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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 34 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 FY10 outside awards were in excess of \$1.3M.

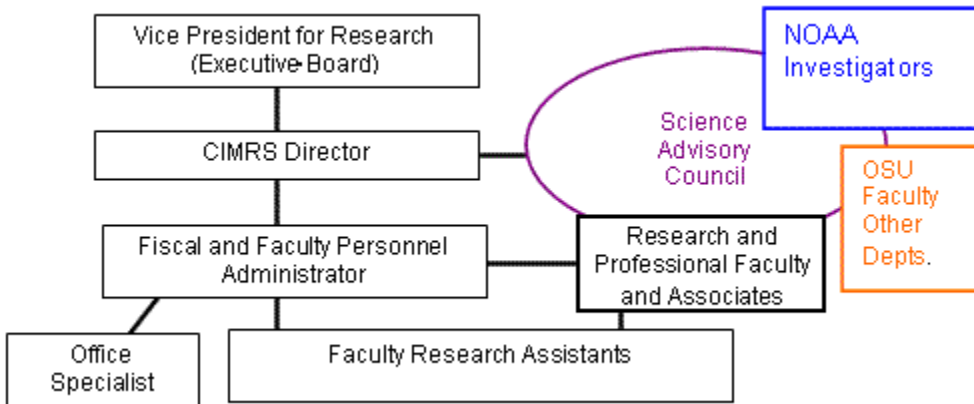
The research focus of CIMRS addresses living and non-living marine resources and is thus linked to programs that require environmental sampling or observing within the ocean and programs that characterize seafloor habitats. This focus encompasses the broad field of marine fisheries (including fisheries 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.



**2009/10
EXECUTIVE BOARD**

John Cassady (Chair)
Vice-President for Research, Oregon State
University

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

Usha Varanasi
Director, Northwest Fisheries Science
Center, NOAA

Stephen Brandt
Director, Oregon Sea Grant, OSU

Eddie Bernard
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

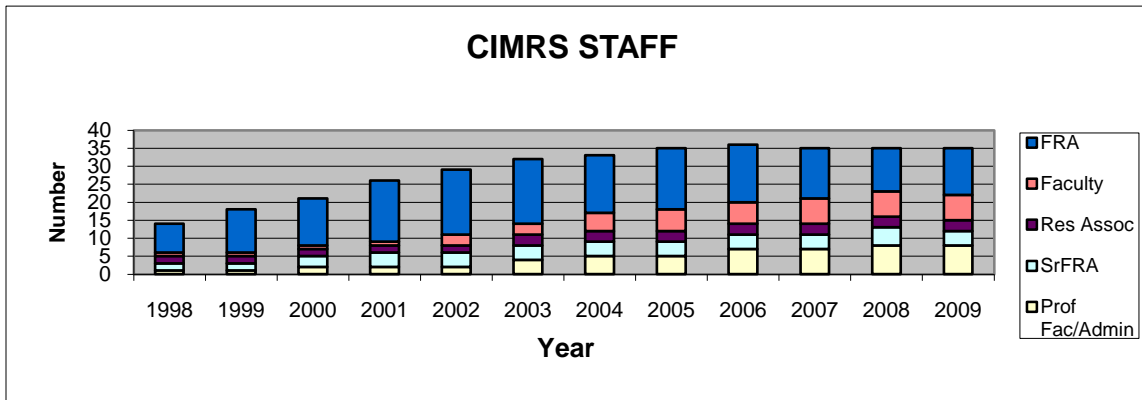
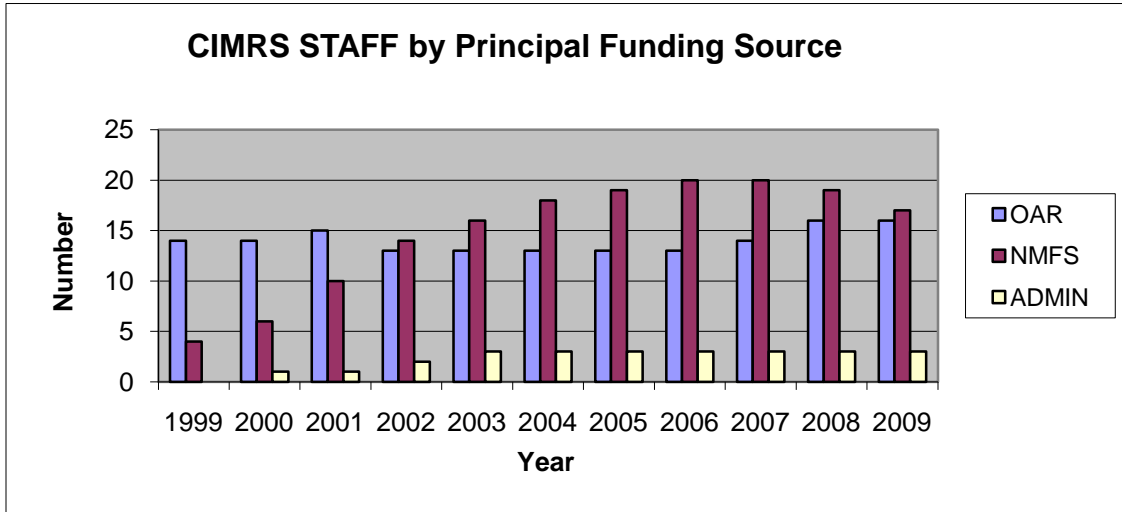
Bill Percy – Professor Emeritus, OSU College of Oceanic and Atmospheric Sciences

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 FY10, \$198,225 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 a part-time office specialist (0.5 FTE). Administration funds were also used for support of one summer REU student, 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 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. Robert Dziak \$9032: "Shallow Water Passive Acoustic Monitoring"

PROJECTS SUPPORTED WITH CONTRIBUTED FUNDS FROM NOAA PARTNER LABORATORIES IN FY 2009/10

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 \$997,835 7/1/09-6/30/10

"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.*

OSU Investigators, Research Staff: Selina and Scott Heppell, Associate Prof. F&W; Bryan Black, Asst. Prof., Sr. Res.; Hui Liu, Jay Peterson, Jim Ruzicka, Research Assoc.; Leah

Feinberg, Tracy Shaw Sr. Faculty Research Asst., Toby Auth, Tristan Britt, Jennifer Menkel, Faculty Research Assistants; Rebecca Baldwin, Graduate Research Assistant

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

“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.

OSU Investigators, Research Staff: Andrew Claxon, Faculty Research Assistant

Collaborating NOAA Investigators: Kym Jacobson, FE/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 and Elizabeth Clarke, FRAM/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: Elizabeth Clarke, FRAM/NWFSC

Estimating Key Life History Parameters of Selected Rockfish

This project supports graduate research in the field of fisheries and wildlife with specific emphasis on stock-assessment related research in seven areas:

- Development of advanced stock assessment methods that address key areas of uncertainty

- Advanced stock projection modeling
- Improved survey design
- Influence of natural and abiotic factors on vital rates
- Climate impacts on production of marine fish stocks
- Factors influencing spatial distribution of stocks
- Key processes governing predator/prey relationships

Current support for GRA K. Thompson has produced literature reviews and preliminary modeling work pertaining to ecosystem models in the Gulf of Alaska ecosystem. This research is being used to develop a dissertation proposal working with Dr.'s Grant Thompson and Selina Heppell and staff of the NMFS Alaska Fisheries Science Center on ecosystem models as they pertain to fisheries management.

OSU Research Faculty: Selina Heppell, Assoc. Prof., Dept. of Fisheries and Wildlife; GRA Kevin Thompson

Collaborating NOAA Investigator: Grant Thompson, REFM/AFSC



Ocean Environment Research – Pacific Marine Environmental Laboratory

Total Award \$1,792,710; 7/1/09-6/30/10

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.

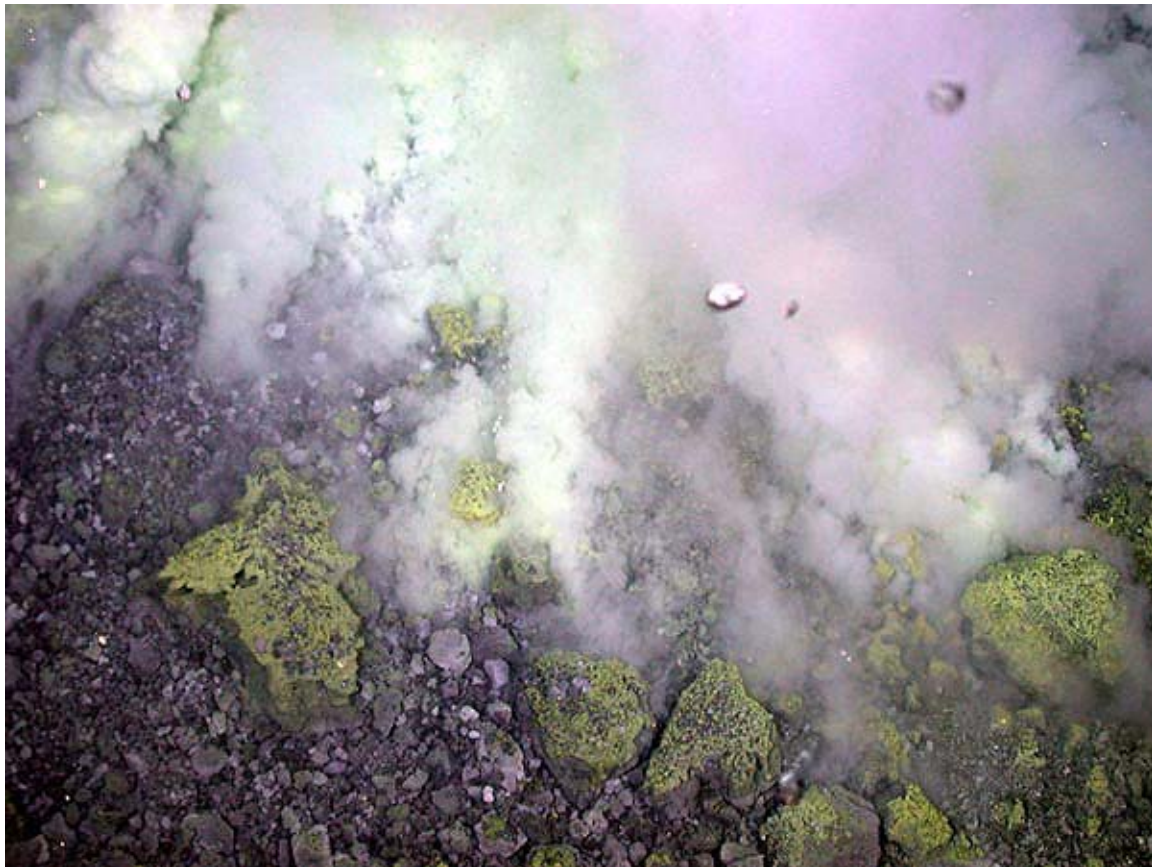
CIMRS researchers involved in the Hydrothermal Emissions project collect, measure, and analyze trace elemental gases in hydrothermal fluids, particularly helium-3, using ultra-high vacuum mass spectrometry. The objective of this research is to assess the locations, mechanisms, chemical flux rates and 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 Niekirk, 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)



FY 2009/10 CONTRACTS

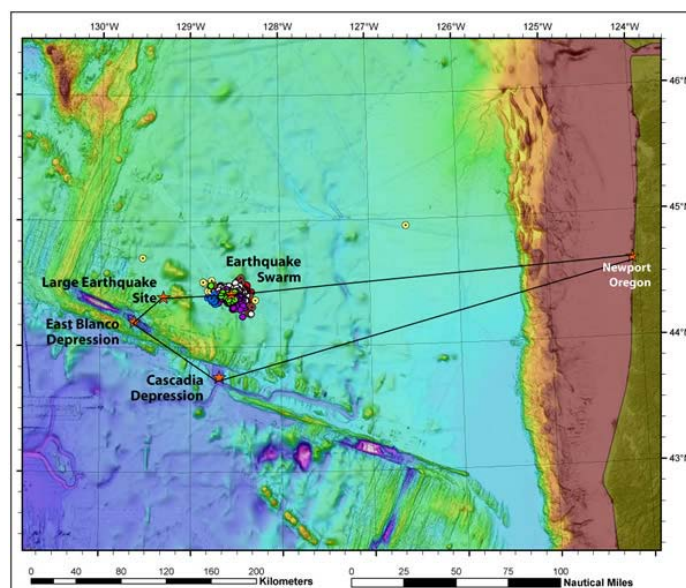
Survival of Juvenile Salmonids...	BPA	\$697,401	9/09-3/10	Banks
Trophic Role of Euphausiids	UW	\$25,785	7/09-3/10	Peterson
Acoustic Detection of Cetaceans	Penn State University	\$11,759	4/09-4/11	Mellinger



FY 2009/10 GRANTS FROM OTHER AGENCIES

Title	Source	Total Funding	Duration	PI
Assessment of T-Wave Processes and Hydroacoustic Monitoring Capabilities in Lau Basin	NSF	\$147,463	10/09-9/11	Dziak/Matsumoto
GLOBEC: Pan-Regional Synthesis: Pacific Ocean Boundry Ecosystems	NSF	\$56,882	9/08-8/11	Peterson
Northern California Ecosystems	NOAA	\$274,330	7/09-6/11	Peterson
Phase 2 Upgrade GPS on Volcano	NSF	\$30,423	5/10-4/11	Chadwick
Strombolian Eruptions, Magma Degassing, and Hydrothermal...	NSF	\$229,962	2/09-1/10	Chadwick
Next Generation Bioacoustic Analysis Software	ONR	\$16,706	4/10-3/13	Mellinger

Title	Source	Total Funding	Duration	PI
Monitoring Marine Mammals with Seagliders	ONR	\$73,707	6/10-4/12	Mellinger
Acoustic Float for Marine Mammal Monitoring	ONR	\$9,780	3/10-12/10	Matsumoto
Detection, Classification, and Density Estimation of Marine Mammals	ONR	\$228,750	6/10-6/11	Mellinger
Acoustic Behavior of Gray Whales	ONR	\$21,924	1/09-12/10	Mellinger
Harmful Algal Bloom	NOAA	\$107,483	9/08-8/11	Peterson





Bransfield Strait deployment of portable hydrophones
Antarctica

INSTITUTE DIRECTOR'S ACTIVITIES

Administrative

National service

Served on the Executive committee for National CI Directors meeting in Washington DC 24-26th, April 2010.

Worked with Renee Bellinger, Ted Strub (Director CIOSS) and Kate Sinner to visit with senate and house of representatives from OR to nominate support for West-Coast Genetic Stock Identification research as a means of addressing fishery and fisherperson hardship stemming from failing Klamath and CA Central Valley Chinook salmon stocks, April 2010

Developed strategic planning document for CIMRS with assistance from faculty, advisory council and fellows

Second national distribution of CIMRS hot item:

CIMRS Announces Results: Coincident Whale and Seismic Airgun Sounds
http://www.nrc.noaa.gov/ci/hotitems/2010/02_cimrs.html

University Service

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

OSU Centers, Institutes and Programs meetings (quarterly)

Development of new faculty line in Marine Resource Economics CIMRS/OSU 50/50 funding with College of AG AREC (Susan Capalbo (HOD, AREC), Gil Sylvia (sup COMES) & Susan Hanna (COMES, AREC), John Stein (Deputy Chief Admin, NWFSC, NOAA) & Bob Iwamoto (NWFSC))

Recruited five new CIMRS post docs

Research

The Institute Director's research was supported in 2008/9 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>Grant #</u>	<u>Funding</u>	<u>Duration</u>	<u>P.I.</u>	<u>Banks</u> <u>mths</u>
					-

West Coast Fisheries (from 2007)	NA06NMF4550286	\$1,299,618	9/1/06-9/30/11	Banks	0
West Coast Fisheries	NA17RJ1362	\$1,059,286	9/1/06-9/30/11	Banks	0.125
Ocean Environment Research	NA17RJ1362	\$1,892,233	7/1/06-9/30/11	Banks	0.125
DNA Analysis of Humpback Whale	NA17RJ1362	\$53,582	7/1/10-9/30/11	Banks/Baker	0
Stock Structure of NP Minke	NA17RJ1362	\$42,616	7/1/10-9/30/11	Banks/Baker	0
Climate and Habitat Effects	NA17RJ1362	\$158,700	7/1/10-9/30/11	Banks/Hurst	0
Ocean Acidification	NA17RJ1362	\$116,318	7/1/10-9/30/11	Banks/Hales	0
Effects of Climate on Long-term Growth of Yellowfin Sole	NA17RJ1362	\$50,424	7/1/10-9/30/11	Banks/Black	0
Seabird Bycatch for WC GF	NA17RJ1362	\$12,000	7/1/10-9/30/11	Banks/Suryan	0
Acoustic Whale Monitoring, SE Bering Sea	NA17RJ1362	\$43,333	7/1/10-9/30/11	Banks/Mellinger	0
Analysis Acoustic Data Beaufort Sea	NA17RJ1362	\$30,901	7/1/10-9/30/11	Banks/Mellinger	0
Sea Lion Resights	NA17RJ1362	\$24,945	7/1/10-9/30/11	Banks/Horning	0
Ocean Survival and Growth of Juvenile Salmnids	BPA-44022	\$695,000	9/1/09-8/31/11	Banks	0
Growth and Behaviour of Fish and Crabs	NA-AB133F09SE1188	\$74,000	8/27/09-12/31/11	Banks	0
Genetic pedigree analysis of McKenzie River spring Chinook salmon: An evaluation of adult outplanting strategies	US Geological Survey GS238A - AMS - USDI	\$183,150	8/02/10-6/30/11	Johnson/Banks	1.5
FY08 Appropriation to OSC	NA08NMF4720662	\$434,901	2008-11	Sylvia/Banks/Morrissey	0.2
		OSU \$155,599			

Strategies to Minimize Catch Of Klamath Chinook	NA08NMF4270421	\$1,000,000	2008-11	Goldenberg(C ASFC)	0.2
		OSU \$298,500			
Klamath River Disaster Economic Relief Funds to OSC	NA07NMF440337	\$931,182	2008-11	Sylvia/Banks	0.2
		OSU \$259,497			
FY09 Appropriation to OSC	NA09NMF4720367	\$199,800	2009-12	Sylvia/Banks	0.2
		OSU \$110,678			
Analysis of DNA Samples to ID Juv. Winter and Spring Run Salmon	CALFED-USFWS DIO57A - RMS - USDI	\$306,211	5/20/08-12/31/12	Banks	1.5
OSU Component for Nonpareil Dam Adult Trap and Genetic Pedigree	OWEB-K9594A - RMS OWEB 1011	\$265,384	1/15/09-10-31-11	Banks	1
Testing Clock Genes, SNPs and Microsatellites for Population Identification among Central Valley Chinook	CA-DWR-Y0258A - RMS CDWR 611	\$599,993	10/01/07-6/30/11	Banks	1
Acquisition of Next Generation Sequencer for Marine Genomics	AES ST INV/Provost - RDR326	\$115,000	7/01/10-6/30/11	Banks/O'Malley/Baker	0.2
TOTAL		\$7,137,694			6.25

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"

*Miller, J.A., M.R. Bellinger, J.T. Golden, L. Fujishin and **M.A. Banks**. 2010. Integration of natural and artificial markers in a mixed stock analysis of Chinook salmon (*Oncorhynchus tshawytscha*). *Fisheries Research* 102:152-159.

*Johansson, M.L. and **M.A. Banks**. 2010. Olfactory Receptor Related to Class A, Type 2 (V1r-Like Ora2) Genes Are Conserved between Distantly Related Rockfishes (*Genus Sebastes*). doi: 10.1093/jhered/esq102 First published online: September 29, 2010.

*+ Thériault, V., G.R. Moyer, and **M.A. Banks**. 2010. Survival and life history characteristics among wild and hatchery coho salmon (*Oncorhynchus kisutch*) returns: how do unfed fry differ from smolt releases? *Canadian Journal of Fisheries and Aquatic Sciences*. 67(3): 486-497.

*+ Johnson, M.A. and **M.A. Banks**. 2009. Interlocus variance of Fst provides evidence for directional selection over an olfactory receptor gene in Coho salmon (*Oncorhynchus kisutch*) populations *Marine Genomics* 2(2):127-131
Among top 25 Articles in Earth & Planetary Science > Marine Genomics October to December 2009.

CIMRS GRADUATE STUDENTS Supported Through Joint Projects

A growing 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 2008-20012 TBA
Major Professor: Selina Heppell
NOAA Fisheries Rep: Grant Thompson, AFSC

Master's Candidates - College of Oceanic and Atmospheric Sciences

Jesse Lamb 2008-2010 "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

2009-2010 PUBLICATIONS

FY10

- Chadwick, W.W.**, D.A. Butterfield, R.W. Embley, V. Tunnicliffe, J.A. Huber, S.L. Nooner, and D.A. Clague. 2010. Axial Seamount. *Oceanography* 23(1): 38-39.
- Chadwick, W.W.**, R.W. Embley, E.T. Baker, J.A. Resing, J.E. Lupton, K.V. Cashman, R.P. Dziak, V. Tunnicliffe, D.A. Butterfield, and Y. Tamura. 2010. Northwest Rota-1 Seamount. *Oceanography* 23(1): 182-183.
- Daly, E. A.**, R.D. Brodeur, L.A. Weitkamp. 2009. Ontogenetic Shifts in Diets of Juvenile and Subadult Coho and Chinook Salmon in Coastal Marine Waters: Important for Marine Survival? *Trnas. Amer. Fish. Soc.* 138 (6): 1420-1438.
- Dziak, R.P.**, M. Park, W.S. Lee, **H. Matsumoto**, D.R. Bohnenstiehl, and **J.H. Haxel**. 2010. Tectonomagmatic activity and ice dynamics in the Bransfield Strait bark-arc basin, Antarctica. *J. Geophys. Res.* 115(B01102), doi:10.1029/2009JB0006295.
- Feinberg, L.R.**, W.T. Peterson and **C. T. Shaw**. 2010. The timing and location of spawning for the Euphausiid *Thysanoessa spinifera* off the Oregon coast, USA. *Deep-Sea Res. II* 57:572-583.
- Harvey, H.R., S.J. Ju, S-K. Son, **L.R. Feinberg**, **C.T. Shaw**, and W.T. Peterson. 2010. The biochemical estimation of age in Euphausiids: Laboratory calibration and field comparisons. *Deep-Sea Res. II* 57: 663-671.
- Keister, J.E.**, T.J. Cowles, W.T. Peterson, **C.A. Morgan**. 2009. Do upwelling filaments result in predictable biological distributions in coastal upwelling ecosystems? *Prog. Oceanogr.* doi: 10.1016/j.pcean.2009.07.042.
- Keister, J.E.**, W.T. Peterson. And S.D. Pierce. 2009. Zooplankton distribution and cross-shelf transfer of carbon in an area of complex mesoscale circulation in the northern California Current. *Deep-Sea Res. I* 56: 212-231.
- Keister, J.E.**, and P.T. Strub. 2009. Spatial and interannual variability in mesoscale circulation in the northern California Current System. *J. Geophys. Res.* 113: doi:10.1029/2007JC004256,2008.
- Litz, M.**, R.D. Brodeur, R.L. Emmett, S.S. Heppell, R.S. Rasmussen, **L. O'Higgins**, and M.S. Morris. 2010. Effects of variable oceanographic conditions on forage fish lipid content

and fatty acid composition in the northern California Current. *Mar. Ecol. Prog. Series.* 405: 71-85.

Lupton, J., R.J. Arculus, **R.R. Greene**, **L.J. Evans**, and C.L. Goddard. 2009. Helium isotope variations in seafloor basalts from the northwest Lau Backarc Basin: Mapping the influence of the Samoan hotspot. *Geophys. Res. Lett.* 36, L17313,doi:10.1029/2009GL039468.

Phillips, A.J., R.D. Brodeur and A.V. Suntssov. 2009. Micronekton community structure in the epipelagic zone of the northern California current upwelling system, *Prog. in Oceanogr.* 80: 74-92.

Shaw, C.T., W.T. Peterson, and **L.R. Feinberg**. 2010. Growth of *Euphausia pacifica* in the upwelling zone off the Oregon coast. *Deep-Sea Res. II* 57: 584-593.

Tweddle, J. F. P.G. Strutton, D.G. Foley, **L. O'Higgins**, A.M. Wood, B. Scott, R.C. Everroad, W.T. Peterson, D. Cannon, M. Hunter, and Z. Forster. 2010. Relationships among upwelling, phytoplankton blooms, and phycotoxins in coastal Oregon shellfish. *Mar. Ecol. Prog. Series.* 405: 131-145



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. The new 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.

SeaFest, the OSU Hatfield Marine Science Center Open House, is an important outreach event that reaches approximately 3000-4000 families introducing them to the science activities at HMSC. CIMRS investigators spend many hours preparing exhibits for and then participating in the day-long event each year.

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

