Prince William's Oily Mess: A Tale of Recovery

Thinking Like a Scientist: Summary

Have you ever wondered how marine life fares following an oil spill? How many die? How many survive to die later? How long does it take for an ecosystem to recover? What about the site of the *Exxon Valdez* oil spill—has the marine life along the shore recovered after 15 years? As a NOAA scientist, Dr. Alan Mearns has been asking and answering these types of questions since the spill occurred in March of 1989.

More with Dr. Mearns

Learn More About Dr. Mearns's Research: Read the Full Interview

Profile of a NOAA Scientist: Learn More About Dr. Mearns's Early Influences and Career

Dr. Mearns is a marine ecologist at NOAA's Hazardous Materials Response Division in the Office of Response and Restoration, part of the National Ocean Service. His office is in Seattle, Washington. His job is to provide scientific information during the cleanup of oil and hazardous substance spills in coastal and marine waters.

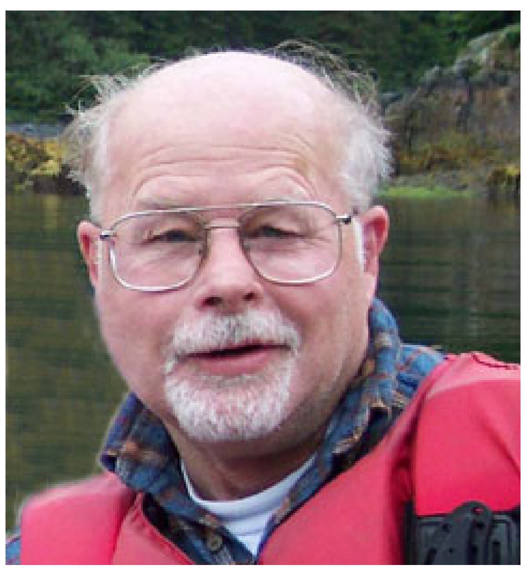
His investigations in Prince William Sound began with two questions:

"Would cleanup methods, such as high-pressure, hot-water washing, speed up the recovery of the shoreline marine life, or would they actually delay the recovery?"

and

"How did the oil affect the populations of marine life and wildlife of Prince William Sound?"

He didn't know then that he and his team would spend the next 10 years trying to



Meet Dr. Alan Mearns, a NOAA scientist who has studied and tracked the biological consequences of the *Exxon Valdez* oil spill that occurred in Prince William Sound in 1989. Read here about the research conducted at his namesake—Mearns Rock! (Photo credit: OR&R, NOAA) answer these two basic questions.

Report a Spill

Dr. Mearns began by breaking down these two questions into numerous smaller, more answerable questions, which is typical of how most scientific investigations begin. Then, to try to answer these questions, Dr. Mearns and his team used the same approach that most scientists use. First, they read all the relevant published literature about the effects of both oil spills and shoreline cleanup activities on marine life. They found that not much was published on these topics. The information in the literature was not good enough to predict whether the hot-water cleanup method would be effective (in removing oil) or if it would really speed up "recovery." To find out for sure, they decided that they needed a long-term field-monitoring study.

(top)

The study they designed called for monitoring approximately 24 sites in three categories:

- **Oiled** (but not cleaned)
- **Oiled and cleaned** (with high-pressure, hot-water washing)
- **Unoiled and not cleaned** (called a "control")

Hundreds of workers used high-pressure hoses to clean the worst of the oiled beaches in the weeks after the spill. (Photo credit: *Exxon Valdez* Oil Spill Trustee Council)

This grand experiment had the attributes required of good science: exposed and control sites (for both oiled and cleaned); replication (more than one site in each category); and repeated sampling over a long period. In the spring of 1990, the research team made its first "reconnaissance" trip to Prince William Sound to confirm that the sites were adequate and simply to "learn the territory." With two boats and a crew of nearly a dozen scientists and technicians, they went out every summer from 1990 to 2000, surveying these sites during the "spring tide" period (a time of very low, low-tides).

To survey marine life on these shorelines, the scientists used methods that gave them quantitative data like the kinds of species present, and their numbers or percent cover in each sampling area. As the tide flowed out, they randomly selected five or 10 points along a 100-foot line parallel to the water line (called a transect or survey line). They did this at three elevations: upper, middle and low tide elevations. At each point on a rocky shore transect, they laid down a one-quarter-square-meter quadrat (0.25 m on a side). You can see one of these quadrats on the ground in the photo to the right; the transect line is vaguely visible near the left center portion of the photo. Then they identified and counted every plant and animal inside the boundary of the quadrat. In areas of "soft" sediment (sand, gravel, or mud) they took a core sample and then, back at the lab, they carefully sorted through the sample and counted and identified all the clams, amphipods, polychaetes, and other marine organisms.

(top)

s a quadrat to sample the organisms of the n Snug Harbor on Knight Island, Prince Alaska. (Photo credit: OR&R, NOAA)

A NOAA researcher examines his sampling quadrat on a cobbled beach in Prince William Sound, Alaska. (Photo credit: OR&R, NOAA)

They found that during the first months after the spill, the oil had killed about half of the marine life on the *oiled* shores. Washing the shore with high-pressure hot water killed most of what survived the initial oiling. This washing removed a lot of oil, but not all of it. By the second summer (1990), seaweeds, barnacles, snails, limpets and other organisms were coming back, but a lot of oil remained in gravel under the shoreline surface. By the third and fourth summers (1991 and 1992) there was, with notable exceptions, a prolific growth of seaweeds, including rockweed, and intertidal animals at *all* of the shoreline sites. The cleaned sites actually took *a year longer* to recover than the oiled but uncleaned sites.

To make sure of their results, they continued the study for another six years. When they reviewed the newer data with the old data, they discovered that there were actually no real differences in the recovery times of the oiled and cleaned sites versus the oiled (but not cleaned) sites. Thus, they had to modify their conclusions and recommendations: heavy cleaning *did* kill off marine life that otherwise survived the oiling, *but* the recovery time was about the same. Heavy cleanup made little difference in the end. It certainly did not remove all the oil, nor did it speed up recovery time of the shoreline marine life.

After 10 years, the team was ready to end its long-term study. However, Dr. Mearns noticed from the data, and from 10 years of shoreline photos, that something else was going on with the intertidal marine life in Prince William Sound. It looked like mussels, seaweeds, clams, barnacles and other organisms were going through a series of cycles. In some years, the shores were covered with mussels. Yet, in other years, mussels were nearly absent and the sites were thick with seaweed. The photos from one site, which featured a large boulder, clearly showed this long-term variation. Another NOAA biologist gave this boulder a name: **Mearns Rock!** Since 2000, Dr. Mearns and several colleagues have continued to return and re-photograph a dozen oiled sites in Prince William Sound, including his namesake rock.

More with Dr. Mearns

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Dr. Mearns's Research:
Read the Full Interview

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(top)

Back to Thinking Like a Scientist: Summary

Full Interview: Dr. Alan Mearns

Have you ever wondered how marine life fares following an oil spill? How many die? How many survive to die later? How long does it take for an ecosystem to recover? What about the site of the *Exxon Valdez* oil spill—has the marine life along the coast recovered after 15 years? As a NOAA scientist, Dr. Alan Mearns has been asking and answering these types of questions since the spill occurred in March of 1989.

A NOAA research team, including Alan Mearns (in yellow pants), examines its sampling quadrat on a cobbled beach in Prince William Sound, Alaska. (Photo credit: OR&R, NOAA)

Dr. Mearns is a marine ecologist at NOAA's Hazardous Materials Response Division in the Office of Response and Restoration, a part of the National Ocean Service. His office is in Seattle, Washington. His job is to provide scientific information during the cleanup of oil and hazardous substance spills in coastal and marine waters. We spoke to Dr. Mearns about his work with oiled ecosystems and particularly his work in Prince William Sound, and his namesake—Mearns Rock. Here is what he had to say:

Interviewer: When did you first start asking scientific questions about the aftermath of the *Exxon Valdez* oil spill?

Alan Mearns: Actually, I was involved in the spill from the very first day. I was in the NOAA HazMat (meaning Hazardous Materials) "war room" in Seattle on the morning of March 25, eight hours after the *Exxon Valdez* struck Bligh Reef. The HazMat Director was briefing the NOAA Administrator, telling him "This is the big one," and seeking support from NOAA. By that time, several NOAA HazMat staff members were already on flights to Alaska.

On that first day, my thoughts centered around how this very large oil spill was going to affect the marine life and wildlife of this productive and remote area. I also wondered how the arrival and activities of thousands of cleanup workers, hundreds of boats, news crews, and dignitaries were going to impact the area. I feared that these human activities might impact Prince William Sound as much as the oil spill itself!

Just a month after the spill occurred, I was asked to participate in a NOAA summer research cruise to survey shorelines and marine life in the spill area. The NOAA Research Vessel *Fairweather* was retrofitted to conduct biological studies for this purpose, and it began surveying the oiled coast of Prince William Sound in May. I joined the cruise in July. My task was to collect and process samples of sediments from several dozen sites along the Kenai Peninsula, Cook Inlet and Kodiak Island (**See a Map of the *Exxon Valdez* oil spill**). This was my first exposure to a major oil spill. During that cruise, I saw many sites, oiled and unoiled, and lots of wildlife. I have visited many of the oiled sites nearly every year since.

Interviewer: In your research with oiled marine life at the site of the *Exxon Valdez* oil spill, what was the first question you wanted to answer?

Alan Mearns: The first question was: ***Would the cleanup methods speed up the recovery of the shoreline marine life, or would they actually delay the recovery?*** Little did I know, then, that my colleagues and I would spend the next 10 years trying to answer this question.

In the spring of 1989, the government approved the use of high-pressure, hot-water washing to remove oil from the seaweed-covered, rocky, boulder, cobble and gravelly shorelines. Floating barges were built that were fitted with large pumps and water heaters to deliver this high-pressure hot water to the shoreline cleanup crews. The crews were using large fire hoses to blast oil out of the rocks and cobble, causing it to float on top of the water (called “refloating”) and washing it back out into the water, where it could be picked up by skimmers fitted on boats.

(top)

In the end, we returned to that first, very basic question I had asked on the first day: ***To what extent would this type of cleanup enhance or delay recovery of shoreline marine life?*** We quickly broke down this simple question into numerous smaller, more answerable questions, and our long-term monitoring project was born. This is a typical scenario in a scientific investigation—scientists often take a very general question or an overwhelmingly large question and break it down into a series of smaller questions that they can answer through experimentation or observation.

Interviewer: Explain to us how you went about deciding how you would answer that first question.

Alan Mearns: We used the same approach that most scientists use when they first tackle a question. First, we read all the relevant published literature about the effects of both oil spills and shoreline cleanup activities on marine life. We found out, however, that not much was published on these topics. There had been some studies about the cleanup of oil spills, but we did not think the information was good enough to predict whether the hot-water cleanup method would be effective (in removing oil) or if it would really speed up “recovery.” To find out for sure, we decided that we needed a field-monitoring study at the site of the *Exxon Valdez* oil spill at both oiled and hot-water cleaned sites.

Fortunately, another research team had already started sampling and surveying the sites we needed. These included sites that were:

- **Oiled** (but not cleaned)
- **Oiled and cleaned** (with high-pressure, hot-water washing)
- **Unoiled and not cleaned** (called a “control”)

It was a grand experiment, with almost all the attributes required of good science, including exposed and control sites (for both oiled and cleaned), replication (more than one site in each category) and repeated sampling over a long period of time, provided we could argue for long-term funding.

Alan Mearns and colleague establish a transect at Mearns Rock, a large boulder located in Snug Harbor on Knight Island in Prince William Sound, Alaska. (Photo credit: OR&R, NOAA)

We also had some data from parts of Prince William Sound that another research team happened to be studying before the *Exxon Valdez* oil spill took place—which was very lucky for us. We wanted to study all of these sites for several years using this “sampling design,” as scientists call it. One of the first questions my research team posed was:

Would the sampling design be sufficient to allow us to clearly conclude when the marine life of oiled versus oiled and cleaned shoreline sites had actually recovered?

In other words, we needed assurance that the control sites were indeed comparable, so that over several years, we could fairly compare recovery at the oiled sites with the natural variation that we expected to occur in the absence of oiling and cleanup.

Additional sampling design questions we asked were:

- How many study sites or sampling areas needed to be monitored in each category (oiled; oiled and cleaned; and control sites)?
- How frequently must we monitor these sites?
- How many replicate samples must we take at each location?
- How often must we sample, to make sure we can claim that "recovery" has occurred?

(top)

First, we made sure that the control sites were indeed unoiled by checking detailed Coast Guard 1989 cleanup records. We needed to know if the unoiled control sites were similar to the oiled sites in terms of wave exposure and other forces of nature. We looked at detailed maps to see where each shoreline site was located, what kind of substrate it was (rocky, boulder, cobble, mud flat) and how it was exposed to wind and waves.

Next, we evaluated how many sites would be needed in each category. We knew one each would not do because marine life and shoreline habitats, whether oiled or not, are extremely patchy. You could easily come to the wrong conclusion by chance alone. We sought three, four or five sites in each of the three categories.

Next, we considered how many replicate samples we needed at each site, at each time period, and at each of several tidal elevations (upper, mid and low intertidal). Again, one sample each would not do. Basic statistical analysis told us that we should have at least five replicate samples of each of the categories (oiled, oiled and cleaned, control). Fortunately, in most places, 5 to 10 samples had been taken at each site and each elevation in 1989.

Finally, we made our first "reconnaissance" trip to Prince William Sound in the spring of 1990, confirming that most sites were adequate, adding or adjusting sites and sampling locations, and just learning the "territory." With two boats and a crew of nearly a dozen scientists and technicians, we went out every summer from 1990 to 2000, surveying these sites during the "spring tide" period (a time of very low, low-tides). After 2000, I led a small research team of three to continue photographing a dozen sites, including Mearns Rock.

Interviewer: What are the some of the field methods you use to study oiled marine life, especially along the coast? What technologies have you used? How have they assisted you in gaining a better understanding of oiled marine life?

Alan Mearns: Any shoreline field investigation requires the following:

- a tide table to plan how much low-tide time we had at each site;
- a statistically based monitoring plan (as described above);
- the logistics for training staff and getting to and operating in the field locations (everything from boats and food to rain gear);
- tools (such as GPS) for precisely locating stations and samples;
- a team of people who are experts in identifying hundreds of species of marine plants and animals (called taxonomists);
- people who are not taxonomists, but who can record the data;
- taxonomic reference books;
- photography equipment;
- dozens of field notebooks and data forms;

- biological survey tools (quadrats, core tubes, shovels, labels, jars, and preservatives); and
- thick steel stakes (i.e., rebar) or marine putty to use as permanent markers at each site.

(top)

To survey the marine life on the shorelines, we used methods that gave us quantitative data like the kinds of species present, and their numbers or percent cover in each sampling area. On our first visit to each site, we randomly selected five or 10 points along a 100-foot line parallel to the water line (called a transect or transect line), using a "random numbers table." At each point on a rocky shore transect, we laid down a one-quarter-square-meter quadrat (0.25 m on a side: you can see quadrats and a transect line in some of the photos on this page) and then identified and counted every plant and animal inside the boundary of the quadrat. Lastly, we used steel rebar or marine putty to permanently mark each quadrat location, so that we could relocate these exact points in subsequent years of our study and resample the same locations. This is known as a "fixed random" experimental design. The sample locations (quadrats) were randomly selected only the first time. In subsequent samples, the same locations are sampled again—so the locations were "fixed" in the remainder of the study.

In areas of "soft" sediment (sand, gravel, or mud) we took a core sample and then, back at the lab, we carefully sorted through the sample and counted and identified all the clams, amphipods, polychaetes, and other marine organisms. Samples were also taken of the sediment to determine grain size distribution, organic content, and oil concentration (more specifically, polycyclic aromatic hydrocarbons or PAHs). Mussels were also collected from each sample location to test their tissues for PAH levels. We could also use the PAH information to "fingerprint" the oil to determine its origin. We did this at three elevations: upper, middle and low tide elevations.

This beach, near Knight Island, was heavily oiled and then cleaned in 1989. (Photo credit: OR&R, NOAA)

Our fieldwork had to be done accurately but quickly, because we had a finite amount of time before the tide turned. If we stayed too long as the tide began to come in, we were flooded off the site! Surveying a dozen sites often took a week or more of especially low spring tides. We repeated this process for many sites, resulting in hundreds of quadrat samples, and thousands of numbers for each survey. One or two weeks of such fieldwork resulted in nearly a year of laboratory work, statistical analysis and report writing!

After three or four years, we thought we had our answer: The cleaned sites actually took a year longer to recover than the oiled, but uncleaned, sites. To make sure, we continued the study, eventually working with a second group of researchers. When we reviewed the new data and all the old data using newer statistical methods, we discovered that there were no real differences in recovery times! Thus, we had to modify our conclusions and recommendations: heavy cleaning did kill off marine life that otherwise survived the oiling, but the recovery time was about the same. Heavy cleanup made little difference in the end; it certainly did not remove all the oil, nor did it speed up recovery time of the shoreline marine life.

After 10 years we were ready to end the program. However, I noticed from our data, and from 10 years of shoreline photos, that something else was going on with the intertidal marine life in Prince William Sound. It looked like mussels, seaweeds, clams, barnacles and other organisms were going through a series of cycles. In some years, the shores were covered with mussels. Yet, in other years, mussels were nearly absent and the places were thick with seaweed. And, in other years, hardly anything at all grew on or inhabited some sites. This variation had no impact on our scientific study, however, because we were always comparing oiled and cleaned sites to unoiled sites.

The photos from one site, which featured a large boulder, clearly showed this long-term variation. My colleague and fellow biologist Gary Shigenaka gave this boulder a name: Mearns Rock! We used the Mearns Rock photos to capture the imagination of the boating public. Since 2000, I and several colleagues have continued to return and rephotograph our oiled sites, including Mearns Rock, in the company of local citizens.

Interviewer: How will you use the data you collected at Mearns Rock and other locations in Prince William Sound?

Alan Mearns: As you may have noticed, the Mearns Rock photo series is only "the tip of the iceberg"; a small piece in a much larger puzzle. Mearns Rock was one of our study sites that was oiled but not cleaned. One purpose of the Mearns Rock photos is to see if we can use these landscape-scale photos to replace some of the very intensive and expensive quantitative biology methods (described above) at future oil spills. We have the photos and the data we collected for the past 10 years, but have not yet begun to compare them.

Another purpose of conducting our annual trips to Prince William Sound was to train local citizens in hopes that they would continue long-term monitoring and photography once we were gone. Each year, we invited members of the Whittier Coast Guard Auxiliary to join us as we traveled around Knight Island. Often, two or more vessels operated by citizens and their families accompanied us. We took them ashore, showed them the photo sites, and dug pits to look for signs of oil.

Showing the photos of Mearns Rock is only the first step in the scientific process. To begin to answer the "so what?" questions, we need to look at similar photos over the same period from other locations, especially locations that were not oiled. About half the people that look at these photos ask, "*Do you have pictures of an unoiled site*?" If you want to begin understanding why marine life has been changing, that is exactly the right question to ask! We hope to make photos from all the sites available in the coming year.

Interviewer: What is the present (2005) situation in regards to rockweed (*Fucus*) and mussel populations and other marine life in Prince William Sound, especially at Mearns Rock?

Alan Mearns: This past summer (June 2004) three of us, accompanied by local citizens, visited about 10 of our oiled, oiled and cleaned, and control sites, including Mearns Rock, which is on Knight Island. From 2001 to 2003, the percent cover of marine life at most sites was very low. This summer it looked like the rockweed was starting a new period of exuberant growth. Mussels were not particularly abundant. Overall, the abundance of conspicuous intertidal marine life has varied greatly at all sites, regardless of whether they were oiled, oiled and cleaned, or unoiled.

Interviewer: Overall, what changes have occurred in Prince William Sound and Mearns Rock since 1989?

Alan Mearns: During 1989, the oil killed off about half of the marine life on the oiled shores. Washing the shore with high-pressure hot water killed off most of what survived oiling. This washing removed a lot of oil, but not all of it. By the second summer (1990), seaweeds, barnacles, snails, limpets and other organisms were coming back, but a lot of oil remained in gravel under the shoreline surface. By the third and fourth summers (1991 and 1992) there was, with notable exceptions, a prolific growth of seaweeds, including rockweed, and intertidal animals at all of our shoreline sites. After that, the abundance of algae and animals at oiled sites (both cleaned and not cleaned) varied considerably from year to year, just as similar variations occurred at the unoiled sites.

(top)

Interviewer: Has Prince William Sound “recovered” from the 1989 *Exxon Valdez* oil spill? What is the evidence to support your answer?

Alan Mearns: As a scientist, I find it difficult to answer the general question, “Has Prince William Sound recovered?” Imagine if a storm completely trashed your garden and then it started to "recover." When would you say that it had completely "recovered"? After a year, you would have some plants and birds come back, looking like they did before, but other plants would be much slower to regrow, and some would have died, perhaps to be replaced by weeds for a season or two. You would have a change in the amount of shade and sunlight coming into various portions of the garden, changing the rates at which various plants grow and flower. And, you would have year-to-year variations in rainfall and soil moisture, which would also change the course of your garden’s "recovery."

So let me try to answer the question about specific groups of organisms affected by the oil spill rather than all of Prince William Sound. In terms of the abundance and diversity of shoreline marine life in oiled areas, meaning the seaweeds, barnacles, mussels and other invertebrates, they have recovered. In fact, that kind of recovery took place within three to four years after the spill, but we didn't know we could say that with specified scientific certainty until we "oversampled" for a period of 10 years. A different answer might be this: all of that shoreline marine life was going to return, no matter what we did. But oil still exists in the shoreline sediments. Of the 10 sites we visited this year (2004), we dug small trenches in soft sediment and found oil sheen at six of the sites. One site has what looks like an asphalt pavement in the upper intertidal zone. The oil had mixed with gravel, then dried out.

Other researchers from government and industry have studied other groups of wildlife affected by the oil spill in Prince William Sound. The answers are mixed. Bald eagles recovered to their former abundance many years ago. Sea otters, however, may still be suffering at several locations, because they continue to feed on contaminated clams and mussels.

Some years ago, an article by writer Marguerite Holloway appeared in *Scientific American*. She used the French term, *mis en mis*—"window in a window"—to describe how people look at recovery. It depends on how close or how distantly you look at Prince William Sound and all the data compiled since March 25, 1989.

Interviewer:What were some of the challenges you faced in conducting your research at Mearns Rock?

Alan Mearns: One was simply getting there! Mearns Rock and the other 12 study sites are located on Knight Island, over 50 miles southeast of the nearest port in Whittier, Alaska. We have been very fortunate to get to the Mearns Rock site each year despite weather delays and engine troubles. May and June are often pleasant months in Prince William Sound, but storms can pop up anytime, especially in July. An engine failure nearly terminated our 2002 survey, but we completed it with the help of a citizen who volunteered his time and vessel.

Another is the timing of the tides. We need a good "minus" tide during daylight hours to photograph our sites. One year, the low tide was at dawn on a very dark and cloudy morning. Our film speed was not fast enough to get quality pictures and I had to rely on the low-light capability of a video camera to get passable photos. We always had to have a contingency plan, had to be ready to go when the tides and weather were right, and to hold back when they weren't.

Also, there was the challenge of funding and support. We have been very fortunate that NOAA and other agencies have funded this work for over 10 years. But it has not been easy. Funding cycles go up and down, and in some years we had to argue and argue that the program should continue for at least one more year. Part of the "art" of being a scientist is being a good proposal writer and giving good speeches and presentations. Fortunately, the trips to Mearns Rock and other sites were relatively low in cost, and it was easier to justify a brief annual photo-survey than it was to justify a major annual biological survey.

Interviewer: Do you or other NOAA scientists continue to study the marine organisms on Mearns Rock? What about other locations in Prince William Sound?

Alan Mearns: Yes, our NOAA HazMat team continues to monitor sites in Prince William Sound. In addition, the *Exxon Valdez* Trustee Council and the Oil Spill Recovery Institute continue to make measurements in the sound.

In the spring of 2001, we had a surprising opportunity to try another approach to answering our question. A large earthquake in Prince William Sound caused a landslide on northern Knight Island, only a few miles from one of our study sites. The landslide buried about 400 meters of old shoreline, creating a new one composed of dozens of house-sized boulders. We used this new shoreline to monitor how marine life colonizes bare rock from the very beginning, and in the absence of mortality from an oil spill. Scientists call this a "natural experiment"—in other words, an experiment created by Mother Nature's manipulation of a situation, rather than a planned manipulation by scientists.

We predicted that recovery of marine life at this new site would be identical to what we saw in 1989-1993 at the oiled and pressure-washed sites. Indeed, our three years of photos clearly show the same sorts of recolonization patterns that we saw elsewhere in the early 1990s, including an explosion of mussels in 2003, three years after the landslide.

(top)

Back to Thinking Like a Scientist: Summary

Profile of a NOAA Scientist: Dr. Alan Mearns

A Marine Scientist's Publications

"In my first year of college, I learned that…there is a big difference between having an "interest in nature" and "studying nature."

–Dr. Alan Mearns

Dr. Alan Mearns (far right) and colleagues on a research expedition in Prince William Sound, Alaska. Dr. Mearns is a marine ecologist at NOAA's Hazardous Materials Response Division in the Office of Response and Restoration, a part of the National Ocean Service. (Photo credit: OR&R, NOAA)

Alan Mearns is a marine ecologist at NOAA's Hazardous Materials Response Division in the Office of Response and Restoration, a part of the National Ocean Service. His office is in Seattle, Washington. We talked to Dr. Mearns about how he came to be a scientist, his career as a scientist at NOAA, and how he came to study the effects of oil spills and other hazardous materials. Here is what he had to say:

Interviewer: Can you tell us how you became interested in a career in science? Can you trace your interest in science back to a childhood experience, a favorite teacher or a favorite course?

Alan Mearns: I became interested in nature early in my childhood. I grew up in Long Beach, California, in the 1950s. When I was 10, we moved out into the "country," where I played among the orange groves with my buddies. There were snakes and lizards everywhere. We noticed that every fence lizard or skink we caught had lost its tail, and I wondered why. I didn't know it then, but I had posed my first scientific question! I kept some horned lizards (called "horny toads") in a box in the garage to see if there was any truth in the story that they spit blood out of their eyes. I am afraid to say what I did to try to get them to squirt blood, but they never did.

A pet shop opened nearby, and I began spending time there. I bought several aquaria and started raising tropical fish in the garage. My high school buddy, who also raised tropical fish, told me about the tropical fish he heard about that lived in the low desert. With our brand new driver's licenses and his 1936 Packard Coupe, we made our first big "fishing" expedition. In the desert, near Palm Springs, we used a seine and dip nets to catch sailfin mollies, swordtails and platies, which we sold to fish stores in Long Beach.

During that trip, a fish not found in pet stores—the desert pupfish (*Cyprinodon macularius*)—piqued my interest. I quickly forgot about the non-native tropical fish I had been so fascinated with since childhood, and tried to learn everything I could about this strange "tropical" fish that had lived in desert springs for thousands of years. I even wrote an article for the Garden Grove Aquarium Society's magazine called "Fish in the Desert?"

Despite all my wonderful childhood experiences with living things, I had not yet learned that there was a big difference between having an *interest in nature*, and *studying nature*. I found out that science is more than enjoying nature. It involves using logical thinking and experimental methods to ask and answer questions about the world around us. Until I learned this, I was using only part of the scientific method: I asked questions about tailless lizards, blood-squirting horny toads and desert pupfish, but I had not rigorously answered my questions. During my college and graduate school years, I was exposed to “scientific thinking”—in other words, thinking through questions and problems using logic and experimental design. It was not until then that I truly used the scientific method to ask and answer questions about nature.

(top)

Interviewer: Tell us about your educational background, and your first job in your field.

Alan Mearns: I was a smart kid, so my folks wanted me to be a doctor or dentist. I began college as a pre-dental major at California State College in Long Beach. It took only two semesters of zoology classes and a class field trip to the Sea of Cortez, in Mexico, to make me realize that I was destined to be a field biologist. During the next three years, I took all the "-ology" classes that my college offered—invertebrate zoology, entomology, botany, and so on. My professors took us on many exciting field trips and gave me my fill of painful lab practical exams—but I am grateful to them for all of it.

After I graduated from college, I decided to go to graduate school. I earned a master's degree at Long Beach, and then a doctorate (PhD) in fisheries at the University of Washington. I had the good fortune of having some wonderful and highly motivated professors, and others, guiding my academic and early professional development.

After earning my PhD, my first job was as a biologist with the Southern California Coastal Water Research Project (http://www.sccwrp.org/) in Los Angeles. I was hired to investigate why fish living around sewage outfalls appeared to have skin tumors. The famous filmmaker and naturalist Jacques Cousteau, and other environmental advocates, had claimed that sewage was causing the tumors. They demanded that the California State Legislature pass laws requiring a higher level of sewage treatment. Their claims seemed “fishy” to me; I suspected the tumors might have another cause. My scientific training caused me to ask questions that challenged the assumptions made by Cousteau and the others.

Dr. Alan Mearns collecting data on a boulder-strewn shoreline in Prince William Sound (Photo credit: OR&R, NOAA)

I discovered that the only places where people looked for the tumor-bearing fish were around the ocean sewage discharges. No one had sampled away from the discharge area. My team and I quickly mounted a survey of remote areas to test the hypothesis that the tumors were unique to fish around the sewage discharges. We discovered that the same fish species away from the discharges also had skin tumors, and that tumors were just as common in these fish as those around the sewage discharges. Further, it had just been discovered that the tumors in fish in the Northwest were caused by a marine parasite. The sewage discharges were not the problem, as people had assumed; the tumors were caused by a parasite! Jacques Cousteau was a wonderful naturalist, adventurer and politician, and brought much-needed attention to the oceans, but he was not a scientist.

Interviewer: Tell us about your career at NOAA. What is your job title? What are your duties?

Alan Mearns: After 10 years at the Water Research Project, and leading the Biology Division there, I came to work for the National Oceanic and Atmospheric Administration (NOAA). Officially, my job title is “ecologist.” My first assignment at NOAA was to help with a program investigating pollution in Puget Sound and the New York Bight. We were challenged with rigorously testing hypotheses about some common popular assumptions about pollution. The Puget Sound research evolved into a nationwide evaluation of marine pollution. Several years later, I led a national team of scientists in an effort called "Historical Trends Assessment." We collected pollutant data from dozens of laboratories all around the U.

S. coastline and wrote several reports showing that marine pollution was increasing during the 1950s and 1960s, and then started to decline in the 1970s.

Then, on March 24, 1989, the *Exxon Valdez* ran aground on Bligh Reef in Prince William Sound, Alaska. Every able-bodied scientist at NOAA in Seattle was called upon to help the NOAA HazMat team, including myself. That summer, I joined the effort and helped design and undertake field surveys to determine the extent and magnitude of effects of the oil on marine life. The next year (1990), I officially joined the HazMat team and was given responsibility for conducting a long-term monitoring survey to document the recovery of injured shoreline marine life.

Currently, I work at NOAA's Hazardous Materials Response Division in Seattle, Washington. During my career at NOAA, I have been assigned as leader of the HazMat Biological Assessment Team and, more recently, as senior staff scientist. My duties include supporting national coordinators and the U.S. Coast Guard during spills of oil and other materials, conducting research on the best ways to clean up oil spills, representing my office at national and international conferences, recommending policy to my managers, and providing training to the Coast Guard and state agencies, industries, and others involved in spill response.

(top)

Interviewer: What advice would you give to a high school student who would like to pursue a career similar to yours—in the marine sciences such as marine biology, marine ecology, marine chemistry, or marine environmental policy?

Dr. Mearns digs for residual oil on a cobbled beach in Prince William Sound. (Photo credit: OR&R, NOAA)

Alan Mearns: I advise taking as much science as you can in high school, especially earth science, biology, chemistry, physics and math. In addition, read everything you can get your hands on, and practice writing whenever possible.

It is critical for you to surround yourself with smart people, and realize that your education never stops. I am still learning to this day!

Every science course I took in college has helped me in my career at NOAA, but I think some of the non-science courses were the most valuable to my future as a scientist. What I learned in courses in philosophy, speech, statistics and writing has been helpful on a daily basis. Of all the courses I took, writing and speech have been among the most useful.

In addition, practical experience outside the federal government was critical in my later work at NOAA. I learned how others approached problems and I brought those skills with me to NOAA. If possible, I recommend that students "try it out" as a volunteer or intern with several types of organizations—in government, nongovernmental organizations, environmental organizations, corporations or schools. Many science-based and policy-based organizations, including NOAA, offer internship opportunities for students.

Interviewer: What are some alternative career options for young people with backgrounds in the marine sciences?

Alan Mearns: There is a great need for well-trained marine environmental scientists in industry, consulting firms, and nongovernmental environmental organizations, as well as at all levels of government. I think there is a critical need for well-trained marine scientists to work for nongovernmental environmental advocacy organizations. These organizations are often in the public limelight and need to make sure that their facts are correct and accurate—in other words, they need to back up their advocacy with science.

(top)

A Marine Scientist's Publications

One of the jobs of scientists is to publish their work in scientific journals. Written papers and reports represent the scientists' "portfolio," the ultimate summary of their work. By submitting papers to journals, scientists subject their work to "peer review," which is a careful review by other scientists selected by the journal's editors. This process insures that mistakes are minimized, that the work represents good science, and that the results and conclusions are understandable. Information that is not subject to peer review, such as most Web sites, should be considered with caution.

Below is a select list of the 150 papers and technical reports that Dr. Mearns' has published. They demonstrate the great variety of subjects that marine scientists may work on during their careers. All but the 1993 article in *Sea Technology* were peer-reviewed.

Mearns, A.J., M. Stekoll, K. Hall, C.J. Beegle-Krause, M. Watson and M. Atkinson. 2003. *Biological and Ecological Effects of Wastewater Discharges from Cruise Ships in Alaska*. Pages 737-747 *In* Oceans 2003 MTS/IEEE Conference Proceedings, September 22-26, San Diego, CA., Marine Technology Society, Columbia, MD.

Mearns, A.J., G. Watabayashi and J. Lankford. 2001. *Dispersing Oil Nearshore in the California Current Region.* CalCOFI Reports 42:97-109.

Mearns, A.J., M.J. Allen and M.D. Moore. 2000. *The Southern California Coastal Water Research Project - 30 Years of Environmental Research in the Southern California Bight.* 1999-2000 Annual Report, Southern California Coastal Water Research Project, Westminster, CA.

Mearns, A.J., B. Benggio and T.D. Waite. 1999. *Ballast water treatment during emergency response: Case of the M/T Igloo Moon.* Pages 1463 - 1468 *In* Proceedings, Oceans '99 MTS/IEEE Conference, Seattle, Washington, October, 1999. Marine Technology Society, Washington, D.C.

Mearns, A.J. 1997. *Cleaning oiled shores: putting bioremediation to the test.* Spill Science and Technology Bulletin 4(4):209-217.

Kendall, A.W. and A.J. Mearns. 1996. *Egg and larval development in relation to systematics of Novumbra hubbsi, the Olympic Mudminnow.* Copeia 1996(3): 684-695.

Mearns, A.J. 1996. *Exxon Valdez Shoreline Treatment and Operations: Implications for Response, Assessment, Monitoring and Research*. Pages 309-328 *In* S.D. Rice, R.B. Spies, D.A. Wolfe and B.A. Wright (editors). Proceedings of the *Exxon Valdez* Oil Spill Symposium. American Fisheries Society Symposium 18. American Fisheries Society, Bethesda, MD. 931 pp.

Mearns, A.J. October 1993. *"Appropriate" Technologies for Marine Pollution Control: Controversy in Fitting the Solution to the Problem—Shoreline Cleaning, Bioremediation, Wastewater treatment, Monitoring and Assessment*. Sea Technology, pp. 31-37.

Mearns, A.J. 1988. *The "odd fish": unusual occurrences of marine life as indicators of changing ocean conditions.* Chapter 7. Pages 137-176 *In* D.F. Soule and G.S. Kleppel (editors), Marine organisms as indicators. Springer-Verlag, New York.

Mearns, A.J., R.C. Swartz, J.M. Cummins, P.A. Dinnel, P. Plesha and P.M. Chapman. 1986. *Inter-laboratory comparison of a sediment toxicity test using the marine amphipod, Rhepoxynius abronius*. Marine Environmental Research 19:13-37.

Mearns, A.J. and T. P. O'Connor. 1984. *Biological effects versus pollutant inputs: the scale of things*. Pages 693-722 *In* H.H. White (ed). Concepts in Marine Pollution Measurements. Maryland Sea Grant

Publication UM-SG-TS-84-03, University of Maryland, College Park, MD. 743 pp.

Mearns, A.J. 1981. *Effects of municipal discharges on open coastal ecosystems*. Pages 25-66 *In* R.A. Geyer (editor). Marine Environmental Pollution 2. Dumping and Mining. Elsevier Scientific Publishing Co., New York. 574 pp.

Mearns, A.J., D.R. Young, R.J. Olson and H.A. Schafer. 1981. *Trophic structure and the cesium-potassium ratio in pelagic ecosystems.* CalCOFI Reports 22:99-110.

Mearns, A.J. and M.J. Sherwood. 1977. *Distribution of neoplasms and other diseases of marine fishes relative to the discharge of wastewater.* Annuals of the New York Academy of Science 128:210-224.

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