The Oregon Sea Grant Program Report
From the very beginning he was there moving and shaking, struggling to build something special, something of lasting value. For nearly twenty years, Bill Wick envisioned a national ocean research and education program capable of helping people use the oceans wisely. With an unwavering sense of purpose and direction, he shepherded us all toward that goal.

In life, Bill Wick embodied the spirit of the Sea Grant College Program. The program reflected his style and took life from his boundless energy. Bill Wick brought to it youth and vitality. And he kept things moving. Through a process not unlike Brownian motion, he constantly stirred the pot bringing to the top the best of ideas and the strongest of people.

With his unfailing gyroscope, Bill kept the program on track, focusing on people's needs and on sound principles of resource conservation.

As Dr. John Byrne, President of Oregon State University, said, "Bill Wick was a professional, a creator, a leader, who knew how to get the job done while being sensitive to all those around him."

When Bill entered a room, he filled it. People knew him as an understanding friend, a colleague of uncommon good sense, patience, and beguiling wit.

Ned Ostenso of the National Sea Grant College Program said, "We must take stock of a world without Bill Wick and wonder what a poorer place it must be . . ."

Bill Wick was born in Eau Claire, Wisconsin, was brought up in Montana, received his bachelor's and master's degrees in wildlife management from Oregon State University, worked as a wildlife biologist in Nevada and Washington, was a county agent in Tillamook County, and in 1967, joined the OSU faculty in Newport. He originated the public education wing of the Hatfield Marine Science Center, developed the first Extension Marine Advisory Program in the nation, and was President of the National Sea Grant Association.

Bill was chosen director of the Oregon Sea Grant College Program in 1973 serving in that position until his retirement in 1990. Along the way he won many honors, including the Wildlife Society's Einarsen Award.

In the end, the name Bill Wick became synonymous with that of Sea Grant, and Sea Grant will probably always bear the mark of this uncommon man.

Jim Larison
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I’m relatively new to Oregon Sea Grant, having come here less than two years ago. But what strikes me about this program is its long and, I think, excellent track record. As coastal and marine issues have evolved, Oregon Sea Grant has been in the right places at the right times, pushing issues forward and helping people use coastal resources wisely.

Sea Grant has been a catalyst, providing start-up money for worthwhile projects, supporting people who have shaped our understanding of the ocean.

Sea Grant hasn't always been visible—by name. It seems to me that Sea Grant people here in Oregon care more about getting the job done than they do about getting credit for it. As a result, it’s sometimes difficult to get a handle on just what Sea Grant is.

It’s not just a program or a network. It is an approach to solving problems and addressing opportunities. Sea Grant is a way of thinking. Most important, it is people.

For a quarter of a century, our people have touched every aspect of coastal life, solving problems and addressing needs through research, extension, and communications.

Research is something we do very well. Sea Grant’s highly competitive research grants program is structured to select and support only the finest science.

But if you really want to make things happen, research alone is not enough. What makes Sea Grant different is our institutionalized and carefully nurtured association with coastal decision makers, resource users and managers, and everyday citizens.

Our Extension Sea Grant Program and Communications Office are among our most visible elements, helping ensure that the results of relevant, timely research are broadly disseminated—and, more important, that they are put to work. Sea Grant is uniquely adept at striking a balance between the necessarily deliberate pace of cutting-edge scientific inquiry and the public’s need to know answers now, and to act now, to address pressing issues.

I’m getting into the swing of Oregon Sea Grant and I must say that it’s an exciting place to be. Let me share with you a few highlights of the Oregon program—scientists, Extension agents, and communicators and the things they have done or helped make happen. Consider this report a snapshot of some of the most pressing challenges facing the Pacific coast, and what Oregon Sea Grant is doing to help address those challenges.

Robert E. Malouf
Director, Oregon Sea Grant
BIENNIAL BUDGET ('91-'93)

Where the money comes from

Federal government (NOAA) • $4,191,800 • 50%

State government (OREGON) • $2,366,800 • 28%

Other • $1,779,900 • 22%

1991-93 Total • $8,338,500
Where the money goes

1991-93 Total • $8,338,500

Research • $4,019,600 • 48%

Extension • $2,927,400 • 35%

Administration • $627,500 • 8%

Communication • $572,100 • 7%

Education • $191,900 • 2%
On a hot, sunny afternoon in early summer 1991, a few boats maneuver slowly on the tailrace just below Bonneville Dam. The concrete fortress of the second powerhouse looms above the boats as they go about a delicate business.

Standing in one of the boats, a group of men begins to pull a net toward themselves. As the net rises to the water's surface, they are greeted by the flashing and splashing of hundreds of small silvery salmon.

Quickly, some of the fish are transferred by hand nets into small pails, and Alec Maule takes the pails away into a makeshift laboratory belowdecks.

Maule, an Oregon State University fish biologist, has been asked to play a key role in a research study being conducted this afternoon. The study is intended, ultimately, to help thousands, millions, indeed hundreds of millions of the relatives of these small salmon as they make their way down the Columbia River.

The problem all these juvenile fish—no more than a few inches long—encounter is massive: the giant barriers of the hydroelectric dams.

The Northwest is in the midst of a salmon crisis of unprecedented proportions. The dams, collectively, have been identified as the single major cause of the salmon's decline in the Columbia River Basin. But researchers have found that even when the small fish are shunted away from the huge power turbines and escape physical injury, many don't survive for long after their passage through Bonneville Dam.

The question is why, and the suspicion is that the stress of the passage through the guts of the dam is weakening the fish.

But this is only a suspicion, or as scientists say, a "working hypothesis." To test it, Alec Maule has been brought in. Earl Dawley, the study leader with the National Marine Fisheries Service, says asking Maule was an obvious step.

"No one in the region knows more about stress in fish than Alec and his colleagues at OSU," says Dawley.

Maule, an assistant professor in the Department of Fisheries and Wildlife, and his colleagues Carl Schreck, a professor in that department, and Stephen Kaattari, a professor of microbiology, have developed their expertise in projects funded by Oregon Sea Grant. The Bonneville Dam study, the work of a few weeks start to finish, is only one way the Sea Grant salmon researchers are contributing to solving the salmon crisis.
Salmon Crisis

The crisis burst to the attention of the Pacific Northwest in 1990, when conservation groups, Indian tribes, and organizations of professional biologists petitioned the federal government to protect five apparently depleted populations of Columbia Basin salmon under the Endangered Species Act (ESA).

Over the next year, the agency responsible for administering the ESA for salmon, the National Marine Fisheries Service, gave its verdict: four of the five petitioned salmon populations were indeed threatened or endangered, and entitled to protection under the strict federal environmental law.

The region had now been put on alert, and information coming from fish biologists revealed that the first ESA petitions represented only the leading edge of a sizable problem. According to the endangered species committee of the American Fisheries Society, more than 214 populations, or stocks, of salmon throughout the Northwest were at serious risk of extinction.

Such disturbing news placed an immediate premium on science that could help, both in the near-term crisis and over the many years it could take to rebuild the stocks.

Sea Grant was ready to contribute.
Dealing with Stress

“We really didn’t plan to become involved in endangered species matters,” says Carl Schreck. He’s sitting at his desk, books crammed on shelves all the way around him, papers and reports stacked up high in front of him. The leader of the Oregon Cooperative Fishery Research Unit doesn’t look like he needs more things to do.

“We were just doing basic science, and, as it turns out, what we’ve learned allows us to provide certain useful pieces of information.”

Schreck specializes in fish endocrinology, the physiology of stress and the reproductive biology of salmon and trout—areas he’s been working in, he says, “since the Pleistocene.” He means before graduate school, sometime in the late 1960s.

Since the early 1980s, Schreck and his colleagues have discovered a good deal about how stress affects salmonids. Although their work describes salmon, their general insight is familiar. “When you’re stressed,” Schreck observes, “your resistance goes to pot.”

Schreck and his colleagues demonstrated clearly, for the first time, how this happens in juvenile salmon. Stress causes the salmon to produce cortisol, a hormone, which in turn suppresses the immune system. That leaves the fish more vulnerable to disease. And during the time when they are recovering from stress, the salmon also are more likely to be vulnerable to predators.

A fish’s response to stress varies over time. The immune system is depressed immediately after the stress, but one day later, the immune system and disease-resisting ability are actually enhanced. A week later, however, the immune system again is depressed, a result of the initial stress. And stresses from various activities—from branding a juvenile, loading it into a truck for transport, and subjecting it to a disease agent en route—are cumulative.

Armed with this knowledge, managers can take steps to reduce the effects of stress. They might change a particular practice so that it’s less stressful, or so it allows the fish time to recover.

The scientists’ insights into stress and recovery have caught the attention of numerous fishery agencies, Schreck notes, and the Sea Grant researchers have been asked in 1992 to help not only with studies of dam migration, but also with others that study barging or trucking the young fish around the dams.

Other techniques developed in Schreck’s laboratory, meanwhile, have been used to address other urgent endangered salmon concerns.

In some populations, the number of spawning adults has become so depleted that it has become essential to ensure that these fish reproduce. The problem is that female salmon tend to die in holding tanks before they are spawned. When this occurs their eggs are lost.

In Sea Grant research dating to the early 1980s, research assistant Martin Fitzpatrick discovered that by injecting a synthetic hormone into the females the maturation process could be accelerated and eggs would ripen before the fish became too weak and sickly. Fitzpatrick later developed a system to predict when fish should be treated with the hormone.

These techniques were used starting in 1990 by managers in California to perpetuate the Sacramento River winter chinook, declared threatened under the ESA, and in Idaho by managers working with Snake River sockeye, declared endangered under the federal law.

Through his Sea Grant research, Schreck has learned that although increased levels of adult female sex hormones can bring the female to ripeness, they also can weaken the fish’s immune system.

“We want to learn to manage the immune system by managing the endocrine system,” says Schreck. “Is there a way to treat the animals so that the immune system won’t go to pot?”

Much could depend on the answer to that question—and the work Schreck and Kaattari have already done offers hope that an answer will be found.
Microbiologist Jo-Ann Leong's pioneering work on the molecular structure of fish viruses has made her the premier investigator in her field—and won her 1993 Distinguished Professor honors from Oregon State University.

**Breakthroughs**

Science sometimes appears to leap forward in great, startling revelations, but mostly this is an illusion, a trick of our attention. The revelations are preceded by often hard, usually slow, mostly painstaking work which, if it has any hope for contributing to that “leap forward,” will very likely be grounded in two guiding virtues. The scientist will be diligent about her science, and she will care passionately about the subject of her research.

Such is the case with the “breakthroughs” of Jo-Ann Leong’s research.

But real headline-grabbing breakthroughs, it must be said first of all, they are.

Leong has gained an international reputation by producing vaccines against viral diseases of fish. Hers are the first vaccines for fish to use
the powerful, but previously unproven, techniques of genetic engineering. The genetically engineered vaccines against two of the killer viruses of Northwest salmon and trout were not only the first for fish; they are among the very few such vaccines to be produced by anyone to date against any virus.

As the result of a decade of sometimes frustrating, pioneering research, Leong has been awarded a patent on one vaccine, against the IPN (infectious pancreatic necrosis) virus. This work was funded by Sea Grant. In companion research, Leong has developed a vaccine against IHN (infectious hematopoietic necrosis) virus and a patent is pending. Already a private company has licensed this university product for commercial production.

While these developments certainly please Leong, they are not what motivated the OSU microbiology professor. She saw a serious problem, and believed she could solve it by applying a new technology.

"Disease is among the most significant deterrents to the development of aquaculture," Leong wrote in her Sea Grant proposal for 1983. "Traditional methods of controlling these diseases [IHN and IPN] by destroying infected fish stocks are expensive and undesirable."

Since viral vaccines produced from weakened strains of virus were "unreliable" and vaccines from killed virus "too expensive," Leong proposed that "recent advances in recombinant DNA technology be used to develop viral vaccines in fish."

As those vaccines have now entered use, Leong's scientific curiosity and her concern for the fish has taken her into new, uncharted territory.

Seeing an opportunity to go beyond specific disease-fighters to a general immune system enhancer, she proposed, in 1991, to produce interferon for trout and salmon. Her hope was, just as human interferon has shown effectiveness against a range of diseases, including hepatitis, HIV infections, and certain cancers, so fish interferon might prove useful against bacterial and viral pathogens.

The search for the gene that tells the fish's cellular machinery to produce the interferon protein has, however, been frustrating. Leong and her assistants have succeeded in identifying elements of the interferon gene, but have yet to capture the whole gene.

Nonetheless, a decade of scientific trailblazing has reinforced the idea in her that more than one path may lead to a desired goal. So Leong has given more of her attention to developing another immune system enhancer, interleukin.

Here, success has come more rapidly. As of the spring of 1992, Leong's lab was "sequencing" the interleukin—identifying the sequence of constituent chemical bases in the interleukin gene. And Leong was optimistic about the future, buoyed by her past successes.

"What Sea Grant can be most proud of," says the microbiologist, "is that they took some chances on us, and it worked out. In another ten years, you'll see a lot of the genetically engineered vaccines available, and producing real benefits."
Polyculture Potential

Hatcheries account for more than 80 percent of the salmon and steelhead produced in the Columbia River Basin. The hatcheries have kept salmonids a presence in the Northwest despite the loss or degradation of much of the fishes' native freshwater habitat. But the new scientific consensus in the 1990s is that hatcheries have sometimes been as much problem as solution and need to be managed so as to not harm wild populations, upon which all production ultimately depends.

A variety of new hatchery types is likely, including “conservation” hatcheries, which perpetuate only endangered stocks, and “supplementation” hatcheries, intended to augment naturally spawning populations.

If Bill McNeil’s vision comes to pass, there will be yet another new form—not a “monoculture” facility, producing only salmon, but a “polyculture” facility, where salmon and other species are raised together, for mutual advantage.

McNeil sees this development as a natural outgrowth of his experimentation with the potential of hatcheries. He’s been experimenting quite awhile.

In the first year of the Oregon Sea Grant program, 1968, McNeil began a small hatchery for chum salmon on Whiskey Creek in Netarts Bay. This experimental facility gave hands-on aquaculture experience to students and faculty through the 1970s, while giving McNeil some of the expertise he brought to starting a salmon hatchery program in Alaska.

After Alaska, McNeil returned to Oregon, managed the ill-fated industrial-scale “salmon ranching” venture funded by Weyerhaeuser, and then returned to academia, at OSU.

If Oregon’s financial, political, and natural environment wasn’t ready for salmon ranching, McNeil reasoned, perhaps a lower-impact model of salmon aquaculture could succeed in the state. McNeil turned his Sea Grant attention to raising salmon first in net pens in Yaquina Bay, and then in holding ponds at the Hatfield Marine Science Center.

Having come so far, it was only a small step for McNeil to go all the way back again to the beginning and see it afresh. The ancient Chinese grew carp, other fish, and ducks, all in the same pond. Why not adapt the process here? he reasoned.

Out in a courtyard at the Hatfield Center stands a miscellaneous collection of tanks, some round, some rectangular, some green plastic, some metal. What they have in common is their part in the Sea Grant polyculture project.

Research assistant John-Eric Levin gives a quick tour. Juvenile coho salmon are the foundation of the system. He feeds the coho a standard diet, and in growing, the salmon produce waste products. The waste water is used to grow seaweed in another group of tanks. Nearby, clams grow in more salmon effluent. And in separate shallow troughs, inch-long abalones are grown on the excess production of seaweed.

The results of this project have been so encouraging that a group of government and private interests has proposed to begin a commercial-size operation in 1993 modeled on the OSU experiment. The commercial venture would make use of the former Oregon Aquafoods facility on Newport’s Yaquina Bay.

It all began with Levin’s discovery that a large red algae known as dulse was the best of several he tested for growing in the wastewater produced by salmon.

The dulse grows in dense, purple clumps the size of a head of lettuce. It produces substantial harvests in a short time. In experimental tanks, Levin has been able to harvest 40 percent of a week’s starting weight of dulse by the end of the week.

Levin also demonstrated that dulse culture in salmon effluent does a fine job in nourishing the Manila clams, the small “steamer” clams that are the mainstay of the retail and restaurant trade. And tests of the ability of red abalone to grow on the seaweed have been very encouraging.

Abalone are small molluscs that command high prices as seafood. “They’re often called the ‘veal of the sea,’” said Levin. “Their meat is light and tender, and can be quite delicious.”

The researchers are plainly enthusiastic about the experimental polyculture system. “All I have to do is feed the salmon,” Levin says. “Everything else is fed by what precedes it in culture.”

“It’s a holistic design.”

At the former Oregon Aquafoods facility, plans are for polyculture of abalone and some ocean “ranching” of coho and chinook salmon. Principal researcher McNeil believes that the polyculture experiment points to an opportunity for diversifying the Oregon coast economy, not only in Yaquina Bay but in other coastal estuaries.

“I’m very enthusiastic about growing salmon in pump-shore systems where salmon are a product in their own right,” he says, “and also a source of nutrients for secondary products.”
The Big Black Box

While each of these Sea Grant research efforts focuses on the freshwater phase of the salmon's life cycle and improving artificial production methods, Bill Pearcy's work deals with the whole other phase of the salmon's life.

Pearcy, a professor in the OSU College of Oceanography, is one of the acknowledged experts on the fate of Pacific salmon in the ocean. In 1992, his book, Ocean Ecology of North Pacific Salmonids, was published by the University of Washington Press, securing that reputation.

These days, he's working with a unique source of information about salmon distribution patterns in the Northeast Pacific: the logs of Japanese research vessels that cruised the region each year from 1976 to 1985. Pearcy participated in several of these cruises in the Gulf of Alaska.

It's desk and computer work, and it's a departure from the ocean sampling projects that provided Pearcy with his initial insights.

"In the late 1970s I came to the realization that we knew very little about salmon when they got to the ocean," says Pearcy. "It was a big black box."
With funding from Sea Grant and others, Pearcy set out to pry the lid off the box. He wanted to see, in particular, what became of coho salmon that originated from Oregon and adjacent areas (the so-called Oregon Production Index, or OPI), and he conducted sampling off the Oregon coast.

No one who has not been out in the Pacific can truly appreciate its real immensity or power. Being there gives a gut appreciation for how difficult it can be to conduct research on the open ocean, for how much we have yet to learn. And yet Pearcy found that, as he prepared his studies, some people already knew what he would find.

“A lot of people said we were wasting our time, because OPI coho went right up to Gulf of Alaska, and we wouldn’t see any off the Oregon coast,” Pearcy recalls.

He found exactly the opposite: juvenile coho spend most of their time in local waters and are not highly migratory.

Another thing people thought they knew: slow growing fish have higher mortality rates. Sorry, Pearcy concluded. Predation was the key factor in juvenile mortalities, not starvation.

“When alternative food supplies for predators like hake and murres are scarce,” Pearcy observed, “they key on salmon.”

But the fruits of the oceanographer’s research were not just observations about distribution and abundance of Oregon coho, as useful as this information was. Pearcy also began to develop a dossier on the relationship between broad-scale, long-term oceanographic changes and salmon survival in the ocean.

The year 1976 was pivotal, for it ushered in a new trend in ocean survival of salmon, Pearcy says. A period of high survival came before, and Oregon salmon runs and catches rose. Since then the Northwest has been in a period of low ocean survival for coho salmon.

The local oceanographic phenomena associated with this disappointing trend are a high sea level, low upwelling of nutrients, and a weak California Current off of Oregon.

The current may be the clue, Pearcy says. “Remember that the Alaska salmon catch in the 1980s and 1990s is higher than ever before; the reverse has been true in Oregon.”

He pulls out a chart and lays it across his desk, running his hand over the Northeast Pacific as he explains that there are two major poles of oceanic flow and they are coupled, positive and negative, out of phase with each other.

When flow into the Gulf of Alaska is strong, he points out, flow is weak in the California Current; and the opposite is true.

Weather is the driving force. When the Aleutian low pressure system is strong and moves east into the Gulf of Alaska, then strong southwest winter winds draw warm air from the south, which generates the upwelling of nutrients. These nutrients nourish the salmon in the Gulf of Alaska. Meanwhile, salmon off the Northwest coast languish. It may not be a happy picture, but it does broaden the frame of discussion about other forces that may be involved in the recent poor returns of salmon to the region from the Columbia River south.

Pearcy leans back, spreads his hands out, as if to say, “I didn’t say you were going to like this explanation, only that maybe it might help keep things in perspective.

“What else would you like science to do?”

Time Enough?

These are just some examples of how Oregon Sea Grant contributes to the continuation, the restoration, and perhaps someday the healthy abundance of the salmon.

No one involved doubts the complexity and the difficulty of the task that lies ahead.

“Salmon evolved in a different system than the one they find themselves in today,” said Alec Maule, as he took a break that summer day aboard the research boat out on the Bonneville tailrace.

“The salmon can evolve to this one,” said the researcher, “but that’s really the problem.

“Given the factors against them, will they survive long enough to evolve?”
Long a symbol of the Northwest’s abundant natural riches, salmon are caught in a crisis of human making. Sea Grant scientists play a key role in trying to understand the salmon’s decline and how it might be reversed.
To hear some people on the Oregon coast talk about it, Pacific whiting is the best thing since sliced bread.

Given the protein content and what you can do with it, it might even be better.

The fish isn’t much to look at—a protruding jaw, big eyes, grayish, tapering body. For longer than anyone knows, this groundfish has swum off the Oregon coast during much of the year. Until the late 1970s Americans didn’t bother to catch it, and for years afterward they sold almost all they caught to foreign processors.

But with the expansion of the American processing sector and the diminishment of harvestable fish stocks, whiting has suddenly taken a role akin to the Great White Hope.

Part of the reason whiting is suddenly getting star billing is that it’s a versatile fish. It lends itself to a variety of products, from the traditional “headed-and-gutted” and fillets to the relatively new market in surimi-based products.

Surimi is a washed, deboned fish protein, and whiting can make a good grade of surimi which, in turn, is transformed into such items as imitation crab flakes.

The other reason whiting is so highly touted is that there appears to be an enormous amount of it. The catch allowed by the Pacific Fishery Management Council in 1992 was 208,000 metric tons, or upwards of 450 million pounds. By anybody’s measure, that’s a lot of economic opportunity.

In Oregon, that opportunity is going mainly to fishing trawlers and to on-shore processing plants, most of them in Newport. Whiting harvest and processing is expected to generate more than $30 million there in 1992.

The amount represents 12 percent of the total earned income in Lincoln County, Oregon’s most prosperous coastal county. That’s why, on the central Oregon coast, Pacific whiting looks like the best thing since sliced bread.

Like many another star, whiting languished in obscurity for years. Its apparent meteoric rise is really the result of patient, even tenacious efforts on the part of its boosters. These efforts came to a head in 1991 and early 1992 when a coalition of interests persuaded the federal government to share the whiting allocation between shore-based and at-sea processors.

That coalition included fishermen and processors, coordinated by the Oregon Coastal Zone Management Association and led by fisherman Barry Fisher of Newport, who persuaded government officials that onshore processing was economically desirable. Oregon legislators Mark Hatfield, Bob Packwood, Peter DeFazio,
Les AuCoin, and Mike Kopetski all supported this home-front effort at economic development. Crucial technical leadership for the effort came from OSU faculty members Gilbert Sylvia, an economist with the Coastal Oregon Marine Experiment Station, and Michael Morrissey, director of the OSU Seafood Lab in Astoria.

The Pacific whiting saga is all these people’s story, but it is also Oregon Sea Grant’s story, for it illustrates well how a long-term interest in a subject can eventually pay a big dividend. It shows how Sea Grant supports economic development and community stability through well-timed contributions of research knowledge and extension assistance.

This part of the Pacific whiting saga goes back to the 1970s, when this unbeautiful fish was still known by the unbeautiful name of “hake.”

**Gaining Respect**

Actually, hake is the name for a respectable species of fish in many parts of the world, but the species of the North Pacific traditionally got less respect than Rodney Dangerfield. The Pacific hake has what appeared to be an intractable defect: as the fish’s flesh warms up, it turns mushy.

The cause and the cure of the problem occupied Sea Grant researcher David Crawford for a number of years during the 1980s. Crawford, Michael Morrissey’s predecessor as the director of the OSU Seafood Lab, came to understand the nature of hake’s distress as well as anyone in the world.

Specialists are still debating where exactly the villain comes from. But they know what it is. Whiting’s flesh is vulnerable to a class of enzyme, known as a protease enzyme, which softens it up the way a good commercial meat tenderizer would. Put more bluntly, it gives whiting a texture like it’s been hit with a baseball bat.

Scientists had tried various approaches to overcome what they artfully referred to as “the texture problem.” In 1988, Crawford was one of two regional researchers to announce a technical breakthrough.

The breakthrough involved surimi. To this mixture of washed, deboned, and concentrated fish protein Crawford added some potassium bromate, the ingredient added to bread to strengthen its proteins. The bromate inactivated the protease enzyme, and the resulting surimi, like bread, had stronger proteins, or what fish-food engineers call “good gel strength.”
Crawford's discovery and a comparable one by researchers with the National Marine Fisheries Service provided the technical assurance that whiting could be worked with. Seafood specialists already knew that if the fish were handled carefully and processed promptly, whiting would lend itself to traditional headed-and-gutted and fillet portions. Added to these, the surimi option made a high-volume fishery viable.

From there, the focus of fish business interests turned to securing an allocation of whiting and then preparing to process it. Again, Oregon Sea Grant provided valuable technical support to that effort.

Hilderbrand's Help

One afternoon in July 1992, Ken Hilderbrand, Extension Sea Grant seafood processing specialist, stood on a staircase above the Newport waterfront. In front of him, the Yaquina Bay bridge arched gracefully above the bay. At the bottom of the stairs, a large trawler was tied up at the dock, a clear, wide-bore plastic hose reaching from its hold to a conveyor belt. The belt, inside a gleaming stainless steel housing, was conveying thousands of Pacific whiting up to temporary storage on the second floor of the new whiting plant owned by Arctic Alaska Fisheries Corporation.

Hilderbrand surveyed the scene with an air of professional satisfaction. "When they bring a boat up here," he explained, "it only takes them a couple hours to pump it off, up through the weighing devices and dewatering screens, up into storage. It's a pretty slick operation."

Inside the plant, the whiting was cut into fillets or fed into a series of precisely engineered machines which turned it into surimi. The Arctic Alaska plant can—and often does—process 300,000 pounds of whiting in a day.

Just down Bay Street from Arctic Alaska, the Pacific Whiting Producers plant was doing much the same thing. Farther up the bay, Arctic Alaska has built another processing plant to turn its fish wastes into valuable fish meal, sold as farm or pet feed.

Hilderbrand could survey this scene with a satisfied air because he helped each of these whiting businesses get started in Newport. For the 23-year veteran of Extension Sea Grant, it was all just part of the job.

A year before, Hilderbrand had contributed to the principal report that demonstrated the feasibility of onshore whiting processing on the Oregon coast. In that report, submitted to the state legislature by the Oregon Coastal Zone Management Association, Hilderbrand had detailed the "infrastructure" requirements that would need to be met if whiting processing was going to succeed on the Oregon coast. The main concerns, Hilderbrand said, were adequate supplies of fresh water and appropriate sites for waste disposal. His conclusion was that Coos Bay and Astoria, as well as Newport, would all be suitable locations.

Then, when the development of processing facilities started in earnest in the fall of 1991 in Newport, Hilderbrand was helpful again.

The whiting plants needed permits to discharge liquid wastewater into Yaquina Bay. The problem was that the state Department of Environmental Quality had no prior experience with such operations and might have required a time-consuming and expensive process to establish an individual permit.

Ken Hilderbrand helped jump-start Oregon's fledgling surimi industry by showing that on-shore whiting processing was not only possible, but feasible.
Recognizing that this could hamstring the companies, Hilderbrand tracked down the necessary information about fish meal and surimi operations and took it to the DEQ. After reviewing the information and holding a public hearing (at which Hilderbrand testified), the DEQ decided to allow surimi and fishmeal plant discharges under existing permit rules. The plants had only to pay a $60 filing fee.

Hilderbrand’s intervention saved each operator $6,000 in application fees, additional money for consultants, hearings, and probably six months of waiting for the permits to be approved.

Mark Conrad, research and development director for Arctic Alaska, says the value of Hilderbrand’s assistance went beyond the time and money saved, directly affecting the outcome of the company’s whole enterprise. “To get what we needed done in the time we needed to get it done,” Conrad said, “it’s fair to say that without Ken’s help we may not have had the plant completed this year.”

Hilderbrand helped the plants in yet another way in the fall of 1991. The plants were producing a substantial amount of solid fish waste daily, but had made no long-term arrangement for disposing of the carcasses. Some were shipped to Eugene, others to Seattle. But the transportation was becoming costly for the fish processors.

Hilderbrand contacted farmers in the Willamette Valley, finding some who were interested in using the whiting waste. About 2,000 tons ultimately were applied to farm fields as compost and fertilizer.

“Unquestionably,” says Conrad of Arctic Alaska, “outside of people on our payroll, there’s nobody that helped more than Ken to put this together.”

### Kolbe’s Research

The Pacific Whiting saga is Sea Grant’s story not only for the direct technical assistance program staff have provided to industry, but also for the research that, in sometimes less apparent ways, explores the limits of the possible with the raw material at hand.

One fall afternoon in 1991, in his OSU laboratory in Gilmore Hall, Ed Kolbe indeed held some of the raw material, a small cylinder of whiting surimi, in his hand.

Kolbe, an OSU associate professor of bioresource engineering, was about to conduct a test to measure the most important characteristic of the surimi, its gel strength.

As the researcher set up the experiment, he provided some background.

Americans are familiar with surimi-based products and have been eating them for years, Kolbe pointed out. But they probably don’t relate the Japanese name to the “crab” flakes and “shrimp” pieces that are made from surimi. “To make surimi, only the protein from the whiting is used,” he said. “When mixed with salt and heated, the protein forms a gel. Since the strength of that gel determines what the surimi can be turned into, measuring the strength is critical.”

But how do you measure the fortitude of a dollop of protein?

There may be those who would smirk at such a question. Let them. They have little appreciation for the subtleties of science.

Whether Ed Kolbe was thinking of the subtleties of science that afternoon is doubtful, but what he certainly was thinking of was the properties of protein, and of that particular parcel of fish protein in his hand.

It had been formed by cooking in a metal tube, and now Kolbe placed the fish cylinder on his lab table. Carefully, he took some “krazy glue” and glued little plastic disks on the two ends of a short cylinder of the gel.

Then he put that disk sandwich into a machine which, operating like a wood lathe, trimmed the cylinder into the shape of an hour glass.
Finally, the hour-glass mass of gelled fish was put into a special measuring device, which twisted the gel, twisted it unmercifully, until it broke.

That was it. Numbers noted, the test was over. Kolbe looked satisfied.

"It's pretty slick," he said.

This "torsion test" was developed at North Carolina State University, where the Oregon Sea Grant scientist was a visiting researcher during 1989 and 1990. Kolbe and his colleagues there found that the test gives the best indication of gel strengths suitable for food products.

There are other ways of testing, but the torsion test, according to Kolbe, is able to sensitively measure how the surimi has been treated and stored and how food tasters will react to the final product.

Perfecting the torsion test on surimi is just one of Kolbe's several technical innovations with whiting that will be of use to processors. Another of his research projects helped secure the whiting allocation for Oregon's shore-based processors in the first place.

Bioresource engineer Ed Kolbe's "torsion tests" helped prove that whiting protein would stand up under the processing it takes to produce surimi.
Frozen Assets

Initially, the National Marine Fisheries Service denied the allocation request of on-shore processors, partly over a concern that the plants wouldn’t be able to operate profitably because harvests are limited to only part of the year and frozen whiting wouldn’t keep well.

But Kolbe demonstrated that whiting surimi would keep fine in frozen storage for as much as 10 months if certain routine conditions were met.

Minus 20 degrees C is the industry standard for freezing surimi, but in his tests Kolbe found that minus 30 degrees preserved the material better.

Kolbe’s information helped persuade NMFS that on-shore processing was viable.

“We demonstrated that you can catch whiting at sea, bring it to shore, make it into surimi, and store it for ten months,” Kolbe said.

“Therefore, shore-based processors can compete with anyone.”

The OSU scientist points out, however, that his research is not driven by who will benefit. In fact, he says, both at-sea and on-shore processors benefit from his freezing research and his other current Sea Grant project—one involving stabilized mince.

Stabilized mince, as the name suggests, is nothing more than whiting fillets chopped fine and stabilized for freezing, in this case with a quantity of normal table sugar, sucrose. Kolbe wanted to know if this mince, once frozen, could later be defrosted and turned into a good-quality surimi.

If it could, whiting processors might benefit in ways. Trawlers, for example, would not have to return to Newport immediately for the special surimi processing. Instead, they could take the fish to any processor along the coast who was equipped to mince it, freeze it and store it.

Later, stocks of frozen mince could let surimi processors extend the production season and stretch out the number of work shifts at the plant.

At-sea processors could enjoy similar advantages, scheduling surimi production to meet harvest patterns or market demands.

The technical question was, would it work? The answer, in mid-1992, appeared to be “yes.”

Kolbe had found that stabilized minced whiting could be stored for up to six months and still make what—according to his gel strength determinations—qualified as good surimi.
Astoria Seafood Lab researcher Haejung An is part of the team investigating ways to stabilize whiting flesh so it will stand up better under processing.

For the remainder of his project, Kolbe still had some unfinished ambitions. He wanted to measure the yield on a pilot-scale production run. The amount of surimi produced from each pound of stabilized mince would determine profitability.

He also wanted to reduce the quantity of sugar used in the mince from 12% to 6%. Preliminary experiments showed that less sugar could still result in a viable surimi after frozen storage.

In sum, Kolbe was optimistic, in his low-key way. "I don't know how it will turn out, but I think we're on the right track," he said.

Cooperative Effort

"No one group—fishermen, processors, managers, researchers, or government officials—could have succeeded alone in building this industry," Barry Fisher told participants in a whiting industry workshop in early 1992.

"Under the rigid discipline of cooperative effort," said Fisher, "we have achieved success."

The contributions of Hilderbrand and Kolbe are part of that success. They are exemplary, not because they are extraordinary, but specifically because they are not. This is the way Sea Grant works—as a program that, through both its research and extension elements, can contribute to the development of appropriate coastal industry.
COAST NOT COASTING

Rapid Change Floors the Accelerator; Sea Grant Steadies the Steering Wheel

Drive along Highway 101 through Lincoln City, and get boxed in traffic, RVs on every side.

Turn to the classifieds in the Coos Bay World and try to find a house near the beach on the south coast for less than $100,000.

Walk into a fish processing plant on the Newport bayfront and listen to the salsa music entertaining the Hispanic workforce.

Signs of change along the Oregon coast are everywhere. It’s simply not the same place it was ten years ago. The numbers tell part of the story.

Take Brookings, the once overlooked town near the California border.

Between the 1980 and 1990 censuses, the population of Brookings grew by 30 percent. The number of people aged 65 and older swelled to 22 percent of the population, and the median value of owner-occupied homes shot up 58 percent, from about $55,000 to $87,000.

Now, you could take the position that Brookings is an extreme. But the story repeats up and down the coast. Take Florence: population up 17 percent; 29 percent are 65 and over; median home value, up 16 percent.

A last example: consider the percentage of women in the labor force who are age 16 or older and have one or more children under age 6. Florence: that group grew during the decade to 59 percent from 37 percent; for Newport, an increase to 67 percent—two out of three—from 39 percent.

Such numbers point to significant changes. Oregon Sea Grant is helping the people of Oregon assess those changes and respond to them.

Research, education, Extension, communication—all of Sea Grant’s primary program areas are involved in this continuing process. But because extending the fruits of research to the public is what Extension Sea Grant is all about, that program plays a central role.
Speed Frightens

When the topic is change at the Oregon coast, Bruce DeYoung's face lights up. The Extension Sea Grant program leader thrives on strategic planning, and the rapid coastal change, coupled with complex social forces, gets his imagination doing drills: What are the trends? Where are they going? What are they hitting? Where can we come in?

“’The main features of the change, of course, are population shifts, economic shifts, and shifts in attitudes towards the coast’s natural resources,’ he says, warming up.

“But take just one, the economic shift: we are being propelled toward a very different sort of economy from what we’ve been familiar with, and the speed is frightening to many people.”

Disputes between advocates of unfettered growth and proponents of preservation or no-growth are on the rise. Meanwhile, local governments struggle to cope with the demands of managing an increasingly complex social, political and environmental landscape.

One place Extension Sea Grant decided to “come in” during the 1991-93 biennium was in helping communities respond to the difficulties of rapid growth.

“You probably couldn’t pick a better case than Warrenton,” DeYoung says.

Getting a Grip

On a rainy winter morning, it might seem that Warrenton has barely changed since Lewis and Clark wintered over, here on the northwestern-most spit of the Oregon coast.

“It continued to rain and blow so violently that there was no movement of the party today,” Lewis wrote in a typical entry in his journal, February 25, 1806.

The combination of abundant rainfall and low-lying lands has marked the area with abundant wetlands. It was those wetlands Fred Smith cued on in November 1991, when he began the Sea Grant growth management study of Warrenton and Hammond.

Coastal communities see immediate benefits from Extension Sea Grant marine safety programs, which train marine workers to respond to the sometimes unusual conditions of marine emergencies.

Smith, a professor in the OSU Department of Agricultural and Resource Economics, and Jim Bergeron, the Extension Sea Grant agent in Clatsop County, had been asked to assemble a study team to help Warrenton.

The two towns had just voted to merge into one, and local officials were preoccupied with the logistics of the change.

The study team looked beyond the demands of the transition period, Smith says, and foresaw significant difficulties for the management of the new, larger town. At the heart of those difficulties were the wetlands.

More than half the city is covered by freshwater marshes, ponds or other lowlands, and both the state and federal governments have laws regulating their management. Yet city staff were “not capable of making very effective decisions” on wetlands and other key issues with which they had little familiarity, Smith says. It was clear, though, that violating state or federal wetlands rules could cost the city far more than making sure it met its responsibilities.

The study team recommended that Warrenton hire more staff.

“The community could afford it, we told them,” Smith recalls. “Otherwise, decisions would be made by default, to the detriment of the community as a whole.”

The city commission got the message. By three months after the Sea Grant report, Warrenton was searching for a community development and planning specialist to handle wetland issues. Meanwhile, on advice from the Sea Grant team, the city had hired a full-time accounting supervisor and a half-time secretary and had arranged for all city staff to receive training on a new networked computer system.

Long-time city manager Gill Gramson called the Sea Grant study “valuable.”
"When someone from outside comes in and focuses on what we know we need to do, it gives us the little extra support we need to convince the elected officials that what we've been saying makes sense," he said.

The study team's work was also a good value, Gramson added.

"If individual communities went out and tried to hire a consultant to provide this sort of study, we probably couldn't afford it."

Smith also counted the effort a success. Not only did the 31-page report prompt changes in the city's administration, but Warrenton also got a grip on its revenue and finance operations, planning, and citizen involvement efforts.

Extension Sea Grant performed the same kind of management and growth studies for the Columbia River community of The Dalles and for Reedsport during 1992. The Dalles study is noteworthy, Smith says, because it signals a broadening of Extension Sea Grant's assistance from the seaside to the state's other dominant coastal area.

**Getting to Yes**

Sometimes a community does not need a comprehensive growth and management study, but something more modest—something to help clear the windshield of the vehicle of government. During the biennium Extension Sea Grant has filled this need as well.

Mediation, the lawyers call it. "Getting to Yes," as one paperback popularized the concept.

Fred Smith calls it conflict resolution. The basic ideas are compelling and are confirmed by years of Extension experience, he says.

"Rather than us coming in as experts with 'the answer,' and saying 'This is what you need to do and it will solve all your problems,' we help people find their own solution," says Smith.

The 'expert' approach might leave clients saying 'thank you' and then going right back to what they were doing before. But when the solution comes from the community, Smith says, it is more likely to last.

"We're taking advantage of the way people learn and the way they actually change," he says.

A good example of this new approach is how Extension Sea Grant helped sort out longstanding administrative struggles between the Port of Umpqua and Douglas County, both of which have interests in tiny Salmon Harbor, on Winchester Bay.

Both the county and the port consider the harbor and Windy Cove, a popular county campground nearby, as theirs. Each entity has a historic stake in the facilities. Complicating the picture is that the harbor is managed by a three-member committee—one member appointed by the port, one by the county, and one agreed to by both.

The opportunities for conflict—between the port commissioners and the county commissioners, the harbor committee and its manager, and various combinations of the groups—often have become reality, says R.C. Hinman, the Extension Sea Grant agent in Lane and Douglas counties.

And yet, Hinman says, the ultimate resolution for disagreements over the harbor and campground could be fair to all.

"There could be a win-win situation if the objective is efficient government," says Hinman, "—meaning the least cost to do the job."

But Hinman defines his job as facilitator, not Great Oz. To this job, which he began in fall 1991, he brought 14 years working with county government in southern Oregon, working at what he calls "teambuilding."

"There are many tools and techniques for making a meeting more effective," he says of his experience.

"But even then it's still just bloody hard work."

The way a meeting is set up and prepared for often determines its success or failure, says Hinman. Moreover, a good facilitator has to be knowledgeable and command trust and respect, and avoid being caught up in the drama of opposing views.

Hinman hosted two workshops in 1992 to bring interested parties together to discuss the fate of Salmon Harbor and the Windy Cove campground.

**Developing Policy Options**

Jim Good has a recurring nightmare.

The ground shudders as immense slabs of rock shear apart. Just offshore of Pacific City, the ocean floor spasms, reacting to a wound much deeper and older than human memory. An earthquake has begun.

On the Oregon coast, many people are in bed and sleeping. But one young couple walks along the beach, looking out to sea and the moonlight.

Abruptly, they are thrown on the sand. The man looks out to sea and notices the waves beginning a rapid rush to shore.

Jim Good's nightmare doesn't get any better.
Youngsters who learn about the sea may grow up to be adults who believe in protecting it. Sea Grant Marine Education specialist Vicki Osis brings the oceans' stories to thousands of young people each year through her Hatfield Marine Science Center programs.

The kind of coastal change that Good, the Extension coastal resources specialist, is concerned about doesn’t arrive in recreational vehicles or service-sector employment at McDonald’s. It comes from the ocean itself, from its natural power.

At its most dramatic, it looks like the earthquakes that are now known to have struck the Oregon coast about every 350 years—the next of which may be due within 50 years.

The earthquakes shake and drop vast sections of the coast. They can be followed by great tsunamis, the waves that roar along at great speed and tower more than 30 feet tall at landfall, devastating everything in their wake.

Earthquakes and tsunamis are the exotics in Good’s bestiary: rare and dangerous. More common, but no less insidious, are beach and seacliff erosion, areas in which Sea Grant researcher Paul Komar has become a recognized authority during the past decade or so. Chronic erosion can rob people of their property as surely as a tsunami can rob them of their lives.

Until recently, most people gave little thought to such hazards. But during the last several years, Good has become a man on a mission, learning about them and spreading the word. His Ph.D., completed in 1992, addressed coastal hazards, and about half of his Sea Grant time has been devoted to helping the public understand them. The labor is bearing fruit.

“The question is,” Good argues, “when the university research we’re doing has significant public policy implications—things like global warming, coastal earthquakes, beach erosion—do we just go out and explain the research and let other people try to figure out what to do with it?”

Passivity doesn’t seem to be part of Good’s repertoire. “My own philosophy is you give people information, and you provide a process or a framework with which to consider that information—and they’ll come up with good decisions.”

He smiles. “I know, it sounds like I still believe in the Jeffersonian democratic ideal.”

Just as the deliberate, list-making Thomas Jefferson might have done, Good took three steps to foster public involvement in coastal natural hazard planning.

First, he organized a conference, bringing together scientists, engineers, managers, and coastal residents to talk about the hazards. At the close, Good organized the audience into focus groups. The groups suggested what information still needed to be gathered and what policy improvements needed to be made.

Good also invited group members to join a policy working group. Thirty-seven out of 160 conference attendees—a satisfying 25 percent response—said yes, they’d invest two days monthly for more than a year.

Finally, Good took these self-selected, diverse group members and helped them get going, acting as their program facilitator. Throughout 1992 the group worked at developing management strategies to respond to coastal hazards. Ultimately, the group planned
to step beyond the study-phase and recommend policy improvements to decision makers.

"It's the most fun and the best thing I've done in a dozen years with Sea Grant," Good says of his work with the group. Like many Extension faculty, he says, he had long wished to get involved, hands-on, in policy issues.

"Rather than going out and educating people about issues," Good says, "we're educating people by involving them in a real process—bringing them in to affect policy change."

Moreover, because participants see the coastal hazards working group as not just a "paper exercise," he says, they have invested effort and intention in it.

Rather quickly, the investment reaped dividends.

The state liked the working group concept so much that it was advanced for funding as the centerpiece of Oregon's coastal natural hazards improvement strategy. The federal coastal zone management program responded with a $14,000 grant to hire a research assistant.

Still, despite all the apparent interest in the hazards effort spawned by Extension Sea Grant, critics might ask whether the program steps beyond an educational mission into advocating changes in state governance.

"Absolutely not," Good says. "We're teaching what the laws and policies are now, and what their implications are from the vantage point of what science is telling us. We're extending the university-based research in a clear and structured way.

"But what people finally do with this information is up to them."

Reaching the Audience

For most people, an aquarium is a kind of museum, a place of fish-in-boxes, a learning environment where people look, but for the most part don't touch. Susan Pilling's vision of the future aquarium looks different.

She sees videodisc players and interactive computers and remote-controlled cameras which can zoom in on a particular part of an aquarium tank. She sees visitors not only looking but doing, putting their hands on—and in—a variety of exhibits.

Pilling, an Extension Sea Grant marine education specialist, is director of OSU's Hatfield Marine Science Center public wing, which contains a free public aquarium, annually visited by hundreds of thousands of people.

Piling wants to be sure visitors continue to have a good time. But the fun she's planning has a serious purpose. "We want to help foster a marine-literate public," she says.

As the coast plays host to more visitors and becomes home to newcomers unfamiliar with its environment, public education about coastal and ocean resources becomes an ever larger and more important task, the marine educator says.

The challenge of informal public education, she says, is that not only do audiences change, but their expectations change as well. "The audience of the 1990s expects more interaction with its information environment and has a far greater technological sophistication than the audience of thirty years ago."

Hence the plans for videodiscs, computers, and satellite images.

Such plans for the Center's public wing are the result of two years of review and reconsideration, Pilling emphasizes.

In the 25 years that the Center's public wing has been open, it has helped build understanding of the ocean and coast, particularly of its natural history. When the private Oregon Coast Aquarium opened next door to the university facility in 1992, people associated with the Hatfield Center and Sea Grant took a good deal of satisfaction from the event.

In large measure, they knew, the university aquarium had proven that an Oregon coastal aquarium could attract hundreds of thousands of visitors.

But the private aquarium's opening also spelled new opportunities for the public one.

The Oregon Coast Aquarium was designed to educate people about coastal natural history: the fish and the birds, all the other living creatures and their habitats, the ecosystems of the coast.

The Marine Science Center's aquarium had emphasized that sort of information, too, for many years. That another institution was now doing much the same thing meant that the university aquarium could refocus its attention.

The Hatfield Center staff decided to focus on scientific research—shifting the emphasis from not just what we know to how we know.

Instead of just showing photographs of seafloor hot springs, for example, the public wing might display models of the instruments, such as the towed cameras or the particle sensors, that are actually used to study the springs.

Such new developments represent an enhancement of, not a departure from, the public wing's historic identity, Pilling says.

"Our mission from the beginning is to communicate the results of research and promote stewardship of marine resources."

Changing times just mean changed approaches.
Creating Conservation

The Northwest salmon crisis is by no means limited to the Columbia and Snake Rivers, although most of the public attention since 1990 has focused on this major river system and the factors, like the giant hydroelectric dams, that have caused the decline of many salmon populations.

Coastal salmon are in serious trouble, too. The 1992 salmon fishing season, the shortest and skimpiest ever, was to a significant degree determined by the need to protect depleted runs of coastal chinook and coho salmon.

The short season was expected to only worsen the fortunes of commercial fishermen and to dramatize the need for state and regional strategies to reverse the downward trend.

That need was one Paul Heikkila had recognized several years before. In 1992, as various government agencies and private groups began to talk earnestly about salmon restoration, Heikkila was quietly doing it.

Heikkila has been the Extension Sea Grant agent in Coos County since 1979, doing all the things that marine Extension agents do. A part-time commercial fisherman himself, much of his work is directed to helping commercial fishermen do their work better. But over the last decade, he became increasingly involved in freshwater fishery habitat projects.

"At first," Heikkila concedes, "people didn't understand the need and what we wanted to do."

Most people seemed to believe that a robust salmon fishery could be sustained by hatchery production of juvenile fish, he says. But gradually through the 1980s, the evidence of erratic runs and poor catches prompted the recognition that a technological fix, by itself, was not enough.

"Increasingly, research was showing that we needed to pay attention to the quality of the fish's natural habitat," says Heikkila. "It was becoming increasingly clear that good quality freshwater habitat was one key to long-term, sustainable, fish production."

Since the late 1980s it has become easier to get people interested and involved in habitat protection, enhancement and restoration projects, the agent says. In his area, the cities and ports of Bandon and Coquille have been involved in various projects, as also have private landowners.

In 1992, Heikkila had three habitat projects in the section of the North Fork Coquille River above Coquille. Each was designed as a demonstration project with a private landowner, to show that work that can help the river and fish can also benefit the landowners.

But not only the landowners are involved. Each project involves a variety of state and local agencies and private businesses.

"These are situations where everyone wins," Heikkila says.

The projects address streambank and in-stream problems caused by logging and grazing practices.

For instance, one demonstration project on the Mason ranch, at river mile 35, highlights some of the creative approaches that the Sea Grant agent and other cooperators are bringing to the task of river rehabilitation.

In summer 1992, Heikkila and representatives of the Oregon Department of Fish and Wildlife and Menasha Corporation, a local wood products firm, deliberately put 100 big logs into a one mile stretch of the river. They held the logs in place with cables anchored to bedrock by water-resistant epoxy glue.

The plan's technical novelty wasn't so much what struck Heikkila. It was the historic irony of putting logs in the river to help fish. Logs in the river were what hurt the fish in the first place.

Splash damming, which caused the most widespread and drastic alteration to the natural character of the North Fork, was done for many years just above the ranch.

In splash damming, loggers piled large quantities of logs behind temporary dams, then released the dams, sending the logs downstream in a torrent of water.

The practice, continued from the 1920s to the 1950s, flattened stream bottoms, scouring them down to bedrock and stripping vegetation from the stream and its banks.

With the loss of gravel to spawn in, and the holes and backwaters to hide in, and the shade trees to find cool water beneath, the salmon and trout of the North Fork found it much harder to survive, says Heikkila.

After splash damming was outlawed in 1957, fish biologists made it a common practice to remove wood from rivers.

"Partly that was a reaction to the havoc of splash damming, but partly it was also the result of a European consciousness," Heikkila said.

"We like to have our river banks neat and park-like. We don't like messiness."

But a tangle of blackberries down near the water, a crowding of cottonwood, myrtle and spruce trees above them, broken tree limbs and uprooted stumps in the river all are part of the natural environment in the North Fork.

"Salmon evolved with this kind of messiness for 20 million years," said Heikkila. "They like it."
So Heikkila and the others tried to duplicate some of nature's "messiness" to help the fish.

Meanwhile, along the streambank adjoining the site of the log-placements, the landowners, the Masons, were enjoying the benefits of a complementary project.

To help shore up that streambank, to make it less vulnerable to the swift snowmelt torrents of spring, and to assist it with retaining water during the hot dry summers, Heikkila, Menasha and others had planted saplings there beginning four years earlier.

Now well-established young trees, they would ultimately provide shade and nutrients for the young salmon that would one day grow up in the pools formed by the instream logs.

None of this provided a quick fix, Heikkila said. But by imitating nature, the efforts held promise of providing lasting benefits.

Perhaps more importantly, the forging of solid links throughout the community made it more likely that the environmental improvements would be observed, acknowledged and replicated in the future.

**Measuring Success**

As the social, cultural, political and natural environments of the Oregon coast continue to change, they will provide opportunities for Oregon Sea Grant to help coastal residents interpret and respond to these changes. The depth, competence and creativity of a public-oriented program like Sea Grant will be tested.

Ultimately only members of the public will know how well the program succeeds.

Working with Coos County landowners, businesses and government agencies, Sea Grant Extension agent Paul Heikkila shows how cooperative habitat conservation projects can benefit endangered fish—and people, too.
As humans we are accustomed to paying attention most readily to objects at our scale. If the objects or phenomena are bigger, so much the better. A Mack truck coming into your driving lane gets your immediate attention; a hurricane coming into your state gets virtually everyone’s attention.

Nonetheless, anyone who spends much time around marine organisms soon gains an appreciation for the other end of the spectrum: the small and the microscopic—the viruses, the bacteria, and their ilk. Perhaps it has something to do with the large effects such small phenomena may have.

During 1991-93, a number of Oregon Sea Grant projects addressed the problems and the opportunities posed by the microscopic marine world. A sampling of those projects reveals perhaps the range and the reach of the program—into this mysterious, usually invisible marine world and back out to the public.

**Brain Drain**

This particular troublemaker seems innocent enough: only one-tenth of a millimeter long, rod-shaped, green, floats in the ocean. But this single-celled ocean plant links together into long chains of phytoplankton and produces a nasty toxin.

The toxin, domoic acid, can be concentrated in the tissues of shellfish that feed on the plankton. When people eat the shellfish, they can get Amnesic Shellfish Poisoning.

In large enough quantities domoic acid poisoning can cause significant memory loss. In larger quantities it can cause death. With effects like these, when domoic acid was detected in Northwest waters for the first time in 1991, people definitely paid attention.

That first documented contact with domoic acid occurred in November and December that year, and health officials in Washington and Oregon quickly banned shellfish harvest because of concerns about the level of the toxin found in the tissues of some shellfish, particularly razor clams. Dungeness crab harvests were also curtailed for a time.

A spasm of public concern lasted for part of that winter, while health and other regulatory agencies tried to gather information and respond appropriately. For a time the news media carried daily stories. A small number of people in Oregon and Washington reported nausea after eating razor clams. But no one died, and no one was reported seriously ill.

Eventually public attention lapsed. The regulatory agencies stopped waving waving big red flags.
For most people, things went back to normal. For some marine biologists and health officials, however, things couldn’t be “normal” as long as there were unanswered questions about domoic acid. The questions seemed basic and important:

- Exactly which species of phytoplankton released domoic acid in Northwest waters?
- What is a “safe” level of exposure to domoic acid? Are all people at equal risk or are some groups at particular risk?
- Why hadn’t outbreaks occurred before in the Northwest? Had they occurred but not been interpreted correctly?
- What environmental conditions favor the toxin’s production? And what was the likelihood outbreaks would occur again?

In the face of such questions, Oregon Sea Grant began to become seriously involved. Director Bob Malouf, a shellfish specialist himself, decided early that research into the causes and potential control of domoic acid poisoning should be a program priority for the upcoming 1993-95 biennium. In the meantime he would do what he could to support research efforts within the current program.

That winter he committed Sea Grant dollars to support the first meeting of West Coast scientists and health officials to focus on the science of domoic acid poisoning. The meeting occurred in March 1992 at the University of Oregon’s Institute of Marine Biology (OIMB), in Charleston, Oregon.

The workshop was designed for scientists to acquaint each other with what they knew about the plankton and the toxin, and to develop an agenda for further research.

For all involved, the information shared at the meeting contained much food for thought.

Domoic acid is not known to be affected by freezing or cooking, experts said, and no medical treatment for acute poisoning exists.

The levels of domoic acid detected in that first Northwest outbreak weren’t as high as those in a 1987 outbreak in northeastern Canada, in which four people died. In Oregon, the levels were on the order of 10 to 180 parts per million (ppm) in seafood tissue samples, while in Canada they were on the order of 10 to 20 times greater, about 200 to 1200 ppm.

The Oregon Health Division, which monitors samples from shellfish collected at about 20 sites on the Oregon coast, considered levels below 20 ppm as safe.

Bill Keene, an epidemiologist with the division, told reporters who attended a press conference hosted by Sea Grant, that “consumers should have reasonable confidence that commercially harvested shellfish from Oregon are as safe as any other product on the market.”

But in his talk prepared for his scientific peers, Keene expressed concern that nothing definite was known about the cumulative effects of low, “safe” doses of domoic acid.

“Does it make a difference if exposure to the domoic acid toxin is acute or occurs over a five-year period, for instance?” Keene posed.

“We don’t know.”

Other biologists confessed that they understood very little about the environmental factors which favor the production of domoic acid. Even the ocean-warming phenomenon known as “El Niño,” which was in effect that winter, might be a factor.

“We’re a long way from being able to answer whether domoic acid production is related to El Niño events,” said Lynda Shapiro, the director of OIMB and a UO biologist.

“But a number of variables that could be important do vary during an El Niño event,” she added.

These variables include the amount of runoff and nutrients that are carried in ocean water, and differences in water temperature which potentially could affect the growth of the plankton.

Clearly, opportunities exist for better understanding this potential health menace, and Oregon Sea Grant intends to be a contributor.

“Class-A” Killer

Studies of certain fish pathogens “have been very limited,” John Fryer wrote twenty years ago for his 1973 Sea Grant proposal, in part “because we lack investigators technically qualified to detect and define” them.

At the time, Fryer proposed to do just that, and thereby began a long-term relationship with Sea Grant, which has seen numerous achievements. Perhaps the most tangible recent measure of the regard with which Fryer and his Department of Microbiology colleagues are held was the nearly $1.5 million that the Department received from the Bonneville Power Administration and the university in order to build a new freshwater fish disease laboratory in Corvallis, along the Willamette River.

The lab, opened in 1990, combines with the Sea Grant-funded Fish Disease Laboratory at the Hatfield Marine Science Center to create “perhaps the finest facilities in the world for fish disease research,” says Fryer.

Six senior scientists and about 40 professionals make up the staff of the two laboratories. Through the years, routine activities, such as certifying imported salmon eggs as disease-free, have had perhaps the most far-reaching benefit, but the discoveries are what make the headlines.
Such a discovery occurred in 1991 when Fryer and his colleagues identified a previously unknown bacterium that kills salmon. Fryer, known for his mordant humor, gave it a characteristic back-handed compliment, calling it a "class-A' pathogen."

The killer bacterium was isolated from salmon held in rearing facilities in the coastal waters of Chile by Fryer and his OSU and Chilean colleagues. The South American country is a major producer of salmon for world markets, and large numbers of salmon are raised in net pens there.

This variety of bacterium had not been detected in North American waters, and Fryer believed Northwest salmon may not carry the disease agent. Whatever the unknowns associated with a newly identified pathogen, Fryer was sure of one thing.

"This organism is dangerous," he said at the time. "It's important that we take steps to make sure that it doesn't get loose among our salmon."

The U.S. Fish and Wildlife Service did just that, by prohibiting import of eggs from Chilean-raised coho salmon.

Apart from the potential threat it posed, the 1991 discovery was significant for a couple of scientific reasons.

One was that the bacterium was unusually hard to grow outside of infected fish. The researchers tried to grow it in about 25 standard prepared media, but none worked.

OSU's salmon disease lab—along with labs specializing in the diseases of other fresh- and salt-water species—puts Oregon scientists on the cutting edge of research into fish pathology.
Then Fryer’s OSU colleague Cathy Lannan overcame the challenge. Lannan, a long-time member of the Fish Disease Laboratory at the Hatfield Center, succeeded in growing the pathogen in a culture of living salmon cells.

A second feature of the bacterium was even a greater scientific curiosity: the bacterium was of a kind not previously linked to diseases of fish; in fact it was a new genus and species of rickettsia. Always one to call a spade a spade, Fryer gave the bacterium the scientific name *Piscirickettsia salmonis* (fish rickettsia of salmon).

Naming a new organism is a rather unusual event in science. Fryer, who has been an international leader in fish disease research for 25 years, has identified and named only one other new genus during that time. *Piscirickettsia* is a rather peculiar pathogen, according to the microbiologist. It grows well in only a limited temperature range and lives inside cells of the infected host fish, attacking the spleen, kidneys, and liver. It seems to be a threat primarily to coho salmon, although it also kills chinook salmon, Atlantic salmon, and rainbow trout.

In 1991 a number of questions about the pathogen remained to be fully answered: What is the disease’s source? How is it transmitted? How can it be treated most successfully?

**Putting Algae to Work**

Say the word “virus” and for most people the associations are decidedly unattractive: colds and flu . . . polio . . . HIV. Viruses are a reminder of the nature of Nature. It is vast, remarkable, but not necessarily friendly.

Viruses are the quintessential *Other*, the distant relatives you never knew you had who move into your house one afternoon while you’re at work. They are all chain smokers, unemployed, and expect you to support them. You don’t know how to say no. Pretty soon you have a nasty cough.

For Russel Meints, “virus” means something else.

For him, viruses—in general—hold a certain fascination that the rest of us miss.

A microbiologist, botanist and the director of the OSU Center for Gene Research, Meints has devoted much of the last dozen years of his professional life to studying viruses of freshwater and marine algae. Since 1991, Oregon Sea Grant has supported his studies.

Algae, the foundation of the ocean food chain, the blue-collar workhorses of the seas, tend to be overlooked by researchers, Meints says.

“Historically, little funding has been devoted to marine algae, although products derived from algae, including carageenans used in food processing, are of increasing commercial importance,” he says.

The potential for harvest of algae and seaweeds for food, for new drugs, and as a source of biomass energy, is being “actively explored worldwide,” according to the scientist, and may be considerable.*

For Meints, algae have been of particular interest because they harbor viruses. The strange, nonliving pathogens insert themselves into and then take over the cellular machinery of the organisms that play unwitting host to them.

Not all viruses cause disease in their hosts, however. In theory, says Meints, an appropriately modified nonpathogenic virus could be used to carry desired genetic information into a host.

The possible applications of such a genetic engineering approach could be many, according to the researcher.

For example, consider food production. Algae, as plants, have properties that make them desirable as food for humans and other organisms. One reason they are not more desirable is that unlike corn, for instance, they have not been subjected to a few thousand years of human experimentation and plant breeding.

Genetic engineering of desirable traits, using viruses as the carriers of the genes determining those traits, could accelerate or bypass that process of algal breeding—dramatically, according to Meints.

“Mechanisms of genetic enhancement,” he says, “open a whole new way of domesticaing a whole new group of organisms.”

Meints’ OSU lab is one of the few in the world involved in genetic engineering of algae. During the 1991-93 biennium the botanist has been working with two species of brown algae that harbor viral infections.

He and his associates have succeeded in isolating the virus, known as FsV-1, from the algae and have begun to describe the virus’ structure. Meanwhile, they have also succeeded in regrowing the algae’s cell wall, after dissolving it to release the virus. Such regrowth is essential to the ultimate success of the genetic engineering project.

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* One example of the exploration of such economic use of algae is the polyculture project of Bill McNeil and John-Eric Levin, described elsewhere in this report.
The Dirty Dozen

As any Wild West marshal could have told you, it's not enough to know that the bank robbers are on the lam. If you want to protect innocent people you have to publicize . . . post handbills: "Wanted" . . . let them know where the bad guys might be and what they look like.

In that spirit, during the biennium Sea Grant published a handbook designed to help seafood processors effectively eliminate seafood pathogens from their products.

A discussion of these measures is the focus of the report, *Hazard Analysis and Critical Control Point Applications to the Seafood Industry*.

Written by Jong Lee, a former professor of food science and technology at OSU, and Ken Hilderbrand, the Extension Sea Grant seafood processing specialist, the publication is intended primarily for seafood processors and others in the seafood industry. But it is no doubt of interest and value to others, including home economists and consumer groups.

Part of the appeal one could call the "Stephen King phenomenon"—the attraction of the nasty and the bizarre. The publication profiles a dozen bacteria and viruses responsible for food-borne diseases. You could think of them as the Dirty Dozen.

The worst of the bunch may well be *Clostridium botulinum*, the bacterium that causes the deadly food-poisoning, botulism. Botulism produces one of the most potent poisons known to humans; "a drop of pure toxin can wipe out half a million people," according to the report.

*Listeria monocytogenes* is another baddie. Like *C. botulinum* it is extremely hardy and can grow at refrigerated temperatures. It also survives dousing in saturated brine solutions.

Listeriosis can be fatal to people with compromised immune systems, including pregnant women and unborn infants. So nasty is this bacterium that the federal Food and Drug Administration has established "zero tolerance" for it in cooked, ready-to-eat seafoods.

The list goes on: *Salmonella, Shigella, and Staphylococcus; three kinds of Vibrios; and a few others.* Many affect the human intestinal tract, causing cramps and diarrhea—among the most common symptoms of the Dirty Dozen.

While seafood can harbor any of these pathogens, the authors of the report make two observations.
Scientists from up and down the Pacific Coast meet to ponder the threats of increased earthquake activity. Tourists wonder when and where to watch for whales. Sixth-graders study the sprawling story of the Columbia River. Fishermen worry about the future of salmon and whiting. And public TV viewers all over the country get an in-depth look at the issues surrounding Oregon’s ocean.

All are audiences for the work of Oregon Sea Grant Communications: the voice of Sea Grant.

The four-person team—director Jim Larison, science writer Joe Cone, managing editor Sandy Ridlington, and secretary Cynthia Newberry—takes communicating seriously.

They see their mission as more than simply supporting Sea Grant’s research, education and outreach programs—although that’s an important part of what they do.

But they go further, using print, radio, television, and film to spread the word about ocean and coastal resources and the public-policy issues that surround them.

Their audience: Anyone who needs to know, from children to government policymakers, from small-town business people to international scientists.

Helping People Decide

“A lot of what we’re about is helping people understand the broad coastal issues that affect them,” says Jim Larison, an award-winning film maker who heads the communications office. “Everything we do is driven by a sense that people have a legitimate need to understand these issues so they can make good decisions—whether it’s where to build a house or how to respond to the salmon crisis.”

Some of the most important decisions are made by government agency heads, members of Congress, and state legislators: People who need sound information in order to make solid public-policy choices. Sea Grant Communications gives them background information on a whole range of onshore and offshore issues: coastal erosion and land use, fisheries, undersea mineral resources, you name it.
Sea Grant research can reach far beyond the seas. Marine chemist William Gerwick of OSU's College of Pharmacy is trying to extract hormone-like substances from seaweeds. The chemicals someday might be used to combat human illness.

At the other end of the scale—but just as important to the Communications mission—are the folks who live and earn their livelihods by the sea.

Communicating with diverse audiences requires a staff with diverse skills. The Sea Grant Communications team must grasp complex scientific and technical subjects, understand how those subjects are tied to the forces of economics, politics and the environment, and then tell the Sea Grant story in language that is both technically accurate and clearly understandable.

That story is driven by the work of hundreds of scientists—many working under Sea Grant contracts—who explore and investigate the ocean environment.

**Working with Scientists**

Many of those scientists work most directly with managing editor Sandy Ridlington, whose job it is to “do whatever the scientists need.” That might mean helping draft or edit a technical report or journal article, writing up the proceedings of a scientific conference, or developing materials that bring ocean science into the public school classrooms.

Ridlington’s work is often directed at small and specific audiences—for instance, the 200 or so port directors nationwide who are interested in a report on container cargo—a fact that daunts her not in the least.

“Milton said he wrote for a ‘fit audience, though few,’” she says. “I see my work that way. A given report may be read by only a few people in the whole country, but those few will understand and use the information—and give me immediate feedback on it.”

In her 11 years with Sea Grant, Ridlington has developed great regard for the writers with whom she works, whether as editor or as an informal “grammar hotline” they can call when they have questions about their own writing.

“Technical editing can involve a lot of conflict between the writer and the editor,” she explains. “I simply do not feel that way. I respect the writer’s text, and I think of my role as collaborative, not confrontational.”

When Ridlington’s work reaches outside the scientific community, it often is to small, tightly focused audiences that can make direct use of the material she writes or edits.

**Special Audiences**

When teachers in towns along the Columbia River asked for material to help their students understand the region where they lived, Ridlington worked with an OSU Extension specialist, Vicki Osis, to produce *The Columbia River: Its Future and You*, an extremely popular two-volume curriculum for fifth- through twelfth-graders.

When seafood processors met with researchers in 1992 to talk about developing new markets for Pacific whiting—one of the most abundant, least exploited fish off the Oregon coast—Ridlington prepared the conference proceedings and sent abstracts to fishermen, processors, and researchers up and down the coast.

Similar efforts have produced books and papers on coastal earthquake and landslide hazards, quality control standards for the seafood industry and—for a more general readership—a soon-to-be-published atlas of the Pacific Ocean’s coastal zones and ecosystems.

Even small audiences add up. Between August 1991 and July 1992, Communications secretary Cindy Newberry shipped out more than 2,300 books, journal articles, and reprints in response to requests from researchers, business, government agencies, and the public.

Not all Sea Grant Communications projects are aimed at specialists and experts. Far from it.

“What makes this office fun and exciting is that we’re involved in bigger efforts to help people understand complicated issues and how those issues will affect them,” says Director Jim Larison.

**Sea Grant On the Air**

One of the program’s most successful vehicles for communicating those issues is *Coastwatch*, the award-winning Sea Grant radio series aired on coastal stations from southwest Washington to northern California.
Produced by science writer Joe Cone, Coastivatch offers listeners news and features about all aspects of the sea and its surrounds: reports on the deepening drift[net] crisis, for instance, or features on dolphin communications.

Cone, who produces 48 separate Coastivatch spots each year, says the program's range is dictated by the diversity of coastal issues and interests, and his own desire to broaden people's understanding of the seas. A journalist by training, Cone finds himself fascinated by the depth and breadth of issues he encounters in his work.

"The pure adventure of reporting about science is a constant source of interest to me," says Cone. "On a daily basis, I'm required to comprehend things for which I've had no formal training at all, from geophysics to marine microbiology. I find that task refreshing and constantly rewarding."

Cone's journalism background helps him explain marine issues to other reporters, whether through releases on newsworthy ocean research or through briefings and background papers for science writers throughout the Northwest.

Reaching the Public

Cone's early interest—and persistence—in the Pacific Northwest salmon crisis, for instance, helped push that story to the forefront in print and broadcast media throughout the region. By keeping himself and other reporters up-to-date on developments in the growing salmon debate, Cone has helped Oregonians at large understand the issues and perspectives involved, and the role they might play in shaping policies to protect not only the salmon, but other threatened resources.

"Joe is a first-rate science writer, and a prolific one," says Jim Larison. "Often, he leads reporters in directions they might not otherwise have found."

Cone's ability to grasp complex scientific stories and tell them clearly have led some of the region's major media, such as the Portland-based Oregonian, to ask him to write bylined features on a variety of ocean-science issues.

Once in a while, one of those issues so grabs Cone's own imagination that he carries it beyond his Sea Grant work. In 1985, for instance, his fascination with undersea geology led him to write Fire Under the Sea, a book about undersea volcanic hot springs. The book, recently reprinted in trade paperback, has won national acclaim for what Oceanus magazine called its "entertaining and compelling account of the discoveries in a young and exciting field."

This year, Cone is working on a book about the salmon crisis and its potential effect on the environment and economy of the Pacific Northwest.

Sea Grant on Film

Cone has also collaborated with Jim Larison on several films, some produced directly by Sea Grant, others done as independent projects. One such film, Oregon's Ocean, is designed to familiarize people with land-use decisions and other issues that could change the way Oregon—and, potentially, other coastal states—manage and protect coastal land and water resources.

Aired on public television networks in 13 coastal states, the half-hour program went on to win a Golden Eagle from the Council on International Nontheatrical Events (CINE) in 1991.

Over the past decade and a half, Larison has produced more than two dozen films for Sea Grant, the Public Broadcasting System, the National Geographic Society and other organizations. Designed for television and schools, several of the films have looked at such ocean-related issues as aquaculture, the marine biosphere, undersea minerals, and sea mammals. Others have probed critical environmental issues, from biodiversity to erosion. Many have won national and international awards.

Working with such film powerhouses as National Geographic and PBS greatly extends the reach and impact of Oregon Sea Grant. With their vast distribution networks and international reputations, such organizations help send the Sea Grant story to audiences that otherwise might never be reached.

Such outside projects, says director Jim Larison, help extend the Communications staff's goal of providing people with the best possible information, in whatever form is appropriate, to help them understand the oceans and their environs.

Ultimately, it is the Sea Grant audience—from scientists to lawmakers, from school children to business owners—who will decide what becomes of that ocean environment.

"If we don't understand what's happening, we may wake up one day and find ourselves telling our kids, 'I remember when you could fish out there,'" says Larison. "We want people to know what's happening so they can make better decisions before it's too late."


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- **Sue Case**, Fiscal Manager
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- **Dr. Eddie Bernard**, Pacific Marine Environmental Lab/NOAA
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