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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 30 research staff and 5 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. In FY09 CIMRS celebrated the promotion of one faculty member to full Professor, non-tenured. 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 FY09 outside awards were in excess of $2.5M.

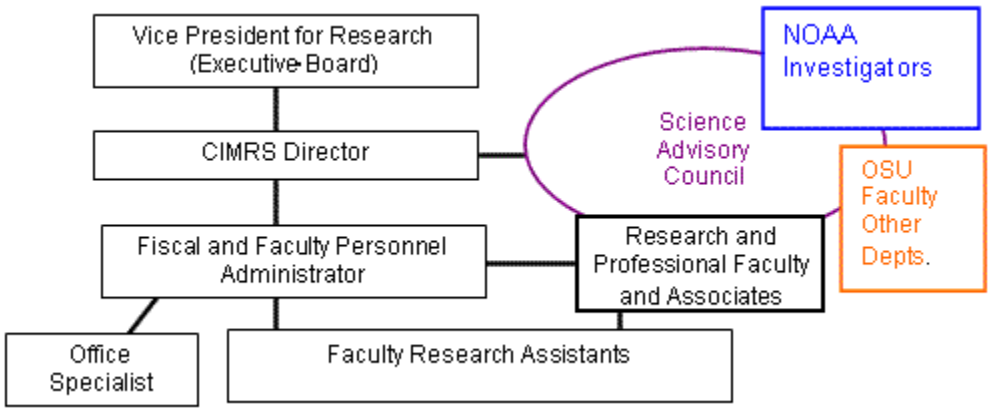
The research focus of CIMRS addresses living and non-living marine resources and is thus linked to programs that require environmental sampling or observing within the ocean and programs that characterize seafloor habitats. This focus encompasses the broad field of marine fisheries (including fisheries 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, CNN, and Canadian Broadcasting Company. Over 20 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.



2008/9
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

Robert Malouf
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

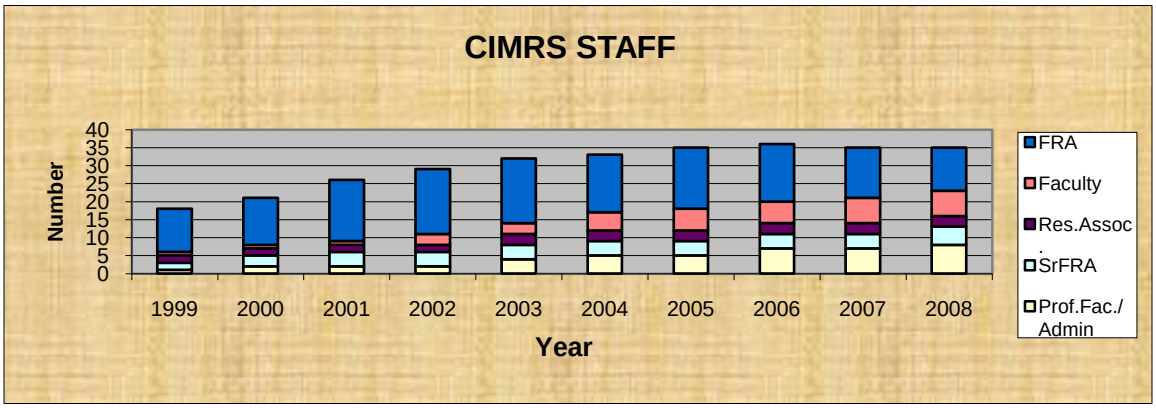
Bill Pearcy – Professor Emeritus, OSU College of Oceanic and Atmospheric Sciences

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

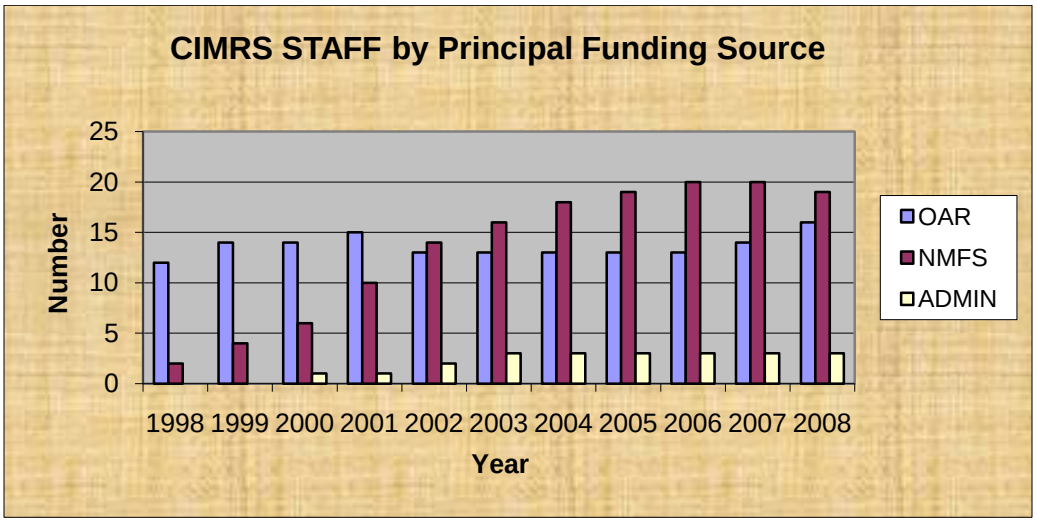
Dawn Wright – Professor, OSU Geosciences

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 FY09, $194,657 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

Two proposals from CIMRS investigators were successfully awarded through the OSU Research Office's Research Equipment Reserve Fund with a minimum 20% match of funds from the Institute's research reserve fund.

Dr. David Mellinger $20K: "LARa-the-Long-term Acoustic Recording Tag"
Dr. Jay Peterson $10.2K: "Instrument Block and Conducting Cable"

Additionally, one request for pilot project funding was awarded by the Science Advisory Committee for a total of $6K to graduate student Mattias Johansson for "Identification of Larval *Sebastes* samples for stock assessment."

PROJECTS SUPPORTED WITH CONTRIBUTED FUNDS FROM NOAA PARTNER LABORATORIES IN FY 2008/9

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 NA06NMF4550286

Total Award $1,183,826; 9/1/08-6/30/09

"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.; Hongsheng Bi, Hui Liu, Jay Peterson, Jim Ruzicka, Research Assoc.; Leah Feinberg, Tracy Shaw Sr. Faculty Research Asst., Toby Auth, Tristan Britt, Jennifer Menkel, Jason Phillips, 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

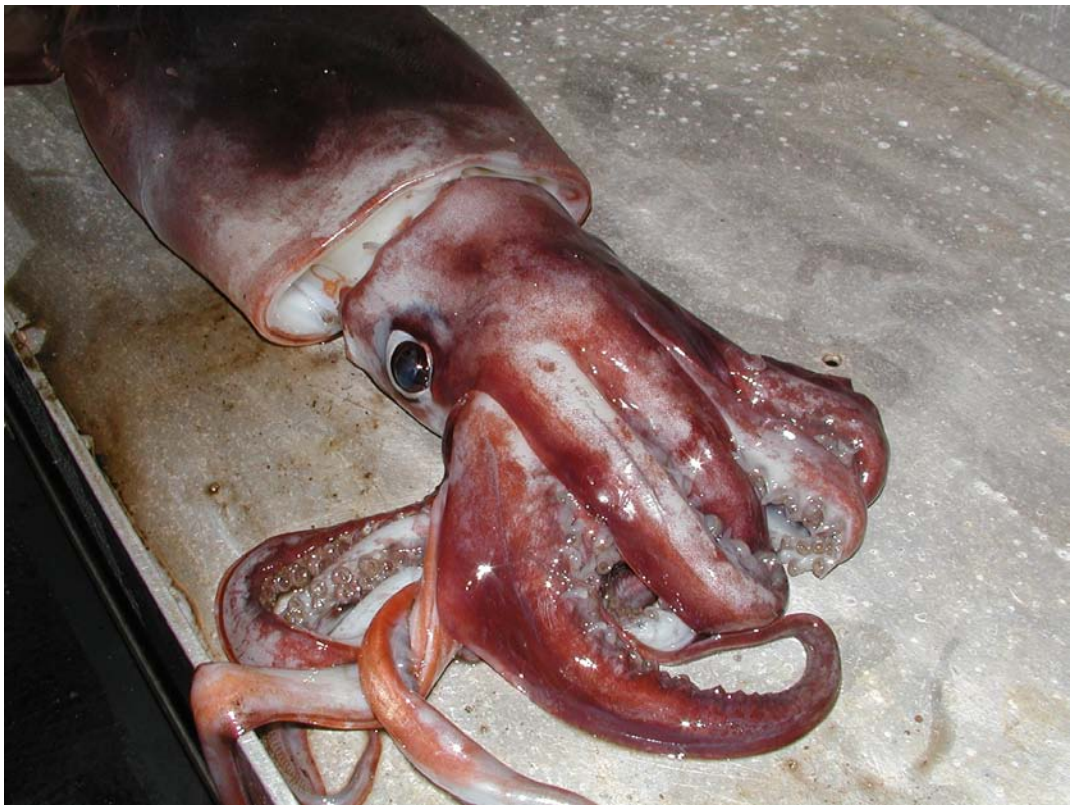
Collaborating NOAA Investigators: Kym Jacobson, FE/NWFSC

"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 four 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.

"Socio-Economic Issues"

This project recognizes the need for research on the linkages between fisheries and ecosystem management and regional economics. OSU is analyzing methods to alleviate negative impacts of regulation through economic incentives and alternative forms of technology. The immediate focus area is *Research in Cooperation with Fisheries*, learning more about coastal communities and assessing the potential impacts of management actions on the community (such as impacts on the cultural role of fishing, kinship and family, fishing effort and the related economic and social changes to individuals and families).

OSU Investigator: Flaxen Conway, Professor, Agriculture and Resource Economics Department; Christina Package, Graduate Student

Collaborating NOAA Investigator: Elizabeth Clarke, FRAM/NWFSC

"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: Vacant
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

Incorporation and Evaluation of Environmental Parameters into the W.C. Groundfish Assessment
The focus of this project is the incorporation and evaluation of environmental parameters into population assessments of West Coast sablefish. Statistical studies are also being performed to establish the suitability of sea level as an independent variable and its control on recruitment trends. Incorporation of recruitment predictions in stock assessment models is being tested.

OSU Research Faculty: Vacant
Collaborating NOAA Investigator: Elizabeth Clarke, FRAM/NWFSC

Projects under Grant NA17RJ1362

Total Award $1,002,919; 7/1/08-6/30/09

"Ocean Environment Research"

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.

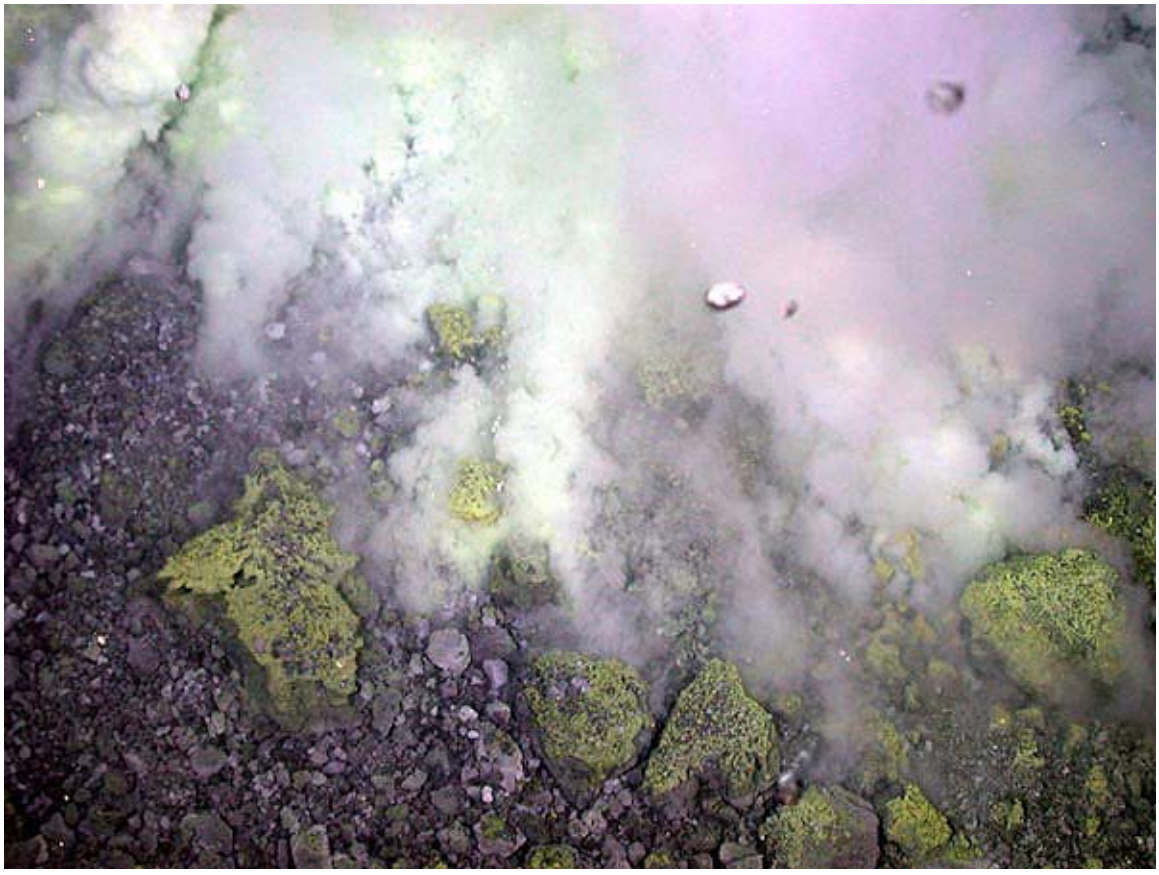
The goal of the Geophysical Monitoring program is to better understand how submarine volcanoes work. Efforts continue to be divided between projects focused on volcano monitoring in the NE Pacific and seafloor mapping and exploration in the Western Pacific.

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 Nieukirk, 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)



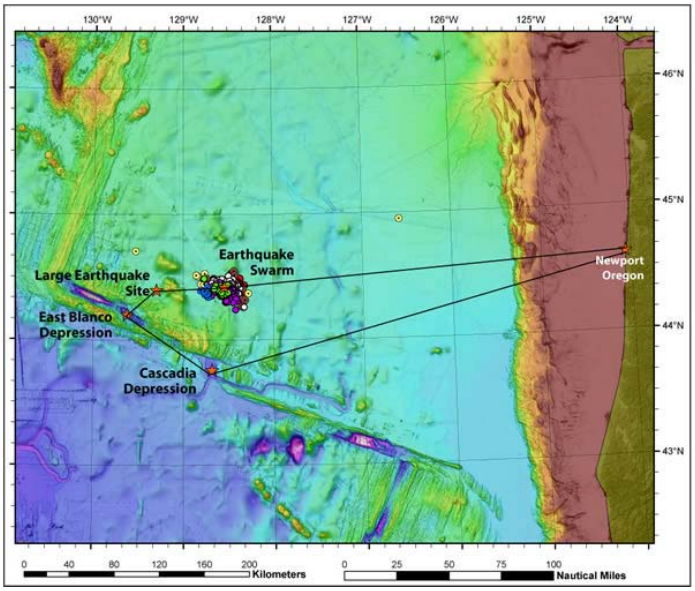
FY 2008/9 CONTRACTS

Climate-related Changes to Gadids	NOAA/AFSC	$10,030	2/09-8/09	Banks
Effects of Temp. on Gadid Fish	NOAA/AFSC	$33,280	3/09-12/09	Banks
Baleen Whale Call MAR	NOAA/NMML	$24,873	9/08-10/09	Mellinger
Loggerhead TEWG	NOAA/NEFSC	$25,000	1/08-3/09	Heppell
Quant. Marine Turtle Management	NOAA/SWFSC	$15,000	3/09-8/09	Heppell
Survival of Juvenile Salmonids…	BPA	$684,362	9/08-8/09	Banks
Trophic Role of Euphausiids	UW	$28,711	7/08-8/09	Peterson
Acoustic Detection of Cetaceans	Penn St. Univ.	$12,877	4/08-4/10	Mellinger
Acoustics Conf.	Nat'l. Park Serv.	$17,625	8/08-7/09	Mellinger
Compare PAMGUARD/ Ishmael	SMRU Ltd.	$15,513	6/09-8/09	Mellinger
Acoustics Conf.	ONR	$17,736	12/08-12/08	Mellinger

FY 2008/9 GRANTS FROM OTHER AGENCIES

Title	Source	Total Funding	Duration	PI
Assessment of T-Wave Processes and Hydroacoustic Monitoring Capabilities in Lau Basin	NSF	$410, 216	10/08-9/09	Dziak/Matsumoto
Real-Time Volcanic Detection	NSF	$137,280	10/06-3/10	Dziak
GLOBEC: Pan-Regional Synthesis: Pacific Ocean Boundry Ecosystems	NSF	$56,882	9/08-8/11	Peterson
GLOBEC: Pan-Regional Synthesis: End to End Energy Budgets	NSF	$154,864	9/08-8/11	Ruzicka
Monitoring Inflation at Axial Seamount	NSF	$21,507	9/08-8/010	Chadwick
Instrument Develop. For Geo-Physical Monitoring at Cabled Seafloor Observatories	NSF	$205,374	9/08-8/10	Chadwick
Upgrade GPS on Volcano	NSF	$28,626	6/08-5/10	Chadwick
Strombolian Eruptions, Magma Degassing, and Hydrothermal…	NSF	$160,342	2/09-1/10	Chadwick

Title	Source	Total Funding	Duration	PI
Density Estimation for Cetaceans Through Acoustics	Univ. St. Andrews	$197,958	6/08-5/10	Mellinger
Auto Detection from Seagliders	ONR	$400,166	7/08-6/10	Mellinger
Factors Influencing Gray Whale Migration	ONR	$49,045	1/09-12/10	Mellinger
Harmful Algal Bloom	NOAA	$90,243	9/08-8/09	Peterson
Fecundity *Euphausia pacifica*	NPRB	$53,313	7/08-2/10	Peterson
Use of Satellite Observations To Improve Ecol. Forecasts…	NASA	$157,087	7/08-6/10	Bi



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, March 2009, highlights include:

- Navigating the Transition and Plans for the Future – Mary Glackin
- FY09 Budget Update - Maureen Wylie
- Integrated Ecosystem Management – Mike Ford

Established and convened new Science Advisory Council (SAC)

- New membership established (http://oregonstate.edu/groups/cimrs/advisory-council.html)
- Meeting convened in Corvallis April 21, summary distributed

First national distribution of CIMRS hot item:

- CIMRS Researchers Discover Burgeoning Life Amidst Acidic Environments at Deep Sea Volcano Eruptions. http://www.nrc.noaa.gov/ci/hotitems/2009/05_cimrs.html

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.

Project Title: Conservation Hatchery Implementation Program: OSU Component for Non-pariel Dam Adult Trap and Genetic Pedigree
Source of Support: Oregon Watershed Enhancement Board
Total Award: $ 265,384 Period Covered: Jan 01, 2009-Oct 31, 2011
Person Months Committed to the Project by PI: .8 (PI)

Project Title: Analysis of DNA Samples to Identify Juvenile Winter and Spring Run Salmon
Source of Support: USDI-FWS
Total Award: $306,211 Period Covered: 5/20/08-6/30/11
Person Months Committed to the Project by PI: 3.0 (PI)

Project Title: Testing Clock Genes, SNPs and Microsatellites for Population Identification Among Central Valley Chinook and Verifying Genetic Transmission of Seasonal Run Time Differences on the Feather River
Source of Support: California Dept. of Water Resources
Total Award: $599,933 Period Covered: 10/1/07-9/30/10
Person Months Committed to the Project by PI: 2-3 (PI)

PUBLICATIONS

Bernier, J.C., S.R. Birkeland, M.J. Cipriano, A.G. McArthur, M.A. Banks. 2008. Differential gene expression between fall and spring run Chinook salmon assessed by long serial

analysis of gene expression (LongSAGE). *Transactions of the American Fisheries Society.* 137:1378-1388.

Guy, T.J., R.E. Gresswell, and M.A. Banks. 2008. Landscape-scale evaluation of genetic structure among barrier-isolated populations of coastal cutthroat trout, *Oncorhynchus clarkii clarkia*. *Canadian Journal of Fisheries and Aquatic Science*. **65**: 1749–1762

Johansson, M. L., M.A. Banks, K.D. Glunt, H.M. Hassel-Finnegan, V.P. Buonaccorsi. 2008. Influence of habitat discontinuity, geographical distance, and oceanography on fine-scale population genetic structure of copper rockfish (Sebastes caurinus) Molecular Ecology. 17(13): 3051-3061.

Johnson, M.A., and M. A. Banks. 2008. Genetic structure, migration and patterns of allelic richness among coho salmon (*Oncorhynchus kisutch*) populations of the Oregon Coast. *Canadian Journal of Fisheries and Aquatic Science* 75(7): 1274-1285

Marin Jarrin, J.R., A.L. Shanks, and M.A. Banks. 2009. Confirmation of the presence and use of sandy beach surf-zones by juvenile Chinook salmon. *Environmental Biology of Fishes* 85:119–125.

Matson, S.E., M.D. Camara, W. Eichert, and M.A. Banks. 2008. P-LOCI: a computer program for choosing the most efficient set of loci for parentage assignment. *Molecular Ecology Resources*. 8(4): 765-768.

Narum, S. R., M.A. Banks, T. D. Beacham, M. R. Bellinger, M. R. Campbell, J. Dekoning, A. Elz, C. M. Guthrie III,C. Kozfkay, K. M. Miller, P. Moran, R. Phillips, L. W. Seeb, C. T. Smith, , K. Warheit, S. F. Young and J. C. Garza. 2008. Differentiating salmon populations at broad and fine geographical scales with microsatellites and single nucleotide polymorphisms. *Molecular Ecology.* 17, 3464–3477

O'Malley, K.G. and M.A. Banks. 2008. A latitudinal cline in the Chinook salmon (Oncorhynchus tshawytscha) Clock gene: evidence for selection on PolyQ length variants. *Proceedings of the Royal Society B.* 22; 275(1653): 2813–2821.

Stick, D.A., C.J. Langdon, M.A. Banks, and M.D. Camara. 2008. Preliminary analyses of genetic structure within and among remnant populations of the olympia oyster, Ostrea conchaphila. *Journal of Shellfish Research*27(2)**:**471-472. (abstract only)

Stick, D.A., C.J. Langdon, M.A. Banks, M.D. Camara. 2009. Nineteen Novel Microsatellite Markers for the Olympia Oyster, Ostrea conchaphila/lurida *Molecular Ecology Resources* **9**:153–155.

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	2006-2009	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, NWFSC
Kevin Thompson	2008-20012	TBA Major Professor: Selina Heppell Minor Rep: TBA NOAA Fisheries Rep: Grant Thompson, AFSC

Master's Candidates - *College of Oceanic and Atmospheric Sciences*

Jesse Lamb	2008-2010	TBA Major Professor: Tim Cowles NOAA Fisheries Rep: Bill Peterson, NMFS

2008-2009 Publications

FY 09

Auth, T.D. 2008. Distribution and community structure of ichthyoplankton from the northern and central California Current in May 2004-06. *Fish. Oceanogr.* 17(4): 316-331.

Bi, H., **R.E. Ruppel**, W.T. Peterson, and E. Casillas, 2008. Spatial distribution of ocean habitat of yearling Chinook (*Oncorhynchus tshawytscha*) and coho (*Oncorhynchus kisutch*) salmon off Washington and Oregon, USA. *Fisheries Oceanography* 17(6): 463-476.

Brodeur, R. D., W.T. Peterson, **T.D. Auth, H. L. Soulen**, **M.M. Parnel,** and A.A. Emerson. 2008. Abundance and diversity of coastal fish larvae as indicators of recent changes in ocean and climate conditions in the Oregon upwelling zone. *Marine Ecology-Prog. Ser.* 366: 187-202.

Chadwick, W. W., Jr., I.C. Wright, U. Schwarz-Schampera, O. Hyvernaud, D. Reymond, and C.E.J. de Ronde. 2008. Cyclic eruptions and sector collapses at Monowai submarine volcano, Kermadec arc: 1998-2007. *Geochemistry, Geophysics, Geosystems* 9(10), Q10014, doi: 10.1029/2008gc002113.

De Ronde, C., E. Baker, R. Embley, J. Lupton, D. Butterfield, K. Faure, M. Leybourne, **W. Chadwick**, J. Ishibashi, J. Resing, S. Walker, **S. Merle, R. Greene**. 2009. Hydrothermal systems of intraoceanic arc. *Geochim. Et Cosmochim. Acta* 73(13):A282-A282 Suppl. S.

Dziak, R.P., D.R. Bohnenstiehl, **H. Matsumoto, M.J. Fowler, J.H. Haxel**, M. Tolstoy, and F. Waldhauser. 2009. January 2009 seafloor spreading event at 9°50′N, East Pacific Rise: Ridge dike intrusion and transform fault interactions from regional hydroacoustic data. *Geochem.,Geophys.,Geosys.* 10(6): Q06T06,doi:10.1029/2009GC002388.

Dziak, R.P., J.H. Haxel, H. Matsumoto, T.K. Lau, S.G. Merle, C.E.J. De Ronde, and R.W. Embley and **D.K. Mellinger**. Observations of regional seismicity and harmonic tremor at Brothers Volcano, south Kermadec Arc, using an ocean-bottom hydrophone array. *J. Geophys. Res.-Solid Earth* 113(B8): Art No. B08S04.

Gertseva, V.V. 2008. The population dynamics of the longnose skate, Raja rhina, in the northeast Pacific Ocean. *Fisheries Research* 95(2-3): 146-153..

Juan-Jorda, M. J., J.A. Barth, M.E. Clarke, and W.W. Wakefield. 2009. Groundfish species associations with distinct oceanographic habitats in the Northern California Current. *Fisheries Oceanography* 18(1): 1-19.

Keister, J.E., W.T. Peterson, S.D. Pierce. 2009. Zooplankton disribution and cross-shelf transfer of carbon in an area of complex mesoscale circulation in the northern California Current. *Deep-Sea Res. Part I* 56(2): 212-231.

Litz, M. N.C. Ecology of the northern subpopulation of northern anchovy (*Engraulis mordax*) in the California Current large marine ecosystem. (Master's thesis) Corvallis, OR: Oregon State University (Fisheries Science); 2008.

Lupton, J., M. Lilley, D. Butterfield, **L. Evans**, R. Embley, G. Massoth, B. Christenson, K-I. Nakamura, and M. Schmidt. 2008. Venting of a separate CO2-rich gas phase from submarine arc volcanoes: Examples from the Mariana and Tonga-Kermadec arcs. *J. Geophys. Res.* 113, B08S12, doi: 10.1029/2007JB005467.

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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. 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.