Intertidal Tidings

Quarterly E-Newsletter

University of Washington Friday Harbor Laboratories

Marine research with focus on earth's future

From the Director

Ocean Change

Kenneth P. Sebens

When I was doing field work for my PhD dissertation, my colleagues and I were looking for sites that were "pristine"—as far as possible from human influences, so we could be sure that the ecological interactions we were measuring were typical of those communites, and not somehow altered by human intervention. So, we worked at beautiful and inaccessible places like Tatoosh Island, and isolated points in the San Juan Islands. Read more in *Ocean Change* (Page 3).

Two FHL Priority Support Opportunities

Matching Fund: Ocean Acidification Facility

As we mentioned last issue, FHL is now in the process of setting up a state-of-the-art lab to study Ocean Acidification. An exciting opportunity of $75,000 for lab equipment can be secured if the amount is matched in donations. Read more about this project in *Matching Fund: Ocean Acidification Facility* (Page 5).

Student Funding for 2010 Programs

This has been an exceptionally hard year for student funding. because of UW tuition increases, reduced endowment income, and a drop in donations. Read how you can help by adopting a FHL student in *Student Funding for 2010 Programs* (Page 5).

Since spring 2008, FHL has been involved in bringing FHL graduate students into local high schools under the NSF program. Learn how this program is increasing ocean literacy in *FHL Enriches San Juan County K-12 Curricula* (Page 11).

Read about current research projects and new courses for primary and secondary school students in Jenny Robert's *FHL Science Outreach Program* (Page 12).

Hannah Snow, the 2009 Friday Harbor Laboratory Young Investigator prize winner describes her research at FHL in *A Summer Close to Snails* (Page 13).

Jaquan Horton emphasizes the importance of Adopt-a-Student on his academic career *(Page 8)*

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Support FHL and Change a Student's Life (Page 25)

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Galina A. Pavlova of the A. N. Belozersky Inst. of Physical-Chemical Biology, Moscow State University, describes her 1991 meeting of Dennis Willows in Moscow which led to their collaboration on TPePs. Read more in *These Mysterious White Neurons* (Page 10).

Green seaweed growing in great drifts called "green tides" can be deadly. Find out more about this innocent looking seaweed in the article by Charles J. O'Kelly in *When Sea Lettuce Goes Bad* (Page 9)

Biodiversity on undersea walls in the San Juan's is the research subject of Graduate Research Assoc. Robin Elahi. See more in *Subtidal Tidings* (Page 6).

FHL will be conducting experiments to understand how organisms will respond under future environmental conditions when its Ocean Acidification research facility comes on-line later this year. Read more in Moose O"Donnell's piece *Ocean Acidification Research Prospects* (Page 7).

Friends, colleagues, and students of Richard Strathmann gathered on New Year's Eve to celebrate his remarkable contributions upon his 2009 retirement as UW Professor and Resident Associate. Director, FHL. See *Strathfest*, (Page 17)

The Robert L. Fernald Endowed Scholarship provides support for graduate students of Comparative Invertebrate Embryology at FHL.

Bob's warm personality, his encouragement of students, and his humor come alive in recollections by his colleagues. Read the wonderful stories told in *Remembering Robert L. Fernald* (Page 18).

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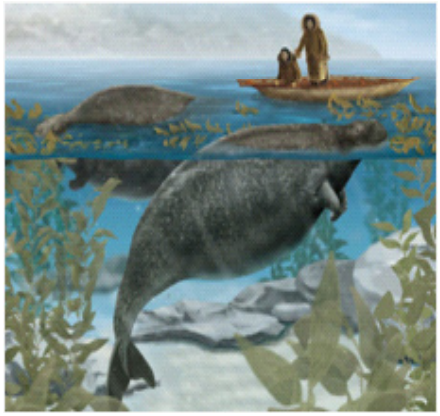
Ocean Change

Ken Sebens, Ph.D.

When I was doing field work for my PhD dissertation, my colleagues and I were looking for sites that were "pristine" – as far as possible from human influences, so we could be sure the ecological interactions we were measuring were typical of those communities, and not somehow altered by human intervention. So, we worked at beautiful and inaccessible places like Tatoosh Island, and isolated points in the San Juan Islands. Sometime during those years, in the mid 1970s, we started to hear about how different Pacific coastal communities had been decades to centuries earlier. Major players, such as sea otters, Steller's sea cow, and many of the larger fish species were either locally or globally extinct. How different were the communities we were investigating back when there were more and larger predatory fish, huge kelp grazers (sea cow), and voracious urchin predators (otters)? Maybe it didn't matter too much for the sea anemones, mussels, coralline algae and other common intertidal denizens we were studying, but who knows? Research happening right now at FHL indicates that the amount of kelp drift and detritus available to both intertidal and subtidal communities could have had a very large effect, for example if otters were controlling urchins which removed kelp in the shallows, urchins in deeper habitats may have been starving. Now they seem to be getting plenty of food.



Stellar's Sea Cow
Source: www.itsnature.org

In the 1970s, we became aware that large predators and herbivores had been removed from coastal ecosystems in many other parts of the world too. When I moved to the east coast, I began to understand the magnitude of this effect; the huge schools of cod that had lured European fishermen to New England and Atlantic Canada were so depleted that it was rare to see one in hundreds of dives in coastal habitats, though some of the offshore submerged rock ledges still had schools of cod. Other fish, such as haddock, had met the same fate. In the 1980s we began to think about how the removal of cod and other large predatory fish in New England may have affected the rest of the community. Huge herds of sea urchins, large crab populations, and abundant lobsters, were all typical of New England coasts in the 1980s, but were probably not typical when huge schools of cod roamed the shallows of the Gulf of Maine every year. Our experiments showed that common prey, such as small crabs and brittle stars, tethered to a piece of chain on the bottom, could persist for days in the coastal zone but were gone in hours at offshore sites with cod populations. The Gulf of Maine had become one huge communal lobster and crab farm – fed by coastal nutrient runoff and sewage feeding phytoplankton, eaten by mussels, then by crabs and lobsters. The lobsters also eat the crabs, and each other sometimes. On top of that, lobster fishers were baiting their dense fields of traps, feeding the ones that weren't caught. And of course, commercial and sport fishing ensured that all those nasty juvenile lobster predators would not return.

Also in the 1980s, I was working in Jamaica and other Caribbean sites. We had seen coral reefs decimated by hurricanes, but starting to recover. Then two catastrophes hit; the first was a disease that wiped out the spiny black sea urchins that grazed algae off most Caribbean reefs in the early 1980s. Combined with heavy fishing on parrotfish and other herbivores, this resulted in a huge bloom of large and small seaweeds that smothered corals and other benthos, preventing recovery. Then, in the late 1980s, we saw the first examples of large scale coral bleaching. Corals turned pure white or patchy, having lost their symbiotic algae after periods of unusually warm temperatures. This happened again a few years later, then many times again for the next two decades. This became a global rather than a local phenomenon and has resulted in huge losses of coral across the globe. The future for coral reefs looks bleak indeed for the coming decades.

Increasing seawater temperatures have caused many species to shift their ranges poleward, and have led to the loss of some species and increases in others that are more tolerant to warming. Locally, introduced Asian oysters seem to have done well, but our local oysters have done poorly, and pinto abalones very poorly, a result of both ocean warming and over a century of exploitation. It is extremely hard to predict how oceanic and coastal communities will change as the sea surface warms; the only safe bet is that there will be a major shift of species, as happens during El Nino years, but over a longer time scale and with more permanent effects. Given the hundreds or thousands of interactions among species, and the effects of disease microorganisms, it may be impossible to predict the makeup of our coastal communities over the next century. In our region, sea surface temperature has risen about a degree centigrade over the past half century, which is a huge change. However, research in the last ten to fifteen years has shown us that another insidious change is happening at the same time, one that could have even larger effects. Increased carbon dioxide in the atmosphere is responsible for the greenhouse effect, trapping heat that warms air, land and fall water. But carbon dioxide when dissolve in the ocean, also creates carbonic acid, lowering the pH of surface waters, making them more acidic. This acidification of the ocean has been measurable and

as sea urchins, fish and corals—(all enzymes have temperature and pH optima) and may eventually make it impossible for some animals to make shells. This was first seen in tropical corals and planktonic mollusks, pteropods, whose shells were observed to dissolve in seawater whose acidity had increased to levels we now see at some times and places in the ocean. Decreased oyster recruitment, growth and survival along the coast of Washington may be tied to these more acidic conditions in recent years. Researchers from NOAA's Pacific Marine Environmental Laboratory in Seattle have been conducting cruises along the coast of Washington and Oregon over the past decade, and recently recorded upwelling events that are bringing more acidic water, normally fairly deep, right to the surface. This water is also low in oxygen and has been implicated in kills of fish and crabs along the outer coast over the past few years. I was aware of low oxygen fish kills in enclosed places such as New York, Chesapeake Bay, and off the mouth of the Mississippi River, but I was totally surprised to see this happening along our exposed outer coast.

We can't escape ocean change at this point in time. Of course, life in the ocean is always changing, given the cycles of El Nino and the Pacific Decadal Oscillation, as well as longer term shifts such as ice ages. How severe is this chemical and physical change, how exceptional is the rate of change, and how radically will planktonic and benthic communities change because of it? Can we predict which species will be most affected, and can we do anything about it? Furthermore, what are the physiological mechanisms that allow some species to cope with these changes? How are other factors such as harvesting, species introductions, and disease also affecting species composition of these communities? These and many more absolutely fundamental questions will be addressed by the new Center for the Ecology of Changing Oceans (CECO) at FHL. This new Center (see our last newsletter) comprises faculty at FHL and in Seattle, plus their collaborators, and includes the new research laboratory for examining the effects of ocean acidification on local species and communities, long-term research in our biological preserves, and dozens of other ecological and oceanographic research projects planned and in progress at FHL. I am very pleased to see this group coming together to address these issues, and I expect there will be some very interesting and useful findings to report very soon. Keep watching.

Berland, Norway land-based mesocosm unit (See note) Photo by James Murray

Berland, Norway floating mesocosm unit (See note) *Photo by Ken Sebens*

Note:

Illustrations on this and the next page are of the National Mesocosm Centre at the Marine Biological Station located at Espeland, in the Raunefjord, 20 km South of downtown Bergen. The most outstanding feature at the station is the Mesocosm Laboratory.

The National Mesocosm Centre includes a floating mesocosm laboratory and a land-based mesocosm system. Both units have water regulating devices and access to continuous water supply from the surface or from 40 m depth. Instruments for monitoring environmental factors are also available: The land-based mesocosm unit is especially suitable for experiments where physical control, e.g. turbulence, is required. It is also suitable for other pelagic experiments dealing with the lower trophic levels not requiring large sample volumes.

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Two FHL Priority Support Opportunities

Matching Fund: Ocean Acidification Facility

As we mentioned last issue, FHL is now in the process of setting up a state-of-the-art lab to study Ocean Acidification. With National Science Foundation funding we will establish a lab that includes in-water mesocosms, laboratory mesocosms and aquaria, as well as an analytical chemistry laboratory building (See Moose O'Donnell's commentary on what goes into the lab in his article *Ocean Acidification Research Prospects, (*Page 14). This new facility will be the first of its kind, available to all users of FHL, and will include state-of-the-art instrumentation. The research focus will be on how changing ocean conditions affect local marine plankton, benthic animals, and plants. This is a timely and critical research field that is now in its very early stages.

NSF partially funded the proposal ($275,000 of a requested $350,000) that will cover most of the instrumentation and the UW has agreed to match this $275,000 for a lab building. We also have an exciting opportunity because our Vice Provost for Research has made a generous offer to match an additional $75,000 if FHL can raise $75,000. With that, we will have $700,000 available for instrumentation, mesocosms and a new lab, rather than the $550,000 ($275,000 from NSF + $275,000 from UW) we have now.

The additional funding would mean a larger and better equipped laboratory building that will be a huge advantage for FHL, and will generate research for many years to come. We expect users to be funded from NSF and other sources for their projects here. This facility will also be the location for several of our new Research Apprenticeships dealing with ocean change and its effects over the next few years.

Berland, mesocosms in operation (See note Page 4)
Photo by James Murray

We are hopeful that you, the members of our community, will be able to help us with some part of the $75,000 match. Please contact the Director (sebens@uw.edu) or use this link to make an on-line donation: *https://secure.gifts.washington.edu/uw_foundation/gift.asp?source_typ=3&source=FHLDIS* On the second screen, in the last part of "**Your Information**", you will see a Comments box. Enter "Ocean Acidification" in the Comments box.

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Student Funding for 2010 Prorgams

This has been an exceptionally hard year for student funding. Not only has the University of Washington raised tuition 14% in each of the last two years, but the income from endowments was cut in half. FHL has embarked on an ambitious plan to offer a full slate of courses in the Fall and Spring quarters as well as our usual summer program. Unfortunately annual fund giving was down last year in spite of far greater need, leaving us in a difficult position with respect to students who are qualified for the courses but can't afford them. We had a substantial number of students decide not to attend the program after being admitted and half of these cited financial reasons as the primary issue.

An Adopt-a-Student alumnus, Jaquan Horton– a PhD student at the University of Washington, explains the importance this funding had on his career path to becoming a scientist in his article on Page 15: *Adopt-a-Student Gave Me The Missing Link* .

For those of you who feel strongly, as I do, that finances should not dictate who has access to our classes, I am asking that you look very hard at the Adopt-a-Student program. We believe this is the best avenue for supporting students because individuals can support one student at $5,000, or two at $2,000 each, and get to know them and hear about their experience at FHL. If you can help us support students in 2010 programs, please contact Rachel Anderson (rachelea@uw.edu) or use this link to make an on-line donation: *https://secure.gifts.washington.edu/uw_foundation/gift.asp?source_typ=3&source=ADOPTS*

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Subtidal Tidings

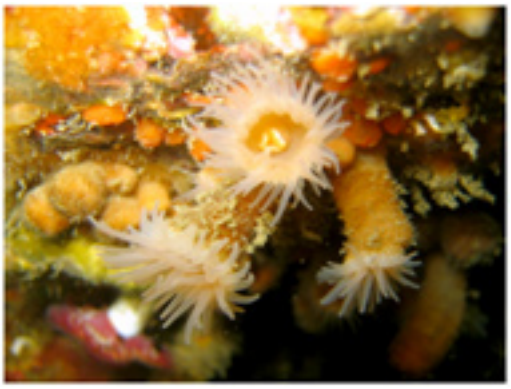
Robin Elahi, Graduate Student

Robin diving

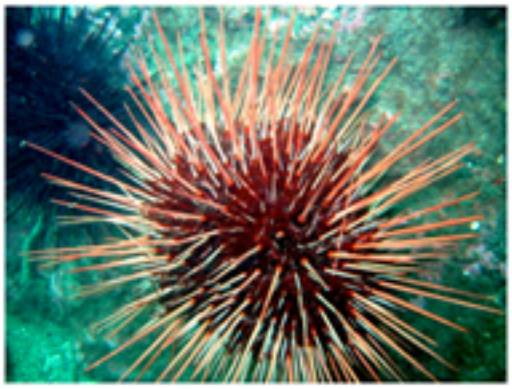
Diversity, in the broadest sense, is cool for lots of reasons. There are so many different people to meet, cultures to experience, places to visit, foods to eat, books to read, games to play…it's practically impossible to get bored! Likewise, diversity in the biological sense is equally exciting and staggering. One back-of-the-envelope calculation estimates that there are 30 million species (not including microbes) on the planet, and scientists have only described about one million of them.

I read the article that made this extraordinary calculation during an undergraduate tropical ecology course in Costa Rica, and it certainly made its mark. In part, that paper is the reason why I study diversity today. Of course, it helped that I read it while camping in a cloud forest inhabited by outspoken howler monkeys, quetzals with streaming iridescent tail feathers, prehistoric tree ferns and insects (lots of them), gold-plated scarab beetles, enormous bullet ants, see-through glass-wing butterflies…the list goes on. I became convinced that I would study insect diversity, and graduate school beckoned on the horizon.

Through several twists of fate including jobs at the New England Aquarium and the Three Seas Marine Biology Program, I no longer study insects, but I do study invertebrates in the ocean. I'm still fascinated by biological diversity, or biodiversity, and I currently study the causes and consequences of marine biodiversity from an ecological perspective. My research revolves around two fundamental questions. First, how can so many species coexist in one place when they struggle for the same basic necessities? Second, what are the effects of biodiversity on important functions of ecosystems, like nutrient cycling, productivity and resource use? The latter is of general interest because humans are responsible for both species extinctions (through overharvesting and habitat destruction) and species invasions (through intentional and accidental introductions of non-native organisms). The rates of extinction and introduction are alarmingly high, and the consequences of some of these altered food webs include economic costs of billions of dollars.



*Zoanthid (*Epizoanthus scotinus*)*
Photo by Robin Elahi



Red urchin Strongylocentrotus franciscanus
Photo by Robin Elahi

To address these questions, I study underwater rock walls. As any recreational diver in Washington can attest, vertical rock surfaces are often covered in a colorful mosaic of animals, including sponges, bryozoans, sea squirts, anemones, barnacles, and tubeworms. All of these organisms have two things in common. First, they capture food particles from the water for sustenance, and serve as a critical link between open water food webs and benthic habitats. Second, they compete for the same limiting resource, which is space on the rock surface. It makes intuitive sense then, that when there are many species (high biodiversity) in a given area, there is little space available in that area.

Using diving surveys in the San Juan Islands, I also learned that sea urchins and chitons were strongly correlated with the amount of space available on walls, and so these seemed likely candidates for field experimentation. I added urchins to some areas, and removed urchins and chitons from others. I found that urchins create space on walls – they have a voracious appetite not just for kelp, but also for the sessile invertebrates on the walls, especially sea squirts. Chitons, on the other hand, appear to move into the newly created space and graze upon tiny algal babies.

What does this mean for biodiversity and space on subtidal walls? In the presence of many urchins, sea squirts can't take over the walls, and this allows a different set of animals to occupy space. Without urchins, sea squirts grow quickly in some places, resulting in very little space on the walls, regardless of the number of species. More importantly, what does this mean for biodiversity and ecosystem function in general?

Although I have studied a very specific system of urchins on rock walls, my research demonstrates that examining the effects of biodiversity at one trophic level can lead to conflicting results, and that understanding ecosystem properties will require a multi-trophic context. This is especially relevant, because higher trophic levels are more susceptible to extinction than lower trophic levels. I hope to continue diving and test the generality of my results in other places— Hood Canal, here I come!

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Ocean Acidification Research Prospects

Moose O'Donnell, Ph.D.

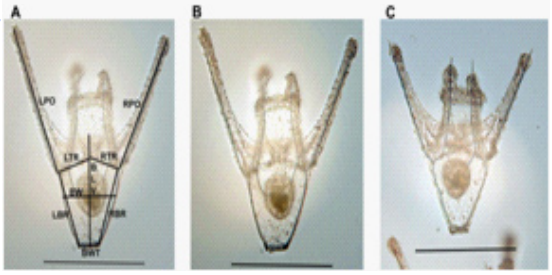
We are looking forward to the renovation of Lab 7 into the Ocean Acidification facility. This laboratory will include equipment to simulate the CO_2 levels predicted for future oceans, allowing researchers to explore the biological effects of ocean acidification. The lab will also include state-of-the-art analytical equipment to quantify the carbonate chemistry of the water. Contrary to what many of us biologists may assume, measuring the pH of seawater is far more complicated than simply dropping in a pH electrode. Instead, it is necessary to measure at least two parameters that can affect the pH and CO_2. We will have a state of the art spectrophotometer, which measures pH by the change in color of a pH sensitive dye (similar to a swimming pool test kit) and is far more repeatable than a glass electrode. The lab will also have instruments to measure the total amount of inorganic carbon, the level of dissolved CO_2 and the total alkalinity of seawater.

Taken together, these instruments will allow researchers at the lab to carefully document their experimental conditions and the chemistry of seawater brought in from the natural environment. Surprisingly, the CO_2 conditions in the natural environment have only received intense study over the last two decades; there is much about the seawater pH researchers need to know. The OA facility at FHL will provide a valuable resource for researchers as they plan and execute experiments to understand how organisms will respond under future environmental conditions.

Panel A is the same as Panel B with measurements.

Panel B shows a larvae of the urchin Lytechinus pictus *raised under approximately ambient (~400 ppm)* CO_2 *conditions....*

Panel C shows a larva from the same group raised under elevated CO_2 *(~1000 ppm). The larvae averaged about 5% smaller with elevated* CO_2



Photos by Moose O/Donnell

Friday Harbor Labs' Open House

May 8, 2010

- Self-guided tours of facilities
- Meet scientists and students
- Learn about current marine research projects
- Tour the research vessel R/V Centennial
- See SCUBA gear and demonstration

Mark your calendar! This event is fun for the whole family. Do you have a question about the marine environment in the San Juans that you would like answered? This is your opportunity to pose questions to the scientists at the Labs. Your children will enjoy seeing the marine life in the laboratories, touring the R/V Centennial, examining SCUBA equipment and watching a SCUBA dive demonstration. There is a tradition of free popcorn, and light refreshments will be available in the Dining Hall for a small fee. Read more in *Coming Events* (Page 33) or click on this link http://depts.washington.edu/fhl/events.html

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Adopt-a-Student Gave Me The Missing Piece

Jaquan Horton, Graduate Student

My graduate research and training is in the field of comparative biomechanics, where I use engineering and physics concepts to describe biological systems. My particular research focuses on investigating the material properties of biological tissues. In the beginning of my graduate career, it was at times difficult to comprehend some of the concepts of this field because my undergraduate training was in general biology, where I had no formal training in engineering or physics. Yet understanding form and function was my passion, and what I wanted to pursue.

In the summer of 2008, I was fortunate to receive funding from the Adopt-a-Student program to take my first comprehensive biomechanics course, at Friday Harbor Laboratories. It was this funding program that enabled me to take part in an extraordinary, and comprehensive learning experience that provided an excellent opportunity to fortify and cement my knowledge and understanding of the concepts and fundamental aspects of biomechanics from experts in the field. In addition, the structure and hands-on nature of the class fit my learning style, which allowed me to excel.

What made the course even more memorable, and truly enriched my experiences, was taking this class at Friday Harbor Laboratories. This phenomenal research station provided an exceptional learning environment, great people traverse the grounds, from the administration and staff, to the many researchers and students. In addition, the collaborative atmosphere cultivates and encourages people to discuss their research, and share their scientific knowledge. As a result, I was also able to gain fresh perspectives and new insight into my research, as well as increase my confidence by helping others.

The formal training of this course helped propel me to another level of appreciation of the field, and success, as a biomechanist. In addition, the course provided me with a more well-rounded and developed background for my future career goals. Since the class, I have gained a profound respect for the dynamic materials and structural adaptations organisms used to solve biological problems. The course undoubtedly increased my technical proficiency and understanding of my field of study, as well as strengthened my abilities to pose innovative research questions as I pursue a research career in biomechanics that uses bio-inspired systems and structures to enhance modern technologies.

I am very thankful for the Adopt-a-Student program. Without the financial assistance and resources of the program, I would not have been able to participate in the course, learn the information that has allowed me to be successful in my research and studies, or determine my future career path. Thank you again to all those who have contributed. I couldn't have done it without you! *(Jaquan is a PhD candidate at University of Washington)*

Return to TOC

Friday Harbor High School Wins First and Fourth in Orca Bowl

The Washington State Ocean Sciences Bowl, or Orca Bowl is a statewide event held in Seattle, that challenges and recognizes high school students' knowledge of the world's oceans. The competition lasts a full day, with teams competing in a round-robin tournament followed by a double elimination. Students tackle questions in all areas of marine studies, including ocean-related physics, chemistry, geology, biology, social sciences and technology.

Teams from Friday Harbor High School placed first and fourth Saturday, February 7th, in Seattle. Friday Harbor High School's A team of Nick Roberts, Audrey Olshefsky, Stewart Bell, Hannah Snow and Mathew Skeels (shown left to right in the photograph) won first place. Team A was coached by the FHL's graduate student, Max Maliska, who currently is in the NSF funded GK-12 program described in Megan Dethier article *FHL Program Enriches K-12 Curricula* (Pg. 16). Friday Harbor's B team of Nicole Le Baron, Graham Ellis, Elle Guard and Gavin Guard placed fourth. and was coached by Nick Frazee, a teacher at Friday Harbor High School. The A team advances to the National Ocean Sciences Bowl finals, all expenses paid, in St. Petersburg, Florida, on April 23-25. The B team won a kayaking trip in the San Juans. All teams receive prizes for participation, with top awards that include scholarships and shipboard science experiences. The event also provides an opportunity for students to meet university and ocean community scientists, faculty and student volunteers.

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When Sea Lettuce Goes Bad

Charles J. O'Kelly, Ph.D.

Giant Ulva *blad at False Bay 2001*
Charles with Marine Phycology students

Fouled sailing routes at the Beijing Olympics. Dead horses on the beaches of France. Stinking piles on the shores of Puget Sound. All caused by a green seaweed that can grow in great drifts called "green tides", wash up on beaches and rot, with potentially deadly consequences. And it's named after a common garden vegetable. What's going on here?

In 2002 my colleague Paul Gabrielson and I posed two questions to students in the FHL summer Marine Phycology classes. How many species of sea lettuce are there around San Juan Island? Which of these, if there's more than one, are most likely to be going bad on the beaches?

The question "how many species" is not trivial. Sea lettuces (genus *Ulva*), as the common name implies, are simple green blades or tubes that look a little bit like your typical salad greens. To the casual observer, all sea lettuces look alike. Trouble is, they also look pretty much alike to the experienced observer. The differences are small, and it's hard to know what they mean. Do they separate the seaweed equivalent of lions, tigers, and bears? Or blue eyes vs. brown? Or just fat vs. skinny?

The students discovered, as have researchers around the world in this decade, that generations of efforts by careful scholars to separate the species of *Ulva* by looking at them have been in vain. The only reliable way to distinguish the species is to sequence portions of their DNA (so-called "marker genes") and look for differences among the sequences.

Tubular Ulva*, Friday Harbor*
Photo by Charles O'Kelly

When they did this, they found evidence for 15 species of *Ulva* in the waters around San Juan Island. In the island's "green tide" trouble spots, however, only one of these species was common. Where "green tides" were absent, so was this species. Moreover, the sea lettuces growing attached on the shorelines that surrounded the drifting "green tides" did not include the species in the green tides.

These findings tell us that, though the different sea lettuce species in Puget Sound may look alike, they don't act alike. They also suggest that, in the San Juan Island area and perhaps elsewhere in Puget Sound, the source material (the "reservoir") for the annual "green tide" episodes is not the very visible growths of *Ulva* that appear on the shores, but a scarcely noticeable pile of fragments left over from previous blooms and mixed with wood chips and other bottom detritus. Knowing what the bloom "reservoir" is can make a significant difference in "green tide" management planning. One can spend a lot of money purging the shoreline of seaweeds that aren't contributing to the problem.

Not all of the 15 species of *Ulva* that the Marine Phycology students have found around San Juan Island correspond to the species names in the keys and guidebooks for this region. In Hawaii, colleague Alison Sherwood (University of Hawaii at Manoa) and I, with post doc Akira Kurihara and student Tara Chandrasekharan (now Tara Shipley) surveyed the *Ulva* flora and likewise found evidence for 15 species – only two of which corresponded to species listed in local guidebooks! Nearly half of the 15 have never been found anywhere else – but we don't yet know whether this means the species occur only in Hawaii, or that tropical marine waters have not yet been sampled effectively enough to know what's there. We suspect the latter.

High Magnification

High magnification
sea lettuce cells
Photo by Charles O'Kelly

The existence of a previously-unrecognized "tropical" collection of sea lettuce species complicate efforts to identify the species present in "green tides" throughout the world, and devise effective strategies to contain the spread of "green tide" species and strains.

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These Mysterious White Neurons

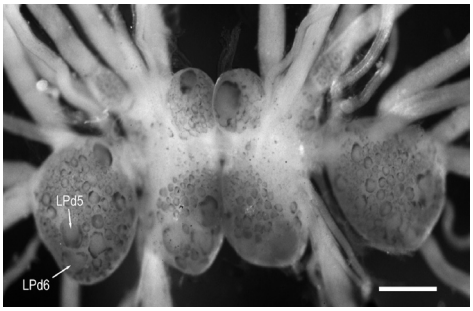
Galina A. Pavlova, Ph.D.

Dennis Willows started as a neurophysiologist in the sixties and was among the first to show that stimulation of single nerve cells (neurons) triggers complex behavioral sequences such as turning and swimming. This study had great success: the papers were published in *Science* and after Dennis's report at a *Symposium* in Hungary the participants rose in applause. That is not typical for a scientific audience).

Dennis has been working mostly on the nudibranch mollusk, *Tritonia diomedea* (Bergh, 1894), which is an extremely beautiful orange or red creature reminding me of a piece of watermelon. This mollusk is useful for studying behavior, e.g., swimming, feeding, mating, crawling and particularly attractive for neurophysiologists because it has large (up to 800 microns) and identifiable (recognizable by size, color and location) neurons in the brain. This allows studying morphology, connections, contents, properties, and functions of the same neuron using a number of mollusks. In the brain of *Tritonia*, in the bilaterally paired (left and right) pedal ganglia among small and medium size (5-100 microns) orange neurons, Dennis discovered two symmetrical large (about 500 microns) white ones, named them Pd5 and Pd6 and wondered, what is the function of these unusual cells.

Tritonia orients in the earth's magnetic field using neurons Pd5 and 6

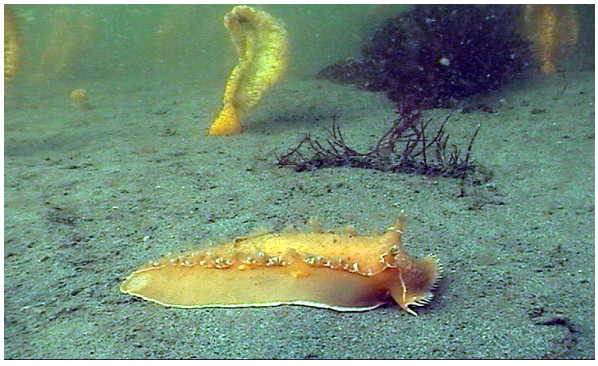
Twenty years later in field and lab experiments, Kenneth Lohmann and Dennis found that *Tritonia diomedea* has a mechanism of navigation and orients in the earth's magnetic field, similar to butterflies, fish and birds which migrate in definite directions. To study this mechanism under laboratory conditions they built a framework wrapped around by a system of wire coils. This miracle of engineering can be seen in Laboratory 2 today. When electrical current was switched on in the coils, the earth's apparent magnetic field directions were artificially rotated. It turned out that the preferred heading of a *Tritonia*, placed inside of the coils, followed the rotations. The mechanism of this motor response may be a reflex arc containing at least magnetic receptors and motor neurons that innervate muscles in the body and the locomotor apparatus. Magnetic receptors are stimulated by the magnetic field rotation and change electrical impulses to motor neurons. The increase in spiking rate stimulates contractions and relaxations in body muscles to change body motions. Recordings from neurons Pd5 and 6 revealed increased electrical activity in response to artificial changes in magnetic field direction. Such changes in activity were observed in other neurons subjected to identical magnetic stimuli. Pd5 and Pd6, that send their nerve fibers to the peripheral nerves, innervating the foot, are apparently motor neurons.



The brain of Tritonia *contains Pd 5,6 (shown in the left pedal ganglion)*

Tritonia Pedal Peptides

Dennis, Philip Lloyd and their collaborators (1995) dissected by hand, individual neurons Pd5 and Pd6 from the brain of several of these mollusks. They extracted, then purified the contents and disclosed a unique trio of peptides (small proteins). These peptides were called *Tritonia* pedal peptides (TPEPs). Thus, Pd5 and Pd6 synthesize white peptides that are seen through the cell membrane giving them their color. Dennis supposed that these peptides may be neurotransmitters (each electrical spike in Pd5 and Pd6) is followed by a secretion of a quantum of TPEPs from the peripheral end of its axon), and TPEPs stimulate locomotor activity. was a member of the neurophysiology group at Moscow State University in the 70s-80s. We successfully investigated control of rhythmic movements in vertebrates (cat) and invertebrates (swimming in a pteropod mollusk, *Clione*). In the 80s-90s, when the group began to break apart and my colleagues immigrated to different countries, I personally started studies of crawling



Crawling Tritonia diomedea
(Photo by Wyeth and Woodward)

II met Dennis when he first came to Moscow in 1991 and was a witness in, not a participant in, the Russian revolution with tanks and barricades. Next we met in FHL in 1995, when I had Grass Foundation support for studying locomotion in *Tritonia*, which crawls as does *Lymnaea*. By that time Dennis had synthesized TPEPs and our collaborations were started. We found that not only serotonin, a neurotransmitter, that increases locomotion in mollusks and some vertebrates, but TPEPs also facilitate locomotor activity in *Tritonia*, and that serotonin and TPEPs may increase the frequency of ciliary beating in isolated ciliated cells. Thus, TPEPs are locomotor neurotransmitters. Later new researchers were involved in this study. It was shown that TPEPs control activity of heart, salivary glands and esophagus in mollusks. Using fluorescent antibodies made against TPEPs, we found TPEPs in different neurons in the brain, in internal organs and ducts, and even in sensory organs of *Tritonia* and other mollusks. We also found numerous TPEPs containing fibers innervating different peripheral organs. Thus, TPEPs are widely spread neurotransmitters, involved in control of different functions in mollusks. Vertebrates, including humans, have the same peripheral tissues, organs and ducts, and if they do not have TPEPs exactly, they have analogous neurotransmitters, serving similar functions. The goal of our present and future studies is to describe the mechanisms of actions of TPEPs. If we do not have enough time, we bequeath this to the next generation of neurophysiologists!

Return to TOC

FHL Program Enriches K-12 Curricula

Megan Dethier, Ph.D.

Lopez student on RV Centennial
Photo by G. Helfman

FHL has been fortunate since spring 2008 to be involved in a national program bringing graduate students into high schools with the goal of increasing ocean literacy among students. Wise use of marine resources requires that the public be literate concerning life in the oceans and human impacts on the ocean. Marine science is usually only a small part of school curricula, yet high school is an excellent stage at which to promote awareness of the oceans while teaching students basic science. The National Science Foundation (NSF) Graduate STEM (Science, Technology, Engineering, and Mathematics) program in K-12 Education supports fellowships and training for graduate students. Through interactions with teachers and students in local schools, graduate fellows can improve their own communication and teaching skills while enriching STEM content and instruction for their K-12 partners.

The University of Washington (UW) has received 5 years of funding from NSF to host a GK-12 program focused on marine and environmental science. Because several UW programs focus on the oceans, at least four departments can recruit graduate students as enthusiastic GK-12 Fellows who can bring their own research into local classrooms. Research on ocean and coastal environments is, by its nature, highly interdisciplinary. Teachers and graduate fellows can use this interdisciplinary approach to teach basic science (biology, chemistry, and physics) and mathematics, while taking advantage of our coastal environments. UW graduate students can use their own experiences to help communicate what science is about, how it is done, and how discoveries are made.

STEM Structure & Benefits

8 Graduate Student Fellow Partners
- *Full support*
  - *50% effort STEM*
  - *50% effort research*
- *Improve teaching skills*
  - *UW course*
  - *Classroom experience*
- *Generate STEM content & Instructions*

8 Teacher Partners
- *Stipend for mentoring graduate fellows*
- *Enriched Curriculum*

During each year of NSF funding, the program supports 8 graduate fellows to partner with 8 high school teachers. Graduate fellows receive an entire year of support, so that they work approximately half-time in this program and have the rest of their time to do their research. Teachers receive a stipend to compensate them for the extra time they put in to coordinating with and mentoring fellows. Each participant may be supported for up to 2 years. The program is focused in schools in Seattle (5-6 teacher-fellow pairs) and San Juan County (2-3 pairs). With the program now in its second full year, in San Juan County we have had one fellow teach on Orcas, one on Lopez, and two in the Friday Harbor High School, in classes ranging from biology to oceanography to chemistry and physics. Other schools will be included in future years.

Benefits to graduate fellows include improved teaching skills. After spending some days in their high school classroom early in the school year to get a sense of the atmosphere, they take an intensive UW course on methods for teaching science at

Plankton sample on RV Centennial
Photo by M. Thorp

the high school level. This course introduces fellows to inquiry-based teaching methods, theory of science education, and effective curricula that create student-centered learning environments. For the rest of the school year they each spend 10 hours/week in the classroom, where they quickly learn just how hard it is to engage and teach high school students! Fellows who completed the first year of the program unanimously talked about how difficult but rewarding this was.

Teachers who have a fellow working with them for a year also benefit substantially. They receive assistance with their teaching, new energy in the classroom to implement inquiry-based learning projects, and exciting additions to their curricula. The high school students, in turn, not only benefit from the new material and projects brought into the classroom, but get to see valuable role models for higher education and careers.

The program also has several elements to encourage interaction and collaboration of the participants. Fellows attend regular seminars where they discuss their experiences, successes, failures, and advice to each other. They also have an internal website where they share lesson plans. Once each quarter all the teachers and fellows gather with program staff to discuss broader issues to improve the program. Fellows also 'polish' and post to a public website at least one lesson plan per quarter – in this way there is a lasting legacy of great teaching ideas that are spread around the country. Fellows also invite their graduate colleagues into the classroom for special activities (e.g., spawning sea urchins), thus broadening the areas of expertise available to the high school classes.

At the end of the academic year, the program hosts a workshop on the University of Washington campus, attended both by 'outgoing' and 'incoming' cohorts of teachers and fellows. Outgoing fellows and teachers give presentations and serve as mentors during the workshop, passing on valuable lessons-learned to their peers. At a second workshop in August, hosted by FHL, teachers and fellows share local field trips, content seminars, pedagogical seminars, and have plenty of time to begin planning their partnership. Teacher-fellow pairs use the relaxed and isolated atmosphere to work on curricula, lesson plans, and scheduling. This workshop is structured so it can be used for professional development credits for teachers.

GK-12 Fellow, Max Maliska lecturing
Photo by Megan Deither

In San Juan County, several classes have already made use of the R/V Centennial to show students how oceanographic data are gathered. Classes from Seattle may eventually come for field trips to FHL. During some weeks, fellows in San Juan County prepare an independent marine science unit that they bring into classes, and in other weeks they help their teacher-partner with 'regular' activities. One fellow made a "larval dispersal" board game incorporating the concepts of currents, gene flow, and larval biology. Another made up taste tests of salinities simulating different ocean basins, to get students thinking about sources and importance of salts in the ocean. This year one of the Lopez classes has a program to regularly collect water samples for analysis by Dr. Rick Keil's Sound Citizen water testing program (http://soundcitizen.org/). So the activities and learning opportunities are very diverse and exciting!

Return to TOC

Friday Harbor Labs Science Outreach Program

Jenny Roberts

Friday Harbor Labs Science Outreach Program is a unique science education program that brings exciting, inquiry-based and relevant environmental science into the elementary, middle and high school classrooms (K-12) of the San Juan Islands. Financially separate from the NSF funded GK-12 program, Friday Harbor Labs Science Outreach Program (FHLSOP) was established in 2001 and is structured as a partnership between the University of Washington Friday Harbor Laboratories, San Juan Island School District, the Spring Street International School, and the San Juan Nature Institute with support from The Russell Family Foundation. The resulting program is distinct in its partnering of research scientists, K-12 students and teachers with the goal of creating an integrated set of projects that teach science and environmental awareness to students. This winter K-12 students are engaged in a number of projects such as:

Invasive Mussel Project:
Three biology classes from Friday Harbor High School participated in a nine day lab to assess the spread of a non-native farmed mussel in the wild population of mussels in Westcott Bay. Students extracted, purified, isolated, amplified, separated by electrophoresis, and stained mussel DNA. The end result was the students were able to identify non-native mussels from the native species by looking at their DNA fingerprint.

Water Quality Sampling in Friday Harbor Marina:
Fifth grade students from the Friday Harbor Elementary School conducted the last water quality monitoring for 2009 at the Friday Harbor Marina. Six sites were sampled for fecal coliform levels, temperature, salinity and direction of flow. Results showed excellent water quality at all sites.

Watershed Stream Surveys
Friday Harbor high school geology students learned about water quality monitoring in the two major watersheds on San Juan Islands and then participated in a field trip to conduct stream surveys and water testing. Samples were collected in the field and then processed in the lab testing for turbidity, hardness, chloride, and phosphates.

Scientific Inquiry/Investigation
UW Marine Biology students introduced first graders to the idea of scientific inquiry/investigation while using loupes to magnify their world 5X. With careful and thoughtful observations, Friday Harobor elementary students answered the questions: What else does it remind me of? What else does it look, feel and smell like? Why did it remind me of that? Why is it like that?

Oceanography Science Laboratory Course
This new course, started in November at Griffin Bay Alternative High School, covers the physical attributes of the local ocean environment, water quality, pollutants, and current social oceanographic issues with an emphasis on fieldwork, lab work, and hands-on activities.

Make a Gift to the K-12 Science Outreach Program Online

Click on this link and enter "K-12" in the Comments box on the second screen to support the FHL K-12 Science Outreach Program. A small contribution will make a difference and will directly benefit the San Juan Islands' school programs: h*ttps://secure.gifts.washington.edu/uw_foundation/gift.asp?source_typ=3&source=FHLDIS*

A Summer Close to Snails

Hannah Snow

My name is Hannah Snow, and last spring as a high school junior, I was awarded the FHL Young Investigator's Prize. The prize allowed me the opportunity to work as a paid intern under Dr. Emily Carrington on the beginning of a three-year project involving intertidal whelk snails and their predator-prey relationship with barnacles under differing environmental conditions. I assisted in constructing experiments in the lab, and under semi-field and field conditions that would help our team gain a better preliminary understanding of interactions between the snail species *Nucella ostrina* and *Nucella lamellosa* and the barnacle *Balanus glandula.*

Many of the experiments I helped to run focused on shell temperature, coloration, and the ellusive feeding patterns of the snails. Air and rock temperature during low tide are the limiting factors that determine how high up on the shore the snails can feed, and therefore, where the optimal zone for barnacle settling. This predator-prey relationship controls an important portion of our local intertidal organism distribution, and as humans influence air temperature, this delicate balance can be easily thrown off. Our lab's study, although only in its infancy, has already made some previously unknown discoveries about the timing of feeding patterns of the snails in relation to tidal cycles.

As a senior in high school, this opportunity to participate in an actual laboratory study was a very unique and eye opening experience. I gained a much greater appreciation for those small little things, like snails, that we pass by each day and sometimes forget the importance they have in the larger picture. It was great to be accepted by such a supportive community as the FH Labs, and the many bright scientists that I met there made my experience not only a great learning opportunity, but also a fun and unique way to spend my summer.

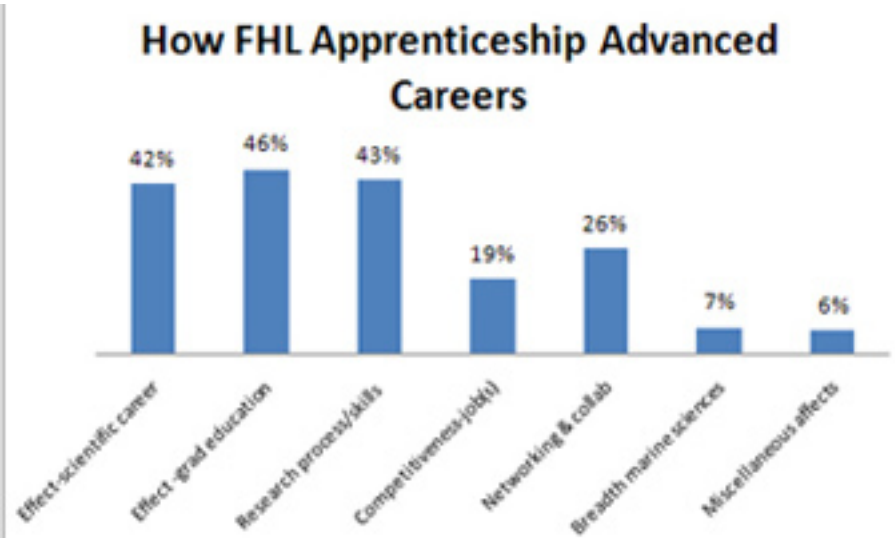
Return to TOC

Research Apprentices On Their Career Thresholds

Laura Long

One hundred eighteen FHL alumni, who first came to the Labs as undergraduate Research Apprentices (RAs), were asked in a recent survey what their experience at FHL did for them— how it advanced their careers. The answers to this question are insights of how one academic experience can provide clarity and shape one's life. Their responses display a variety of perspectives. Some talk about the importance of the research performed, others describe how they were awakened to the science process, and some talk about the impact upon their career or graduate education. The answers were organized into seven categories:

- Effect on scientific career
- Effect on graduate education
- Research process and skills developed from that process
- Competitiveness for jobs
- Networking and collaboration
- Revelation of the vast scope of marine sciences
- Miscellaneous effects



Free form Responses and Statistics

"My first experience at FHL, the apprenticeship, acquainted me with mentors who have been instrumental in my path to becoming a neurobiologist. Without Shaun Cain and Jim Murray, I may still be working in a bagel store. Now I'm working on my Masters and hope to continue research as a PhD and ultimately become a professor."

It is difficult to develop statistics from free-form answers. Things said by one alumnus may not be said by another, but we cannot assume anything about what is not said. For instance, 31 of the 118 talk about the networking/collaboration/mentors established during the RA program. However, if the other 87 alums were specifically asked about networking, perhaps most would attribute the start of their professional contacts to the RA program at FHL.

Some talk about the 'eureka' of discovering their capabilities to perform research while others address how the time at FHL led to decisions about career selections and/or graduate studies without discussing the core Apprenticeship activity—the research. In this following response, we know the "experience" consists of the research process but the unsaid cannot be shown in the survey statistics.

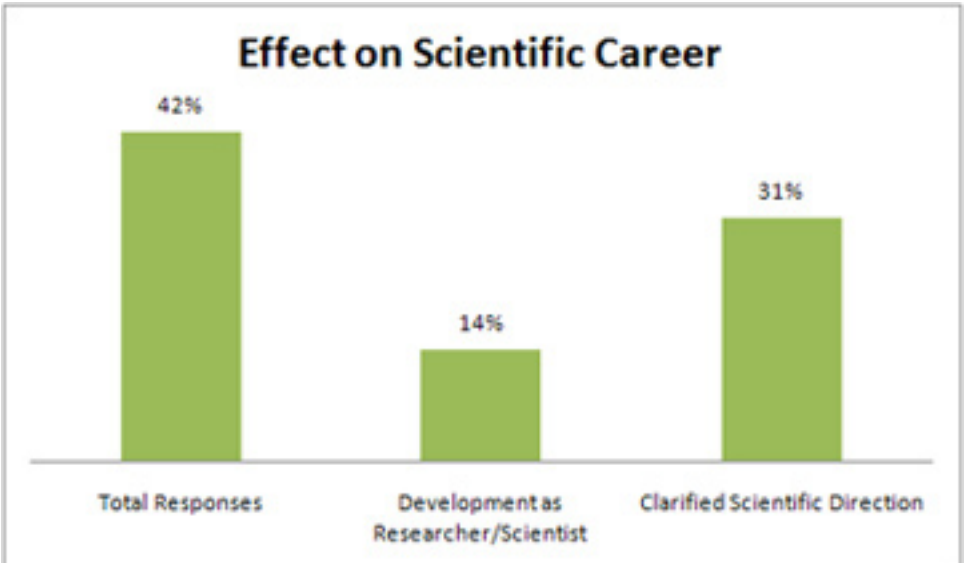
One last thing to mention is that some alumni were narrow in their responses while others spread their stories over many topics related to their careers and may show up in the counts for four of five of the categories. Thus, the sum of counts is greater than 118 and the sum of percents is greater than 100%.

Effect on Scientific Career

"*It started me as a real scientist. I was just a kid in college, done with my freshman year. And I had a bad experience. I hated all those intro courses I had to take. I didn't learn anything specific, just everything in general. And I wasn't excited by anything I had learned. Then I came to FHL and saw what real science was about. How excited people got aboutheir projects, and how interactive the whole thing was. I swear, I learned more the 3 months that I was there than my entire freshman year of college without studying and without formal classes. My experience there solidified my goal of being a science major in college, and ultimately encouraged me to go on to get a PhD. I will always be striving to find a community like the one at FHL that I can work in."*

Some of the most moving statements by research apprentices in the survey are those stating that their experiences at FHL awakened them to their scientific careers. These splendid testimonies are expressed in two ways:

- *It awakened them to realizing they wanted to be scientists*
- *Their scientific direction was clarified*



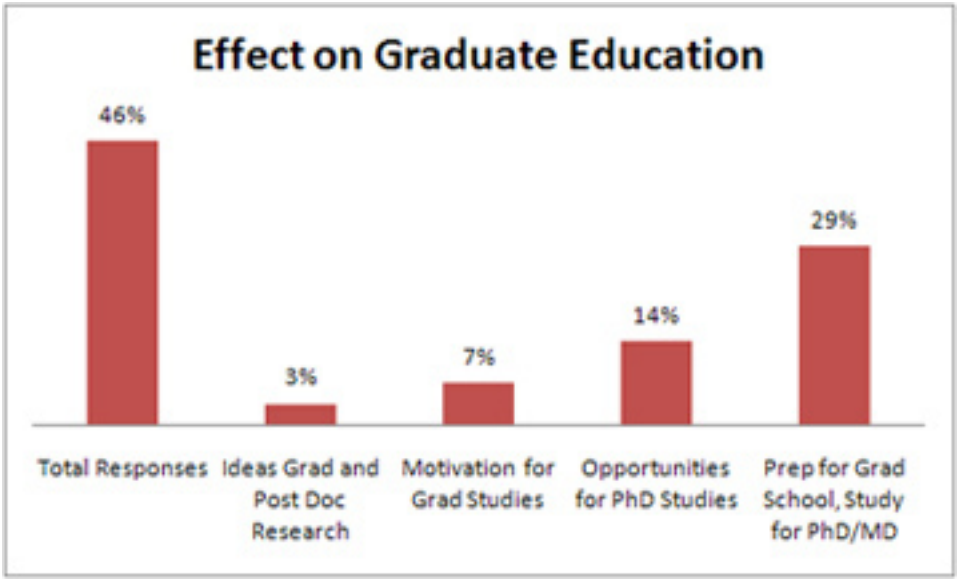
"Well, it changed, completed my head. Really. It was my first step in science. I learned many things that I am still using, like GIS. I remember spending hours with my TA, Lyle, who helped me a lot. I learned how to start and finish a research project. Words are not enough."
"My experience at FHL as a student in the late 1980s was pivotal in my development as a scientist. I was able to mingle with real live scientists, learn about their research, and also experience them as people."

Effect on Graduate Education

"My time at FHL allowed me to reach the decision to pursue marine ecology as a graduate student."
"The in-depth, organismal marine phycology course was the foundation for my interest in pursuing a career in science. After completing my BA in liberal arts I worked in publishing for five years, when switching career paths back to science, I looked back to my course at FHL as "the best time of my life" for inspiration for the next step. I then applied to FHL as a research apprentice and that program gave me the critical experience needed to pursue graduate research in marine science. FHL has EVERYTHING to do with my current position as a graduate student working on the ecology of sea grasses."
Forty six percent of the research apprentices link their experiences at FHL to their graduate education.

- A small percent continued development of research started at FHL into their graduate and post-graduate programs.
- 7% said they found their motivation to pursue graduate studies at FHL. *(Those attributing their development as researcher's /scientists are actually saying the same thing in different terms. When we collate these two categories, 20 % of the research apprentices were motivated to get their graduate education at FHL.)*
- 14% believe that their acceptance into PhD programs was facilitated by the FHL research on their CVs.
- 29% felt better prepared for graduate studies.

"It allowed me to learn skills not available at my home university which makes me more competitive as a PhD applicant and researcher." "It was largely instrumental in my admission to graduate school."



Research Process and Skills

"It allowed me to gain experience and confidence in developing, carrying out, and presenting an independent research project…."
"I had not completed an independent research project during my undergraduate studies, and participating in a research apprenticeship at FHL was to me a way to experience that process I hadn't fully taken advantage of as an under graduate. With the apprenticeship program, I had guidance from a faculty member, a project of limited scope (accomplished with a three to four-month period) and the opportunity to design and present a poster and paper for publication. The experience boosted my confidence as a scientist and helped me understand what I might expect in graduate school."

Independent research is the seminal characteristic of the RA program. While only 43% speak about their research at FHL, the research is the unspoken experience behind their graduate education and career statements.

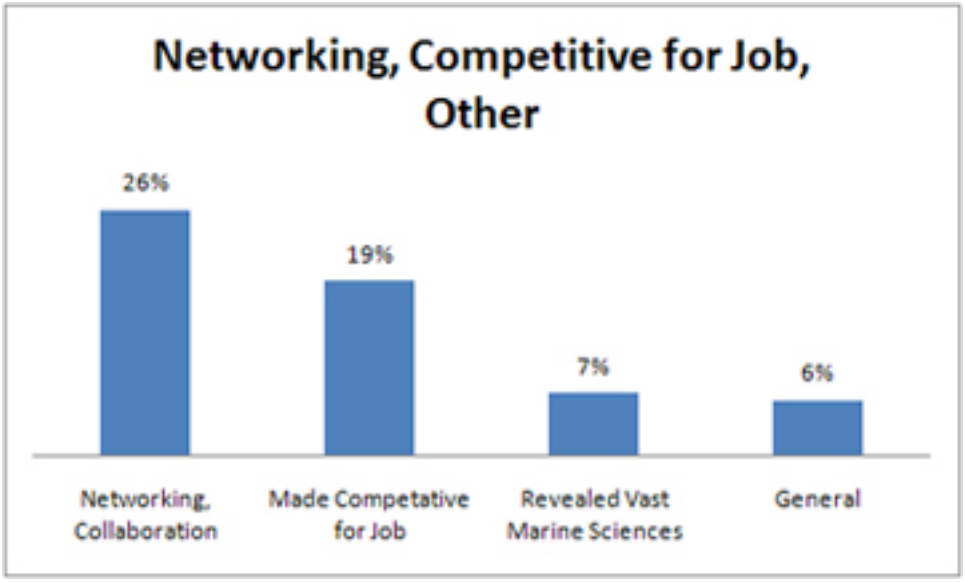
- *32 % speak about the research process*
- *7% refer to unique field experience*
- *7% state that the research developed critical thinking and analytical skills*
- *6% recognize that they learned scientific writing skills*
- *3% remembered the intense learning that occurred*

"As an under grad, I gained valuable hands-on research experience and analytical skills that are hard to find on the main campus. Yet, to be a successful researcher, experience with independent projects (from thinking of hypotheses and goals to collecting data, analyzing data, and presenting, both orally and in written form) is vital."

Networking, Competitive For Job, and Other

"The people I met there proved to be incredibly helpful in advancing my career and entering the marine policy field. I met a future boss, future thesis advisor, and many colleagues whom I continue to run into regularly in my job."
"Most successes in my research careers were possible because I was introduced and have practical experience working at the diversity of marine organisms at FHL. It includes multiple collaborations, friends and interactions for many aspects of integrative and system biology."

Twenty six percent of the research apprentices stated that their networks among scientists started at FHL. The FHL faculty and researchers demonstrate their respect for students by maintaining contacts during the years the students are gaining professional skills and experience.



"All the techniques I learned at FHL help me greatly in my job today. I learned many molecular techniques, how to approach scientific projects, and how to work in a lab setting. I also learned a lot about ocean biology, which helps me in my Oceanography research position today."
Nineteen percent of the respondents felt that the FHL apprenticeship made them more competitive for their job.

"I developed an appreciation of the variety of organisms that are available to address interesting biological questions."
"FHL opened my eyes to the world of the ocean and its limitless expanse of opportunity for discovery in all fields of science."
7% of the apprentices said that the FHL experience made them aware of the variety and diversity of marine life.

"It gave me confidence in my capabilities in scientific research and the motivation to pursue other similar programs."
6% of the apprentices said they gained confidence and purpose or ended up with a more balanced education through the FHL program.

Return to TOC

Strathfest Celebration

Friends, colleagues, and students of Dr. Richard Strathmann gathered at New Year's Eve to celebrate his remarkable career and the contributions that he and Megumi Strathmann have made to research and the teaching of invertebrate embryology and larval biology. Richard retired as Professor of Bioldogy at the University of Washington and Resident Associate Director of FHL in 2009. As emeritus faculty, he will continue research and teaching at FHL including plans to teach Larval Biology this summer.

Through their commitment to graduate teaching and mentorship, the Strathmanns have carried on the legacy of Robert Fernald, Paul Illg, and other educators at FHL, building the Labs' reputation as a premier location to study the development and ecology of marine invertebrates. In 27 years of teaching at FHL, Richard has taught Larval Biology 15 times and Comparative Invertebrate Embryology 12 times, graduating more than 150 students from each of the two courses. His own graduate students often served as teaching assistants for those courses and many later became co-instructors. Those students, in turn, encouraged their students to work and study at FHL. This extensive tradition of mentorship that Richard fostered has paid dividends in the vitality and collaborative nature of these courses and in the substantial worldwide growth of larval biology as an academic discipline.

Art by F. Oyarzun

In addition to the New Year's celebration, the three-day "Strathfest" event included an informal open-mike tribute and slideshow, an auction of home-grown larval art and memorabilia, and a larval poetry reading. These events gave attendees an opportunity to reflect on how interactions with Richard and Meg developed their own skills and philosophies of teaching, research, and mentoring, and generated a far-reaching sense of community. The larval art auction also had a practical benefit, netting more than $4,200 for the Richard and Megumi Strathmann Endowed Fellowship fund which provides scholarships for students attending summer Courses at FHL.

Larvae Skit

Some of the Strathfest attendees

An extraordinary feature of the event was the reunion or, in many cases, first meeting of academic generations and colleagues from around the world who have come through but not neccessarily overlapped at FHL. Colleagues and students who worked with the Strathmanns in earlier years, for example, mingled with some of the most recent graduates of his FHL courses. In addition to providing a chance to swap favorite Strathmann stories, these interactions also honored Richard's legacy by showcasing the diverse areas of science his mentoring has inspired. This informal exchange also provided a lead-in to the more formal symposium and contributed paper and poster session in Richard's honor at the annual meeting of the Society for Integrative and Comparative Biology in Seattle, held in the days immediately following the events at FHL.

The Hadields

More Strathfest attendees

If you wish to honor Richard and Megumi by contributing to the Strathmann Fund, click on this link:*https://secure.gifts.washington.eduufoundation/gift.asp?source_typ=3&source=STRATHS*

Return to TOC

Remembering Robert L. Fernald

The Robert L. Fernald Endowed Scholarship provides support for graduate students of Comparative Invertebrate Embryology at the Friday Harbor Laboratories. Established in 1981, the scholarship was named in honor of Professor Robert Fernald who taught his first course in invertebrate embryology at Friday Harbor in 1950. Over three decades he guided and inspired many students toward professions in teaching and research in invertebrate embryology and development.

Robert L. Fernald received his Ph.D. in 1941 from the University of California, Berkeley. He taught in the Department of Zoology, University of Washington, Seattle, from 1946 to 1975 and was Director of Friday Harbor Laboratories from 1956 until 1972 As Professor Emeritus, he continued to teach the course in Comparative Invertebrate Embryology until shortly before his premature death in 1983.

We invited many students and colleagues of Bob's to capture some of their memories of his years in Friday Harbor Labs. He is reborn in these recollections for all to enjoy. Come meet Bob Fernald, dedicated teacher, devoted scientist, loyal friend.

RICHARD STRATHMANN – FRIDAY HARBOR LABS

Bob Fernald encouraged research on development of diverse animals long before the renewed interest in evolution of development. He answered students' questions and suggested possibilities while, despite his extensive knowledge, encouraging students' confidence that they were the experts, or at least becoming the experts. Megumi once overheard Bob expressing interest in a student's discovery of something that Bob already knew, without Bob's revealing that he had already seen it. In this way Bob played a key role in research decisions of many students.

A curious feature of Bob's career is that he stimulated extensive research on development of marine invertebrates while never publishing on the topic himself. Bob's extensive notes on methods for obtaining and culturing invertebrate embryos were available at FHL in unpublished form. His friends persuaded him, in his retirement, to write them as a book and publish them, and he obtained a grant from NIH to do that. He had just begun when he died. Megumi had been hired to assist Bob. She continued the work of expanding notes from Bob and others into the book on methods that continues to assist studies on development of diverse marine invertebrates. Bob's picture is in the front of this book, which owes so much to Bob's observations and inspiration. *(Editor's Note: The above photo is that which appears in the book.)*

An unusual feature of Bob's course in comparative embryology was his emphasis on diverse animals rather than a few model systems. He also emphasized observation of live material. These emphases continue. Bob's course offered (and offers) five weeks of observation and thinking, without a restricting focus on a narrow set of problems and without the distraction of replicated experiments to be completed before deadlines. It is a course of intensive contemplation of continuous change in developing animals. As a result, the course has served students with varied interests and backgrounds, from developmental biology to ecology. With Bob's approach, the students are given an extraordinary opportunity to develop their own questions.

As a graduate student I had changed dissertation topics several times, looking for a satisfying topic. Bob Fernald's course in comparative embryology of marine invertebrates introduced me to beautiful and diverse embryos and larvae. I wondered about the forms of these small initial stages in life and how their forms and behaviors adapted them to their environment. Bob encouraged this interest, along with my advisor, Alan Kohn. The next 40 years of my research, my whole research career, has concerned the functional biology of marine embryos and larvae.

When a replacement was sought for Bob Fernald, as director of the Friday Harbor Laboratories, one candidate said he did not know how FHL functioned on its budget unless the director swept the floors. Not long before I had seen Bob mopping up water that an investigator had spilled and left in the round tank room.

JOANN OTTO – WESTERN WASHINGTON UNIVERSITY

I first met Dr.. Fernald when I arrived at FHL in June, 1971, to take the summer invertebrate courses. We were to register on Sunday so I went to the main office. After I registered with the secretary (Estelle Johnson, I think), she told me that the Director wanted to meet each student. I was astounded! He welcomed me to FHL, and we talked for perhaps 10 minutes.

Bob & Joann going to the beach
Photo by Trish Morse

By the end of our conversation, I felt that FHL was 'home' for the summer; little did I know that it would be one of my 'homes' for the rest of my life! During that summer, students saw Dr. Fernald frequently as he typically ate dinner in the dining hall. He interacted with all of us and was always asking what organisms we were studying. He also made sure that FHL was like a home for everyone. One Saturday night, most students and at least some faculty members had a wild and raucous party in one of the dorms. On Monday morning, every class was read a missive from the Director that pointed out that many families with young children were living on campus, along with other non-partiers, and that they had the right not to be disturbed. We got the message!

I really got to know Dr. Fernald when I took his Invertebrate Embryology class in 1974. He was a wonderful teacher and incredibly enthusiastic about all types of embryos that we encountered. His lectures were clear and informative, but the aspect of his teaching that sticks with me the most was that he was very willing to say that he had no clue about something we were observing and then helped us figure it out (if possible). He would get us started checking references to see if someone else had observed a particular feature of an embryo and encouraged us to draw what we saw. Many of the species we used were not well studied, and he wanted to be sure there was a record.

Midway through the Embryology course, he asked me if I might be interested in being the teaching assistant for the summer embryology course; there was no interested or qualified UW student to be the TA and he thought I would do a good job. I was thrilled! My major professor agreed that I could stay at FHL through August to do research on my dissertation project between the courses and then TA. During that time, Dr. Fernald became my mentor and we discussed my research projects daily. I was working on hydroid stolon movement at the time and he mentioned that an odd jellyfish, Haliclystus, had a planula that he thought might move in a similar fashion. I managed to get *Haliclystus* to spawn and develop and suddenly I had another project on my plate! He told me he felt that he could not give me advice on some of the cellular biology I was doing so he arranged for me to meet with cell biologists on campus during the summer. These meetings gave me the opportunity to meet with prominent cell biologists and get their advice which was invaluable. One of the people I met became my postdoctoral advisor and one of my closest personal friends. When I was the TA in the summer course, I gave two lectures. I asked him to attend them and give me feedback. His advice, particularly on how to make illustrations tell a story, is a key part of my teaching to this day. His encouragement and positive feedback during that summer were essential to my success as a graduate student and in my later career. He gave me a huge boost in confidence.

After that summer, he and I corresponded by letter and we became friends. He told me stories of people at the labs, particularly Chris Reed, who was in my embryology course and was also under Dr.. Fernald's tutelage the summer after the course. After earning my Ph.D. in the spring of 1976, I returned to FHL to resume work on Haliclystus for the summer. I had become friends with the Illgs and frequently was invited to parties on their beach. At that time, Dr.. Fernald taught me how to grill salmon over an open fire; of course, I had to listen to different opinions from other 'experts', but his technique remains the best.

Dr. Fernald had a wonderful sense of humor, great enthusiasm, and compassion. He was a friend to many, many people, who all adored him.

JON NORENBURG – US NATIONAL MUSEUM, SMITHSONIAN, WASHINGTON, DC

I was a know-it-all first year PhD student in 1976, ignorant of the larger world of invertebrate zoology, when Trish Morse convinced me that it would be a good idea to take Invertebrate Embryology with someone named Robert Fernald at a place called Friday Harbor Laboratories. I arrived in March, 1977, a very quiet time at the labs, to take the spring Invertebrate Embryology class and six additional weeks of independent study at Friday Harbor. Alerted to my arrival by Trish, Bob had me housed opposite him in Lab 6 and proceeded to become Uncle to me - listening for countless hours to all I thought I knew about nemerteans and their evolution, allowing me to save face on occasion by guiding me with subtle questions or comments that I would research later, making a weekly dinner for me, and, best of all, inviting me to accompany him on his trips all over the island to collect and prepare material for the upcoming Embryology class. He introduced me to Ruth and "Father" Paul Illg, who would become life-long family, but also to young researchers, like Joann Otto, Chris Reed and Steve Stricker, whose excellence I simultaneously admired and feared, as I realized how little I really knew. Without Bob, fear might have won and caused me to retreat into my shell like an incompetent larva. I think he sensed that. Though I worked long hours in the lab during his course, I was not Bob's best student, even that year. (Probably it was Diana Padilla, with whom I

Ishared many late hours at the water table.) His teaching was superb, even inspiring, but it did not alter my career; it is the seemingly insignificant - the love of his work, his caring touch for all students, his faith in me - that altered my life and rooted part of my soul forever alongside his in the Friday Harbor Laboratories.

ALAN KOHN – UNIVERSITY OF WASHINGTON

Cocktails on the front porch of Director's House
Photo by Alan Kohn

I first met Bob Fernald in March, 1961, when I journeyed from Florida on my first trip to Washington State to interview for a faculty position in invertebrate biology in the University of Washington Department of Zoology. Bob not only invited me to FHL during my short stay, but he personally drove me up and back to Seattle in his Buick and generously hosted my stay. When I joined the faculty that fall, part of my agreement was that I was to be available to teach at FHL in summers, at most every other year. I first taught there in the summer of 1963, and Bob most generously offered to provide free lodging in the Director's house for the duration of my stay. This was most welcome, as Marian found it easier to stay at home with our three young children. A much appreciated fringe benefit of Bob's hospitality was an invitation to the daily cocktail parties on the front porch, immediately preceding dinner in the dining hall. This ideal arrangement ended after 1965 with completion of the apartments, but it was a most appreciated welcome to FHL life.

Prior to coming to FHL, I had been very interested in visiting marine biological laboratories of various sorts and comparing their facilities, activities, and ambiance. This peripatetic journey began as an undergraduate with my first summer job, at Hopkins Marine Station (Stanford University, 1951) and continued at numerous other laboratories over the next decade. After my first teaching role at FHL in 1963, I completely lost interest in further comparative study of marine laboratories and terminated that project. I'm sure that Bob Fernald had a lot to do with that.

COLIN HERMANS – FRIDAY HARBOR, WASHINGTON

Bob Fernald was an outstanding teacher who set very high standards for me as both an undergraduate trying to get into graduate school, and as a graduate student trying to earn a post doc. He demanded excellence without prescribing what form that excellence should take. I had to figure it out.

He was avuncular and mentored me long before I knew what either word meant. He was always "Dr. Fernald" to me and to my generation of graduate students. Only later did he become "Uncle Bob."

Thanks to having been his graduate student, I was very successful in my applications for post docs. In my travels, domestic and abroad, the fact that I had been Bob Fernald's graduate student, seemed to open doors magically. Thanks to Bob, and of course others, I came from The Friday Harbor Labs and not a lonely outpost on an unknown island.

By 1975 I was able to identify in the literature what I called the Fernald School of invertebrate development as expressed in his lectures and in the lectures and publication of his students (Schroeder and Hermans, 1975). Accordingly, the species chosen for study are selected more on the lack of predictability of the discoveries to be made than on their bearing one hypothesis or another. Hypothesis testing came as a second step, well grounded in basic knowledge of the species involved. The method of hypothesis testing was more often comparative than experimental.

Knowledge of "the literature" and of the "organism" came first for Bob Fernald. He was very critical of students and developmental biologists who did not know "shit from apple butter." Although very critical, he treated everyone with great respect and understanding.

To have Bob Fernald on my side was a huge advantage for me.

FU-SHIANG CHAI – SALT SPRING ISLAND, BC CANADA

REMEMBERING MY FRIEND, R. L. FERNALD

Bob and Fu-Shiang in Trish's Convertable
Photo by Trish Morse

Robert L. Fernald was my teacher, thesis supervisor, role model, colleague and, above all, he was and always will be my friend. Bob and I met when he signed my registration form when I enrolled in the graduate program at the UW in September, 1958. The same year he was appointed as the Director of the FHL. The following are some fragments of memory.....

1) B+ AVERAGE: After examining my undergraduate transcript, Bob told me "You have some deficiencies in your undergraduate program. You should take some courses to make up the deficiency. In order to retain your RA or TA Scholarship you need to maintain a B+ average." So my first year as a graduate student was hellish; I worked hard, reading when I walked, when I ate and when I sat on the toilet.

2) RAISING MY HAND, 'STARFISH, SIR!": In 1959, Bob accepted three new graduate students, John Long from Kansas, Herb Potswald from Minnesota, and Jim Waters from California. One day he called the four of us to his office and said: "You must think about research now. John has decided to work on Brachiopods. There are some lesser known but interesting invertebrate animals to be found at Friday Harbor seashores, a starfish, a tube-worm and a snail and the three of you can choose. Fu-Shiang, since you are the senior student, you choose first." I raised my hand and said respectfully "Starfish, Sir." That was the beginning of my lifelong association with sea stars. Bob then looked at Herb; as always the gentleman, Herb said "Let Jim choose first." Jim chose the snail and Herb settled with the tube-worm. In later days Jim transferred to Dr. Snyder's lab and did his research on the feeding apparatus of snakes.

3) YOU CAN FIND A NEW SUPERVISOR: In the spring of 1960 several of my friends were planning to visit Yellowstone National Park and they asked me to join them, but I had promised Bob to go with him the same weekend. I went to his office and told him that I wanted go to Yellowstone Park. He was very quiet for a minute; his neck began to turn red, then his face and then he told me very calmly "Go to Yellowstone Park and you can find a new supervisor." Many years later I finally went to Yellowstone with my wife and daughters.

4) ONE HUNDRED TEN DOLLARS: In September, 1964, I completed my Ph.D. degree and was $800 in debt. My twin daughters were four months old.

My first job offer was from Sacramento State College with an annual salary of $7500. I was prepared to accept the offer and told Bob of my intention. He took out his checkbook and signed a check and handed it to me. "Go to Sacramento and look at the department before you decide."

My trip cost $110. I tried to repay him several times and he always said: "The purpose of money is to buy happiness. That $110 was well-spent." Some years later I did the same thing for several of my students and I know that my students have done the same for their students.

5) TO ENGLAND: I was not happy at Sacramento State, too much teaching, too little research and the quality of students was not up to my expectations; also the Vietnam War distressed me. In April,1966, Bob called me and asked me if I would like to go to England to teach Invertebrate Embryology in the University of Newcastle-Upon-Tyne. I said " Yes!" without hesitation. So that summer we packed up and returned to Seattle. Our plan was to take the train to Vancouver and on to Montreal. Bob surprised us at the train station in Vancouver and we spent a half day touring the city and enjoying a wonderful lunch together.

We said goodbye to Bob at the station. Our daughters were two and a half years old then and we returned to Seattle when they were five. By that time I had accepted a position at the University of Alberta in Edmonton, Canada, where we spent twenty-four years.

6) OUR LAST SUPPER: Bob and I taught invertebrate embryology a number of times together at FHL and I always stayed with him at the director's house; he cooked and I washed dishes.

In late January, 1983 I had to go to FH to meet with two of my Ph.D. students on Saturday, returning to Edmonton on Sunday. I called Bob and he told me that he had just purchased a new futon for me to sleep on. He met me at the ferry terminal; we went to his Griffin Bay home. He said that Kings Market had run out of oysters so we did not have our oyster dinner. Instead he barbecued a salmon. As always we drank wine and had a very lengthy dinner; afterward, we visited Whiteley's house and walked on the beach. Without realizing it, it was our last supper together as he passed away the following week.

7) I CRIED ON KEN-TING BEACH: In the summer of 1983 I was a visiting professor in Sun Yat Sen University, Taiwan, where I taught a seashore ecology course to nine graduate students. In this course we systematically visited a number of places around Taiwan. We did some collections, identifications and some measurement and analyses. We used to stay in adjacent motels and play cards in the evening. One night after all the students had returned to their rooms, I decided to take a walk alone on the beach.

While walking, it was as if I had entered a trance; Bob and I were walking together for an hour and talked about many things. I suddenly returned to myself; my hair was wet, my bare feet were cold. Then I sat down on the beach and cried. A fifty-three year old man crying like a child. I remembered when Richard Cloney called me about six months earlier and told me Bob had died, I was angry but did not shed a single tear. I asked my wife why I was not crying; she said "You will when the time comes."

And perhaps that was the time.

GRETCHEN LAMBERT - SEATTLE

My first summer at FHL was 1964, to take the algology and advanced invertebrate courses. Dr. Fernald (as all of us of course addressed him in those days) had made short appointments with all the new students to get to know us, one on one. So a day or two after my arrival I sat down in his office with him in the Main Lab (it was only much later to be known as the Fernald Lab) and in his uniquely personable, friendly and warm way while he looked through my application he asked me about my background, how I liked the University of Miami Institute of Marine Science where I had completed only my first semester as a beginning graduate student, and why I had chosen to come to FHL. I was very impressed at his personal interest in each of us but I was totally unprepared for subsequent meetings with him around the FHL campus; that short interview with each of us was all he needed to memorize our names and each of us as individuals. He greeted me with a "Hi, Gretchen" each time we passed.

Charley and I met that summer, married the following Feb. and then transferred to UW to complete our graduate work, most of which was in residence at FHL. Bob took great delight in introducing us as one of FHL's best success stories, to visitors he often showed around the labs, telling them that we had met there; I suspect he took personal credit for the matchmaking! During and after I completed my M.S. degree, until Charley finished his Ph.D., Bob was so considerate in giving me part time work that provided important financial support to augment Charley's predoctoral grant. I completed a number of faunal and photographic surveys of some of the most important biodiverse shoreline areas on San Juan Island and Pt. George, which remain in the file cabinet at FHL as unique baseline studies of these areas as they were in the late 1960's. In the winter he hired me for a few hours a week as librarian, and in the summer as a tour guide.

Party on Illg's beach
Photo by Alan Kohn

In the years after 1970, when Charley completed his Ph.D., we returned many times to FHL, and it was always a special time to see and visit with Bob. It was a great honor to have been invited a number of times to parties at his home, and class parties on the beach at which he enjoyed overseeing the salmon barbecue. Bob Fernald was a remarkably knowledgeable developmental biologist, with a truly impressive knowledge of the local fauna; he was also an excellent director and fundraiser for the Labs. He cared passionately about everyone at FHL and was in my opinion the single most important person to set and maintain the warm community feeling at the Labs that continues today. It is a high priority for us to contribute to the Fernald Fund (and other scholarship funds) every year, because without the NSF student support grant that he had obtained in 1964, Charley and I could not have gone to FHL, and our lives and careers would have been much different.

CHARLEY LAMBERT - SEATTLE

I was a grad student from San Diego State University when I first went to FH in 1964. Shortly after arriving on campus Dr. Fernald interviewed me about my research project and the classes I had selected. After that time he asked me questions about my classes and work and seemed to really know me and what I was working on. Later when I was a Ph.D. student at FHL Bob got Gordy Robilliard and me to make the fire for the 4th of July salmon BBQ. He was very particular that we use only small pieces of drift-wood and to burn the fire until it was only red hot coals with no flames. He spread the coals evenly and placed the salmon supported by chicken wire fencing in a pipe frame. This gave the salmon its unique flavor.

In Seattle I attended several of his lectures in vertebrate embryology and was amazed to see him draw diagrams in 3 colors using both hands. They were excellent diagrams, a real shame that they were always erased!

I recall Drs. Fernald and Paul Illg collecting invertebrates at Sooke, on Vancouver Island. They asked me to identify the ascidians. I tried my best but several were beyond my abilities to put a name on them. Bob commiserated with me and agreed that they were not like anything on San Juan Island; I appreciated that. In subsequent years we realized they were primarily northern California species that had somehow found this refuge in the protected and unusually warm waters around Sooke.

Bob cooking hot dogs on the beach
Photo by Alan Kohn

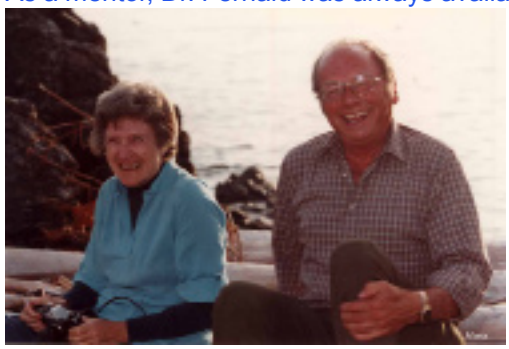
STEVE STRICKER – UNIVERSITY OF NEW MEXICO

Although I can think of literally hundreds of examples of the great kindness and generosity Robert Fernald bestowed upon the many students he mentored, what I remember most clearly are his warm sense of humor, huge grin, and hearty laugh that he so readily shared with all of us. As an illustration of these traits, I had unexpectedly received a fellowship in the spring of 1979 that required me to find a replacement for the summer Invert course I was supposed to TA at FHL. Fortunately, fellow graduate student, Chris Reed, generously volunteered to step in after having found someone else to cover his TAship that summer down on campus for a professor who will remain nameless. After we had thought that everything had been worked out, Fernald came into the room following a phone conversation he had with the Zoology professor who turns out was none too pleased to have to break in another TA for his course. With a straight face and very precisely, Fernald said something to the effect: “Christopher, I just chatted with Dr._____, who asked me to kindly relay to you the message that he wouldn’t—and I quote: ‘let you kiss his tush on the fifth floor of the Bon Marche’ ”. We all sat stunned, particularly Chris who probably had various thoughts racing through his head (e.g. “Why pick on me: I was only trying to help someone out” and “does the Bon Marche really have that many floors?”). We then noticed a distinct twinkle in Fernald’s eyes, and all tension melted away, as Fernald broke out that infectious chuckle of his that I can still hear very, very clearly to this day.

MARY RICE – SMITHSONIAN MARINE STATION, FORT PIERCE, FLORIDA

Little did I realize my good fortune when, in 1961, I started graduate studies in comparative invertebrate embryology under the guidance of Dr. Robert L. Fernald. It was his wise counsel, gentle criticism, support and encouragement that led me through the trials and tribulations of exams, research, and dissertation to completion of the Ph.D. and also into my future career of research.

As a mentor, Dr. Fernald was always available for advice and encouragement while, at the same time, he gave his students the freedom and confidence to follow their own curiosity in the selection and pursuit of their dissertation research. Copies of their theses in the Library of the Friday Harbor Labs are evidence of the productivity of Fernald’s students and of their contributions to the knowledge of the embryology and development of the marine invertebrates of the Pacific Northwest. For me, personally, the training and friendship of my graduate advisor, Robert Fernald, continued to be a positive and long-lasting influence throughout my later professional career at the Smithsonian Institution, in both my research pursuits and in the inauguration and administration of a new marine station, the Smithsonian Marine Station in Fort Pierce, Florida.



TRISH MORSE – FRIDAY HARBOR, WASHINGTON

During the summer of 1962, my sister, a physical oceanographer at UW, invited our Cape Cod family to visit the Seattle World's Fair. As part of that trip, she arranged for me, having just received my MS degree, to travel with a young medical student, Sharon, driving a beach wagon (filled with the lab's food for the week) to the Friday Harbor Laboratories. Warmly welcomed by Bob Fernald and Paul Illg, these two professors opened up a world of discovery and adventure in one week that was central to the continued development of my professional life. Bob Fernald treated me as a scientist; he set up a trip on the Hydah, let me use the labs boats to visit various sites. He invited me to join the group at his home for drinks before we all returned to the dining hall for dinner. It was there I met Dixy Lee Ray a professor in her lederhosen, holding her two dogs with her silver Jaguar and Frank and Rig Pitelka, old friends from Berkeley.

Bob Fernald and Paul Illg
Photo by Trish Morse

Over the years, I developed a close relationship with Bob Fernald. He was a mentor and friend. I recall the day we spent preparing a celebration for Paul Illg's retirement. We picked blackberries at the Stanley's home, made an amazing delicious blackberry cobbler (he was a terrific cook) and just hung out at his beautiful home overlooking Griffin Bay before joining a huge beach group on Arthur Whiteley's wonderful beach for the celebration.

Bob had an amazing way of treating each person individually as his friend. I went on field trips with him to collect stauromedusae at Grandmother's Cove because Joann Otto was due to arrive that week and he wanted to make sure she had her organisms to immediately do her research. I spent one summer in Lab 6 where each day when he came to work, he would stop and say, the coffee will be ready in 10 minutes! His guidance was so welcomed. His clear devotion to his students and colleagues took so many of us through what might otherwise have been difficult times. His clear call for excellence set a bar for us all, no matter our gender, background or scientific interests.

1982 DEVELOPMENT OF THE ROBERT L. FERNALD ENDOWED SCHOLARSHIP

In recognition of his many contributions to the field of invertebrate embryology, a symposium was dedicated to him in 1977 at the annual meeting of the American Society of Zoologists in Toronto, Canada. Royalties of the book resulting from the symposium, Settlement and Metamorphosis of Marine Invertebrates (Editors F. S. Chia and M. E. Rice) were used to found and initially fund the Robert L. Fernald Endowed Scholarship. Supplemental funds by students, colleagues, and friends expanded the Endowment, and, today ongoing contributions continue to support the scholarship.

Over the past 30 years, since the scholarship was established, numerous students in the Comparative Invertebrate Embryology course have received support from the Robert L. Fernald Endowed Scholarship. The benefit to students both now and into the future serves as a lasting tribute to the achievement of Robert Fernald as a Director of Friday Harbor Laboratories and as a beloved and respected teacher of embryology.

You can participate in this special remembrance of Robert L. Fernald by clicking on this link, *https://secure.gifts.washington.edu/uw_foundation/gift.asp?source_typ=3&source=FERNFE* and contributing any amount, small or large, to the Endowed Scholarship. Student financial support is critical during this difficult economic time. Your generosity will be greatly appreciated.

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Support Friday Harbor Laboratories and Change a Student's Life

2004 class in Marine Invertebrate Zoology

Each year FHL attracts more than 125 scientists and more than 250 of the world's most promising students.

Distinguished scientists work side by side with students on problems in marine biology, ecology, biomedical models, and many other fields. Interdisciplinary research has fostered important new lines of inquiry that are now pursued around the world for example, photoproteins from jellyfish are used in muscle and heart research and in an effort to eliminate malaria, a disease that kills a child every 30 seconds. Students at Friday Harbor Laboratories evolve! Most notice a sudden transition to treatment as peers by *faculty,* graduate students and technical people. They perceiive FHL as a bridge, from undergraduate to graduate status. Numerous FHL discoveries have contributed significantly to our scientific knowledge, but in the end, FHL's most important "products" are the people, the best and the brightest who develop their potential as students, teachers and researchers.

Friday Harbor Laboratories provides a life changing experience for many students each year. Along with these life-changing experiences, there will certainly be important scientific discoveries and new knowledge emerging from these students.

I hope that you will choose to make Friday Harbor Laboratories a life changing experience, by making your gift now. I assure you, gifts of any size to FHL make a difference.

Thank you,

A.O. Dennis Willows
Professor Emeritus of Biology and Director Emeritus
Friday Harbor Laboratories

P.S. Take a moment to think back and recall those people who have helped you along your way. And then remember that there were those who helped you who you didn't even know.

Make a gift online

To make a gift online, click on this link. https://secure.gifts.washington.edu/uw_foundation/gift.asp?source_typ=2&source=EHU You will be transferred to the University of Washington's secure server for private gifts.

For more information about supporting FHL, contact the FHL Director, Ken Sebens sebens@uw.edu or Rachel Anderson in the Development Office rachelea@uw.edu , 206-616-0760 or 360-378-2165.

Scholarship / Fellowship Funds

Emily Carrington Student Travel Endowment:
Supports travel for students at FHL

Ellie Dorsey Memorial Fund:
Generates an annual gift presented to a student in memory of Ellie Dorsey

Patricia Dudley Endowment
Supports the study of systematics and structure of organisms and marine ecology

Fernald Fellowship Endowment:
Supports graduate students for studies of marine invertebrate development

FHL Discretionary Fund for Excellence:
Provides funds for student aid and encourages diverse initiatives that benefit FHL

FHL Research and Graduate Fellowship Endowment:
Supports graduate students and postdocs for marine science studies

Anne Hof Blinks Fellowship Endowment:
Supports students of diverse backgrounds in marine science studies

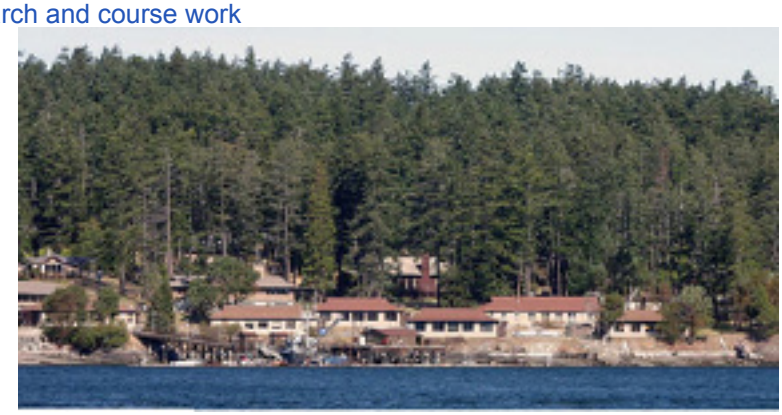
Illg Distinguished Lectureship Endowment:
Brings specialists to present lectures on invertebrate biology and to meet FHL students and researchers

Kohn Fellowship Endowment:
Supports graduate study of invertebrate biology research and course work

Karel F. Liem Endowment:
Supports research on fishes

Marine Life Endowment:
Preserves FHL foundation courses in Marine Algae / Botany, Comparative Invertebrate Embryology, Marine Invertebrate Biology and Marine Fish Biology

Marine Science Fund:
A current use fund to support students at FHL



Larry McEdward Memorial Fund:
Provides annual support for a graduate student in memory of Larry McEdward

Mellon Mentor Endowment for Excellence in Research Training:
Provides faculty salary in support of internship in marine science, matched 1:1 by the Mellon Foundation

Reed Undergraduate Endowment:
Scholarships to undergraduates for study of marine sciences

Brooks and Suzanne Ragen Endowed Scholarship
Scholarships to graduate and undergraduate students for study in the marine sciences

Seagrass Conservation Fund:
Promotes investigation, including student directed projects, of the relationship between natural and human-caused stress on seagrass survival in the Northeast Pacific

Keneth Sebens Student Endowment:
A current use fund to support students at FHL

Richard and Megumi Strathmannn Endowed Fellowship:
Supports graduate students working at FHL on natural and physical science problems of the Pacific Northwest

Stephen & Ruth Wainwright Fellowship Endowment:
Fellowships for graduate students studying form and function of organisms

Dennis Willows Director's Endowment:
Provides FHL directors with discretionary funds for unbudgeted needs including student assistance

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Coming Events

FHL Open House May 8th, 11:00 a.m. to 4:00 p.m.

The public is enthusiastically invited to participate in the 2010 FHL Open House. This event offers a splendid opportunity to meet scientists and students at the Labs and check out the research and teaching facilities. From 11 a.m. to 4 p.m., the Labs will be open for self-guided tours. Scientists and students will showcase their marine science research, answer questions and provide demonstrations. There will be posters, marine plants and animals, microscopes, plankton sampling and observations, and activities for visitors of all ages. Kids are particularly encouraged to attend.

The public is invited to learn more about the equipment used by scientists in marine zoology, botany, fisheries and oceanography. People can step aboard and tour our 58' research vessel, the R/V Centennial, and check out its remotely operated vehicle (ROV), oceanographic tools, and high-tech sonar systems. There will be several lectures given by FHL scientists. There will also be a demonstration of SCUBA equipment and a SCUBA dive from the FHL dock. Sturdy shoes are recommended because the tour route includes rough dock planks, gravel paths and trails. You can find free popcorn in the tradition of Friday Harbor Laboratories' Open Houses, and light refreshments available in the Dining Hall for a small fee.

Jazz at the Labs (Benefiting FHL's K-12 Program) June 19th, 6:00 to 9:00pm

On Saturday night, June 19th, Friday Harbor Laboratories will hold its 9th annual Jazz at the Labs, an evening of food, fun and great music at Friday Harbor Labs. As in the past, proceeds from Jazz at the Labs will benefit the Friday Harbor Laboratories K-12 Science Outreach Program in the San Juan Island Elementary, Middle and High Schools and the Spring Street International School.

This year's program will begin with dinner from 6:00 – 7:00 P.M. During dinner, music will be provided by Dennis Willows and the San Juan Jazz Quintet, with vocals by Jill Urbach. SJJQ has entertained audiences in the PNW since 1990, playing standards, swing, bebop, originals and latin jazz, every Friday evening 6-9pm at Pazzo Vivo Bistro in Friday Harbor. Starting at 7:00 p.m., Chris Amemiya and Jazz Coalescence, the outstanding jazz band from Seattle, will perform featuring jazz standards with their own special edge. These guys can play! That's what people said about last year's Jazz at the Labs. And they were right about both the San Juan Jazz Quintet and Seattle's Jazz Coalescence, two groups featuring some of the Pacific Northwest's most prominent jazz musicians who play terrific jazz. And they're back again.

FHL Contact Information

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Kenneth P. Sebens, Director

Adam Summers, Resident Associate Director

Visit the FHL web site http://depts.washington.edu/fhl/ and click on People in the left side menu for listings of FHL staff, resident scientists and advisory board members.

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