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DIRECTOR'S STATEMENT

The OSU/NOAA Cooperative Institute for Marine Resources Studies (CIMRS) represents a strong, long-term, NOAA-university partnership dedicated to research in marine science, graduate and public education, and cooperation with regional industries and communities that are dependent on marine resources.

An integral part of the OSU's Hatfield Marine Science Center (HMSC), CIMRS is a model cooperative institute for many reasons. By its co-location with three regional NOAA laboratories representing two NOAA Line Offices, the Institute is able to bring together research partners from a variety of disciplines to address complex multidisciplinary issues relating to the living and non-living components of the marine environment. It is also the administrative home for approximately 37 research staff and 4 research faculty working on collaborative projects with NOAA investigators who serve as OSU courtesy faculty. No other OSU research institute provides both grant administration and personnel review in the manner of an academic department. CIMRS faculty also conduct research with funding from agencies such as NSF and ONR, which extends the impact of the Institute and its value to NOAA. In FY11 outside awards were in excess of \$900,000.

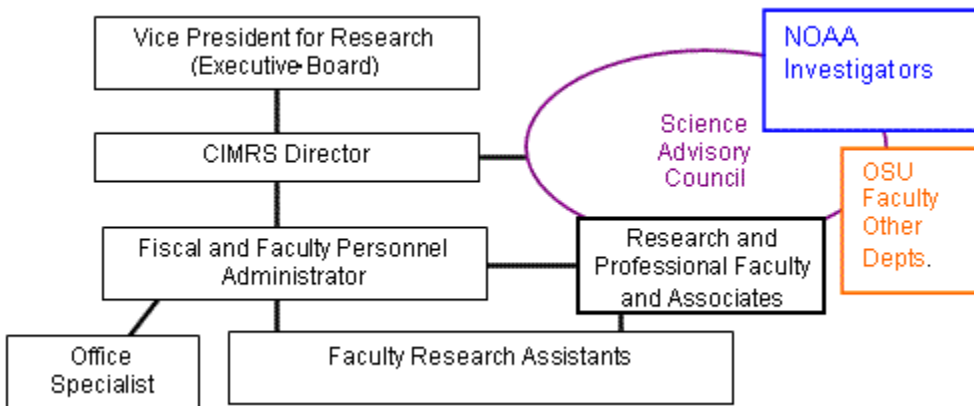
The research focus of CIMRS addresses living and non-living marine resources and is thus linked to programs that require environmental sampling or observing within the ocean and programs that characterize seafloor habitats. This focus encompasses the broad field of marine fisheries (including fisheries oceanography, habitat research, and ecosystem-based management), geological/chemical oceanography, marine mammal acoustics, and the effects of climate change on marine ecosystems. It thus addresses ecosystem and climate mission goals in NOAA's 5-year research plan and poises CIMRS research to contribute to NOAA's 20-year research vision.

The Institute thrives because of the commitment of leaders from within the laboratories of its NOAA associates and the OSU Research Office. As a result, during the past few years external research grant funding has grown, graduate student opportunities have diversified, and CIMRS has entrained many more OSU investigators from a broad range of disciplines to join together and address research problems of environmental, economic and social importance. Media recognition of CIMRS research this year included, but was not limited to Oregon Public Broadcasting, NPR, and Discovery Channel. Fourteen publications appeared in peer-reviewed scientific journals reporting results from CIMRS collaborative research.

In summary, the scientific accomplishments of CIMRS demonstrate its value to both NOAA and the University. Its purpose is to serve as a bridge between traditional disciplines, a crossroad for fostering new ideas, and a dependable source of new research and analysis. It is anticipated that ongoing efforts will continue to raise the profile of the Institute and the partnerships it cultivates. For more information, please contact our website at <http://oregonstate.edu/groups/cimrs>. Additional information is available from the HMSC Annual Reports, <http://hmsc.oregonstate.edu/overview.html>.

ORGANIZATION

CIMRS is administered through the OSU Research Office with oversight from an Executive Board made up of members from the participating NOAA laboratories and collaborating OSU colleges and programs under the terms of a Memorandum of Understanding between OSU and NOAA/NMFS. A Science Advisory Council (SAC) gives input on research directions, progress, and policy to the Director.



**2010/11
EXECUTIVE BOARD**

Rick Spinrad (Chair)
Vice-President for Research, Oregon State
University

Mark Abbott
Dean, College of Oceanic & Atmos.
Sciences, OSU

John Stein,
Acting Director, Northwest Fisheries Science
Center, NOAA

Stephen Brandt
Director, Oregon Sea Grant, OSU

Eddie Bernard/Mark Koehn, Acting
Director, Pacific Marine Environmental
Laboratory, NOAA

George Boehlert
Director, Hatfield Marine Science
Center, OSU

Sherman Bloomer
Dean, College of Sciences, OSU

Michael Banks
Director, CIMRS (Ex Officio), OSU

Larry Curtis
Assoc. Dean, College of Agricult. Sci., OSU

SCIENCE ADVISORY COUNCIL

Jerri Bartholomew – Associate Professor, OSU Microbiology

Michael Blouin – Professor, OSU Zoology

Elizabeth Clarke, NOAA, NWFSC/FRAM, Seattle

Tracy Collier, NOAA, NWFSC/EC, Seattle

David Noakes – Professor, OSU Fisheries & Wildlife

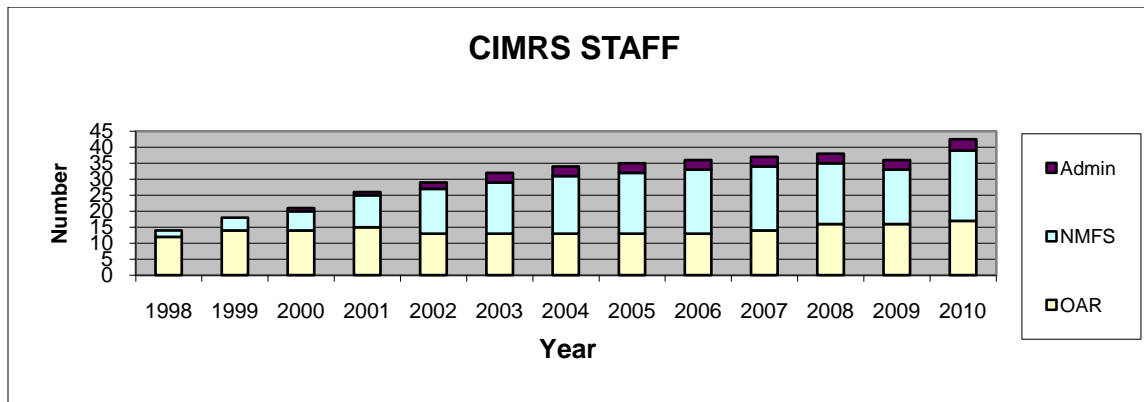
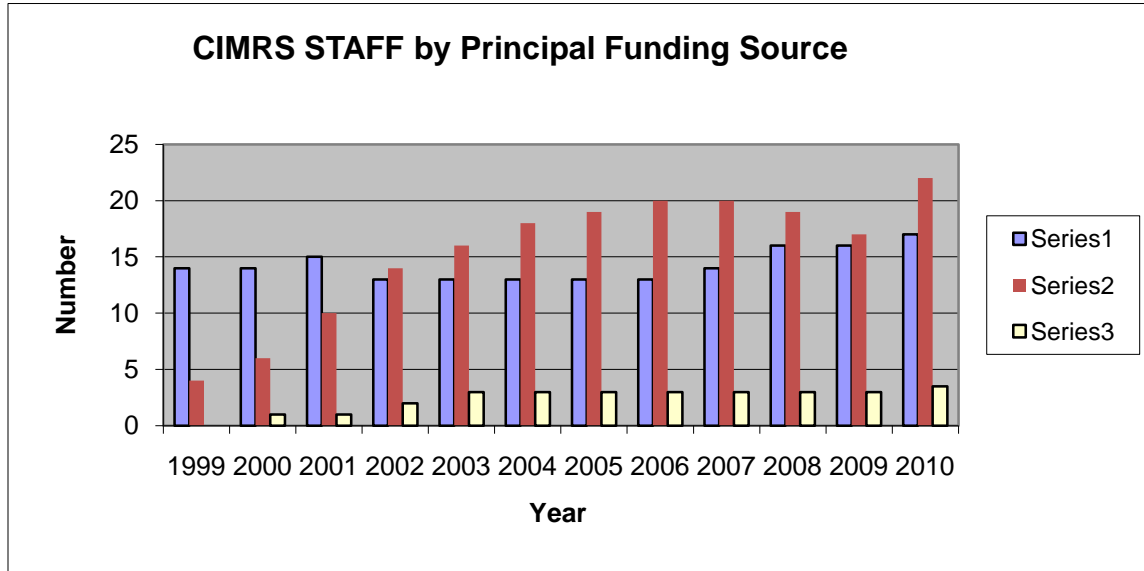
Bill Percy – Professor Emeritus, OSU College of Oceanic and Atmospheric Sciences

Clare Reimers – Professor, OSU College of Oceanic and Atmospheric Sciences

Dawn Wright – Professor, OSU Geosciences

Ex-Officio – Michael Banks

The number of CIMRS staff has grown steadily over the years as a result of new research initiatives in fisheries ecology, stock assessment, and marine mammal acoustics. The range of responsibilities and expertise of the staff have also grown and been recognized through promotion.



Faculty = Research Professors and the Director, ResAssoc = Research Associates, PrFac = Professional Faculty, Admin= Technical/Admin Staff, SFRA=Senior Faculty Research Assistants, FRA= Faculty Research Assistants.

ADMINISTRATIVE SUPPORT

In FY11, \$269,995 was expended by the University for CIMRS administration. These funds provided salary and benefits for the Director, Michael Banks (0.37 FTE), the Fiscal and Faculty Personnel Administrator, Jessica Waddell (1.0 FTE), and two part-time office specialists (0.5 FTE). Administration funds were also used for consultant fees, personnel training and staffing, routine office supply costs, communications, computer network fees, vehicle rental/travel, hosting meetings, and contributing to public events at HMSC. Administrative support provided by the HMSC Business Office is not included in this figure.

Additional directed support from the NWFSC for project coordination provided another portion of the Director's salary and benefits (0.15 FTE).

RESEARCH SUPPORT

The Institute also independently supports requests for small pilot projects, frequently in conjunction with a college or department. This year CIMRS (in conjunction with the Department of Fisheries and Wildlife) funded the following project:

J. Zappa/K. Borgen \$4,000: "Effects of Hemocyanin in Diet on Flesh Coloration and Growth of Juvenile Lingcod"

The OSU Research Office supported a proposal from CIMRS investigators awarded through the Research Equipment Reserve Fund with a minimum 20% match of funds from the Institute's research reserve fund.

Dr. Louise Copeman/Chris Langdon \$26,668 (\$6672 commitment from CIMRS): "Agilent/HP 6890 Gas Chromatograph for Lipid Analysis"

PROJECTS SUPPORTED WITH CONTRIBUTED FUNDS FROM NOAA PARTNER LABORATORIES IN FY 2010/11

This section summarizes directed research projects undertaken by CIMRS with research funding received from NOAA through the Northwest Fisheries Science Center and the Pacific Marine Environmental Laboratory. All projects were approved by the Assistant Administrator and the Grants Management Division of NOAA after independent merit review.

Projects under Grant NA17RJ1362

West Coast Fisheries Research – Northwest Fisheries Science Center

Total Award \$1,059,286 7/1/10-9/30/12

"The Effects of Ocean Variability on Marine Survival of Fishes"

This project supports the active monitoring of ocean conditions, zooplankton distributions, and fish populations off the coasts of Washington, Oregon and California. New field efforts and retrospective analysis of historical data are being undertaken with all efforts emphasizing relationships between ocean conditions and growth and survival of marine fishes. Specific focus areas are *Plume Habitat and Pelagic Fish Ecology*, *Zooplankton Ecology*, *Nekton Distribution*, *Trophic Ecology*, *Pelagic/Demersal Fish Habitat and Bioacoustics Studies*, and *Long-term Indices of Annual Growth of Long-lived Groundfishes*.

A new project in FY 11 created an educational/outreach exhibit with an interactive touch screen computer displaying current and historical physical and biological ocean conditions gathered from the NOAA's NWFSC "Ocean Ecosystem Indicator" website will be developed for the HMSC Visitor Center. This hands-on exhibit will engage visitors and promote their interaction with data to gain an understanding of science that is being conducted on the very campus they are visiting. Data includes Pacific Decadal Oscillation phase, MEI El Nino Index, Sea Surface Temperature, upwelling, copepod abundance and type, dates of spring transition etc. and other variables that are developed and included in the index.

OSU Investigators, Research Staff: Selina and Scott Heppell, Associate Prof. F&W; Mattias Johansson, Jay Peterson, David Rupp, Jim Ruzicka, Research Associates; Leah Feinberg, Tracy Shaw Sr. Faculty Research Assistants; Toby Auth, Tristan Britt, Jennifer Menkel, Faculty Research Assistants; Rebecca Baldwin, Graduate Research Assistant, Kathryn Stoffer, Student Intern

Collaborating NOAA Investigators: Ric Brodeur, Bill Peterson, Tom Wainwright, Rick Brown

"Watershed and Estuarine Processes"

Cumulative habitat loss, species introductions, and waste inputs have altered biological communities and reduced the resilience of many Northwest estuaries. This project concentrates on studies of Estuarine Habitats and Salmonid Life History and surveys of Salmon Utilization within the Columbia River Estuary.

Another method of investigation actually maps land use to identify changes in ecologically significant units of salmonid habitat along the West Coast. Validation of the mapped areas identifies what methods are best and what new reference data are needed in support of legally defensible estimates of habitat change over time.

OSU Investigators, Research Staff: Andrew Claxon, Faculty Research Assistant; Robert Kennedy, Asst. Prof., Sr. Res.; Peder Nelson, Faculty Research Assistant

Collaborating NOAA Investigators: Kym Jacobson, FE/NWFSC; Chris Jordan NWFSC

"Fisheries Habitat Investigations"

The objective of this work is to integrate many types of oceanographic, biological, geological (e.g., seafloor bathymetry, sidescan sonar images, sediment and rock types, active fault zones, observations and measurements from submersibles) and groundfish fisheries data (including fishery dependent records) into a Geographical Information System (GIS) so that information

can be overlain on spatial maps. These maps are then utilized to characterize, classify and predict the distribution of seafloor habitats, to study relationships between habitat type and productive versus unproductive fishing grounds, and to document the consequences of management measures on fishing activities and habitat.

OSU Investigators, Research Staff: Chris Goldfinger, Associate Prof., College of Oceanic and Atmospheric Sciences, Jack Barth, Professor, College of Oceanic and Atmospheric Sciences, Steve Pierce, Research Associate, Chris Romsos, Faculty Research Assistant (all COAS)

Collaborating NOAA Investigators: Waldo Wakefield, NWFSC



Dosidicus gigas (Humboldt or Jumbo squid)

Although the squid were reported off southern Oregon during an unusually warm water event in 1997, their appearance during five recent summers in Oregon waters suggests that this subtropical predator may now be well established in Pacific Northwest waters. The presence of the squid may be related to a warming Ocean, but it has not been proven yet.

“Stock Assessment Improvement”

Population Dynamics and Stock Assessment of W.C. Groundfish

Stock assessments and statistical analyses provide the basis for identifying over fished and threatened stocks, guiding and monitoring rebuilding of these stocks, and forecasting

biologically sustainable harvest levels for healthy stocks of commercial fish. They are conducted periodically to track changes in abundance and are supported by long-term fishery-dependent and fishery-independent monitoring, and life history studies.

OSU Research Faculty: Megan O'Connor, Research Associate
Collaborating NOAA Investigator: Jim Hastie, NWFSC



Ocean Environment Research OAR– Pacific Marine Environmental Laboratory

Total Award \$1,892,233; 7/1/10-6/30/12

This multidisciplinary project seeks to quantify the effects of submarine volcanic and hydrothermal activity on the ocean. Continuous acoustic monitoring of spreading centers in the world's oceans allows investigators to detect and study the chemical, physical, geological and biological effects of tectonic activity on the global ocean and to follow free-ranging populations of large cetaceans. Specific focus areas are *Ocean Observing Systems, Hydrothermal Venting, Marine Mammal Acoustics, Microbiology of Seafloor Vents and Eruptions, Fisheries Oceanography*.

The Acoustic Monitoring Project provides wide-area, continuous seismic monitoring of global ridge systems using low-frequency acoustics. The primary focus of the effort is in using the U.S. Navy SOSUS hydrophone arrays to provide real-time monitoring of the Juan de Fuca /Gorda Ridge systems to queue event response efforts. Additionally, CIMRS investigators maintain and deploy both autonomous and near real-time (via satellite) hydrophone technologies for acoustic characterization of remote regions of the global oceans.

In order to acoustically monitor areas of the world ocean not covered by existing fixed hydrophone arrays, CIMRS scientists have developed autonomous moored hydrophone instruments to record acoustic energy from both underwater seismic activity as well as that from whale calls. These instruments are capable of recording frequencies from 1 - 1000 Hz, and can record data for over a year before servicing is required. The hydrophones are designed to be deployed as an array of independent instruments whose geometry can be determined by the needs of the experimenter in order to localize acoustic sources of interest.

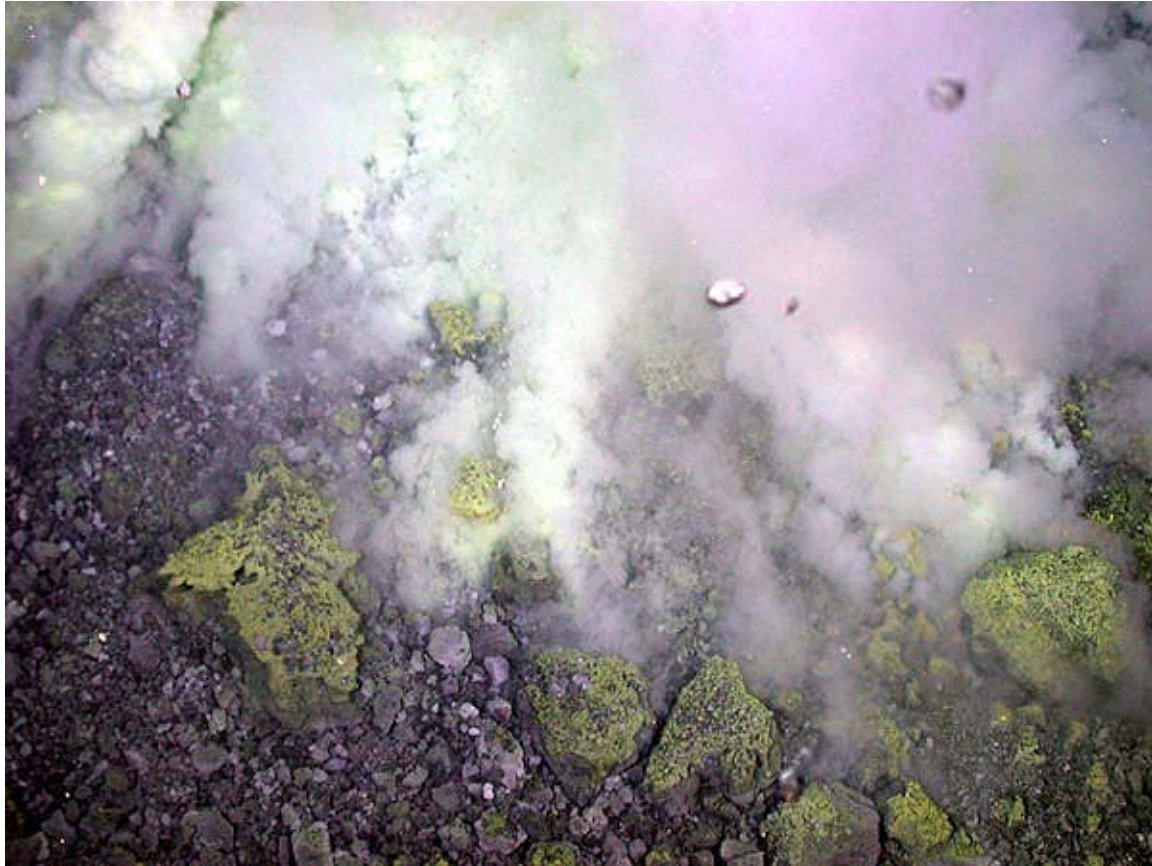
The goal of the Geophysical Monitoring program is to better understand how submarine volcanoes work. Efforts continue to be divided between projects focused on volcano monitoring in the NE Pacific and seafloor mapping and exploration in the Western Pacific.

CIMRS researchers involved in the Hydrothermal Emissions project collect, measure, and analyze trace elemental gases in hydrothermal fluids, particularly helium-3, using ultra-high vacuum mass spectrometry. The objective of this research is to assess the locations, mechanisms, chemical flux rates and ages of active hydrothermal systems along sea floor spreading centers with the eventual end result of quantifying and predicting large-scale spatial and temporal effects of venting on ocean chemical and thermal budgets.

The Coastal Tide Modeling project assesses the effects of increasing the spatial resolution of a coastal tide model on the modeled tides and tidal currents for a variety of sites along the open coast, island locations and within embayments. The OSU tidal inversion software (OTIS) has been modified and tested for simulating tides at the very high spatial resolution required for tsunami hazard modeling.

OSU Investigators, Research Staff: William Chadwick, Professor., Sr. Res., Robert Dziak, Professor., Sr. Res., David Mellinger, Associate Prof., Sr., Res., Haru Matsumoto, Assistant Professor, Sr. Research; Andra Bobbitt, Susan Merle, Sharon Nieu Kirk, Sr. Faculty Research Assistants; Leigh Evans, Matthew Fowler, Ron Greene, Joe Haxel, Sara Heimlich, Faculty Research Assistants; Andy Lau, Professional Faculty (all CIMRS); Gary Egbert, Prof., S. Erofeev, Research Associate, COAS

Collaborating NOAA Investigators: Robert Embley, Vasily Titov, Stephen Hammond, John Lupton (all PMEL/OERD)



Fisheries Oceanography projects involve collaboration with investigators from NOAA's Alaska Fisheries Science Center on studies that are broad ranging, from physical, biological, chemical and anthropogenic events and conditions affecting the state of the oceans. This year's 36-day cruise focused on the ecosystems of the eastern Bering Sea, performing multiple hydrographic samplings, zooplankton experimentation and bird observations.

Fisheries Oceanography
Alaska Fisheries Science Center

Climate and Habitat Effects on Productivity of Alaska Groundfish and Crabs - \$158,700
OSU Investigators, Research Staff:

Louise Copeman, Research Associate, Post-doc; Whitney Clerf, Courtney Danley, Faculty Research Assistants

Collaborating NOAA Investigators: Tom Hurst, AFSC/RACE

Stock Structure of NP Minke Whales - \$42,616

OSU Investigators, Research Staff:

Scott Baker, Assoc. Prof., F&W; Debbie Steel, Faculty Research Assistant

Collaborating NOAA Investigators: Phil Clapham, AFSC/NMML

DNA Analysis of Humpback Whales - \$53,582

OSU Investigators, Research Staff:

Scott Baker, Assoc. Prof., F&W; Debbie Steel, Faculty Research Assistant

Collaborating NOAA Investigators: Paul Wade, AFSC/NMML

Steller Sea Lion Resights at Sea Lion Caves, Oregon - \$24,945

OSU Investigators, Research Staff:

Marcus Horning, Assoc. Prof., F&W; Kim Raum-Suryan, Faculty Research Assistant

Collaborating NOAA Investigators: J. Scordino, AFSC/NMML

Acoustic Whale Monitoring in the southeastern Bering Sea - \$43,333

OSU Investigators, Research Staff:

David Mellinger, Assoc. Prof., Sr. Res., Holger Klinck, Elizabeth Kusel, Research Assoc., Post-docs

Collaborating NOAA Investigators: Catherine Berchok, AFSC/NMML

Analysis of Acoustic Data Collected in the Beaufort Sea - \$30,901

OSU Investigators, Research Staff:

David Mellinger, Assoc. Prof., Sr. Res; Sharon Nieukirk, Sr. Faculty Research Asst.

Collaborating NOAA Investigators: Catherine Berchok, AFSC/NMML

Impacts of Climate on Long-term Growth Patterns of Yellowfin Sole in the Bering Sea: Empirical Modeling and Incorporation into Stock Assessment Models - \$50,424

OSU Investigators, Research Staff:

Bryan Black, Asst. Prof., Sr. Res.

Collaborating NOAA Investigators: Thomas Helser, Beth Matta, Tom Wilderbuer, AFSC/REFM

Seabird Bycatch Avoidance for West Coast Groundfish Fisheries - \$12,000

OSU Investigators, Research Staff:

Rob Suryan, Asst. Prof., Sr. Res.

Collaborating NOAA Investigators: Shannon Fitzgerald, M. Perez, K. Rivera, AFSC/REEM

OFFICE OF CLIMATE OBSERVATION

Ocean Acidification Monitoring and Prediction in Oregon Coastal Waters - \$116,318

OSU Investigators, Research Staff: Jack Barth, Prof. OSU/COAS; Burke Hales, Associate Prof. OSU/COAS; A. Erofeeva, Res. Associate Post-doc, OSU/COAS

Collaborating NOAA Investigators: Dr. Richard Feely, NOAA, PMEL



FY 2010/11 CONTRACTS

Survival and Growth of Juvenile BPA \$695,000
Salmonids...



FY 20010/11 GRANTS FROM OTHER AGENCIES

Title	Source	Total Funding	Duration	PI
Assessment of T-Wave Processes and Hydroacoustic Monitoring Capabilities in Lau Basin	NSF	\$113,771	10/09-9/11	Dziak/Matsumoto
Continuous Acoustic&Volcanic Debris Records	NSF	\$88,059	9/01/10-8/31/11	Dziak
Monitoring Inflation at Axial Seamount	NSF	\$21,507	9/15/07-8/31/11	Chadwick
Next Generation Bioacoustic Analysis Software	ONR	\$255,733	4/10-3/13	Mellinger
Detection, Classif., Local. Workshop	ONR	\$29,095	1/01/11-5/31/12	Mellinger
Factors Influencing the Acoustic Behav. Gray Whales	ONR	\$72,359	1/01/09-12/31/11	Mellinger
Detection, Classif.& Density Estimation of Marine Mammals	ONR	\$328,750	6/22/10-6/30/12	Mellinger
Density Estimate for Cetaceans	ONR	\$37,319	4/01/11-3/31/13	Mellinger
Passive Acoustic Monitoring of the Arctic	NFWF	\$25,021	10/01/10-7/31/12	Klinck
Detection, Classification, and Density Estimation of Marine Mammals	ONR	\$328,750	6/10-6/11	Mellinger
Acoustic Behavior of Gray Whales	ONR	\$21,924	1/09-12/11	Mellinger



INSTITUTE DIRECTOR'S ACTIVITIES

Administrative

National service

Served on the Executive committee for National CI Directors meeting in Washington DC 22-23, March 2011.

Responded to NOAA's RFP for a West Coast Cooperative Institute to support research facilities in the area of marine resources, which would secure funding for five years, and with favorable review, an additional five years. The final budget request of \$33,760,688 included four research themes: Marine Ecosystems and Habitat, Protection and Restoration of Marine Resources, Seafloor Processes, and Marine Bioacoustics.

University Service

Hosted joint meetings with OSU faculty leaders, CIMRS students, staff and faculty

OSU Centers, Institutes and Programs meetings (quarterly)

OSU Provost's Marine Council meetings (quarterly)

Recruited two new CIMRS Post Docs

Research

The Institute Director's research was supported in 2010/11 through grants awarded to the Coastal Oregon Marine Station, Dept. of Fisheries and Wildlife where he holds a faculty appointment at the rank of Associate Professor.

<u>Title</u>	<u>Funding</u>	<u>Duration</u>	<u>P.I.</u>	<u>Banks mths</u>
Genetic pedigree analysis of McKenzie River spring Chinook salmon: An evaluation of adult outplanting strategies	\$183,150	8/02/10-6/30/11	Johnson/Banks	1.5
FY08 Appropriation to OSC	\$434,901	2008-11	Sylvia/Banks/ Morrissey	0.2
	OSU \$155,599			

Strategies to Minimize Catch Of Klamath Chinook	\$1,000,000	2008-11	Goldenberg(CAS)	0.2
	OSU \$298,500			
Klamath River Disaster Economic Relief Funds to OSC	\$931,182	2008-11	Sylvia/Banks	0.2
	OSU \$259,497			
FY09 Appropriation to OSC	\$199,800	2009-12	Sylvia/Banks	0.2
	OSU \$110,678			
Analysis of DNA Samples to ID Juv. Winter and Spring Run Salmon	\$306,211	5/20/08-12/31/12	Banks	1.5
OSU Component for Nonpareil Dam Adult Trap and Genetic Pedigree	\$265,384	1/15/09-10-31-11	Banks	1
Testing Clock Genes, SNPs and Microsatellites for Population Identification among Central Valley Chinook	\$599,993	10/01/07-6/30/11	Banks	1
Acquisition of Next Generation Sequencer for Marine Genomics	\$115,000	7/01/10-6/30/11	Banks/O'Malley/Baker	0.2

PUBLICATIONS

MARINE FISHERIES GENETICS & CONSERVATION (n=5)

*Papers by students or postdoctoral advisees, whom I offer first authorship as a matter of policy.
+ Reported last year "in press"

*Johnson M.A., and M.A. Banks. In press. Sequence conservation among orthologous vomeronasal type 1 receptor-like (Ora) genes does not support the differential tuning hypothesis in Salmonidae. *Gene*.

*Baldwin R.E., M.A. Banks, and K.C. Jacobson. 2011. Integrating fish and parasite data as a holistic solution for identifying the elusive stock structure of Pacific sardines (*Sardinops sagax*) *Reviews in Fish Biology and Fisheries* doi 10.1007/s11160-011-9227-5

*Baldwin R.E., M-B Rew, M.L. Johansson, M.A. Banks, and K.C. Jacobson. 2011. Population structure of three species of Anisakis nematodes recovered from Pacific sardine (*Sardinops sagax*) distributed throughout the California Current System. *Journal of Parasitology* doi: 10.1645/GE-2690.1

*Thériault, V., G.R. Moyer, L.S. Jackson, M.S. Blouin, and M.A. Banks. 2011. Reduced reproductive success of hatchery coho salmon in the wild: insights into most likely mechanisms. *Molecular Ecology*. doi: 10.1111/j.1365-294X.2011.05058.x

*+Johansson, M.L. and M.A. Banks. 2011. Olfactory Receptor Related to Class A, Type 2 (V1r-Like Ora2) Genes Are Conserved between Distantly Related Rockfishes (Genus *Sebastes*). *Journal of Heredity*. 102(1):113-7.

CIMRS GRADUATE STUDENTS SUPPORTED THROUGH JOINT PROJECTS

A number of graduate student projects are being supported with contributed grant funds from NOAA Fisheries. The CIMRS Director works to match qualified students with projects and courtesy faculty based at the Hatfield Marine Science Center and at main campus.

Ph.D. Candidates – Fisheries and Wildlife

Rebecca Baldwin 2006-2010 Using Parasite Community Data and Population Genetics for Assessing Pacific Sardine (*Sardinops sagax*) Population Structure along the west coast of North America
Co-Major Professor: Michael Banks/Kym Jacobson
NOAA Fisheries Rep: Kym Jacobson, NWFS

Kevin Thompson 2008-2012 TBA
Major Professor: Selina Heppell
NOAA Fisheries Rep: Grant Thompson, AFSC

Master's Candidates - College of Oceanic and Atmospheric Sciences

Jesse Lamb 2008-2011 Comparing the hydrography and copepod community structure between the continental shelf ecosystems of Washington and Oregon, USA, 1998 - 2009: Can a single transect serve as an index of ocean conditions over a broader area?
Major Professor: Tim Cowles
NOAA Fisheries Rep: Bill Peterson, NMFS

Master's Candidates – Fisheries and Wildlife

James Losee 2010-13 Does Interannual Variability of Trophically Transmitted Parasites in Chinook and Coho Salmon Relate to Physical and Biological Processes in the Northern California Current?

Major Professor: Jessica Miller
NOAA Fisheries Rep: Kym Jacobson, NWFS



2010-2011 PUBLICATIONS

- Auth, T.D.** 2010. Importance of far off-shore sampling in evaluating the ichthyoplankton community in the Northern California Current. *Calif. Coop. Ocean. Fish. Invest. Rpts.* 50: 107-117.
- Baldwin, R.E., M. Rew, M. Johansson, M. Banks,** and K. Jacobson. 2011. Population structure of three species of Anisakis nematodes recovered from Pacific sardine (*Sardinops sagax*) distributed throughout the California current system. *J. of Parasitology* 97(4): in press.
- Black, B. A.** I.D. Schroeder, W.J. Sydeman, S.J. Bograd, P.W. Lawson. 2010. Wintertime ocean conditions synchronize rockfish growth and seabird reproduction in the central California Current ecosystem. *Canadian J. Fish. & Aquat. Sci.* 67 (7): 1149-1158.
- Black, B. A.,** J.B. Dunham, B.W. Blundon, M.F. Raggon, D. Zima. 2010. Spatial variability in growth-increment chronologies of long-lived freshwater mussels: Implications for climate impacts and reconstructions. *Ecoscience* 17 (3): 240-250.
- Brodeur, R.D., **E.A. Daly,** C.A. Benkwitt, C.A. Morgan, and R.L. Emmett. 2011. Catching the prey: Sampling juvenile fish and invertebrate prey fields of juvenile coho and Chinook salmon during their early marine residence. *Fisheries Res.* 108:65-73.
- Copeman, L.A.,** B.J. Laurel. 2010. Experimental evidence of fatty acid limited growth and survival in Pacific cod (*Gadus macrocephalus*) larvae. *Marine Ecology Progress Series* 412:259-272.
- Daly, EA.,** C. E. Benkwitt, R.D. Brodeur, **M. Litz, L.A. Copeman.** 2010. Fatty acid profiles of juvenile salmon indicate prey selection strategies in coastal marine waters. *Mar. Biol.* 157 (9): 1975-1987.
- DeRonde, C., G. Massoth, D. Butterfield, B. Christenson, J. Ishibashi, R. Ditchburn, M. Hannington, R. Brathwaite, J. Lupton, V. Kamenetsky, I. Graham, G. Zellmer, **R. Dziak,** R. Embley, V. Dekov, F. Munnik, K/ Lahr, **L. Evans,** K. Takai. 2011. Submarine hydrothermal activity and gold-rich mineralization at Brothers Volcano, Kermadec Arc, New Zealand. *Miner Deposita* DOI: 10. 1007/s00126-011-0345-8.
- Hart, T. D.,** J.E. R. Clemons, W.W. Wakefield, S.S. Heppell. 2010. Day and night abundance, distribution, and activity patterns of demersal fishes on Heceta Bank, Oregon. *Fish. Bull.* 108 (4): 466-477.
- Hooft, E., H.Patel, W. Wilcock, K. Becker, D. Butterfield, E. Davis, **R. Dziak,** K. Inderbitzen, M. Lilley, P. McGill, D. Toomey, and D. Stakes. 2010. A seismic swarm and regional

hydrothermal and hydrologic perturbations: The northern Endeavour segment, February 2005. *Geochem. Geophys. Geosystems* 11: Art. No. Q12015.

- Klinck, H., and D.K. Mellinger.** 2011. The energy ratio mapping algorithm (ERMA): a tool to improve the energy-based detection of odontocete clicks. *J. Acoust. Soc. Am.* 129(4):1807-1812.
- Klinck, H., D. K., Mellinger, K. Klinck, J. Hager,** L. Kindermann, O. Boebel. 2010. Long-range underwater vocalizations of the crabeater seal (*Lobodon carcinophaga*). *J. Acoust. Soc. Am.* 128 (1): 474-479.
- Kuesel, E.T., D.K. Mellinger,** L. Thomas, T. Marques, D. Moretti, J. Ward. 2011. Cetacean population density estimation from single fixed sensors using passive acoustics. *J. Acoust. Soc. Amer.* 129(6): 3610-3622.
- Laurel, B.J., **L.A. Copeman,** T.P. Hurst, C.C. Parrish. 2010. The ecological significance of lipid/fatty acid synthesis in developing eggs and unfed larvae of Pacific cod (*Gadus macrocephalus*). *Marine Biology* 157(8): 1713-1724.
- Liu, Hui** and W.T. Peterson. 2010. Seasonal and inter-annual variations in the abundance and biomass of *Neocalanus plumchrus* in continental slope waters off Oregon. *Fish. Oceanogr.* 19(5): 354-369.
- Matta, M.E., **B.A. Black,** T.K. Wilderbuer. 2010. Climate-driven synchrony in otolith growth-increment chronologies for three Bering Sea flatfish species. *Mar. Ecol. Prog. Ser.* 413: 137-145.
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CIMRS OUTREACH ACTIVITIES

Educational and scientific outreach is important in all aspects of CIMRS research. Websites are a venue that reach an enormous audience. CIMRS investigators feature their collaborative research efforts in the fields of fisheries oceanography, geophysical and acoustic monitoring of spreading centers, ocean exploration, and bioacoustic monitoring of large cetaceans at several sites hosted by NOAA and CIMRS. One award winning website (<http://www.pmel.noaa.gov/vents>) features educational curricula, video clips of in situ seafloor experiments, and animated 3-dimensional fly-through movies of seafloor ridges.

The Visitor Center at OSU's Hatfield Marine Science Center also lends a convenient outlet for educational displays and programs which may be viewed by 150,000 attendees annually. This year exhibits were updated and renovated with large screen format for Patterns of Sound and Sounds of the Seas. Considerable collaborative effort was extended to Sea Grants' Ocean Quest 09 program, teaching summer interns about the latest underwater eruptive events at NW Rota in the Kermadec-Tonga Trench and sharing exciting videos with the public. NOAA's Teacher-at-Sea Program and the Ocean Exploration Program have helped sponsor educators on land and at sea who together present and interpret research activities for the general public. CIMRS investigators have also collaborated with Sea Grant Educational staff to design and prepare interactive exhibits. At the "ROPOS Exhibit", visitors can pilot a remotely operated vehicle to the seafloor and back with a joystick while viewing computer-generated and real video clips of the seafloor. Another exhibit "Sensing the Sea" allows visitors to "experiment" with sounds propagating through a salt water tank, simulating physical, biological, and anthropogenic sound that researchers monitor in the global oceans.

The newest still-developing exhibit "Sensing Salmon Runs" is an interactive display of the data collected by OSU and NOAA collaborators to predict future salmon runs in the Pacific Northwest. The exhibit display provides this information in ways that will engage the public in a free choice learning experience. Data used for the "predictions" include Pacific Decadal Oscillation phase, MEI El Nino Index, Sea Surface Temperature, upwelling, copepod abundance and type, dates of spring transition, etc.

CIMRS researchers also provide valuable volunteer hours at K-12 Science Fairs and related activities throughout the year.

