.974$) best that explained jumbo squid growth in both sexes, where the females were more old (1.4 month) and big (10 cm) than the males. The females had a maximum DGR of 2.09 mmd^{-1} (220 days; 407.6 mm ML) and at males 2.1 mmd^{-1} (200 days; 365.9 mm ML); whereas in the Gulf of California the DGR is 2.65 mmd^{-1} and 2.44 mmd^{-1} respectively. Consequently, our results indicate that the growth of jumbo squid in the Gulf of California is faster than the squid along the west coast.

C-7. Swimming behavior of *Dosidicus gigas* paralarvae

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Studies on the swimming abilities and metabolic demands of adult *Dosidicus gigas* form an important context for this species' range expansion. The mobility of paralarvae and juveniles is extremely relevant as well, but it has not been studied, as these smaller life stages are more difficult to find and cannot be caught by jigs or tagged like adults. However, in June of 2006, we discovered an egg mass of *Dosidicus gigas* for the first time in the wild. Hatchlings from this egg mass were maintained in the laboratory for seven days and their behavior was recorded on video. The video was then analyzed to quantify the speed and mechanics of paralarval swimming. These results are compared with similar studies of loliginid hatchlings. Despite their smaller size and relative lack of development, *Dosidicus* hatchlings are active, capable swimmers that can easily alter speed and direction. They are negatively buoyant, and must swim continously to counteract sinking, indicating that *Dosidicus* likely has high metabolic demands even from the time of hatching.

C-8. Population structure, somatic and reproductive condition of *Dosidicus gigas* before, during and after ENSO events in the Humboldt Current System

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Dosidicus gigas inhabits a wide range of habitats from epipelagic to mesopelagic and is distributed in the Eastern Pacific from California (USA) to Chile. As other squids, is a short-lived species with highly labile populations and exhibiting large fluctuations in abundance, quickly responding to environmental variability. However, the mechanism through which populations respond to environmental conditions like El Niño or La Niña is unknown.

During the period of study (1989-2006), several El Niño and La Niña events have occurred. These events have an impact on abundance, population structure, somatic condition and reproductive investment. These impacts would be related to the intensity of these events. So, moderate events like El Niño in 1992 did not change severely the abundance and population structure. However, during 1995-1998, in which a cold event (La Niña 1996) and an extraordinary warm period (El Niño 1997-1998) occurred, the abundances were reduced strongly. In this period, the population was composed by of small-sized maturing individuals. Females and males responded differently to similar factors. It is postulate that the gradual increase in effort from 1991 (48797 hours) to 1995 (142668 hours) and the cold environmental condition during 1996 (La Niña) could have reduced the abundance, size at maturity and somatic condition during 1996. After the event El Niño 1997-1998, the abundances recover slowly. From 2001 to 2006, the population structure was composed by large squid, which reach maturity at large size.

Keywords: Dosidicus gigas; Temporal variability; Enso events; Population structure; Reproduction; Condition; Humboldt Current System.

C-9. Estimation of the biomass of *Dosidicus gigas* off central Chile and its impact on Chilean hake (*Merluccius gayi*)

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An estimation of the biomass of *Dosidicus gigas* off central Chile (32º00'S - 41º30'S) was made using data collected from July to November of 2005 on board of the commercial bottom trawl fleet, and data from a crustacean survey, where *D. gigas* is part of the bycatch. A geostatistical approach was applied to estimate a "minimum biomass" of the resource. Besides, using estimates of Q/B ratio and diet composition of *D. gigas* from data collected in 2005-2006 in a specific study, the consumption of Chilean hake (*Merluccius gayi*) was assessed. Finally, assuming a direct relationship between the biomass and the capture per unit of effort, CPUE, the biomass of *D. gigas* and its consumption was estimated for 2002 to 2006. Maps of the spatial distribution of *D. gigas* are showed.

Keywords: biomass, geostatistics, jumbo squid, *Dosidicus gigas*, consumption, Chilean hake, *Merluccius gayi*, central Chile.

C-10. Marine protected area monitoring: Prospective (*a priori*) power analysis for detecting changes in density of fish on rocky reefs

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Our remotely operated vehicle (ROV) surveys are designed to measure, among other things, density of benthic fish within and outside of MPAs over time. In this presentation we focus on power analysis applied to finfish density collected using ROV from California to central Oregon. We applied two-sample power analysis to estimate optimal unit of transect size and sampling area to detect change. Mean abundance with associated variance was obtained from 12 separate locations that included five MPAs. Seven species of fish were selected whose maximum densities were at least four times the minimum. We used power analysis to first determine the most efficient transect length between 50 m^2 and 800 m^2. Using the selected transect length we next estimated the total number of transects needed to detect changes in density between sites for mean differences of 50% to 200%. We focus here on only four of the species: lingcod (*Ophiodon elongatus*), California sheephead (*Semicossyphus pulcher*), blue rockfish (*Sebastes mystinus*) and vermilion rockfish (*Sebastes miniatus*) to simplify the presentation. We used linear regression, with mean density as the independent variable and standard deviation as the dependent variable, to estimate variance for population. Correlations (R^2) were high. Both one- and two-tailed tests were used to project sampling effort. All tests were run with $\alpha = 0.05$ and $\beta = 0.8$ and variances obtained from the regression model. We found that smaller transect sizes (< 800 m^2) required the least sampled area. We selected 50 m^2 for estimating sample area to detect change. Using 50 m^2 transects a one-tailed test would require from 0.7 ha to 1.2 ha to detect a 150% increase in mean density for the four species. This corresponds to strip transect lengths between 2.9 km and 5.0 km (150 to 250 transects). Two-tailed comparisons require 27% more sample area. We also examined the additional power of multiple years (or periods) of sampling using bootstrap analysis. Findings indicated that California's ROV sampling of 14 locations in 2007 from the northern Channel Islands to Monterey will be able to detect changes in mean density as small as 50%.

Keywords: Power analysis, effect size, density, ROV, strip transect, rocky reef, lingcod, California sheephead, blue rockfish, vermilion rockfish

C-11. Pelagic ecology of a Northern Boundary Current System: Overview of a collaborative multi-disciplinary marine research program off southern Australia

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Waters between Cape Otway and the Head of the Great Australian Bight have been described as a Northern Boundary Current System. This ecosystem has similarities to the Eastern Boundary Current System off the west coast of North America and supports globally-important populations of several marine predators, such as blue whales, short-tailed shearwaters and southern bluefin tuna. Warm, nutrient-poor water from Leeuwin Current penetrates the Great Australian Bight from the west during winter. Cool, nutrient-rich water from the westward Flinders Current intrudes onto the shelf during summer-autumn. South-easterly winds during summer-autumn induce coastal upwelling. Levels of primary and secondary production in the areas influenced by the coastal upwelling plume are high. Chlorophyll and zooplankton maxima have also been identified in the waters below the surface mixed layer. Australia's largest populations of small pelagic fishes occur in the region. Sardines usually predominate in shelf waters, and anchovies are abundant inshore. However, following mass mortality events in 1995 and 1998 the distribution of anchovy expanded into upwelling areas, before contracting back into inshore waters as the sardine population recovered. These two species, and other small pelagic fishes, are important components of the diets of several key predators in the region. For example, southern blue fin tuna, which ranges throughout the world's southern oceans, forms large feeding aggregations in the Great Australian Bight during summer-autumn. Hence, the Northern Boundary Current System off southern Australia is one of the most important pelagic ecosystems in the Southern Hemisphere. A large-scale integrated marine observing system is currently being established in the region. This observing system forms part of an ongoing collaborative multi-disciplinary research program that has drawn from the approach instigated by CalCOFI.

C-12. Changes in the spawning habitat of Sardine (*Sardinops sagax*) off California between 1951 and 2005

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We analyzed a subset of the CalCOFI time series (54 years from 1951 to 2005, 309 cruises) to determine how sardine spawning distributions have changed over the past five decades. We detected 6 significant changes in sardine egg distributions between 1951 and 1969, no significant differences during the prolonged fishery collapse, and 6 significant changes in distribution between 1996 and 2005 during recovery of the fishery. Actual sardine habitat varied by region along the California coast (north and south of Point Conception, 35.5^{o}N, and south of Ensenada, 32^{o}N), and by season (Spring and Fall), but we did not detect notable variability related to ENSO years. General Additive Models revealed that sardine egg presence was significantly related to salinity in all regions studied, and also to zooplankton displacement volume in the southern California Bight. Temperature, oxygen, nutrients and chlorophyll had less effect on actual spawning habitat. Intensity of the California Current has a negative salinity signature; while upwelling, and cyclonic eddies all have positive salinity signatures. These processes likely underpin the physical forcing impacting sardine spawning habitat in the California Current System.

C-13. Comparisons of emergent red abalone densities between San Miguel Island (southern California) and northern California based on SCUBA surveys

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A quantitative SCUBA-based survey of red abalone (*Haliotis rufescens*) at San Miguel Island (SMI) was completed in August of 2006 by the California Department of Fish and Game with strong field support from commercial, recreational, academic and federal agency divers. The purpose of the survey was to estimate the current abundance and size frequency of emergent red abalone. The California Fish and Game Commission will use the survey data with other available information in consideration of reopening the SMI red abalone fishery. In this paper we compare spatial distribution, density, recruitment and size frequency results from SMI to recent surveys of seven representative fished areas in northern California. The northern California red abalone fishery has been monitored since 1975 and appears to be sustainable. A total of 400 strip transects (4x30 m) were completed at 202 randomly distributed stations at SMI. Stations were located only in areas of kelp canopy which was used as a surrogate indicator for hard substrate. An effort to equally distribute the sampling in three zones on SMI was hampered by adverse weather, so most of the sampling was done off two zones on the southern side of the island. Emergent abalone densities were generally lower at SMI than at the northern California sites. Abalone densities ranged from 0.02 to 0.16 ± 0.01 per m^2 at SMI and from 1.07 ± 0.31 to 0.43 ± 0.19 per m^2 in northern California. Compared to northern California, a larger proportion of stations at SMI had emergent densities below the Minimum Viable Population (MVP) level (0.2 per m^2) published in the Abalone Recovery and Management Plan. The proportion of stations with densities lower than MVP ranged from 76% to 98% in the SMI zones compared to 16% to 50% at northern California sites. Size frequency weighted by density at SMI suggested lower levels of recent recruitment (emergent abalone ≤ 140 mm) than at northern California sites.

Keywords: Red abalone, emergent density, size frequency, recruitment, SCUBA survey, San Miguel Island, northern California

C-14. Effects of ocean climate on transboundary movement of the pacific sardine between the EEZs of Mexico and the United States

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Interannual to multidecadal changes in ocean climate directly impact access to transboundary coastal pelagic resources between fisheries operating in U.S. and Mexican waters. The subject of this study is the northern, "subarctic stock" of the Pacific sardine that is centered off California in the U.S. and which extends southwards to the region off central Baja California during Spring spawning. This study is a preliminary analysis of the scale of year-to-year shifts in the distribution of the Pacific sardine (*Sardinops sagax caeruleus*) using data from 2002 and 2003. Estimates of sardine biomass in U.S. and Mexican waters, based on the rates of egg production measured during the IMECOCAL and CalCOFI surveys of April 2002 and April 2003, show order of magnitude differences in the relative proportions of biomass in the Mexican EEZ that are associated with the strong contrast in ocean climate resulting from the regional effects of El Niño during April 2003. Results indicate a significant northward shift of the "subarctic" sardine stock off Mexico during 2003: we estimate that approximately 20 percent of the total biomass of the stock was located in the Mexican EEZ during spring of 2002 while the shift in ocean climate resulted in the presence of only 2 percent of the biomass of the stock in Mexican waters during April, 2003. A second, more southerly "subtropical" sardine stock extended from southern to central Baja California in April, 2003, but it was out of reach of the fleet operating from Ensenada in northern Baja California. These results suggest that long-term warming of the coastal ocean may result in a persistent displacement of the Mexican portion of the subarctic sardine stock into the waters of the EEZ of the United States. However, this might also be compensated somewhat by the simultaneous northward expansion of the more southerly stock.

C-15. Age-specific migration and availability of Pacific sardine (*Sardinops sagax*) off the west coast of the American continent

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Pacific sardine (*Sardinops sagax*) off the west coast of the American continent extends from Baja California, Mexico to British Columbia, Canada. Its migration along the coast was evident from the tagging experiments conducted in the 1930s and 1940s. Sardine population reached 3 million tons in the 1930s and declined till the mid-1960s when moratorium was set for the fisheries off US coast. In the mid-1980, sardine reappeared in the fisheries off California and the population has been monitored by routine fishery-independent surveys for the spawning biomass and stock assessment since 1986. Special ichthyoplankton-trawl surveys were conducted in March and July in July 2003 - March 2005 off Oregon and Washington (Northwest: NW) to gain knowledge of biological characteristics of Pacific sardine in that area and migration. Off California, as the population of sardine increases, its spatial distribution has expanded to offshore area from the inshore area. Therefore not all sardine are available to the California fisheries which are near shore. The availability coefficient, a multiplier of fishing mortality, is an important parameter, which was once used for stock assessment. The purposes of this report are to obtain estimates of length-specific migration rates of sardine between central California and NW and estimates of the availability coefficients for commercial caches off California.

Both length-specific migration rates and availability coefficients were based on the length distribution and biomass estimates in different ways: The length-specific migration rates from NW to California were computed from the difference of length-specific biomass estimates from trawl surveys off NW in July and March in 2003-2005, which were compared with estimates from historical catch and tagging data. The total biomass in each survey was estimated by a stratified sampling scheme: inshore area and offshore area. The length-specific availability coefficients off California were estimated from length distribution and biomass estimates in the port area and non-port area off California based on 2005 sardine spawning biomass survey and commercial catches off California. Bootstrapping methods were used to obtain 95% confidence intervals for the migration rates and availability coefficients.

Estimates of length-specific migration rates from NW to California in the winter were obtained ranging from 20% to 100% .The estimates of overall migration rate from California to NW were between 6%-17%, and no length-specific availability coefficients were estimated due to insufficient data. The availability coefficients for the fishing mortality ranged from 0-40% with peak at length 150mm. It appears that based on recent surveys, sardines are still migrating. Statistical results lead to new biological and oceanographic questions.

C-16. Not enough ado about nothing

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Zero catch is not an issue with theoretical Normal and Log Normal statistical distributions and the presence of zeroes is often concealed or minimized in analyses. With highly patterned oceanic distributions, the zero catch is an integral part of the results defining the spaces among patches, schools, and school groups. Furthermore the environment contains uninhabitable local sites and of course the distribution range is collectively determined by rather large fields of zero catch.

The latter category, range definition, can become problematic if bootstrapping is used for determining confidence limits. The hazard is that large contiguous fields of zeros can enter the reflexive use of bootstrapping as independent points. If this occurs the number of independent points is inflated.

In the extreme, if this were permitted, the precision of estimate of a coastal fish abundance could be made as precise as needed by merely extending the field of samples to the International Date Line and beyond.

C-17. Using top predators to assess the efficacy of the Vandenberg State Marine Reserve

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The Vandenberg State Marine Reserve (VSMR) was established in 1994, but its efficacy in protecting local marine populations has yet to be tested. We tested the hypothesis that lower trophic level organisms are more abundant inside the VSMR than outside by monitoring the foraging habits of four seabirds (Brandt's and Pelagic Cormorants, Pacific Loons, and Surf Scoters) and two marine mammals (harbor seals and California sea lions). In theory, the abundance and species composition of foraging predators will reflect the community structure of lower trophic level organisms within a given habitat. We measured foraging rates at study plots inside and outside the reserve using a paired design. The VSMR spans the coastal boundary of Point Arguello and we controlled for headland effects by selecting one pair of study plots on the windward side and one on the leeward side of the promontory. All species but harbor seals showed either no difference or a higher abundance outside the reserve than inside. Additionally, pelagic and demersal fish predators (sea lion, harbor seal and Brandt's and Pelagic Cormorants) foraged more in leeward plots than windward while the benthic invertebrate specialist (Surf Scoter) foraged more in windward plots. Our results suggest prey abundance is not enhanced inside the VSMR and that the reserve should be larger and extended in the leeward direction to better protect pelagic and demersal fish populations. Our results also suggest a strong difference in community structure between windward and leeward habitats.

C-18. Catch strategies for the California sardine

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Parallel to the sharp decline in landings of Pacific sardine during the 1940s and 50s the stock also suffered a sharp decline, which was initially attributed to overfishing. However, later research has indicated that long before any fishing began, the Pacific sardine stock was subject to similar crashes. Overfishing thus need not have been the sole cause of the decline of the sardine stock in the 1930s and 40s, and it might have declined in any case due to natural reasons, as it apparently has done periodically in the past. In this paper we develop a model of the long-term prospects for the Pacific sardine in which the surplus growth of the stock is influenced by a random variable generating fluctuations which can have an enduring effect, partly through a serial correlation in the environmental disturbances, but also and more importantly because the effect of these random disturbances is related to the size of the stock itself. We use the model to generate fluctuations in the sardine stock that resemble those that may be expected to occur in reality, in order to compare alternative fishing strategies. We find that the model supports the harvest policy currently in place for the U.S. P. sardine fishery. We make no claim that the model explains the fluctuations in the sardine stock, as it does not incorporate any physical processes that would generate such fluctuations.

C-19. Anomalies in the cross-shelf plankton community off the central Oregon coast during spring 2007

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The distributions and concentrations of ichthyo- and zooplankton were examined from the surface (0-20 m) waters of stations extending from 19 to 232 km offshore at 9-47 km intervals along the Newport Hydrographic (NH) line in the northern California Current (NCC) during March and April 2007. Historic and ongoing sampling regimes used to characterize the plankton community in this region have usually incorporated only more-inshore (<120 km offshore) stations. A total of 656 fish larvae representing 17 taxa from 8 families were collected in 17 bongo samples from 8 stations in March and 9 in April. Two taxa accounted for 87.4% of the total standardized larval fish concentration: *Stenobrachius leucopsarus* (64.3%) and *Sebastes* spp. (23.1%). Concentrations of both of these taxa and total larvae were much higher at normally-unsampled far-offshore (157-232 km) than normally-sampled more-inshore (19-120 km) stations during both months. However, there were no significant differences in mean lengths of either *S. leucopsarus* or *Sebastes* spp. larvae collected at the far-offshore than more-inshore stations during either month. Unusually high concentrations of a normally boreal copepod species, *Neocalanus plumchrus*, were also collected at the far-offshore stations. The anomalous distributions and concentrations observed in the plankton may be related to environmental conditions associated with unusually cold offshore water present in the NCC early in 2007. Increased sampling effort at far-offshore stations may be required to adequately characterize the plankton community of the NCC in the future.

C-20. Relationships between diver and commercial fishing gear surveys of nearshore fishes

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Relatively little fishery dependent or independent information is available to evaluate nearshore fish populations. The Department of Fish and Game (CDFG) has started to collect landings, logbook, and other fishery dependent information, and in conjunction with other marine scientists, has developed a standardized protocol for diver surveys of nearshore fishes and invertebrates. As fishery dependent and fishery independent information are collected, however, it is important to understand what the data represent, i.e., how the different sampling techniques relate to one another, how they are affected by environmental variation, and how they vary in time and space.

In 2005, we worked with two nearshore commercial fishermen to conduct standardized fishing and diving operations in Carmel Bay, California. Our primary objective was to determine if and how catch-per-unit-effort (CPUE) of nearshore commercial fishing operations was related to estimates of fish densities derived from diver surveys. Our second objective was to compare surface fishing CPUE and diver density estimates with abundance estimates generated from mark-recapture experiments.

After 16 day of sampling, we observed no evidence of a statistically significant relationship among estimates of CPUE for any combinations of sampling methods. Estimates of CPUE from commercial fishing gear in nearshore kelp and shallow rock habitats were highly variable, and were also significantly influenced by habitat and depth. For most species, population estimates based on diver densities were smaller than tag-recapture estimates of abundance. Spatial patterns of CPUE generated by SCUBA and handline fishing reflected similar spatial patterns in abundance mark-recapture estimates.

C-21. Ommastrephid paralarvae during 1997-1999 IMECOCAL cruises

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In México, only few attempts have been made in order to identify squid paralarvae. This study represents an effort to identify those of the ommastrephid species recorded off the west coast of the Baja California Peninsula, their abundance, distribution, and its relation to the oceanographic processes. All cephalopods paralarvae were sorted from zooplankton samples collected with standard Bongo net tows during six oceanographic cruises carried out from 1997 to 1999 by the IMECOCAL Program. The region surveyed included the marine area from Ensenada, BC to Punta Abreojos BCS. The ommastrephid paralarvae (Pl) were identified based on the size of the lateral suckers of the proboscis, and on the ocular and intestinal photophores. These Pl constituted among 1.3% to 85.6% of the total abundance of Pl of cephalopods, and were represented by five species identified for the first time along the west coast of Baja California, México: *Dosidicus gigas*, *Sthenoteuthis oualaniensis*, *Eucleoteuthis luminosa*, *Hyaloteuthis pelagica*, and *Ommastrephes bartramii*, and two groups of very small Pl (less than 3 mm mantle length). The first group named "SD complex" corresponding with *D. gigas* and/or *S. oualaniensis* (all proboscis suckers of same size), while the second group, "EHO complex" corresponding with *E. luminosa*, *H. pelagica* and/or *O. bartramii*. *D. gigas* dominated by far with 756 Pl/1000 m^3, followed by SD complex (380 Pl/1000 m^3), *S. oualaniensis* (181 Pl/1000 m^3), EHO complex (14 Pl/1000m^3); *E. luminosa* and *H. pelagica* apported less than 13 Pl/1000 m^3, and we identified only 3 Pl/1000 m^3 of *O. bartramii*. Paralarvae of *D. gigas* and SD complex, were found consistently distributed in the first 50 km from the coast in the south region of the study area, associated with Transitional Subtropical Surface Water, and to the boundary with Subarctic Water mass related both to the 1997-2001 El Niño-La Niña events. *E. luminosa*, *H. pelagica*, EHO complex, and *O. bartramii,* were found distributed in oceanic waters associated to the latitudinal presence of the Subarctic water. The SD and the EHO complex most likely represent recent spawning events of adults of the species involved, but also probably related to larval transport processes. The CCA statistical analysis applied to the physical and biological data showed the separation of two groups, one formed by three taxa (*S. oualaniensis*, SD complex, and *D. gigas*) and another with four (EHO complex, *O. bartramii*, *H. pelagica*, and *E. luminosa*) associated to different environmental conditions.

POSTER TITLES AND ABSTRACTS

P-1. Fecundity, maturity index and oocyte quality on maximum size females of flying jumbo squid *Dosidicus gigas* (d' Orbigny, 1835) in Gulf of California , México

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Actually, *Dosidicus gigas* is a very important fishery in México. The flying jumbo squid is exploited mainly into the Gulf of California; however the west coast of Baja Peninsula could be a potential site for the capture of the squid. To achieve regulate the commercial exploitation, is required the knowledge of the reproductive and other biological and ecological parameters. Previous studies published diverse fecundity estimations and maturity index for flying jumbo squids from Gulf of California; in those works the squid size were less than 80 cm DML, we consider that those estimations are incomplete, because we captured females as big as 98 cm DML. In the present work is estimated the total, partial and potential fecundity with the gravimetric method in matured females bigger than 80 cm LM. Additionally the oocytes quality were determined with histochemistry technique (Sudan Black) and digital image analysis, quantifying the concentration of lipids in the oocytes, founding as a preliminary results the dominance of phospholipids in previtellogenic oocytes and majority of triacylglycerols in vitellogenic oocytes.

Key words: *Dosidicus gigas*, Fecundity, Maturity index, Gonadosomatic index, lipids

Fecundidad, índice de madurez y calidad de los ovocitos en hembras de talla máximas de calamar gigante *dosidicus gigas* (d´orbigny, 1835) en el Golfo de California, México

Dosidicus gigas es un recurso pesquero de gran importancia económica para México. Actualmente el calamar gigante se explota en el Golfo de California; sin embargo, la costa occidental representa un sitio potencial para su captura.

Para lograr regular la explotación comercial, es requerido el conocimiento de la biología reproductiva y otros parámetros biológicos y ecológicos de la especie.

Estudios previos han llegado a diversas estimaciones de fecundidad e índices de madurez en los calamares del Golfo de California, en dichos trabajos los calamares presentaron tallas <80 cm LDM, por lo que se considera que la información esta incompleta, ya que hemos capturado hembras de hasta 98 cm LDM.

En este trabajo se analizaron los ejemplares >80 cm LDM para estimar la fecundidad total, parcial y potencial mediante el método gravimétrico. Adicionalmente mediante histoquímica (Negro Sudan) y análisis de imagen se cuantificaron lípidos para determinar la calidad de los ovocitos, obteniendo como resultado preliminar la dominancia de fosfolípidos en ovocitos previtelogénicos y de triglicéridos en ovocitos vitelogénicos.

Palabras clave: *Dosidicus gigas*, fecundidad, índice de madurez, Índice gonadosomático, lípidos

P-2. Spatial and temporal variations in albacore habitat in the Northeast Pacific using remotely-sensed environmental data

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Albacore tuna occurs through much of the temperate waters of the North Pacific and undergoes zonal feeding migrations across the entire basin. Oceanic habitat preferences and timing of immigration and emigration into the Eastern North Pacific have not been studied. We used albacore logbook CPUE data for 1999 through 2004 stratified by month, latitude, and longitude (33,652 records) along with satellite-derived environmental variables (Reynolds SST, SeaWIFS SSChl, AVISO SSH, and ERS- or QSCAT-derived wind stress curl). CPUE was mapped for the main fishing season (May through October), overlaid on environmental maps, and environmental records were extracted for each catch location where fishing occurred using both positive and zero sets. The optimum range (mean and variance) of each variable was estimated based on catch and CPUE was related to all environmental variables using GAM modeling by month. We plotted binary prediction map of distributional range of this species based on optimal habitat for each month and year. Catch varied significantly between years and all four environmental factors were related to the distribution of albacore in this region.

P-3. Trophic ecology of dominant micronektonic fish species in the northern California Current

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In addition to a number of commercial species, the productive California Current off Oregon hosts a significant assemblage of small, actively moving pelagic animals known as micronekton. In order to better understand the role of principal micronektonic components in the dynamics of the entire pelagic community, we investigated feeding habits of three dominant myctophid species (*Diaphus theta*, *Tarletonbeania crenularis* and *Stenobrachius leucopsarus*) and age-0 juveniles of hake (*Merluccius productus*) - an important commercial species with recent northward expansions into the northern California Current. Based on Index of Relative Importance, *Euphausia pacifica* was the most important prey for all four species. Three lanternfishes showed marked differences in utilization of other types of prey. Copepods were the only other major food category for *S. leucopsaurus*, while diet of both *T. crenularis* and *D. theta* was more diverse and prey selectivity more evenly distributed. *T. crenularis* consumed larvaceans, hyperiids and salps (in decreasing order of importance) while copepods, hyperiids and larvaceans were more important for *D .theta*. Of less common prey, *D. theta* consumed ostracods, larval bivalves and pteropod mollusks. Observed differences in myctophid feeding can be interpreted based on their structural morphology, differing energy requirements and their "active" vs. "inactive" lifestyles. Juvenile hake fed mainly on euphausiids and copepods accounting for over 90 % of wet weight biomass of all identified prey items.

P-4. The rockfish we have known: A summary of rockfish species encountered during 20 years of environmental monitoring off San Diego County

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The rockfish of the Pacific Coast of North America (genus *Sebastes*) are an extraordinarily diverse and successful group of fishes that occur in many habitats from the intertidal to depths up to 1,500 m. These fishes represent an important aspect of the marine demersal landscape primarily because of their role as major predators. Rockfish are also important to humans as a source of food and income, with various species having comprised a significant proportion of the Pacific Coast bottom fishery over the years. Additionally, many rockfish species are commonly collected by large ocean monitoring programs as part of regulatory permit requirements, although much of these data are not widely distributed beyond the dischargers or regulators. In southern California, for example, the City of San Diego has been monitoring the local coastal waters since 1962, first in areas surrounding the Point Loma Ocean Outfall (1962-present) and later including the more southern region encompassing the South Bay Ocean Outfall and extending into northern Baja California (~1995-present). Since the mid-1980s, the City's ocean monitoring program has included periodic otter-trawl surveys of demersal fish communities focused over mostly soft-bottom habitats, although rocky substrates and outcroppings are scattered throughout. These surveys have been conducted as often as four times a year, at depths between 10 and 600 m, and have resulted in the capture of over 16,000 rockfish from 23 different species. However, the majority of these trawl-caught fish represent only three species: the halfbanded rockfish *S. semicinctus* (42%), the stripetail rockfish *S. saxicola* (39%), and the calico rockfish *S. dalli* (7%). In this paper, we investigate the distribution of a total of 28 species of rockfish collected off San Diego (23 from trawls and 5 additional species from the City's rig fishing program). As a supplement to our poster presentation, we will also be showing video footage of rockfish filmed during ROV surveys of the Point Loma outfall.

P-5. Vertical associations of chaetognaths and their relation to the water column in the main mouth of Bahia La Paz (Gulf of California)

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The stratification of the water column appears to have an important effect on the vertical migration of the Chaetognaths. The Bahía de La Paz is strongly influenced by the waters of the Gulf of California and it has an important influence on zooplankton in general. In consequence we wanted to determine the vertical associations of chaetognaths and their relation to the water column in the mouth of Bahía de La Paz, during 2001 and 2002. Four oceanographic cruises were made and analyzed in planned sampling of 9 to 14 stations and at four depths (0 – 50 m; 50 – 100 m; 100 – 150 m; 150 – 200 m). There were 13 of *Sagitta* and others of the genera *Krohnitta* and *Pterosagitta.* The Bray-Curtis index defined groups of strata in the four sampling periods. In May 2001 the Surface Group (0 – 50 m) was dominated by *Sagitta enflata*, the Subsurface Group (50 – 100 m) was dominated by *S. decipiens*, *S. pacifica* and *S. enflata* and the deepest group (100 – 200 m) was dominated by *S. decipiens, S. enflat and S. bierri.* In July 2001 the Surface Group appeared dominated by *S. enflata* and *S. minima*, with a large group comprising the other depths (50 – 200 m) dominated by *S. enflata* and *S. decipiens*. In October 2001 the Surface Group was dominated by *S. enflata* and *S. pacifica* and the group comprising all the other depths (50 – 200 m) was dominate by *S. enflata*, *S. minima* and in a minor amount by *S. decipiens.* In February, 2002, three groups appeared. The Surface Group was dominated by *S. enflata* a Subsurface group (50 – 100 m) was dominated by *S. enflata* and *S. bedoti*, and a deeper group comprising the 100– to 150-m depths was dominated by *S. enflata* and *S. decipiens.* The seasonal variation of the chaetognaths was probably associated with the seasonality of the water column, such as has been shown for other groups of zooplankton.

P-6. Results of the 2004-2005 SWFSC ichthyoplankton survey of shallow coastal waters in the Southern California Bight

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NOAA Southwest Fisheries Science Center, working with the Environmental Monitoring Division of the Bureau of Sanitation, City of Los Angeles Department of Public Works, conducted a survey of fish eggs and larvae in the nearshore zone of the Southern California Bight during 2004—2005. Oblique bongo net tows through the water column were made at the 8-, 15-, 22-, 36-, and 75-m isobaths off Ormond Beach, Playa del Rey, Seal Beach and San Onofre, California, during six quarterly surveys from January 2004 to July 2005. The 120 samples yielded 41 categories of fish eggs and 72 of fish larvae. Egg categories included 33 species (97.5% of the total standardized egg abundance), 2 genera (< 0.1%), 2 families (1.5%), 2 orders (0.3%), plus "unidentified" (0.6%) and "disintegrated" eggs (<0.1%). Larval fish categories included 63 species (92.3% of the total standardized abundance), 7 genera (7.7%), 1 family (<0.1%), and "disintegrated" larvae (<0.1%). The five most abundant taxa accounted for about 94% of the total standardized fish egg abundance and about 88% of the total standardized larval fish abundance. Northern anchovy, *Engraulis mordax*, was the overwhelmingly dominant species, accounting for 76.1% of the total fish eggs and 70.9% of the total fish larvae. For comparison, in the 2004 and 2005 CalCOFI surveys northern anchovy eggs accounted for 54.6% of the total fish eggs and 43.7% of the total fish larvae collected off southern California.

Compared with results of an earlier ichthyoplankton survey by USC and the Natural History Museum of Los Angeles County, which occupied the same stations from 1978–1984, larvae of seven of the ten most abundant families in that study were among the most abundant in our study although the rank order of abundance changed for all except northern anchovy, the dominant taxon in both studies. Three families ranked among the ten most abundant in the 1980's (Clupeidae, Scombridae, Atherinopsidae, all with a generally warm-water affinity) were not among the top ten during the current survey and three families were added to the ten most abundant for the current survey (Pleuronectidae, Merlucciidae, Bathylagidae, all with a generally cool-water affinity). Among the taxa declining most in relative larval abundance between the two studies were Clupeidae (Pacific sardine), which decreased from 6.0% to 0.4% of the total fish larvae, and Scombridae (Pacific mackerel), which declined from 1.4% to 0.03% of the fish larvae. Among the larger increases, Sebastidae (rockfishes) contributed 1.1% of the total larvae in the earlier study and 8.0% in the current study.

P-7. CalCOFI gazetteer: Towards a local geographic dictionary

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A geographic dictionary, or gazetteer, is a collection of named geographic regions specific to a project's needs. Such a dictionary provides an index of place names, feature classes, and spatial reference systems as well as a record of the metadata associated with these regional definitions. It's value lies in presenting standardized naming schemes as a shared classification system. This approach creates opportunities for improved visualization, automated analysis and cross-project synthesis. We discuss the basic components of a geographic dictionary, highlight the benefits of such a system and explore implementation of a CalCOFI gazetteer. We present an initial set of regional classifications. This represents a first step in plans to gather information regarding relevant regional classifications that have developed over time in local practice.

P-8. Trace metal concentrations in the zooplankton from the northern and central Gulf of California in August 2003

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The need to know the biogeochemical cycles of the trace metals (TM) in the marine environment, requires a large set of data on the chemical composition of waters, suspended particulate matter, phyto-and zooplankton, sediments and other components of marine ecosystems. Because of hard methodological requirements to the analysis of TM concentrations in the sea water, the zooplankton seems to be reliable object for biogeochemical studies being an effective integrator of what occurs with TM in the surface layer of the water column. A preliminary evaluation of the presence of some major and trace metals in the zooplankton, collected with a standard Bongo net with a size 505 μm in August of 2003 in the northern and central parts of the Gulf of California (GC) has been accomplished in this work. The general characterization of the zooplankton is composed predominantly by calanoid copepods, chaetognaths, cladocera and urochordata in the most of the samples. The sub-samples of zooplankton, washed with desionised water and oven dried were processed with a method of an instrumental neutron activation analysis to determine the contents of various major and trace elements. The concentrations were very variable for the majority of elements and corresponding concentration ranges were: As (1.7-19.5 mg kg^{-1}), Ba (34-365 mg kg^{-1}), Br (212-453 mg kg^{-1}), Ca (1.01-4.8 %), Co (3.01-23.8 mg kg^{-1}), Cr (0.71-58.5 mg kg^{-1}), Cs (0.032-1.38 mg kg^{-1}), Eu (0.007-0.22 mg kg^{-1}), Fe (80-9100 mg kg^{-1}), La (0.24-0.68 mg kg^{-1}), Na (3.64-17.1 %) , Rb (6.79-39.3 mg kg^{-1}), Sb (0.36-5.76 mg kg^{-1}), Sc (0.007-1.36 mg kg^{-1}), Se (0.3-4.23 mg kg^{-1}), Sr (105-15450 mg kg^{-1}), Zn (20-2570 mg kg^{-1}) and Zr (19-525 mg kg^{-1}). The spatial distributions of the concentrations of some elements in zooplankton of the studied parts of the GC, as well as of the ratios between the elements, are presented and discussed, along with the posible interpretations of observed patterns. The highest concentrations in Na were detected in the zooplankton samples from Upper Gulf, especially in front of the delta of the Colorado River, due to the higher salinities caused by an evaporation of the seawater. Some elements of terrigenous origin (e.g. Fe and Sc) could appear in the zooplankton in excessive quantities as a result of the capture of the particles supplied from the land to the GC by the riverine or eolic input. The biofiltration could be responsible for the existence of the spots and bands of the high contents of Sc and Fe in a zooplankton of the Northern GC. A high enrichment of the zooplankton for Sr is found in some stations of the central part of the Northern Gulf. High levels of As found in August of 2003 in the zooplankton to the south of Ángel de la Guarda and Tiburón Islands are probably controlled by the supply of this element from the deep horizons of the water column toward the surface water layer in this part of the gulf, subjected to the strong vertical mixing that occur in this area.

Key Words: Trace metals, Gulf of California, zooplankton.

P-9. Morphological and genetical analysis of Rhynchoteuthion paralarvae of Humboldt squid *Dosidicus gigas* (d'Orbigny, 1835) and purple squid *Sthenoteuthis oualaniensis* (Lesson, 1830)

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Dosidicus gigas is an ecological and commercial key specie found in the pelagic environment in the Gulf of California (GC) and the Occidental Coast of Peninsula de Baja California (OCPBC). However, many aspects about its early stage, required for recruitment estimations and management that is still unknown. The similarity between its Rhychoteuthion paralarvae with that of *Sthenoteuthis oualaniensis* enables their identification, preventing the exact location of spawning areas and its seasonality. The goal of this study is to provide a morphological/morphometrical criterion, supported by a genetic molecular analysis, to distinguish these Rhynchoteuthions. Morphometrical analysis indicates that the head length index, head base width index, the coefficient head length index/head base width index, eye diameter index and the coefficient eye diameter index/head length index represent 72.2% of the inter-specific morphometric variability. The discriminating function analysis suggests more similarity between *D. gigas* from OCPBC and *S. oualaniensis* from Hawaii, than between *D. gigas* from SRB and *D. gigas* from OCPBC. The DNA sequence analysis allowed the identification of 180 of the 197 paralarvae from OCPBC as *D. gigas* (30 haplotypes). The rest were identified molecularly as *Eucleoteuthis luminosa* (n=13, 7 haplotypes). *S. oualaniensis*'s Rhynchoteuthion was not found. The restriction endonuclease *Hae III* had one restriction site producing fragments of 162 and 395 pb in *D. gigas*, 217 and 340 bp in *E. luminosa* and none in *S. oualanienis.*

Keywords: Citocrhome oxidase I**,** *Dosidicus gigas*, morphlogy/morphometry, *Sthenoteuthis oualaniensis*

P-10. Spatial and temporal variation of red spiny lobster *Panulirus interruptus* (Randall, 1840) phyllosoma larvae, in relation with oceanographic conditions during 2000-2001 period

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Panulirus interruptus (Randall 1840) distributes from Point Conception, USA (34.5°N) to Magdalena Bay, Mexico (24.5°N). The central part of Baja California coast, traditionally has been considered a zone of reproduction and recruitment for this species. The area is influenced by the California Current and the Equatorial Current, affecting reproductive periods and recruitment of the red lobster, depending of the dominant characteristics. Both circulations types are modified by the influence of the El Niño and La Niña events; which shift the distribution and abundance patterns of the phyllosomas stages. The goal of this work is to evaluate these patterns during the cooling the 2000-2001 period. We present advances on the study of the distribution and abundance of larval stages of *P. interruptus* in the western coast of the Baja California Peninsula for both year. The samples were taken by IMECOCAL program, collected in eight oceanographic surveys made in January, April, July and October. The survey area included from Ensenada, B.C. to the North part of Bahía Magdalena, B.C.S. The phyllosoma larval stages were determined by the keys of Johnson (1956), the counts were adjusted to $10m^2$ sea surface (Smith and Richardson 1979). 293 samples with a total of 1912 larvae/$10m^2$ were analyzed in 2000 and 244 samples with 1737 larvae/10 m^2 for 2001. The larval distribution in January 2000 was in the south part of the study area, unlike January 2001 where the larvae distributed in the north and south part; during April and July of both years the distribution was in the central part, whereas October of both years its distribution was in all the area. The eleven stages were found, stages VI to VIII were most frequents and abundant. The greater abundances appeared in January and October of both years. During 2000, sea surface temperature and surface salinity ranged, in stations with phyllosomas, it went of 16.2 to 22.57 °C and 32.32 to 35.7 ups and for the 2001 from 15 to 25.4 °C and 33.02 to 34.42 ups respectively. First stages (I, II and, III) appeared from July to October, corresponding with the reproductive period in temperatures between 19.33 and 25.38°C and in the last stages was found in January and July, between 15.29 and 21.15 °C match with the puerulus recruitment according to literature.

Key words: Phyllosomas, red lobster, IMECOCAL, Peninsula of Baja California

P-11. CalCOFI data management: Developing community standards

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CalCOFI represents a partnership of multiple agencies conducting quarterly joint oceanographic cruises, CalCOFI field team members work as a cohesive cross-agency unit to accomplish the cruise goals. Associated participants frequently integrate their field measurements and sampling with the long-term core CalCOFI measurements and samples. Once a cruise concludes, however, this cohesive unit disperses; individuals return to their respective agencies and labs to process samples and analyze data. Each group uses lab or agency specific methods and software to generate data products in local formats. These diverse data processing methods, products, and storage formats create challenges for merging datasets. Development and incorporation of shared data management practices or joint standards enable data integration. Shared practices include

- **Standard, persistent vocabulary and formats** e.g. use of the same labels for the same data columns with translation tables for different units
- **Standard, persistent date & position formats**
- **Standard line & station designations for gridded data** e.g. 93.3 120.0
- **Sequential station numbering** e.g. order-occupied
- **Event numbers** e.g. when needed for resolving station activities
- **Distribution of data in non-proprietary format** e.g. tab delimited text or csv
- **Metadata** i.e. details of context, measurements & equipment

Designating common columns, such as order occupied or event number, and adding them to existing data products allows heterogeneous datasets to be related and ingested into relational databases or into data analysis and visualization applications.

P-12. Ocean informatics DataZoo: A Multi-Project data publishing system

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The DataZoo information system is a hub in the Ocean Informatics learning environment that creates a central forum for data exchange, collaborative design, and community building. It is a central repository for data and metadata of member projects, providing data aggregation, ingestion, description, visualization, download, integration, and standardized exchange. It serves as a publishing arena for datasets from individual project members and from project groups. A number of design features facilitate scientific work. For example, local work benefits from data availability and queriability while community work benefits from alignment with metadata standards. The flow of data from the field to a local repository is supported through cross-project extensibility, dataset ingestion templates, and time-series storage of study collections. Data integration and exchange are enabled by the use of study-specific internal indexing, cross-project dictionaries, and augmented metadata describing data to a column level. Ancillary related tools are being developed such as project-specific sampling grid converters, dataset joining tools, and a date-time calculator. Working together with LTER and CalCOFI participants to develop a local information system creates the opportunity to improve capture of data and metadata as well as to understand community needs.

P-13. Local Metadata: Augmenting the ecological metadata language

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Metadata is an integral and necessary part of data sharing; the enactment of a metadata standard not only guides the creation of local metadata documents but is also a link between local and broader communities. A full metadata record, including but not limited to descriptions of the field environment, detailed accounts of analytical methods, and summaries of quality control procedures, is essential to the understanding and use of any dataset. Without the context of the data, measurement values are subject to misinterpretation and misuse. A rich local metadata standard prompts consideration of the range of information necessary to form a complete metadata record. Such a standard creates a structure and format that provide those knowledgeable about a dataset a place to record unique as well as common elements. Standardized metadata functionally makes possible automated comparisons and visual presentation of datasets. In addition to establishing a local foundation for data sharing, a standard becomes an integrative bridge when developed in parallel with community and national standards. The Ecological Metadata Language (EML) provides a metadata specification with growing acceptance in environmental science communities. In this poster, we discuss adaptations and augmentations made to EML for the Ocean Informatics community information system (DataZoo) in order to ensure the local metadata structure, while still linked to the broader community, is optimized to capture any complexity associated with local oceanographic datasets.

P-14. Jumbo squid (*Dosidicus gigas*) occurrences and distributions in Pacific Northwest waters during 2004-2007

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Spatial and temporal variability of jumbo squid was examined between Heceta Head, Oregon (44.0° N) and Willapa Bay, Washington (46.6° N) during 18 cruises from June to November 2004, June to October 2005, and May to September in 2006 and 2007. The Northwest Fisheries Science Center Stock Assessment Improvement Program Surveys captured approximately 200 jumbo squid as bycatch from 2004 to 2007 with a Nordic 264 midwater trawl. During each year, jumbo squid were generally captured during August and early September cruises offshore, but their distribution shifted shoreward in later cruises. Jumbo squid catches were highest 125 km of off Heceta Head in most years, and they appear to be associated somewhat with Heceta Bank. The Willapa Bay transect had the most widespread distribution of jumbo squid in the late (September to November) cruises. Environmental variables and squid lengths in relation to distribution were also examined. Although they were reported off southern Oregon during the anomalously warm ENSO event in 1997, their appearance during four recent summers in Oregon waters suggests that this voracious subtropical predator may now be well established in Pacific Northwest waters.

Keywords: Northern California current, distribution, *Dosidicus gigas*, Jumbo squid, Humboldt squid

P-15. A subsurface warm-eddy off Northern Baja California in July 2004

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Upper-ocean eddies are commonly observed from remote sensing, but submerged eddies are more difficult to detect. During July 2004, a 21-day hydrographic survey in the southern region of the California Current was carried out to investigate the mesoscale variability. We observed for the first time a subsurface anticyclonic eddy off northern Baja California with the same water mass characteristics as the California Undercurrent. The core of the eddy was quasi-circular with radii of 35 km and thickness of 250 m. The maximum swirl velocity was ~ 3 cm/s. The water mass of the core of the eddy was characterized by potential temperature of 11º C, salinity of 34.5, and dissolved oxygen of 1.4 ml/l. The eddy propagated westward. The subsurface warm-eddy could transport relatively saline water into the North Pacific subtropical gyre.

P-16. A summary of the northwest survey in June 2007: Sardines revisited

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During July of 2003, March and July of 2004 and March of 2005, the Southwest Fisheries Science Center, Fisheries Resources Division (FRD), conducted a survey in the region 42° - 48° N latitudes and extending offshore to 128° W. The recent June 2007 survey revisited a sub-region of the original survey three years later in an attempt to understand and compare the annual spawning variability in adult Pacific sardine (*Sardinops sagax*) off of the coast of Oregon and Washington.

The 2007 survey was slightly abbreviated from the previous surveys in that the region examined was 42° to 47° N and only offshore to 126° W. Results from previous surveys indicated that this region encompassed the majority of the spawning population of sardine. All procedures conducted during the 2007 survey followed the same protocol as the previous summer surveys: station activities included CUFES collections, icthyoplankton tows, CTD casts, weather observations, and a thirty minute surface trawl using a Nordic 264 midwater trawl conducted at night at speeds of three to three and a half knots.

Initial results indicate that both the egg and adult sardine occurrences were more northward and offshore than the 2003 and 2004 summer surveys. With only three surveys being conducted in the summers of 2003, 2004 and 2007 and with environmental factors significantly different in each of the summer years, it is difficult to draw conclusions as to spawning and adult distribution patterns.

P-17. Reproductive aspects of jumbo squid *Dosidicus gigas* d'Orbigny, 1835 caught along the west coast of the peninsula of Baja California in 2004-2006

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The jumbo squid is an important fishery species in Mexican waters, is distributed in the Gulf of California and along the west coast of the peninsula of Baja California. Its rate of growth may be affected by the oceanography features of each zone. All the specimens were collected during eleven cruises from January, April, July and October of 2004, 2005 and February, April and July 2006. In total, 476 squids were caught (323 females and 153 males). The female : male ratio was 2.6 : 1. The maturity stages of 461 squids were described (310 females and 151 males) according to the maturity stages proposed by Lipinski and Underhill (1995): I-II immature, III maturing, IV-V mature and VI spent. The maturity stage confirmed the existence of two groups of females and males. At least the 50% of males and females were maturity around the year independent of length; except for October. Our results show that female maturity is higher in July and February suggesting that there are two possible spawning peaks.

P-18. Evidence of spawning of jumbo squid along the Gulf of California

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In this work the spatial distribution of 145 juveniles of jumbo squid collected during five opportunity research cruises in the Gulf of California is presented. The juveniles were captured with a dip net during nightly hours while the ship was stopped, although the effort of collection was not the same in all cruises. The organism collected swam solitary or in small school between 2 and 12 organisms. The samples were collected in June (2006, 2007), May (1982, 2004) and April 2005 with a total distribution of size of 6-59 mm of DML. The identification of the juveniles was made following established criteria that consider the absence of ocular photophores and corporal morphometrics relation; in the case of juveniles collected in May 2004, their identification were corroborated through genetic analysis. Using the equation suggest by Markaida (2001) the number of living days were calculated finding that maximum size of the juveniles (59 mm of DML) is equal to 51.1 days of hatch. Spatial distribution shows juveniles are localized in areas distant of the coast, mainly along the Guaymas and Carmen basin increasing the only one area described for spawning inside the Gulf of California. Studies on the displacement speed of juveniles are important to carry out. Also is necessary to explore more areas which permit to infer about the preferences of the habitat in this early life stages of *Dosidicus gigas*.

P-19. Interannual variability in the population structure of jumbo squid (*Dosidicus gigas*) in Santa Rosalía, central Gulf of California

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The population structure of the jumbo squid *Dosidicus gigas* was described in the area of Santa Rosalía (central Gulf of California) during the years 2003 and 2004. In addition, we analyzed the interannual variability in the size structure of jumbo squid during a wider time period 1996-2004 (except 2000-2002). The results evidenced clear differences in the size and sexual maturity structure of males and females between 2003 and 2004. Jumbo squid population observed during the fishing season of 2003 showed high proportions of individuals with big size and sexually mature. In contrast, the majority of the specimens sampled during 2004 were smaller and immature. Expanding our time period, we observed a strong interannual variability in the size structure of jumbo squid within the Gulf of California which was also reflected in the size at maturity. These changes in the population structure of jumbo squid seem to be related with the occurrence and intensity of El Niño or La Niña events and should be considered for the management strategy of jumbo squid fishery within the Gulf of California.

P-20. Is diel vertical migration important to oceanic carbon export flux?

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The active transport of carbon out of the surface ocean by migrating fish that form the deep scattering layer is poorly known, but potentially large. Biomass measurements and CTD profiles from the CCE-P0704 cruise were combined with physiological and mortality rates from the literature using a computer model. The model results indicate an overall fish mediated transport of 0.7-3.2 mg C m^{-2} d^{-1} in the California Current. The fish carbon flux is similar to estimates of the migratory zooplankton flux from other ecosystems (2-3 mg C m^{-2} d^{-1}, summarized in Al-Mutairi and Landry, 2001), and is 6-7% of the passive carbon flux measured concurrently with sediment traps. The measured fish biomass is biased low due to net avoidance. We hope to measure this bias on future CCE-LTER cruises by combining quantitative sonar data with mesopelagic trawl sampling.

P-21. The importance of hake in the diet of the jumbo squid *Dosidicus gigas* in the north of the Peruvian zone (2005-2007)

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The jumbo squid is a voracious and highly opportunistic species that was blamed in the past for the decrease of some economically important fish populations like e.g. the Peruvian hake. The objective of the present work is to evaluate the importance of hake as a basic item of the diet of the jumbo squid.

14 surveys in the area off Talara (3°34'S) were conducted in depths from 5 to 60 m and a distance from the coast of 3 to 40 nm in the period from March 2005 to June 2007. In total 2365 individuals in the size range 42.1-108.2 cm mantle length (ML) were collected by manual jigging of which 23.4% presented stomach content. Qualitative and quantitative analysis were conducted to calculate the index of relative importance (%IRI) and the daily feeding ration. Additionally the grade of dietary similarity was calculated using the Bray-Curtis Index.

Between 4 and 15 prey items of the diet was composed mainly of cephalopods (%IRI = 40.1-98.1), crustacean (%IRI = 0.89-57.2) and with lower importance teleosts (Myctophidae, Merluccidae, Engraulidae and others, %IRI = 0.02-43.4). Cannibalism represented the most important part in the diet (%IRI $\geq$ 40). Hake was registered in 42.9% of the stomach samples with a %IRI below 3.76 with the exception of November 2006 when an %IRI of 15.5 was found.

The multivariate analysis showed two basic clusters with high similarity level only differentiated by the presence of conspecifics and non-identified cephalopods. Daily ration varied between 12.4 and 323.3 $g \cdot ind^{-1} \cdot day^{-1}$ which represent 0.09 to 1.96% of body weight. Hake consumption was found to be less than 0.04% of body weight.

These results indicate that hake does not constitute an important prey item of jumbo squid diet.

Keywords: *D. gigas*, espectro alimentario, ración diaria, merluza.

P-22. A taxonomic revision of the eastern Pacific swell shark, Genus *Cephaloscyllium* Gill 1862 (Chondrichthyes, Carcharhiniformes, Scyliorhinidae), with comments on the status of *C. Uter* (Jordan & Gilbert 1896)

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The genus *Cephaloscyllium* Gill 1862 (Chondrichthyes, Carcharhiniformes, Scyliorhinidae), arguably has one representative species in the eastern Pacific, *C. ventriosum* (Garman 1880). While the *C. ventriosum* holotype was collected from central Chile, a second species, *C. uter*, (Jordan and Gilbert 1896) was described from California. Garman (1913) classified *C. uter* as a junior synonym of *C. ventriosum*, but there has since been some confusion in the literature as to whether *C. uter* is valid and separate from *C. ventriosum*. This study marks the first morphometric and meristic analysis comparing the holotype of *C. ventriosum* from Chile with Californian *Cephaloscyllium* specimens and presents a revision of the genus for the eastern Pacific. Based on a comparison of morphometric and meristic data from specimens collected from Monterey, California; Santa Catalina Island, California; Santa Barbara, California; Guadalupe Island, Mexico; and Valparaiso, Chile, it is concluded that the California and Chilean *Cephaloscyllium* represent a single, wide-ranging species, *C. ventriosum*.

P-23. Assessment of *Dosidicus gigas* sperm longevity using fluorescence microscopy

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During mating, many male squids deposit sperm in packets ('spermatangia') externally to the female's buccal area where it is then stored for an unknown time before fertilization at spawning. When coupled with locomotory information from tagging studies, estimates of sperm longevity may help ascertain potential for interbreeding between populations. So that we may measure sperm longevity of species that must be examined at sea, we employed an alternative to traditional motility assays thereby avoiding the complications of shipboard vibration. Spermatangia of *Dosidicus gigas* from the Gulf of California were stored in 1 ML filtered seawater at 12°C for seven days, and sperm suspensions fixed in 3% formaldehyde every 12 hours. Samples were then refrigerated until examined at a later date. Sperm suspensions were filtered onto black polycarbonate filters and counterstained with Propidium Iodide, which only enters cells that were dead at fixing, and DAPI, which stains the nucleic acids of all cells. Filters were examined and photographed using fluorescence microscopy, and Adobe Photoshop® was used to quantify the number of live vs. dead sperm. Sperm lived slightly longer than five days. Given the maximum migration rate of *D. gigas*, females mated in the Gulf of California would not be likely to carry viable sperm to northern regions such as the Monterey Bay, where they have recently become resident.

P-24. The potential application of molecular methods for improving the taxonomic resolution of jumbo squid predation on rockfish off of Central California

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In the California Current, ongoing food habits studies demonstrate that larger *D. gigas* commonly feed on adult groundfish, including rockfish (*Sebastes*), Pacific hake, and several species of small flatfish. Of those rockfish that can be identified using traditional hard parts analysis (primarily otoliths), shortbelly rockfish (*S. jordani*) are the most frequently occurring species. However, many prey items cannot be identified to the species level, as squid often do not consume the heads, and consequently the otoliths, of larger prey. As the continued presence of squid has the potential to effect substantial change on California Current food webs, identification of those *Sebastes* species most vulnerable to predation would greatly improve the estimation of the impacts of this predator on both ecologically and commercially important species. We report the results of an initial attempt to develop prey identification to the species level for a sample of *Sebastes* prey remains collected off of Central California. The approach compares the genotype of an unknown individual at six nuclear microsatellite loci to a reference data set of genotypes from 759 individual fish from 33 *Sebastes* species commonly found off of Central California. Genetic assignment is accomplished using the program GENECLASS2, which calculates the likelihood that a tested genotype was derived from each reference species sample. We demonstrate that *Sebastes* DNA extracted from vertebrae or other remains recovered from D. gigas stomach samples can be successful amplified and identified to species. Although DNA degredation prevented the identification of all samples,this approach has great potential for forensic identification of *Sebastes* species in cases when morphological approaches are not possible.

P-25. Larval dynamics of *Panulirus interruptus* during the 1997-1999 ENSO event in the west coast of Baja California, Mexico.

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The spiny lobster (*Panulirus interruptus*) displays a very complex life cycle, and is subject to the influence of oceanographic processes like gyres, currents and upwelling. One of the most important processes that determine reproductive success is the El Niño-Southern Oscillation, since it modifies environmental conditions, and the larval stages of the lobster are affected during this event. In order to evaluate the impact of ENSO 1997-1999 on the dynamics of the larvae of the spiny lobster *P. interruptus*, off the west coast of the Baja California peninsula, eight oceanographic cruises were carried out during 1997 to 1999, by the IMECOCAL program. All phyllosomas were extracted from the plankton samples collected, and the developmental stage was assigned; the larvae counts were standardized to a marine surface area of $10m^2$. larval developmental stages (I-IV) were found in the summer, followed by intermediate larval stages (V-VIII) at the end of autumn, with final larval stages (IX-XI) occurring in the spring, and finally culminating with the presence of pelagic puerulus in summer of the following year. These results suggest a duration of the phyllosoma pelagic phase of approximately a year. Differences in the distribution and the abundance of larvae regarding to El Niño-La Niña events, latitude, coastal-ocean and night-day were tested using a Mann-Whitnney U- statistical test. Significant difference in larvae abundance were registered during the El Niño ($p < 0.001$), with highest values during autumn 1997 and 1998 due to a larger number of larvae in intermediate stages. Large numbers of phyllosoma larvae were predominantly distributed offshore and in the southern area ($p < 0.001$) along the study period. Significant variations between day-night captures ($p < 0.001$), suggest daily vertical movements of the larvae between the surface and deeper waters, mainly during the final developmental stages (XI). We conclude that El Niño 1997-1998 had a favorable effect on phyllosoma survival and probably promoting a decreasing developmental time. Pelagic puerulus were observed only during cold 1999. The distribution of the larvae was related to the prevailing currents, and in some cases, associated with oceanographic gyres. The mechanisms promoting lobster larvae distribution off the west coast of the Baja California peninsula are still unknown.