



A Cradle of Great Earthquakes: Exploring the Underwater San Andreas Fault

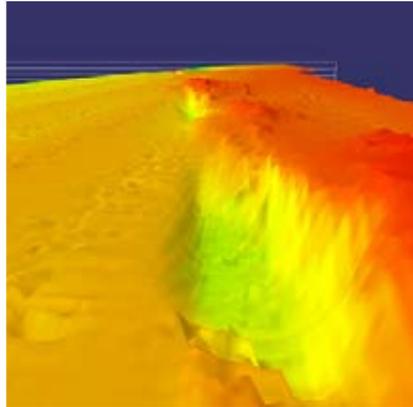
by Waldo Wakefield, Research Biologist,
NOAA Fisheries and OSU Courtesy Faculty

The Northern San Andreas Fault, in spite of its infamy beginning in the great San Francisco earthquake of 1906, has remained largely unexplored along its submerged segment off the northern California coast.

In September 2010, an interdisciplinary team of scientists including HMSC's Waldo Wakefield of NOAA Fisheries, OSU's Chris Goldfinger, and Elizabeth Clarke from NOAA Fisheries Seattle explored the undersea portion of the Northern San Andreas Fault aboard the research vessel *Pacific Storm* and the sailing research vessel *Derek M. Baylis*. The *Baylis*, powered by a combination of wind and diesel, consumes a minimal amount of fossil fuel, allowing researchers to decrease their environmental footprint while conducting their research. It is also quiet under sail, a distinct advantage for research employing acoustics.

During the expedition, the team used multibeam sonar followed by seismic reflection data to create three-dimensional maps of the seafloor and underlying strata. These geophysical maps were then used to prioritize a series of dive sites for the autonomous underwater vehicle (AUV) *Lucille*, which returned tens of thousands of photos of the seafloor. The AUV is operated cooperatively between the NW and Pacific Islands Fisheries Science Centers in collaboration with Woods Hole Oceanographic Institute. Some of the dive sites

were located in areas where the fault was overlain with sediments while other dive sites focused on areas where the multibeam and seismic data showed rock outcrops. In addition, the *Pacific Storm's* fisheries sonar system was used to conduct complementary acoustical surveys of the overlying water column.



This image shows the subsurface San Andreas Fault, approximately eight miles offshore Fort Bragg, Calif. The fault scarp, or step-like feature is 30-50 meters high. The depressions shown next to it, called 'sag ponds' on land, result from small changes in the trend of the fault.

Image courtesy of San Andreas Fault 2010 Expedition, NOAA/OER

Researchers now have a virtually complete high-resolution map of the submerged fault, and digital still cameras aboard the AUV *Lucille* provided first time views of the surface features of the seabed and the creatures that inhabit it (see photos, page 5). This intensive field effort has generated a massive amount of images and information that will take some time to process, so stay tuned for the rest of the story.

This research was sponsored by

NOAA's Office of Ocean Exploration and Research, NOAA Fisheries, the California Seafloor Mapping Program, and the U.S. Geological Survey. For more information about the expedition, go to:

<http://oceanexplorer.noaa.gov/explorations/10sanandreas/welcome.html>

Innovations

Junior Brings Big Excitement with a Small Footprint

by Michael Banks, CIMRS
Director and OSU Professor

With our mission of collaborative, interdisciplinary research, HMSC was proud to add a new Roche Bioscience Junior 454 Genome Sequencer (nicknamed "Junior") in early August. Junior is specialized for genetics research, and owing to its high capacity has a way of bringing researchers together (in spite of it being no larger than a microwave oven). As a state-of-the-art instrument, Junior has exponentially expanded our genetics and genomics research capabilities, expanding the scope of research questions that HMSC scientists can address. The output generating all the excitement is genetic sequence data for species as wide-ranging as

marine microbes, oysters, krill, salmon and rockfish, and whales, spanning the breath of HMSC's diverse marine science.

To understand the big excitement that little Junior has generated, consider this: previously, HMSC scientists could generate close to 100 genetic sequence reads in any day, while the Junior 454 increases sequence generated to 100,000 similar reads in three days!

Enthusiasm for Junior's capabilities has drawn in keen players

from across the campus, including OSU and agency research partners. This 'first in Oregon' high tech acquisition was enabled through strategic investment from OSU's Research and Provost's Offices, with matching funds from HMSC's Marine Mammal Institute, Cooperative Institute for Marine Resource Studies and Coastal Oregon Marine Experiment Station. Keep an eye out for research advances made possible by our new technological marvel!



Notes from the Director

This fall once again highlights HMSC's healthy involvement in international marine science. PICES, the International North Pacific Marine Science Organization, rotated its venue to the US last month, and for the first time met in Portland.



Dr. George Boehlert, HMSC Director

HMSC was represented with 18 scientists at the meeting, with roles ranging from committee or working group membership, to convening scientific sessions, to a multitude of scientific presentations. Xiuning Du from Bill Peterson's lab was awarded the best presentation award by the Biological Oceanography Committee and Brett Dumbauld was awarded the best poster award (see photo page 5). HMSC, through the organizational work of John Chapman and volunteer Ralph Breitenstein, also hosted the "rapid assessment survey" of invasive aquatic species in Yaquina Bay and Coos Bay (see article page 8). With 13 additional OSU scientists from Corvallis attending, Oregon was very well represented. Next year's PICES meeting rotates to Khabarovsk, across the Amur River from China in Russia's far east. No doubt a tougher travel, but clearly an exotic meeting venue!

On the marine science facilities front, the Port and its contractors are making great strides for the NOAA Marine Operations Center facilities, and have just initiated the "in-water" work of pile driving and excavation after receiving their permits. The buildings are up and roofs on, and the project seems to be on track. On a less rosy note, however, we have not been successful in funding the Marine Mammal and Marine Genomics Building. Despite strong support from Representative Cowan and the state legislature for state match funding, the proposal was not funded by the National Institutes of Standards and Technology, where only 5 of 124 proposals were successful. We will be going back to the drawing board to address the space limitations at HMSC that hinder growth of scientific programs here.

Finally, I would like to mention that the last issue of *Upwelling* was the first to request your financial support in meeting a generous challenge grant for buying new microscopes. I would like to express my thanks to the many Friends of HMSC whose donations enabled us to meet this challenge; these funds also served as matching funding that resulted in even more support from the main OSU campus. Thus, instead of simply getting 17 new dissecting scopes, we will be ordering 20 dissecting scopes and 6 new compound microscopes. Our instructors (and students) are excited about this new equipment that will combine with the renovated education wing to greatly improve our educational programs.



Friends of Hatfield Marine Science Center Have Heard Our Call!

by Itchung Cheung, Instructor and
HMSC Academic Program Coordinator

The Hatfield Marine Science Center is the backbone of undergraduate and graduate courses, teacher training, and professional training in the marine sciences within OSU. HMSC's academic programs cut across several colleges and departments that offer experiential courses encompassing wet labs, field experiences and seminar-style lectures in a unique teaching environment. As the "gateway" to the ocean and coastal zone, marine lab coursework brings the ocean to life for majors and often lead to decisions about graduate school and future careers. Lab coursework requiring microscopes are integral to the finer scales of undergraduate and graduate education at OSU.

NEW microscopes, which are integral components of courses and essential tools for students and instructors have been ordered as a result of the matching funds from you! As part of our renovation of the education wing, the addition of these new microscopes enable HMSC to provide the quality competitive coursework with state of the art teaching laboratory space to support diverse research, education, and outreach requirements of a modern marine laboratory.

Thanks in part to your contributions, HMSC will continue to be a place of experiential learning in the marine sciences. Students and faculty from several OSU departments and colleges and the many undergraduate internship



programs, weekend courses and summer online-hybrid courses at Hatfield will all benefit from the unique learning environment that you've helped enhance.

Through donor support, we have matched Janet Webster's (HMSC Librarian and generous 'Friends of the HMSC' supporter) CHALLENGE GRANT of \$6000! This is in addition to an allocation of \$4,000 each from HMSC, and the Departments of Biology and Fisheries and Wildlife. We appreciate your support!

Thank you for your support.
To become a member of the Friends of HMSC, or for more information, please see
<http://hmsc.oregonstate.edu/friends/>

Sea Grant Briefs

OctoCam is Back!

by Nancee Hunter, Director of
Education, Oregon Sea Grant

Our new octopus made its public debut on Nov. 13 in the central aquarium at the Visitor Center along with a new event, called “Octopus Day,” featuring activities for children, a display of a dissected octopus with its internal anatomy labeled, and the official unveiling – and first public feeding – of the new octopus.

This is the latest in a long series of giant Pacific octopuses to greet visitors at one of the Center’s most popular and endearing exhibits. The new animal is the successor to Deriq, the octopus who took the Internet by storm earlier this year when the Visitor Center installed a live, streaming Web video feed dubbed the OctoCam (<http://hmsc.oregonstate.edu/visitor/octocam>).

The tank has remained empty, and the OctoCam off the air, since Deriq died in June. Dr. Tim Miller-Morgan, Oregon Sea Grant’s fish veterinarian, determined that the animal died of a microscopic parasite infection. The source of the infection was discovered to be the red rock crabs the animals were fed.

Aquarists have changed the octopus feeding regimen to prevent future infections. Instead of live crabs, the new animals are being fed fish. And a study to learn more about the crab-parasite connection will be conducted in hopes of returning to live feeding at some point.

While the center normally has ready access to octopuses from local crab fishermen (the animals

often climb into crab traps to feast on the contents), the animal’s demise coincided with the closing of crab season, so it took several months to acquire a replacement.

With the replacement in house, showing signs of happiness and health, the OctoCam is back on line, webcasting live, infrared video of the tank and occasional glimpses of the animal.

Visitor Center staff also plan to use the OctoCam as a science teaching tool for classrooms far from the Pacific Coast. The system actually uses two cameras – one inside the tank, and one outside, which lets Web visitors see and hear the thrice-weekly feeding and interpretive programs. That gives us a great opportunity to engage with classrooms. Students and teachers from just about anywhere in the world can watch the animals being fed, listen to the presentation and then submit their own questions and get them answered live, on the spot, by our aquarists. Such a program was tested this summer, and we are now working with teachers to develop curriculum materials so it can be offered to more schools. Check out OctoCam at: <http://hmsc.oregonstate.edu/visitor/octocam>



Aquarist’s Notebook

by Harrison Baker
HMSC Student Aquarist

Nov. 10—three days before “Octopus Day”

“Harrison, I can’t find the octopus!” I turned to see Kathryn Hawes, our museum education assistant, trying—with limited success—to appear calm. Kathryn had already checked the floors—octopuses can breathe on land as long as their gills stay wet—and found no sign of the animal. We quickly rolled back the mesh tank cover to find that our 10-pound female Giant Pacific Octopus had gone where no octopus had gone before: into the hollow false rock that conceals the outflow of her tank. She had moved the camouflaged lid, which is secured with a bar on the underside, to make an aperture big enough to slip through. After a little planning and discussion, Kathryn, Bill Hanshumaker and I eventually managed to bribe the creature to the surface and walk her back to familiar territory.

Octopuses can be difficult animals for humans to understand, and incidents like the one described above remind us that our animals are, indeed, wild. Even in a tank surrounded by adoring humans, the octopus’ brain is wired for a solitary existence. The best we can do is make the experience of captivity as physically and psychologically stress-free as possible, and try to see every husbandry concern from the perspective of the animal. Many

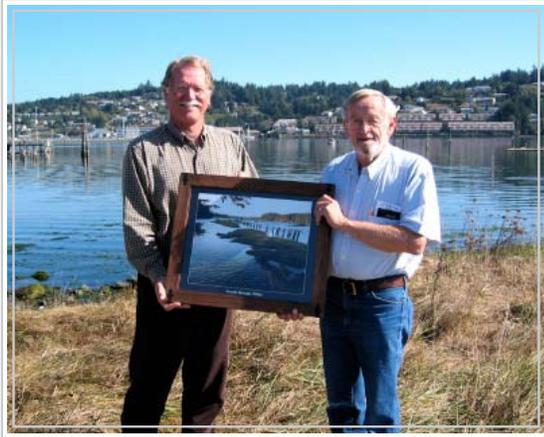
things we consider harmless or even beneficial—lots of food, bright light, hugs—can be very stressful for marine animals.

Every day, we undertake the paradoxical task of imperfectly emulating a natural environment to teach others to respect and protect the real thing. We do this because we know the ocean—the best place for the animals we keep—is in trouble. When we do our jobs right, our fellow humans take heed and our animals forgive us our trespasses.

The day after our adventure, curator Dennis Glaze and Visitor Center aquarist José Marin Jarrin made some alterations to the tank to prevent future wanderings—a plastic mesh screen under the rock and more weight on the compartment lid.

Meanwhile, the octopus slept. Our work was done.

Member Highlights

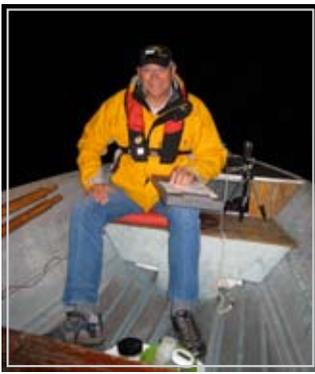


Lavern Weber, HMSC Director from 1977-2002, along with his wife Pat, has remained an ardent supporter of HMSC through generous financial donations to HMSC's diverse programs. In particular, the Lavern Weber Visiting Scientist Fellowship supports HMSC's mission by fostering examination of new specialties and expertise at the HMSC, while stimulating cooperative research with different institutions and providing new opportunities for OSU students. Fred Allendorf of University of Montana, our upcoming 2011 Weber Fellow, will give a public talk this spring on his research. We thank Dr. Weber, pictured above (right) with current HMSC Director, Dr. George Boehlert, for his recent generous donation to the Fellowship program.

The recent **Friends of the HMSC Member-Only Event** entitled "DNA Demystified: The Use of Genetics in HMSC Salmon Research" was a huge success! A lively and engaged group of Members and Volunteers had lots of questions for the three presenters. Through a combination of lecture, lab tour, hands on activities and a "Meet the Scientists" reception, Members gained an understanding of the genetic research incorporated into Project CROOS, a dynamic and growing partnership between salmon fishermen and HMSC scientists. "Junior" (see article, page 1) was a highlight of the lab tour. Pictured to the right is Renee Bellinger, CROOS Project Coordinator, in the lab that participants toured.



Volunteer Corner



Volunteer **Ralph Breitenstein** recently received the Epsilon Sigma Phi (ESP) – Friend of Extension Award. This award is the highest recognition presented by an ESP chapter to a non-Extension (lay) person, company or organization and is designed to recognize truly

outstanding support and personal involvement in Extension efforts. Ralph has volunteered at the HMSC since 2007, contributing a total of 2,131 hours to date, in activities as diverse as securing funding for biological invasion research, improving and creating some of the current exhibits in the Visitor Center, public education, and student mentoring. In addition, Ralph has been engaged in a personal project focusing on the life history of the introduced mud shrimp parasite *Orthione griffenis*, which is causing rapid mud shrimp population declines in the Yaquina Bay. His contributions to HMSC are truly appreciated!



Councilmen **Dann Cutter** (Waldport), **Mark Camara** (Toledo) and **Bob Emmett** (Toledo), follow in the long tradition of public service by Hatfielders in local government. Congratulations to Councilmen Cutter (*shown on the left*) and Camara (*on the right*) who were recently reelected; Councilman Emmett (*not pictured*) did not seek reelection and is winding down his term. We thank them and all the Hatfielders who volunteer in their communities for their service.



Shawn Brateng, staff in HMSC's IT Department, was the invisible force behind Red Octopus Theatre Company's highly successful production of *The Rocky Horror Picture Show* at the Newport Performing Arts Center in October. As Director, Shawn made this somewhat absurd and outrageous production come alive onstage, adding a few laughs and a bit of color to an otherwise dark and dreary season. To celebrate, Shawn (*center in photo*) cut his long ponytail at the conclusion of the final show to donate to the *Locks for Angels* charity.

Photo credit: Nancy Jane Reid.

HMSC Snapshots

In September 2010, an interdisciplinary team of HMSC and agency scientists explored the undersea portion of the **Northern San Andreas Fault** (NSAF) (see article, page 1). Some of the inhabitants of the NSAF environment were fishes and invertebrates commonly known for this area of the California Current, including Dover sole, English sole, rex sole, skates as well as sculpins and poachers. Where the NSAF outcropped, the images captured by the Autonomous Underwater Vehicle (AUV) *Lucille* revealed invertebrates such as the feather star or crinoid, and numerous giant anemones, basketstars, and in some areas sponges. Feather stars and basket stars are known to inhabit rocky habitats in areas of strong currents that deliver food to these filter feeding organisms. AUV images from one of the first dive sites also showed very high concentrations of euphausiids or krill.



Hatfielders on the AUV team included Erica Fruh (above) and Russell Haner (right), both of NOAA.



Above: Image taken with the AUV's downward looking digital camera showing plankton just above the seafloor, rockfishes, a sculpin, and anemones at the San Andreas Fault site.

(NOAA Fisheries NWFSC)

Honor Roll



Xiuning Du, a visiting graduate student from China in Bill Peterson's lab, was recently honored with the Best Presentation Award for the Biological Oceanography section of the recent PICES-2010 Meeting in Portland. This international conference focuses on North Pacific marine science, and her presentation was entitled "Feeding rates of adult *Euphausia pacifica* on natural particle assemblages in the coastal upwelling zone off Oregon, USA." **Brett Dumbault**, OSU-HMSC Faculty with USDA, received an award for Best Poster.

Bill Hanshumaker, Public Marine Education Specialist at HMSC and Extension Sea Grant Faculty, recently earned his PhD. through OSU Department of Fisheries and Wildlife. "Dr. Bill's" successful dissertation defense entitled *Making an Aquarium Environment Interactive: A Design Research Analysis of Exhibit Design Processes* was presented at the Corvallis campus on September 9, 2010. Congratulations!



Bill Peterson was recently promoted to Senior Scientist, the highest level that one can achieve on a science track within NOAA. He joins just a handful of Senior Scientists at the Northwest Fisheries Science Center (based in Seattle). The award is for one's "body of work" and in this case, includes number and quality of publications, supervisory skills, service at Fisheries Headquarters in Washington DC, and outreach. Bill runs a highly-successful research program here at Hatfield based on biweekly sampling of hydrography, zooplankton and krill in the ocean off Newport (now in its 15th year). This program allows study of how climate change may impact marine food chains. Further, it addresses long-term changes in ocean conditions and how this may impact survival of salmonids off Oregon and Washington. This work is summarized at a popular website which provides information on "ocean conditions and salmon forecasting" (<http://www.nwfsc.noaa.gov>).



Summer Swelling: HMSC Academic Programs Update

We had an incredible summer at HMSC. An impressive number of students spent the summer at Hatfield conducting research, taking courses and communicating marine research in the field, laboratory, classrooms and visitor center. From docks to decks, students involved in the many summer activities could be found on the docks of Newport to the decks of the R/V *Elakha*. No nook or cranny was empty, including HMSC's housing filled with nearly 30 summer interns and 23 summer session students. Now that's what I call a summer bloom!

--Itchung Cheung, HMSC Academic Coordinator & Instructor

CERM Students Putting Mud on the Boots, Acquainting with Oregon Marine Resource Issues

by Chris Eardley, CERM Teaching Assistant & MRM Graduate Student

"This course has an almost rite-of-passage feel to it," explained Cynthia Sells, one of ten students enrolled in this fall's Coastal Ecology and Resource Management (CERM) course. Indeed, CERM offers students exposure to a wide gamut of Oregon marine issues and concepts. Sells and her classmates got a jump-start on the term, beginning a week early to immerse in a 5-day field component that took them up and down the Oregon coast. The first week featured talks on topics from coastal economies to coastal oceanography. The students toured a watershed restoration site, dredged for oysters in Toledo, and stalked invasive species on the Yaquina. And a humpback whale washing ashore at Ona Beach afforded a rare glimpse at cetacean ecology in action (and made up for not seeing many whales on the whale watch trip!).



CERM provides a unique opportunity for students to connect with the HMSC community. A host of speakers from the Hatfield and Oregon coast communities generously donate their time to contribute to student learning. Members of the Hatfield community also guide students in their

term projects and a number of graduate students are mentoring too. This year's class is exploring topics from permitting obstacles in marine mammal research to Dungeness crab movements.

Student interests are as diverse as the topics covered in class and this year's students are excited about their experiences thus far. Amy Davis, a 2010 CERM student new to Oregon has summed up her take on the course: "This was a great way to be introduced to current issues surrounding the state of Oregon. It's clear there is much work to be done."

The final student research posters were presented by students in the HMSC lobby at the end of the fall term on Wednesday December 8, 2010. This event was well attended by the HMSC community.

Alex Hirota, OSU Biology 2010 HMSC Visitor Center Intern, 2010 OSU Spring Term Marine Biology Student

This summer I spent 12 weeks as an intern for the HMSC Visitor Center communicating marine research to the public. My focus was on a new wave energy display project for the Visitor Center. Working with Kaety Hildenbrand, a Marine Fisheries Extension Agent for Oregon Sea Grant Extension, I had the opportunity to write a summary paper



highlighting several types of wave energy devices, how they work, and how the research has progressed. This led to the creation of a display poster in the Visitor Center explaining how the different types of devices will work. The final part of my summer project involved creating a conceptual design for a new exhibit that will replace the Chaos Wheel with an interactive exhibit highlighting tsunamis, erosion, and wave-energy.

My summer internship experience also had me leading estuary tours, a deep-sea volcano presentation, and public interpretation work in the VC.

**Danielle Asson, OSU Biology
2010 REU Intern
2010 OSU Spring Term Marine Biology Student**

My summer experience at HMSC was one of the most rewarding of my science career. I worked with John Chapman and Brett Dumbauld studying the mud shrimp *Upogebia pugettensis* in Pacific Northwest estuaries. *U. pugettensis* is extremely important to many estuarine biological and chemical processes. They are experiencing severe population declines, coinciding with heavy infestations of an introduced isopod parasite. Little was known about these species, so my research involved going onto the mudflats at low tide (sometimes at 5 in the morning) and collecting shrimp for measurements. Eventually over 1700 shrimp from 21 different sites were collected and measured! We found very interesting trends, including that host size is the determinant factor in vulnerability to infestation (bigger hosts are more infested), and female shrimp seem to grow into vulnerable sizes faster than males. I had the opportunity to present this research at the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS) conference in September, and I will also be presenting at the American Society for Limnology and Oceanography (ASLO) conference in February.

Not only was this internship a great scientific opportunity in which I gained a number of new research skills, but over the ten weeks I met some amazing people, made many new friends and did some incredible things, such as an awesome trip to Mt. Rainier. Overall, I would say this experience was one of the best in my life, and I have many memories, experiences, and skills I will remember forever.



**Melissa Prectl, OSU Biology
2010 REU Intern
2010 OSU Spring Term Marine Biology Student**



Hatfield is an amazing facility and the fact that it is comprised of many different agencies made the REU experience unique. I definitely enjoyed the exposure to a wide array of research and appreciated how easy it was to explore different labs. Participating in the REU was a very rewarding experience in which I was able to be a part of cutting edge climate change research.

This past summer, I worked with Bill Peterson and his NOAA lab to investigate the effects of ocean acidification on hatching and development of two copepod species, *Calanus pacificus* and *Calanus marshallae*, and one species of euphausiids, *Euphausia pacifica*. We found evidence that decreasing pH slows development for all three

species. There were no significant differences in hatching success between the pH treatments, but a larger proportion of larval deformity was observed for all species in the lower pH treatments. My research included participating in bi-weekly cruises to collect gravid females for my experiments. In August, I participated in a week-long research cruise with the Peterson lab on the NOAA ship the *Miller Freeman*. While on these cruises I performed technician responsibilities that included water-column sampling for chlorophyll analysis, plankton net tows, and CTD deployment. I look forward to presenting my research at the 2011 American Society for Limnology and Oceanography (ASLO) conference this February in Puerto Rico.



Hatfield Marine Science Center

2030 SE Marine Science Drive
Newport, OR 97365

www.hmsc.oregonstate.edu/friends

Upwelling is produced and distributed 3 times a year to the Friends of HMSC membership. Your feedback is welcome.
(email: maryann.bozza@oregonstate.edu)

First Ever Rapid Assessment Survey for Invasives on the Oregon Coast

By Ralph Breitenstein, HMSC Volunteer

John Chapman and Ralph Breitenstein, OSU, HMSC and Thomas Therriault, Fisheries and Oceans Canada, organized the first general survey of introduced coastal marine species in Oregon. The survey, hosted at HMSC between October 17 and 30, was financed by PICES (North Pacific International Commission for the Exploration of the Seas) and Oregon Sea Grant. Scientists and taxonomists from the United States, Canada, Russia and Japan surveyed marine invertebrates and algae of the Yaquina and Coos estuaries to measure species invasions across the North Pacific and establish a baseline for estimating extinctions. Of the 200+ species identified, 25 were previously unknown in Oregon estuaries, several are new introductions to the Oregon coast, to North America or to the North Pacific, two are possibly new to science and 32 species (about 16%) of the total are likely introduced



species. Additional products of the survey included a Canada/USA intercalibration of green crab sampling methods, tests of parasitic bopyrid isopod invasion probabilities, tests of a ballast water “propagule pressure hypothesis” and many samples for genetics for a broad diversity of the species. On a positive note, we found a native amphipod crustacean *Melita oregonensis*, known only from Coos Bay, and probably threatened by invasions of two other introduced *Melita* species on this coast, is still there.