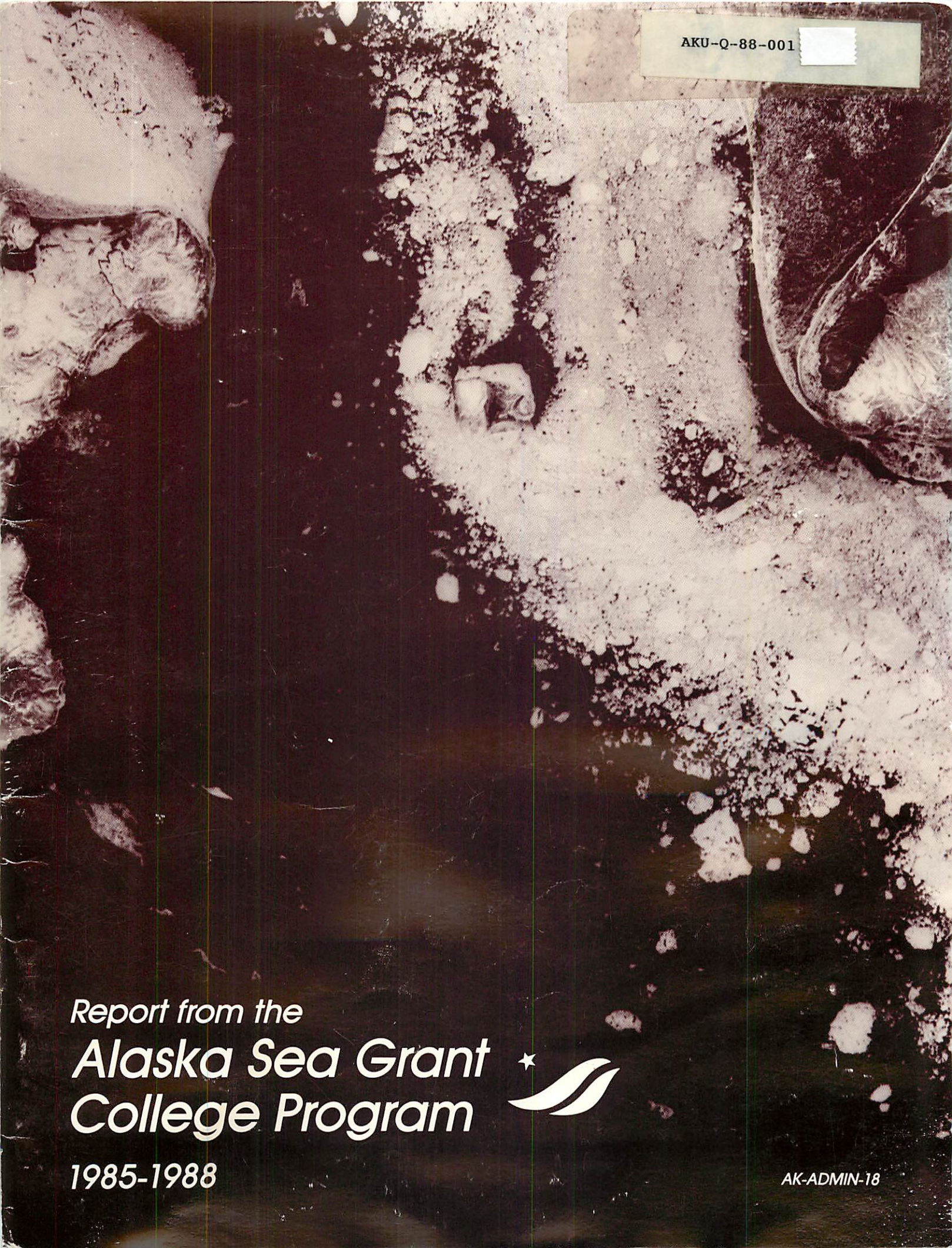
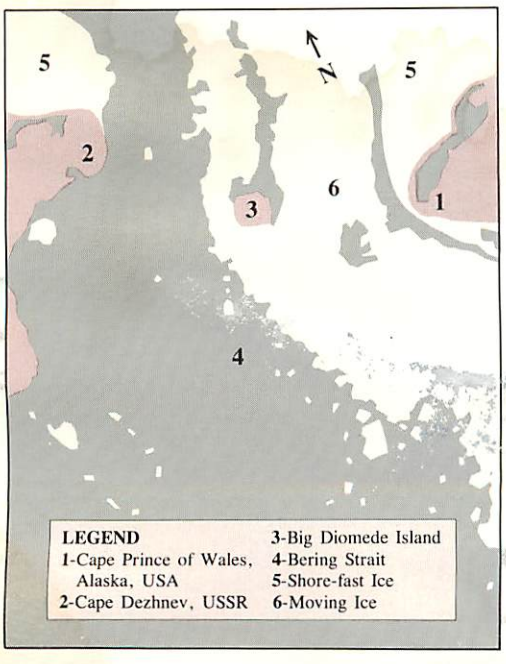


Report from the Alaska Sea Grant College Program

1985-1988

AK-ADMIN-18



Cover Photo

The vast distance between the continents of Asia and North America narrows to 50 miles at the Bering Strait between Cape Dezhnev, USSR, and Cape Prince of Wales, Alaska, USA. The distance is narrowing also between the two countries in the sharing of fisheries science information. Alaska Sea Grant, sponsor of several international conferences on crab, sablefish, rockfish, seafood quality, and pollock has provided a vehicle for scientific information exchange between these nations where little communication existed before.

This late May satellite photo shows ice carried northward with the Alaska coastal water mass. The ice is present in the Bering Strait from November to June. North and south, respectively, of the Bering Strait are the highly productive Chukchi and Bering seas. The fisheries in the biologically rich Bering Sea have become the target of U.S. fishermen since the Exclusive Economic Zone was extended to 200 miles offshore in 1976. Before 1976, the area was fished almost exclusively by foreign fleets.

Report from the Alaska Sea Grant College Program

January 1, 1985-December 31, 1988

Alaska Sea Grant College Program
138 Irving II
University of Alaska
Fairbanks, Alaska 99775-5040

AK-ADMIN-18

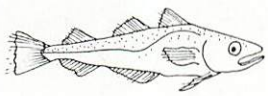
Editor
Kurt Byers

Technical Editor
Sue Keller

Writers
Kurt Byers
Doug Coughenower
Chuck Crapo
Sue Keller
Donald Kramer
Deborah Mercy
Hank Pennington
Douglas Schneider
Craig Wiese

Graphic Designer, Illustrator
Karen Lundquist

Typesetters
Dolores Baker
Ingrid Nelson
Pamela Orr



Photograph and Figure Credits
Cover Landsat photo courtesy of NOAA, EROS Data Center, Sioux Falls, South Dakota, and Geo-Data Center, Geophysical Institute, University of Alaska Fairbanks. Shoreline and float inside front cover, p.i, Craig Wiese, MAP. Boat p.iii, tugboat p.iv, ASG director p.1, K. Byers, ASG. Man with salmon p.2, Alaska Seafood Marketing Institute. UAF campus p.3, K. Byers, ASG. Oil containment booms p.4, tanker p.6, rubber raft p.7, vacuum truck p.8, copyright 1989 Roy M. Corral. Scientist p.9, Ted Cooney, University of Alaska Institute of Marine Science. Cleanup crew p.10, barges p.11, D. Schneider, ASG. Loon p.12, copyright 1989 Roy M. Corral. Man with otter p.12, copyright 1989 Alissa Crandall. Oil spill map data p.13, Carol Barnhill, Alaska Department of Fish and Game (ADF&G). Octopus print p.14, sablefish p.15, ASG file. Net bag p.16, John Hyde, ADF&G. Fishery Industrial Technology Center construction p.17, FITC file. FITC director p.17, man recording data and inset p.18, S. Keller, ASG. Crab p.19, Marion Stirrup. Researchers p.20, hatchery photos p.22, D. Schneider, ASG. Men in survival suits p.24, H. Pennington, MAP. Crabber, p.25, D. Kramer, MAP. First aid training p.26, researchers p.27, S. Keller, ASG. Gillnet hanger p.28, D. Mercy, MAP. Boats p.29, K. Byers, ASG. Woman p.30, MAP file. *Amphissa* snail p.32, W. Heard, National Marine Fisheries Service (NMFS). Pollock p.33, S. Keller, ASG. Fish by-products processor and products p.34, K. Byers, ASG. Chum salmon, p.35, J. Hyde, ADF&G. Child with starfish p.36, Steve Jewett, University of Alaska. Octopus p.37, L. Barr, NMFS. Woman p.38, Hall Anderson, *Ketchikan Daily News*. Fur seals p.38, B.E. Lawhead, courtesy Center for Marine Conservation. Fishboard p.39, Karen Stomberg, ASG. Gillnetter, Lynn Canal, Alaska, p.40, J. Hyde, ADF&G. *Elysian* sculpture University of Alaska Fairbanks, inside back cover, K. Byers, ASG.

This book was produced by the Alaska Sea Grant College Program which is cooperatively supported by the U.S. Department of Commerce, NOAA Office of Sea Grant and Extramural Programs, under grant number NA86AA-D-SG041, project number A/75-01; and by the University of Alaska with funds appropriated by the state.

Elmer E. Rasmuson Library Cataloging-in-Publication Data

Alaska Sea Grant College Program.
Report from the Alaska Sea Grant College Program : January 1, 1985-December 31, 198[illegible]

1. Oceanography--Research--Arctic Ocean. 2 Oceanography--Research--North Pacific Ocean. I. Title.

GC58.A43 1989

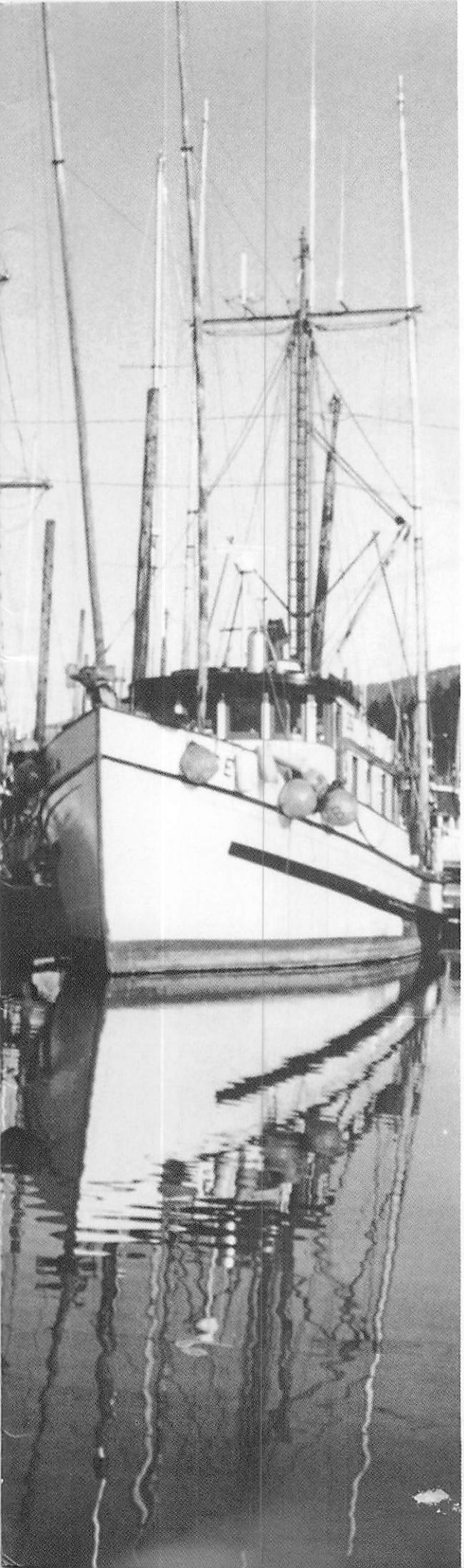
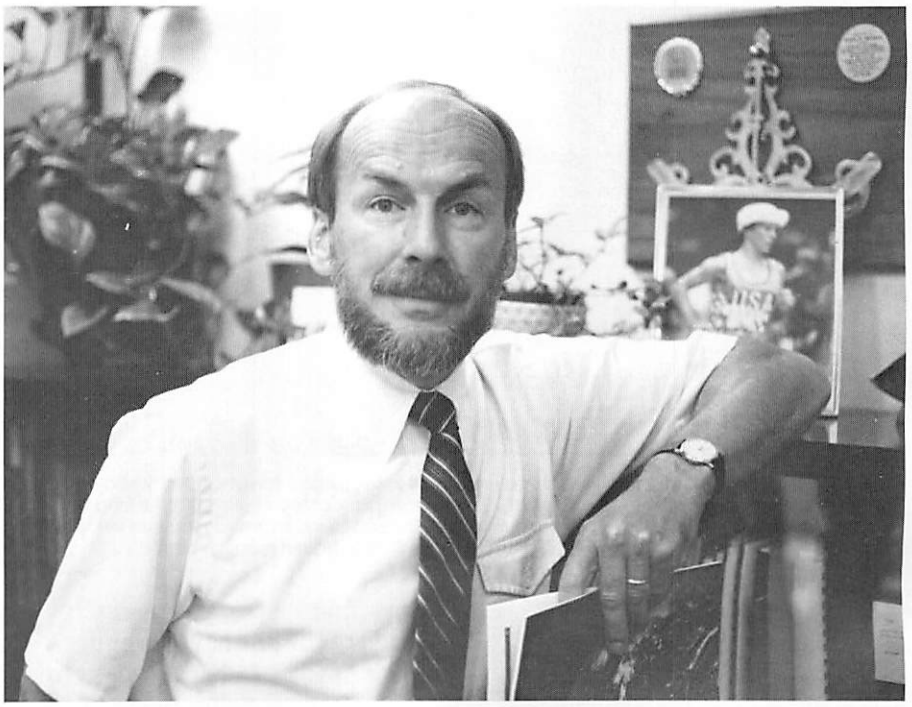


Table of Contents

The *Columbia Queen*, a 99-ton wood-hull tug launched in 1942 towed supply barges between remote outposts in the Aleutian Islands during World War II. Then bristling with a 3-inch cannon and a .50 caliber machine gun, the venerable 1500 horsepower tug is now in a more placid line of work, nuzzling vacation cruise liners into and out of port at Juneau, Alaska.

Alaska Sea Grant: In Partnership for Alaska's Future

To respond to the unique challenges of Alaska's seas and coasts, the Alaska Sea Grant College Program was established in 1970 by an agreement between the University of Alaska and National Office of Sea Grant. Today Alaska Sea Grant is a link in the network of twenty-nine state and regional Sea Grant programs under the National Oceanic and Atmospheric Administration. The theory of Sea Grant operation is effective: Universities tap their brainpower to solve problems associated with use of our oceans. Sea Grant's focus on research, advisory services, and education, with emphasis on cooperation among industry, academia, and government, has increased the pool of marine scientists and made a substantial impact on the national marine economy.

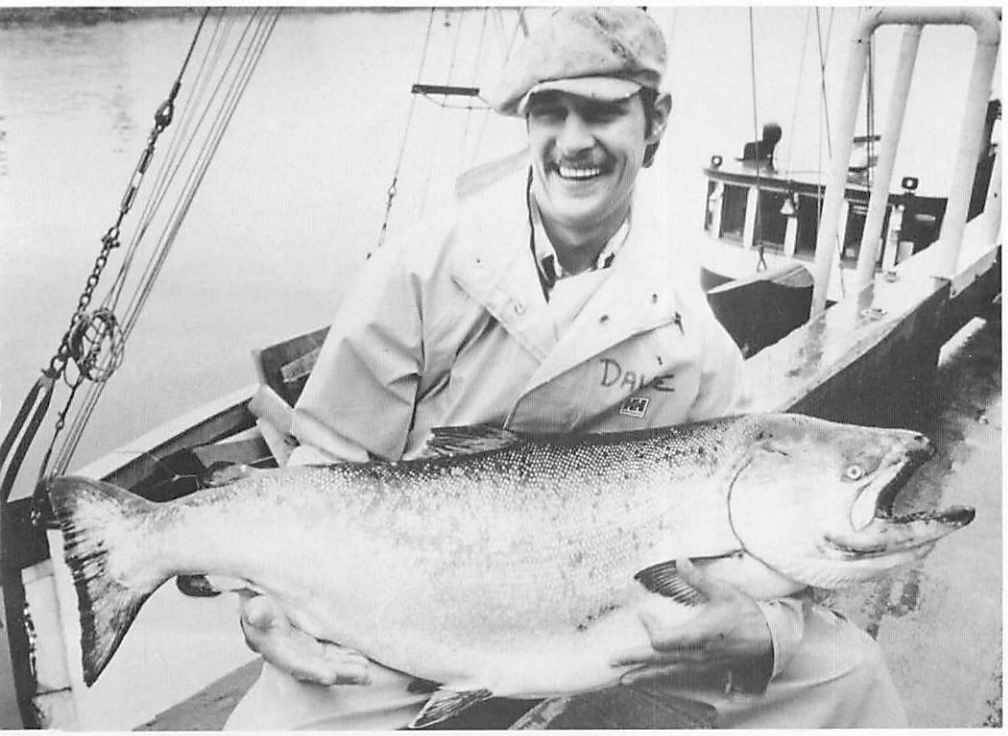


Ronald K. Dearborn, Director, Alaska Sea Grant College Program.

Sea Grant plays an important role in Alaska where marine resources are critical to the economy. Because fishing is Alaska's number one industry, fishery resource issues are the outstanding influence on Alaska Sea Grant's direction. The developing industries of aquaculture, recreation, and tourism also depend on a continued clean and productive environment. Alaska Sea Grant responds to the needs of these industries too.

Alaska Sea Grant serves Alaska well by drawing most investigators from the faculty of its major academic institution, the University of Alaska. Within the University of Alaska, Sea Grant provides leadership for developing multidisciplinary research programs in fisheries and ocean sciences. The strengthened structure under the recent university reorganization has renewed the importance of fisheries and marine science, and has enhanced Alaska Sea Grant opportunities.

Alaska Sea Grant researchers provide scientific information for sound management in the salmon, herring, and shellfish fisheries managed by the Alaska Department of Fish and Game, and in the groundfish fisheries under federal management. Research needs for management in the latter fishery are more urgent because of changes brought about by the Magnuson Act passed by Congress in 1976. The act gave management authority to the United States in the U.S. Fisheries Conservation Zone, which extends from 3 to 200 miles offshore. In 1978, foreign vessels harvested 99.7 percent of the groundfish in the conservation zone, but now the U.S.



Alaska Sea Grant directs much of its effort to support Alaska's largest private industry, seafood harvesting and processing. A renewable natural resource that contains assets like the king salmon pictured above generates billions of dollars in expenditures and revenues. To maintain the resource, economic activity must be tempered by prudent, scientifically based management.

fishing industry accounts for nearly all the harvest off our coasts. The increase in domestic harvesting under the Magnuson Act has put pressure on the North Pacific Fishery Management Council to increase allocations as much as possible, and thus precise biological and oceanographic knowledge is necessary.

Alaska Sea Grant research in fisheries science, fisheries economics, fisheries enhancement, and fisheries oceanography all contribute to the scientific base needed by fisheries managers and policy makers. In 1987 our program started investing in fisheries oceanography, a fairly new field of ocean and fisheries science, because of the exciting scientific opportunities and the practical needs of fisheries managers. The research results will not have an immediate payoff; rather a long-term investment is being made to gain a basic understanding of fish and ocean environment interaction. Alaska Sea Grant's physical oceanography work also complements and is part of NOAA's Coastal Ocean Program and Ocean System Studies, and similar global ocean science programs of the National Science Foundation. Clearly, fisheries oceanography is an area of national importance in which the University of Alaska and its Sea Grant program are important players.

Fisheries development, specifically aquaculture and food science technology, also guide Alaska Sea Grant research. Now that U.S. vessels are harvesting most of the traditional species in the fisheries conservation zone, targets of expansion are aquaculture, harvesting efficiency, and processing less utilized species. Food science and technology in the Alaska Sea Grant College Program focuses on the development and upgrading of fish processing, with the objective that fish from the conservation zone will compete well in the world market and bring maximum benefit to the United States. Research involves product development, plant practices, full utilization of harvested fish, and quality assurance and shelf life. Alaska Sea Grant has been active in this research for several years.

Graduate research and training are a special asset of university-based Alaska Sea Grant research. Support for students working on Alaska Sea Grant projects in many of the above research areas is a critical part of our program. In the course of studying problems associated with the development and conservation of marine resources, graduate students prepare themselves for professional challenges and thus become a primary means of technology transfer.

Joining with Management Agencies

The perspective and activities of Alaska Sea Grant are broadened by a close liaison between Sea Grant and several management agencies: the Alaska Department of Fish and Game, the National Marine Fisheries Service, and the North Pacific Fishery Management Council. Alaska Sea Grant's partnership with primary

resource managers is enhanced by our ability to anticipate and respond to marine issues. For example, in 1988 Alaska Sea Grant was active in three successful fishery and marine mammal observer programs. With funds from the North Pacific Fishery Management Council, we operated a pilot program that sent observers on high seas commercial fishing cruises to record information on harvested fish. We also trained observers who were placed aboard offshore crab processing vessels by the Alaska Department of Fish and Game. And we hired observers to record fishery-mammal interactions in the nearshore salmon fishery of the Copper River Delta. The latter, a continuing program, has produced the most significant fishery-mammal observer data from Alaska waters, a region with a major portion of the nation's fish and marine mammals.

Communicating with the Public

Research results, current information, and advice are provided to the community by the public outreach component of Alaska Sea Grant, made up of the Marine Advisory Program headquartered in Anchorage and Public Information Services in Fairbanks. Public Information Services is a major vehicle by which Alaska Sea Grant maintains contact with the public, and with fisheries agencies and associations. Through a series of conferences and workshops Alaska Sea Grant brings experts on important topics to the fishing industry, fishery managers, and scientists. Primarily through publications and news releases Alaska Sea Grant shares the outcome of our research and educational activity. Our role in public education has recently been expanded in areas of broad interest such as marine debris.

The Marine Advisory Program receives half its funding from Alaska Sea Grant and half from the School of Fisheries and Ocean Sciences. With field agents in seven coastal communities, the Marine Advisory Program effectively provides technical education for coastal and marine resource development. The Marine Advisory Program is active in commercial fisheries development, marine safety, fisheries business management, seafood technology, aquaculture, and marine recreation.

Alaskans have become more aware in recent years that a high quality marine environment in Alaska is essential for the success of the fishing industry and tourism and recreation industries. The recent Prince William Sound oil spill, the largest in U.S. history, further underscores Alaska's interdependence with a quality environment. Upon the grounding of the *Exxon Valdez*, on-the-ball Marine Advisory agents and immediate Alaska Sea Grant research funding played a significant part in responding to the spill (see *Exxon Valdez* story, page 5).

Rapid response capability in the event of unexpected incidents such as the oil spill, as well as long-term projects, are critical to Alaska Sea Grant's marine conservation goals. Both creative short-term flexibility and carefully planned long-term investment allow the Alaska Sea Grant College Program to contribute to the wise use of Alaska's marine resources.

— Ron Dearborn, Director
Alaska Sea Grant College Program

West Ridge, University of Alaska Fairbanks campus, headquarters of the Alaska Sea Grant College Program. Alaska Sea Grant is part of the University of Alaska Fairbanks School of Fisheries and Ocean Sciences. Alaska Sea Grant sponsors UAF researchers in Fairbanks, Anchorage, Juneau, Seward, and Kodiak, and supports advisory agents and specialists in Kodiak, Anchorage, Dillingham, Petersburg, Cordova, Sitka, Kotzebue, and Homer.

Oil containment boom being stretched by the fishing vessel *Pagan*. Fishermen, untrained in oil spill cleanup, proved to be quick learners, and were effective in deploying containment boom.

A Challenge Met: Fishermen Fight the Spill of the *Exxon Valdez*

Alaska is big, and so are the news stories from a state that is one-fifth the size of the Lower 48 and features half the U.S. coastline. Last winter, Alaska made national headlines for its record cold winter with temperatures plunging below -70 degrees Fahrenheit, and for the saga of three grey whales and the race against time to free them from thickening arctic ice. But those stories are insignificant compared to the events that would begin to unfold in early spring 1989. It was then that the grounding of the supertanker Exxon Valdez *and its spill of 11 million gallons of Alaska crude oil sent shockwaves that now reverberate around the world.*

Alaska Sea Grant with its rapid response research capability and alert advisory agents quickly and effectively reacted to the environmental and economic disaster. Alaska Sea Grant was first to dispatch scientists to the sound, and an advisory agent was one of the principal forces in marshaling a cadre of local fishermen to a successful grassroots defense of Prince William Sound fish hatcheries.

Alaska Sea Grant science writer Douglas Schneider has documented these and other aspects of the event. Following is his report.

"I don't think you could spill enough oil in Prince William Sound to harm the commercial fisheries and shellfish."

—Chevron Spokesman Clayton McAuliffe in "A Problem in Search of a Perspective," by Tom Kizzia, *Alaska Advocate* (Apr. 7, 1977):6.

Valdez, Alaska. Day 88 of the oil spill. It's 6 AM and overcast. Only the weather seems to have remained unaffected by humankind in this small fishing and tourist town transformed since late March into a city of bureaucrats, politicians, oil industry obedients, and job seekers in the wake of the largest oil spill in American history.

Valdez is a picturesque town, nestled amidst emerald-green coastal mountains on the shores of North America's northernmost ice-free harbor. It was this unspoiled harbor that oil developers first eyed when they considered routes to transport huge reserves of North Slope crude oil southward from wells above the Arctic Circle at Prudhoe Bay. A pipeline would convey 24 percent of America's domestically produced oil 800 miles south to Valdez, where it would be loaded into tankers and shipped farther south to refineries along the West Coast.

I roll out of my sleeping bag and pull on wool socks and hip boots. This is my fourth visit to Valdez. Usually I drive the 380 miles from my home in Fairbanks to fish for pink salmon from the edge of the city sea wall or from the Alyeska pipeline terminus access road directly across the bay. I wish this was another fishing trip. Instead I'm here to report on efforts to save one of the most pristine natural environments on Earth.

Helicopters warm up on the airport tarmac, oblivious to the overcast and fog that hang over the runway. I can easily hear the slow wop-wop-wop of their idling blades, even from my site a half-mile away at a local campground. Only two weeks ago this campground was filled with Alaska's unemployed seeking the $1,750 weekly wage paid by Exxon's oil cleanup subcontractors. Tent cities packed with hundreds of college students, divorced mothers, bachelors, and family men sprouted like dandelions in every gravel pit and dead-end turnout within 25 miles of the city. The Valdez population doubled to more than 6,000. If building the trans-Alaska pipeline in the late 1970s was the biggest economic boom in Alaska's history, then cleaning

up what's left of the 11 million gallons of crude oil spilled by the supertanker *Exxon Valdez* cannot be far behind.

Eighty-eight days have passed since the tanker slammed into Bligh Reef about 25 miles from the Alyeska Terminal. There are 3,000 people scrubbing oiled rocks on beaches from Prince William Sound to the Aleutian Islands. Another 7,000 people work in support of the cleanup. Exxon officials don't use the word clean. Instead they boast of having "treated" 161 miles of the 787 miles of coast oiled by the catastrophe. Thus far, one man has died, crushed by a ship's dumbwaiter in the early days following the spill. The scrubbing continues, even as the U.S. Coast Guard, the state, and Exxon haggle over the definition of a clean beach.

Day 88 of the spill is only day two for me. I was here during week four to report on the cleanup progress. Confusion reigned among the multitude of state and federal agency and industry officials charged with the cleanup. I returned home, frustrated with the mushrooming bureaucracy in Valdez. I wasn't the only one stymied by events in Valdez. Said one Alaska Department of Environmental Conservation employee on day 24: "We haven't managed to pick up any oil, but we have one hell of a bureaucracy here."

But it is midsummer now. The tent cities interfere with the lucrative tourist trade, taking the best camping spots. Someone somewhere makes a decision to hire cleanup workers only in Anchorage. The Valdez jobseekers disappear overnight. Replacing the great Alaska unwashed and their plastic tents are Texas and New Jersey tourists and their Winnebagos, many hoping to catch a glimpse of the oily mess that in fact never touched the shores of Valdez.

Repair barges hug the sides of the crippled *Exxon Valdez*, while containment booms surround oil still leaking from the ship's holds. More than 42 million gallons of oil remained in the tanker following the spill of 11 million gallons.

I finish packing my gear. I need to be at the float plane dock by 7 AM. A hastily arranged flight to Sleepy Bay, about an hour flight southwest of Valdez by floatplane, is planned by representatives from the Alaska Department of Fish and Game, the National Oceanic and Atmospheric Administration, and the Cordova District Fishermen United. There they will tour an oiled beach Exxon proposes to clean. If there is an empty seat, I can go along.

Fishermen Unite to Save Hatcheries

Perhaps it was ironic fate that caused the *Exxon Valdez* to rupture atop a reef just after midnight on Good Friday March 24, 1989. For it was exactly 25 years earlier that North America's most powerful recorded earthquake, centered in Prince William Sound, ripped through Alaska killing 131 people, obliterating Valdez, and destroying or damaging several other communities. Alaskans who lived through the quake call that day Black Friday. The name seems more appropriate for Alaska's latest disaster.

In the days that followed the grounding of the supertanker, fishermen gathered in the Valdez and Cordova offices of the regional commercial fishermen's association, the Cordova District Fishermen United. They traced on nautical charts the spill's likely path through the island-rich west side of the sound and listened to reports of what *wasn't* being done to stop the spreading slick. Forced to watch from the sidelines, it seemed to them that no one was in charge.

Among the group of anxious and outraged fishermen was Rick Steiner. Himself a fisherman and resident of the sound, Steiner also is a University of Alaska associate professor of fisheries science and the sound's Sea Grant Marine Advisory Program agent. He wonders why Alyeska Pipeline Service Company, a consortium of seven oil companies that operate the trans-Alaska pipeline, is not living up to their own contingency plan that requires it to clean up oil spills. After three days of listening to excuses and promises backed by inaction, Steiner and the leadership of the fishermen's group decide to do something, anything, to protect the sound.

"Who was going to do it for us?" asks Jack Lamb, a 26-year resident of the sound, commercial fisherman, and president of the Cordova District Fishermen United. "Certainly not the people from Exxon. This is our home and we will fight for it."

Their chance to enter the fray comes on day 4, during a midnight meeting with Alaska Department of Environmental Conservation Commissioner Dennis Kelso, Exxon Shipping President Frank Iarossi, and U.S. Coast Guard Admiral E. Nelson, Jr. There Rick Steiner, Jack Lamb, and Riki Ott, herself a fisherman and marine biologist, emphasize the need to protect critical salmon spawning habitat and the vital salmon rearing hatcheries. To their astonishment, at meeting's end fishermen are given a free hand to combat the spread of the slick. Exxon's Iarossi agrees to pay whatever it costs.

But the cleanup is made all but impossible by a dramatic shift in weather. Oil that had spread slowly across the flat-calm water of the sound in the first days of the spill is whipped into a froth by 70 mile per hour winds. Oil is tossed 100 miles across the sound, and in some places oil is blown 40 feet into trees and high onto steep cliffs. The chance for a quick and easy cleanup is lost.

Mapping strategy, Steiner and fishing leaders call on fisher-

Everything imaginable was used to combat oil. Here a fisherman uses his motor's prop wash in an attempt to push oil away from shore. Most efforts, although heroic, were futile.

Barge-mounted vacuum trucks like this proved invaluable to cleaning up oil lassoed by fishermen towing oil containment booms. The trucks are normally used by oil companies in operations on the North Slope. It took fishermen to commandeer one before oil companies began volunteering vacuum trucks to the cleanup effort.

men to string oil containment booms across the entrances to bays and inlets where salmon hatcheries are located. Main Bay, Esther Bay, Port San Juan, and others become the lines of defense. Together the hatcheries, owned by fishermen's cooperatives or by the state, ensure the return each year to the sound of about 21 million pink, chum, coho, sockeye, and chinook salmon. In the war to contain oil that is rapidly being lost by the bureaucracy, optimistic fishermen view the battle to save the hatcheries as winnable. Others call it a symbolic fight. Symbolic or not, it is better than doing nothing, says Lamb.

So the call for fishermen goes out. Marine Advisory Agent Steiner chuckles when he recalls how it worked. "These guys had no contracts from Exxon. They had nothing but my promise that money would come to pay their expenses. But they came anyway."

The manpower and determination was there, but essential equipment was not. Fishermen found themselves amid floating oil with no oil containment booms. In a marathon session of telephone calls, Steiner managed to collect booms from around the world, all sent to the sound on the promise that money will come; just send Exxon the bill.

"I figure we spent more than a million dollars of their [Exxon] money in the first couple days getting booms here," says Steiner, laughing at how ridiculous it seems in retrospect. "They put us, a bunch of fishermen, in charge of their mess. I still can't believe it."

At last with booms, the fishermen toil day and night, constructing floating barriers around the hatcheries. Entire bays are cordoned off against the oil onslaught. At times, it seems pointless. Booms sway; some break. But in the end the fishermen win. The hatcheries are saved.

Another victory comes during one of numerous brainstorming sessions, when Jack Lamb learns that heavy duty vacuum trucks are on their way to the vast oil drilling fields in Prudhoe Bay. The trucks are normally used to pump petroleum products from or between storage facilities. A plan is hatched to get one to Valdez — to see if it can vacuum oil from the water.

"We kind of kidnapped one to get it down here right away," recalls Lamb. "We got ahold of the right individual and had the driver head it south in the middle of the night."

Dubbed the "super sucker" by its commandeers, the vacuum truck is fitted on a barge and used to slurp pools of oil lassoed by fishermen towing begged, borrowed, and outright stolen oil containment booms. To fishermen who have made their livings chasing schools of fast moving salmon, catching pools of floating oil is a comparatively easy task.

As it turned out, the system of using fishermen to corral oil and the super sucker to pump it from the water worked well. Within days, the oil companies shipped in additional super suckers to combat the spread of oil. The effort soon mushroomed to include dozens of fishing vessels. Locals called the effort heroic and nicknamed the fishing vessel armada the "mosquito fleet" because it looked like so many insects buzzing around the sprawling sound.

Scientists Converge on the Sound

But fishermen cannot begin to pick up the huge quantities of oil now washing onto beaches throughout western Prince William Sound. Oil is even heading out of the sound, carried atop Gulf of Alaska currents that flush the sound about every two weeks, according to Alaska Sea Grant researchers. Oil would eventually follow the currents southwest and wash ashore at Resurrection Bay, Kenai Fiords National Monument, Katmai National Park, Kachemak Bay, Cook Inlet, Alaska Peninsula, and Kodiak Island archipelago. And oil would hit islands in the Aleutian Chain, some 700 miles from where the *Exxon Valdez* went aground.

Fishermen in communities down-current from the oil spill sit impatiently, waiting for fisheries managers to decide whether to allow harvest of the millions of salmon migrating home to spawn. For many the news is bad. In Cook Inlet and in waters off the nation's number one fishing port, Kodiak, salmon seasons are closed or postponed. The risk of fouling nets with oil and catching oil-contaminated fish is too great, say Alaska Department of Fish and Game biologists.

But for scientists interested in conducting research in Prince William Sound, the oil spill presents an irresistible opportunity. Money to conduct studies on everything from mussel reproduction to hypothermia in sea otters is made available through a federal multi-agency trusteeship.

At the University of Alaska, initial research efforts were organized the day of the spill by Ron Dearborn, director of the Alaska Sea Grant College Program. Forty-eight hours later an Alaska Sea Grant scientific team composed of scientists from the Institute of Marine Science and School of Fisheries and Ocean Sciences was in the sound collecting samples and taking inventory of marine species in areas the spill would later affect. The information provides scientists with a control against which the oil's effects can be measured.

"Sea Grant enabled scientists to take advantage of a very short time frame that was available to get data on the sound in areas not yet affected," says Dearborn. "Even though other federal agencies took extraordinary actions to provide funding, all of it lagged by several critical days."

Since the spill, nearly two dozen University of Alaska researchers and technicians have traveled to the sound to conduct research. Much of the on-site work is done from aboard the R/V *Alpha Helix*, the National Science Foundation oceanographic research vessel operated by the University of Alaska. Funding for the research comes from Alaska Sea Grant, the University

Sea Grant researcher Dr. David Shaw (left) led Alaska Sea Grant's emergency response oil spill research team. Here he extracts sediment taken from the bottom of Prince William Sound to look for oil contamination. Dr. Ted Cooney took this photo aboard the National Science Foundation research vessel *Alpha Helix*, operated by the University of Alaska. Cooney, also a member of the emergency response team, says that strong currents from the open ocean carried healthy, untainted plankton and other forage to Prince William Sound, which probably helped thousands of salmon fry survive the oil spill.

of Alaska, the National Science Foundation, the Alaska Legislature, and Exxon.

Alaska Sea Grant and University of Alaska scientific efforts focus on assessing the spill's impact on sensitive tidal areas, where many of the sound's marine species exist. Scientists also are examining how naturally occurring bacteria break down oil hydrocarbons to harmless compounds, and are taking a close look at the oceanography of the sound to better predict the course of oil spills should they occur in the future. Renewed attention is being paid to areas of the sound isolated from the main currents, to see what long-term effects oil has on the environment. In all, more than a dozen research projects are under way or are proposed for funding.

"The focus of the research is to study change," says Dr. Peter McRoy, marine scientist at the Institute of Marine Science. "We [university researchers] see this as an opportunity to study changes to the sound that result from the spill. From such a large-scale event, we can learn a lot about how the system responds."

Take salmon for example. With many commercial fishing seasons closed due to oil, uncaught salmon are migrating up streams, rivers, and lakes in record numbers. Researchers need to know exactly what happens when so many fish crowd into a spawning area. Right now all they can do is guess, says McRoy.

"We just don't know what will happen," says McRoy. "It could mean a lot to understand how this increase (in spawning salmon) affects the system, whether it translates to more fish or has adverse impacts on the ecosystem."

Of particular interest to McRoy is the process of succession. Succession occurs when a natural or human-induced event kills or displaces resident plant, bird, or animal species. In time, other species more suited to the new environment move in to fill the void. McRoy says succession may be occurring in areas heavily oiled by the Exxon Valdez spill.

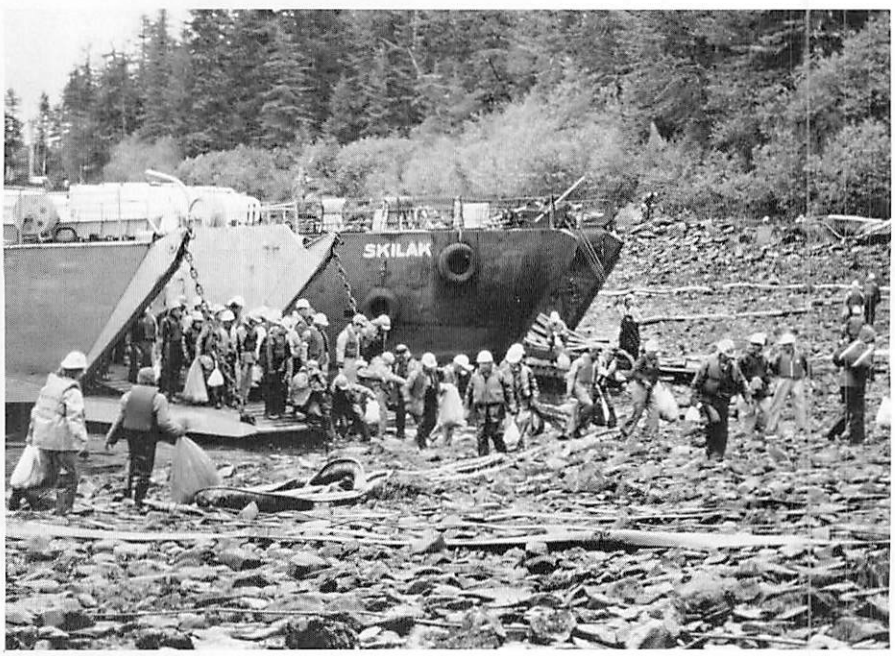
"We may see a burst of plant growth in intertidal areas where oil has displaced animal life," says McRoy. He said oftentimes seaweeds are the first marine species to recolonize areas where animal species have been killed or driven off.

McRoy concedes that research in the sound is not expected to provide answers to all the questions. But, he says, "At least we'll know more about predicting what may happen following an oil spill, and be able to concentrate our efforts more effectively."

A Day at the Beach

Sharon Christopherson from the National Oceanic and Atmospheric Administration couldn't make the flight to Sleepy Bay; too much work to do in town, she says. I take her place. With me is Marilyn Sigman, biologist with the Alaska Department of Fish and Game, and Jeannine Buller, manager of the Valdez office of the Cordova District Fishermen United.

Sleepy Bay, shaped like a catcher's mitt, lies on the north side of Latouche Island at the southwestern end of the sound.



Reminiscent of a World War II amphibious assault, workers deploy from U.S. Navy troop transports, ready to attack oil on Prince William Sound beachheads. Offshore, thousands of workers live aboard Navy troopships, ferry boats, and commercial fishing vessels.

Oil reportedly soaks the beach to a depth of two feet. Until now, Exxon has based its cleanup plan on oil that has penetrated two inches of beach. Here the stakes are higher because an anadromous fish stream crosses the oiled intertidal zone. No one knows what will happen when and if salmon return to spawn in the oiled shallows.

This is my first flight across the sound. Mountains surround us, vertical walls jutting from the water's edge. It is breathtaking. Across the sound, hundreds of spruce-covered islands seem to drift suspended in the morning fog. Amid the beauty that surrounds us are oiled beaches. I have never seen an oiled beach.

Knight Island, Naked Island, Green Island, Smith Island, and dozens more have been hit. Oil washed indiscriminately onto beaches, thickly coating some, while only staining others. Some beaches were spared.

Approaching Sleepy Bay, I see we will not be alone. Below, two large barges loaded with heavy equipment are beached. Another much larger barge sits just offshore. Onshore, workers snake fire hoses across the rock-strewn beach, preparing for cleanup.

A few minutes later we too are on the beach. It's black, greasy and shiny — not like the clean gray, driftwood-cluttered beaches near town. Here the goo coats every rock and log along a 100-foot-wide swath of beach. It runs the entire length of the bay; a mile, maybe more. I dig my foot into the gravel to see how far down the oil goes. What I need is a shovel. Oil has penetrated at least a foot into the gravel. The oil has hardened on the larger rocks and boulders. Water beads on the rocks like rain on a waxed car.

Top–Finding a place to land among the dozens of vessels packed into tiny bays along Prince William Sound was tricky. Here in Sleepy Bay two Exxon cleanup barges sit amid floating oil that leaches from the beach and rolls in on the tide. *Bottom*–The two Exxon barges were rushed to Sleepy Bay, loaded with tons of heavy equipment to "treat" the heavily oiled beach. Soon after this photo was taken, the barges were ordered off the beach because the Exxon cleanup plan for the area had not received federal or state approval. Permission was eventually given and treatment did take place.

The drone of diesel engines from barges and escort vessels distort the eery quiet in Sleepy Bay. There are no birds. They are dead or have flown to oil-free parts of the sound. A lone bald eagle flies overhead, but doesn't land.

In the days to follow, heavy equipment will scoop up parts of the Sleepy Bay shoreline. The oiled gravel will be dumped just offshore, where officials hope the crash of waves will refloat the oil to be collected by skimmers and super suckers. But four feet of oil have soaked into the banks of the salmon stream and it can't be

Left– An oil soaked loon, and (inset) a sea otter being cleaned of oil by rescue workers. Approximately 30,000 sea and migratory birds, 116 bald eagles, and 900 sea otters are known to have died in the spill. An Alaska Sea Grant biological oceanographer predicts 90 percent of Prince William Sound's natural populations will recover in five to eight years.

removed without damaging the spawning areas. Officials opt to leave the cleanup of Sleepy Bay to the force of winter storms.

Prevention

In the end, the oil spill will cost Exxon more than one billion dollars. Millions will be spent to clean beaches and to reimburse fishermen for losses suffered from closed fishing seasons. Still more millions will be spent for repairs to the *Exxon Valdez*, barred in July from entering California's San Diego Harbor after it was spotted trailing an oil slick one mile wide and 18 miles long.

The spill's impacts could have been lessened, officials say, had the Alyeska consortium followed through with their pledge of adequate protection against spills. But Alyeska is not the only complacent party. State and federal agencies with jurisdiction over the spill, Alaska voters, and the rest of the American public with its thirst for oil must share responsibility.

There's an adage that says some good can be found in all things bad, and some good can come from this tragedy.

There is good, for example, to be found in a recent meeting of Alyeska executives and Prince William Sound fishermen. Organized by Alaska Sea Grant Marine Advisory Program agent Rick Steiner, the two groups met in June behind closed doors in an Anchorage hotel. There they agreed on an oil spill contingency plan to replace the one agreed on in the 1970s by the state and Alyeska. The original plan failed, officials say, because it was impossible to implement and had fallen into disarray caused by complacency. "The public process failed in the original plan," says Steiner. "They [oil company and state agency officials] knew the contingency plan wouldn't work."

The new contingency plan calls for, among other things, sea-going tugs specially built and equipped with oil containment gear to escort loaded tankers from the Valdez oil terminal to the sound's entrance near Hinchinbrook Island. "The problem with the *Exxon Valdez* spill was delay in controlling it," says Steiner. "The novel approach to this plan is that oil containment equipment will be alongside the tankers should there be a spill."

The plan is modeled after measures taken at a similar oil terminal in Sullom Voe, in the Scottish Shetland Islands. Sponsored by Alaska Sea Grant, Steiner in May traveled to the Shetland Island terminal to review their oil spill precautions. His findings provide much of the framework for the contingency plan. Steiner also met with U.S. Transportation Secretary Samuel Skinner to present his findings and recommendations, and has addressed oil development concerns of Pacific Fisheries Legislative Task Force members

who met in Kodiak, Alaska, in June. State and federal officials are currently reviewing the new oil spill contingency plan.

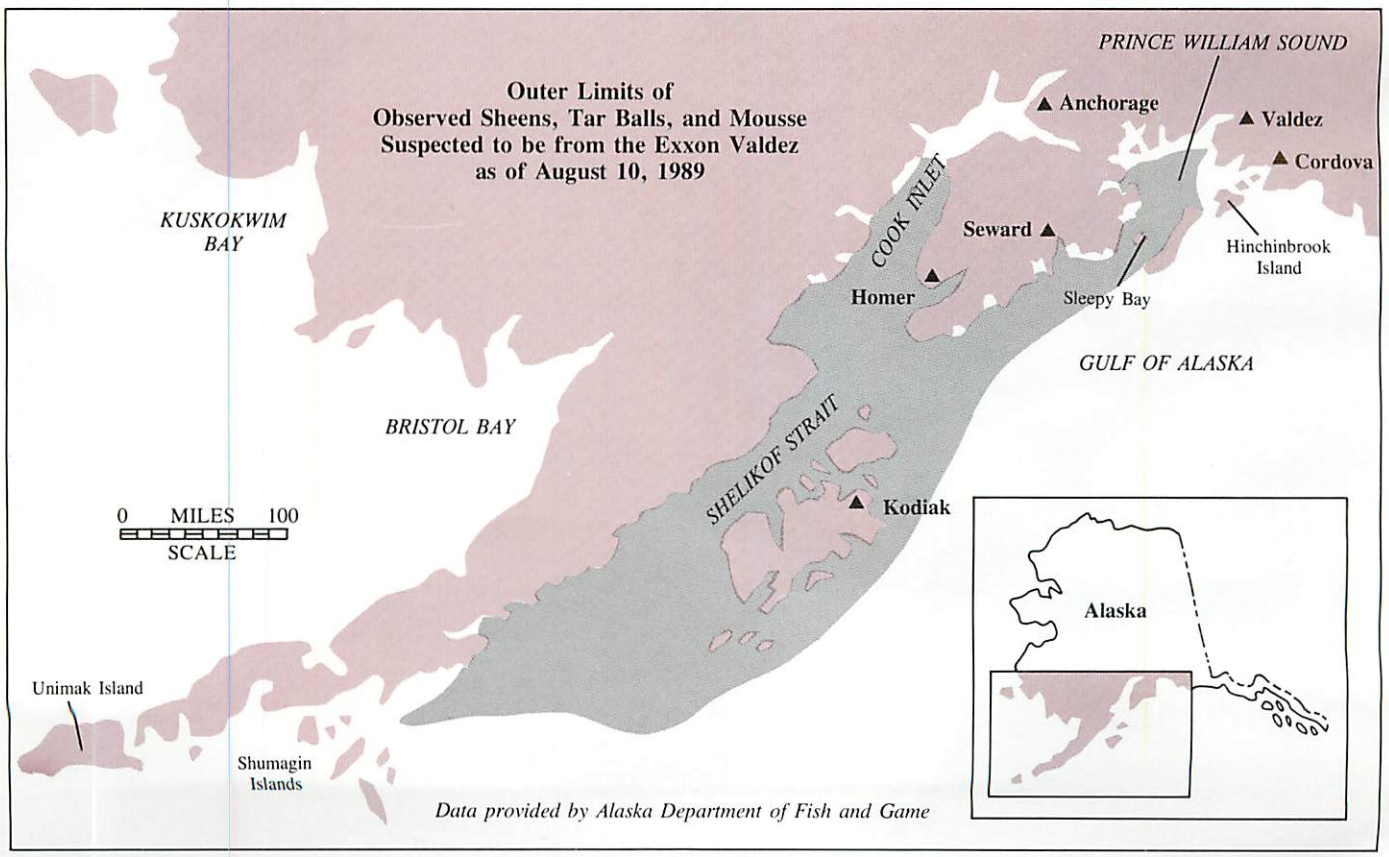
"Just about everything we suggested they put in the plan," says Steiner. "It's more than just a response plan. There's prevention factored into it."

The plan also calls for navigational aids to guide tankers through tricky parts of the sound, and establishes an advisory oversight committee made of fishermen, state, and federal agency officials. The plan also calls for restoring funds for the U.S. Coast Guard radar monitoring station and authority to direct vessel traffic, like air traffic controllers direct airliners. The plan is expected to cost Alyeska about $45 million per year to operate, far less than the cost of cleaning up just one major spill.

Perhaps the biggest problem, admits Steiner, will be combating the complacency that led to the disaster. Since 1978 some 8,800 tanker loads of crude oil have been taken through the sound without a major mishap. Ideas to keep oil spill workers enthused about their jobs include frequent scheduled and unscheduled drills, and rotation of people among jobs to avoid boredom.

No doubt the price for these precautions will be high, and ultimately the American public will pay. For some, the increased costs will be unacceptable. After all, the damage in Alaska does not directly affect the general public. To most Americans, Prince William Sound is just a place on a map. From newspaper and television they learn something of its immense proportions, of its unequaled bounty, and of its irreplaceable beauty. But they cannot really comprehend what has happened here unless they have seen it for themselves.

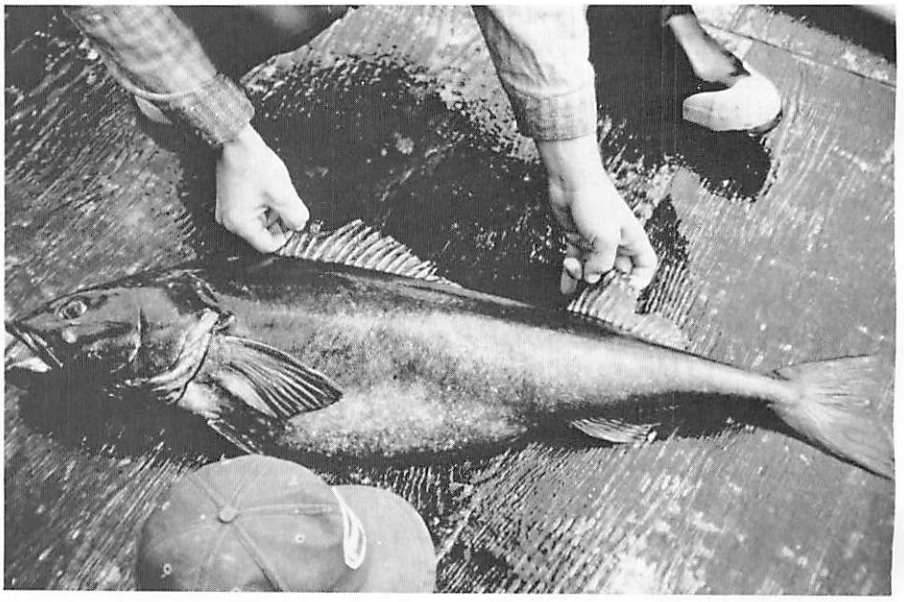
Jack Lamb has seen it and he knows: "Picture in your mind a place that holds great beauty and lasting memories. Now picture that place, wherever it may be, covered in murky, life-choking crude oil. If you can imagine your favorite place like this, then you can understand what has happened to our home." □



Research Probes Marine Resource Issues, Supports Seafood Industry

Alaska's commercial fishing industry has historically focused on the harvest of salmon, shellfish, and other commercial species found in nearshore waters. Although some American fishermen braved the storm-driven seas of the Gulf of Alaska and Bering Sea to search for groundfish such as cod and pollock, the vast and lucrative high seas fishery was dominated by trawlers and processors from Japan, Taiwan, Korea, the Soviet Union, Poland, and elsewhere.

American entry in the groundfish industry began after the U.S. Congress passed the 1976 Magnuson Fishery Conservation and Management Act. Passage of the act spurred profound change in international commercial fisheries as foreign harvest operations were forced out of the extended U.S. zone, and American fishermen began to take over. Initially, U.S. fishermen teamed with foreign fishermen in joint venture operations. By 1985 joint venture operations accounted for about 42 percent of the groundfish harvested in the Gulf of Alaska and Bering Sea. And by 1989 transition from a foreign dominated fishery to a U.S. fishery was complete, with American fishermen projected to catch 100 percent of the more than 2 million metric tons of groundfish harvested off Alaska's coasts.



Sablefish is one of the oldest fisheries in the U.S., with catch records dating to 1906. This groundfish is the focus of much debate on allocation and catch limits. Alaska Sea Grant sponsored an international symposium on sablefish in 1983.

Groundfish processing also is moving toward American control. U.S. investors have invested millions in large factory ships that catch and process groundfish harvests. And foreign investors, interested in maintaining supplies of groundfish in the wake of Americanization, have built shore-based processing plants in Alaska, creating jobs for thousands of Americans.

FITC Develops Seafood Technology and Products

The growth of the Alaska groundfish industry brings with it challenges and opportunities to develop innovative uses for groundfish products. Leading the way toward new product development is Alaska Sea Grant research at the University of Alaska Fishery Industrial Technology Center (FITC) in Kodiak, Alaska.

Conceived by Alaska Sea Grant and established in 1981 by the Alaska Legislature, FITC is charged with creating new economic and employment opportunities through product development, seafood quality control, harvesting and processing techniques, and training. Ideally located in the nation's largest fishing port, FITC nurtures the groundfish industry through

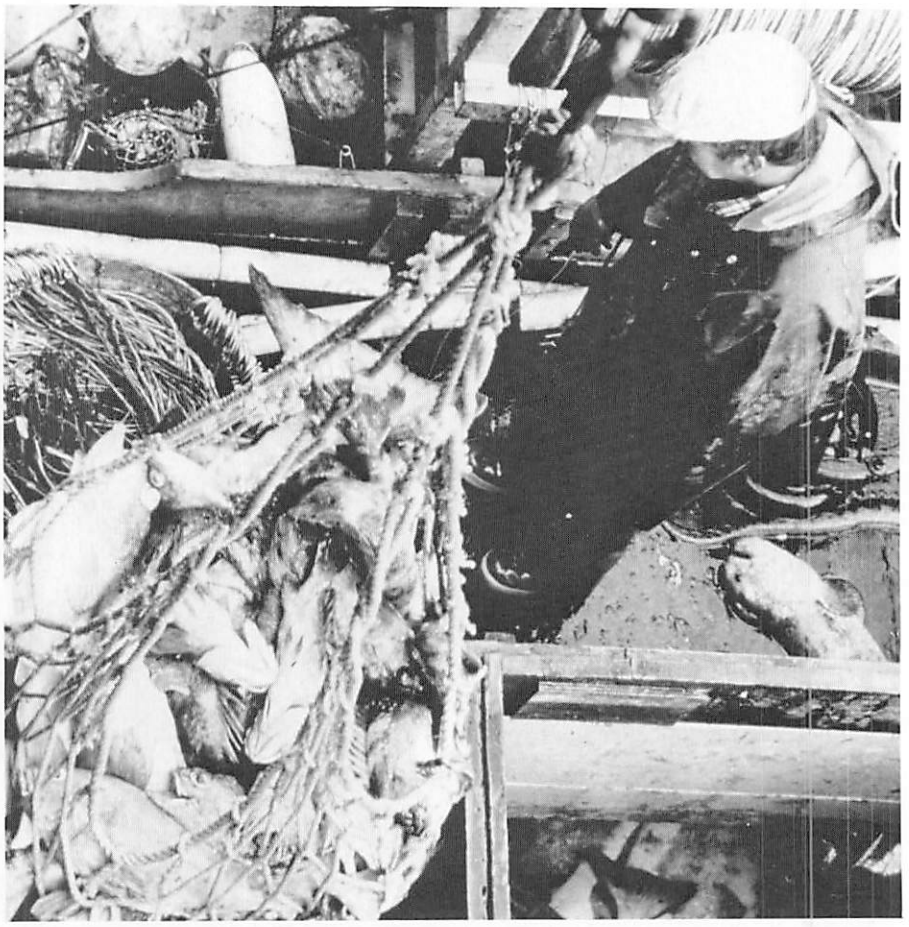
development of new seafood products and processing methods, and helps industry address concerns such as proposed seafood quality standards.

Convinced of FITC's value, the state in 1988 allocated $8 million toward construction of new research and development facilities. Scheduled to be completed in 1990, the complex will feature modern laboratories and a model seafood processing plant. Test kitchens, where researchers can prepare new products for consumers who will pass ultimate judgment, are part of the new fisheries center.

At FITC, researchers backed by Alaska Sea Grant are exploring new uses for groundfish-based surimi products, and working with processors to improve handling methods that will reduce or eliminate seafood spoilage. Researchers also are examining energy waste in seafood processing plants in an effort to maximize efficiency and reduce electricity costs.

Surimi is a relatively new product to the American market that uses minced pollock to manufacture imitation seafoods such as crab, shrimp, and scallops. Food scientists are finding new uses for this versatile and abundant groundfish in sausages, soups, and snack foods. Surimi is even being used in non-food items such as protein enriched skin creams.

Realizing surimi's full potential depends to a great extent on minimizing the loss of important proteins that provide texture, stability, and nutrition to surimi. The chief cause of protein loss is washing during the processing phase. FITC researcher Dr. John French is studying the effect of washing on the molecular properties of proteins. Knowing how processing methods enhance or damage the structure of surimi will help researchers develop methods that result in a product with ideal properties.



Net bag with groundfish. The United States has reaped great economic benefits from harvest of Bering Sea and Gulf of Alaska groundfish, but the windfall is accompanied by myriad management problems. Fisheries managers are handicapped in making management decisions by the lack of reliable scientific data, even though the fishery is beginning to show signs of over-harvest.

While new seafood product development is crucial to maintaining a competitive edge in the marketplace, Alaska Sea Grant also is helping the industry address concern over seafood quality. Research funded through FITC is aimed at reducing and eliminating harmful microbes that cause seafood to spoil, which can lead to food poisoning.

Drs. Brian Himelbloom, E.L. Elliot, and Jong Lee, director of FITC, work closely with industry to identify sources of microbial contamination in salmon, white fish, and surimi. Their study focuses on methods commonly used by processors — filleting, skinning, deboning, freezing, and glazing — that may introduce microbes into seafood. After sources of

contamination are determined, researchers will issue recommendations to correct the problems.

Seafood By-Products Have New Uses

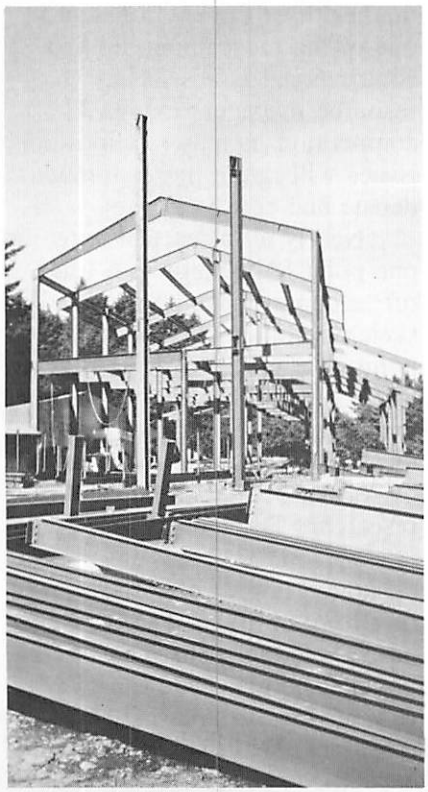
The rapid growth of the groundfish industry has not been without problems, or without innovative solutions. Researchers estimate that more than one billion pounds of useable protein are discarded each year by Alaska seafood processors. Much of the protein is a by-product of processing the nearly two million metric tons of groundfish caught off Alaska each year. Alaska Sea Grant has been working for nearly ten years to find new uses for these by-products.

Efforts began in 1980 with sponsorship of research by Dr. Fred Husby, an animal science professor at the University of Alaska Fairbanks. Husby developed a seafood-based cattle and swine feed for the then-flourishing Alaska livestock industry. Husby found shellfish and finfish by-products to be excellent sources of protein. Further work by Husby led to development of a high energy dog food containing herring. The latter research was funded by an Alaskan feed company that now sells the new feed to professional dog mushers. The Fairbanks company recently expanded sales into Norway. Husby's work is featured in the June/July 1989 issue of *Mushing*, an internationally distributed magazine of dog-sledding trends.

Alaska Sea Grant also has sponsored important research on processing fish wastes into aquaculture feeds, and on the use of seafood wastes in fertilizers.

In January 1989, Dr. Stephen Sparrow of the University of Alaska Fairbanks Agricultural and Forestry Experiment Station began tests to determine how well plants can use nitrogen and phosphorus from seafood wastes, essential elements to healthy growth. If successful, seafood based fertilizers would be developed and marketed both in and outside Alaska.

Alaska Sea Grant will co-sponsor an international conference on fish by-product opportunities in April 1990 in Anchorage, Alaska. The Alaska Fisheries Development Founda-



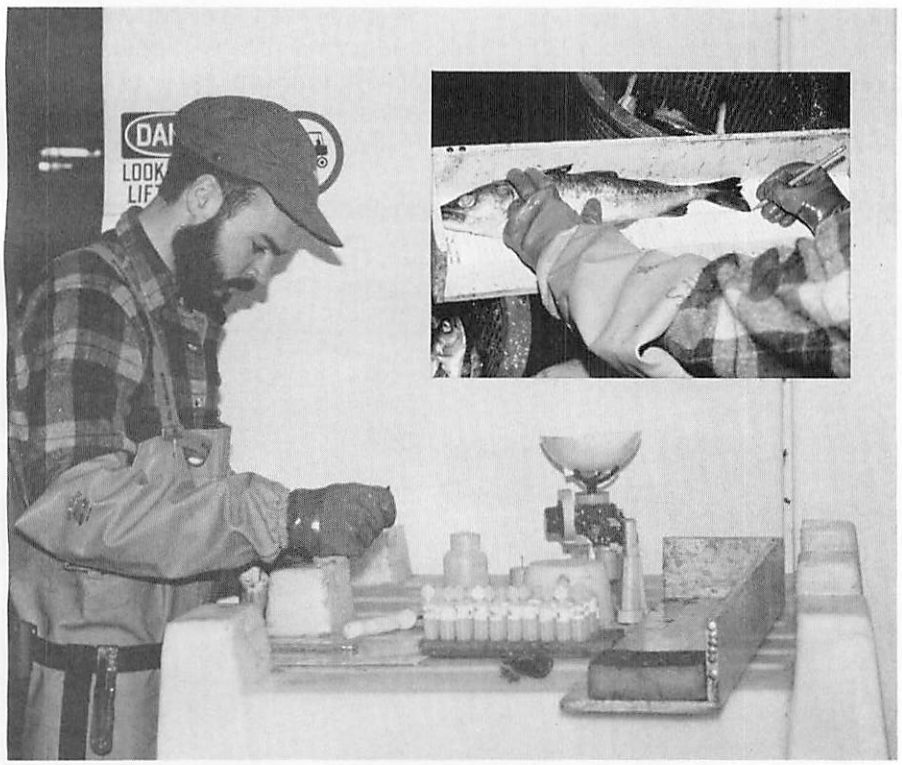
Construction of the $8 million University of Alaska Fishery Industrial Technology Center in Kodiak (left) will be completed in 1990. FITC was conceived by Alaska Sea Grant and first funded by the State of Alaska in 1981. *Above*– Fishery Industrial Technology Center Director Dr. Jong Lee tends a combined exhibit by Alaska Sea Grant, FITC, and American Fisheries Society at Kodiak ComFish, Alaska's largest commercial fishing trade show.

tion and NOAA's National Marine Fisheries Service also are sponsors of the conference.

Growth of the groundfish industry has caused concern among industry and fishery management experts who wonder how far exploitation can proceed without causing ecosystem damage. The point at which harvest affects a stock's ability to replenish itself is called the threshold. Knowing the threshold is crucial to wise use and conservation of Alaska's groundfish stocks. The question is the focus of an Alaska Sea Grant study conducted by Dr. Terry Quinn of the Juneau Center for Fisheries and Ocean Sciences.

Using a computer simulation, Quinn is analyzing the effects of fishing on Bering Sea pollock. Results of this work should help managers more accurately define the pollock harvest threshold, and ensure a continuing supply of this abundant and important resource.

This research complements Alaska Sea Grant Marine Advisory Program research that examines the economic effects of intensive capital investment in the offshore groundfishery.



Before offshore groundfisheries were taken over by American and joint venture operations, fisheries managers had access to catch data provided by U.S. observers, who were required to sail on foreign fishing vessels by international agreement. Because the increasingly prevalent American fishing vessels have not carried observers, fisheries managers have lost access to essential data. Alaska Sea Grant, funded by the North Pacific Fishery Management Council, developed a domestic pilot observer program which provided information for a soon-to-be implemented permanent domestic observer program. Observer Tyson Vogeler (above) worked in Kodiak processing factories as part of the pilot program, recording data such as pollock numbers, sex, size, and maturity, information critical to avoiding fish stock depletion. Similar data were collected by observers on U.S. vessels in the Gulf of Alaska and Bering Sea.

Sea Grant Research Supports Management

To fishermen in Alaska, whether they fish commercially for salmon in Cook Inlet, operate a subsistence salmon set net in Bristol Bay, or cast lures from stream's edge for salmon on the Kenai Peninsula, the three most important words are allocation, allocation, allocation. Translated it means, "How big is my piece of the resource pie?"

Dividing the pie has been the subject of great debate among user groups. Commercial fishermen want their allocation increased. So do recreational fishermen. The trouble is, only so many fish can be caught and too many people want to catch them. Balancing the needs of a growing Alaska population with the health of the environment is one of the most important and controversial issues facing resource managers today. As competition increases, allocation issues will ignite more strenuous debate and conflict.

Nearly all sides will agree on one point. Allocation is a trade-off: a compromise based on sketchy biological data, the political clout of user groups, and economic benefits of one use over another. Sorting through these complex issues was the task of Alaska Sea Grant economics researcher Dr. Doug Larson.

Larson examined the economic impact of a wide range of allocation issues and decisions on commercial fishermen, recreational fishermen, and others who rely on Alaska's marine resources. While his work is not expected to provide resource

managers with the ideal answer to the dilemmas associated with allocation, the research is expected to help managers understand and appreciate the consequences of allocation decisions. And most important, use of Larson's research could help prevent over-harvest of valuable resources, such as the king crab industry in Alaska.

King crab was once a species harvested only by Alaska Natives. Commercial harvests by the Japanese and Soviets during the 1930s and '40s alerted Americans to the bountiful stocks of crab roaming the ocean floor just off Alaska's shores.

American fishermen started to pursue crab stocks in nearshore waters in the 1950s. But it wasn't until the decline of salmon in the 1970s, coupled with the extension of U.S. territorial rights from 3 to 200 miles from shore under the 1976 Magnuson Fishery Conservation and Management Act, that large-scale American involvement in Alaska's king crab fishery was catalyzed. The result was an unparalleled but short-lived boom in the Alaska commercial fishing industry.

Throughout the 1970s, it seemed king crab were in endless supply, sustaining an economic bonanza in places like Kodiak, then called the king crab capital of the world. In 1980, fishermen harvested a record 180 million pounds, valued at $226 million — more valuable than the vaunted Alaska salmon fishery that year. Then, for reasons not fully understood, king crab populations plummeted. Harvests five years later were the lowest, 15 million pounds, since statehood.

Tanner crab accounts for about two-thirds of Alaska's shellfish harvest. In 1985 Alaska Sea Grant sponsored two major scientific meetings on crab and a third symposium is planned for 1989. Since 1984 Alaska Sea Grant has sponsored two research projects on king crab and two projects on Dungeness crab.

King Crab Study To Answer Breeding Questions

Researchers attribute the decline to a variety of reasons, but say overfishing and the disruption of king crab breeding patterns are important factors. An Alaska Sea Grant study directed toward better understanding the reproductive behavior of this valuable animal is being conducted by Dr. A.J. Paul at the University of Alaska Marine Center in Seward, Alaska. The center is part of the Institute of Marine Science.

Paul believes the decline may be related to male size in comparison to female size during mating. Previous researchers found that females are more likely to mate with males larger than themselves. To find out more, Paul is studying mating relationships of red king crab. Key to the study are determining the size at which male red king crab are sexually mature and how females respond to male crabs smaller and larger than themselves.

King crab, as well as other commercially popular crab species such as tanner and Dungeness, are found in both state and federally managed waters. Realizing the importance of Paul's research, NOAA's National Marine Fisheries Service and the Alaska Department of Fish and Game in 1988 and 1989 helped capture and transport live crab for the study. Crabs came from Cook Inlet, Kodiak Island, and the western Bering Sea.

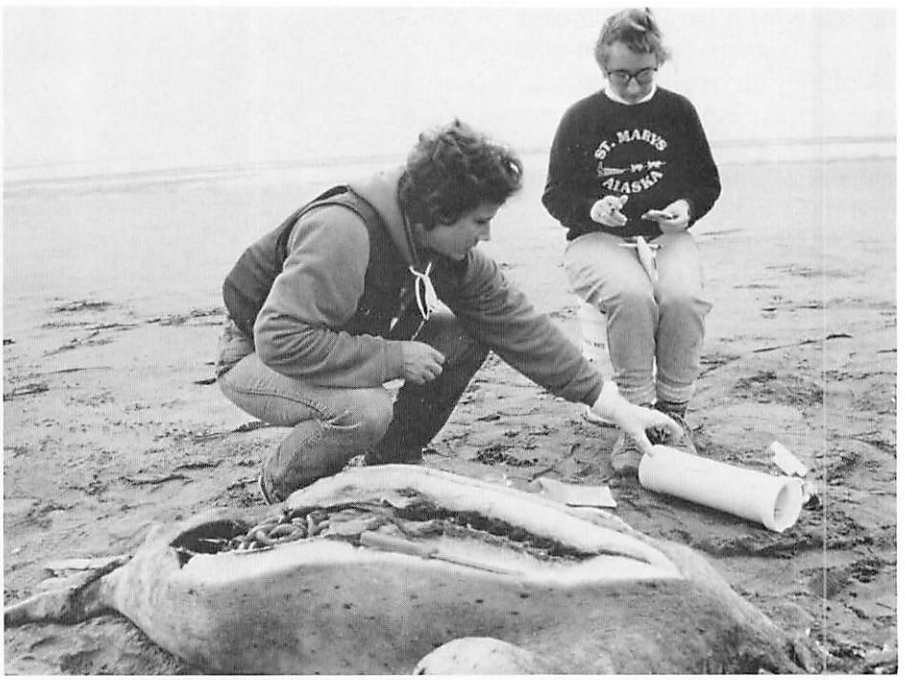
Fisherman, Marine Mammal Conflicts Studied

King crab is *not the only* marine population reduced by interactions with humans in Alaska. Marine mammals, beginning with

the relentless pursuit by Russian and American traders of northern fur seals, had severe blows dealt to their populations. Long time Alaskans will remember that the state even paid a bounty on seals. More recently, Steller sea lions, and sea otters — the nemesis of fishermen throughout Alaska — often are shot when they become entangled in fishing nets, looking for an easy meal. While scientists have not singled out fishermen as the cause of the decline of marine mammals, the U.S. Congress passed the Marine Mammal Protection Act in 1972 to, among other things, prohibit the killing of any protected marine mammal except in the defense of human life.

Laws will go a long way toward changing the attitudes of some fishermen and deterring the reckless destruction of valuable marine mammals. But laws won't keep marine mammals out of fishermen's nets. Finding solutions to this problem has been the job of Alaska Sea Grant researcher Kate Wynne.

Working from the Alaska Sea Grant Marine Advisory Program office in Cordova, Wynne is only minutes away from the Copper River Delta, the seasonal home for hundreds of sea otters and Steller sea lions. Cordova also is the home of some 800 commercial salmon fishermen. All compete for the several million sockeye salmon that migrate annually to the delta. Contact between fishermen and marine mammals is high with several marine mammal fatalities reported each year. Learning how fishermen can successfully avoid or harmlessly repel marine mammals is the subject of Wynne's investigations.



Alaska Sea Grant researcher Kate Wynne, left, and assistant Jill Anthony take tissue samples from a harbor seal found dead on the Copper River Delta. Wynne conducts beach surveys from low-flying airplanes, landing on hard-packed beaches to perform necropsies on dead marine mammals. Wynne also sails on fishing vessels to observe and record how fishermen deal with marine mammals that approach or become entangled in nets.

Acknowledging the need for reliable information on marine mammals and interactions with fishermen, the region's fishing association, the Cordova District Fishermen United, was instrumental in the success of Wynne's research. CDFU worked with its members to encourage cooperation with the project and dissemination of the results.

In the study's first season, 1988, Wynne recorded several techniques used to repel mammals from fishing nets. Most common was gunshots fired into the water near encroaching animals. This was effective, but new laws may ban the practice. A second effective method was using skiffs to chase animals away. The most surefire but impractical method was to haul in the nets whenever marine mammals were near.

Wynne's findings were the subject of much discussion at an Alaska Sea Grant sponsored meeting attended by law enforcement and fishing industry representatives, who gathered in Anchorage, Alaska in January 1989 to review proposed marine mammal protections. Wynne's research continues in 1989 with surveys of beached marine mammal carcasses to determine the probable cause of death.

Aquaculture Enhances Alaska Fishing Industry

Like the 1896 Gold Rush that brought wealth-seekers north

through Alaska to the Canadian Klondike gold fields, the discovery by traders of massive wild salmon runs in the early 1900s lured thousands of fishermen northward from the Pacific Northwest.

As in all economic booms, the eventual bust was as inevitable in the unregulated Alaska fishing industry as it was in the gold fields. Annual wild salmon harvests that in the 1930s approached 130 million fish, had by 1967 dwindled to about 20 million fish. Stocks had been overfished, mismanaged, and dealt severe blows by nature. By the early 1970s, the salmon fishing industry was in grave danger of extinction.

Taking control of the crisis, the State of Alaska launched an all-out effort to manage and rebuild remaining stocks. Instrumental in the effort was the state's new salmon ranching program and the creation in 1974 of the Fisheries Rehabilitation, Enhancement and Development Division within the Alaska Department of Fish and Game.

A form of aquaculture, salmon ranching is the process of using indoor hatcheries to collect, breed, and raise salmon. Hatcheries dramatically increase the survival rate of salmon because hazards such as drought, floods, and freezing temperatures are eliminated. Young salmon are released to continue normal development with their wild counterparts prior to migrating back to the hatchery to spawn. Salmon hatcheries contribute millions of salmon to the commercial fishing industry and are widely supported by fishermen.

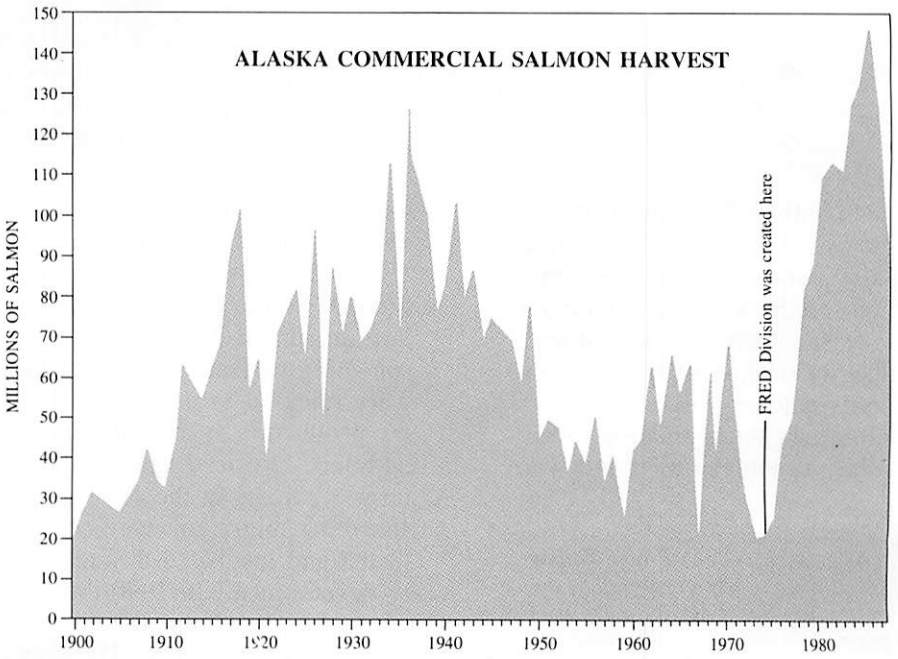
Conversely, salmon farming involves raising salmon in floating pens in sheltered ocean bays and fiords. The salmon are harvested from the pens when they reach market size. The practice is banned in Alaska but is a major industry in Norway, Ireland, Scotland, Japan, Chile, and many other countries.

Making the Alaska salmon ranching program work successfully meant learning the biology of the five species inhabiting the state — sockeye, pink, chinook, chum, and coho. Research by Alaska Sea Grant scientists at the University of Alaska contributed to this initial goal.

Early Alaska Sea Grant aquaculture research focused on more fully understanding salmon migratory processes and egg fertilization and development, and improving strategies for raising coho salmon in lakes. Now, with much of the basic research in salmon ranching accomplished, Alaska Sea Grant aquaculture studies focus on understanding and improving the genetic composition of hatchery-reared salmon.

Sea Grant Study To Produce Larger Fish in Hatchery

One study, directed by Dr. William Smoker at the University of Alaska, Juneau Center for Fisheries and Ocean Sciences, is aimed at increasing the size of hatchery-reared pink salmon by selecting large fish for breeding. The project is supported cooperatively by Alaska Sea Grant and the Prince William Sound Aquaculture Corporation, a private non-profit enterprise



Data provided by Alaska Department of Fish and Game

Left– Allen Edsall, fish culturist at the private non-profit Medvejie Hatchery just outside Sitka, Alaska, displays king salmon fingerlings. In an experimental project to accelerate growth, king salmon are placed in salt water a year earlier than normal. The procedure produces larger fish faster, lowers costs, and frees up hatchery space to raise more fish. King salmon are held in net pens in a sheltered lagoon while they adjust to the salt water. Freshwater from a bubbler percolates to the top of the pen, forming a layer that helps salmon acclimate to their new environment. *Below–* A feeding frenzy erupts several times each day when fish are fed.

that controls five hatcheries in the sound.* Pink salmon for the study came from the corporation's A.F. Koernig hatchery in Port San Juan, Alaska. More than 21 million of the corporation's hatchery-raised pink, chum, sockeye, chinook, and coho salmon returned and were harvested by fishermen in the sound during the 1989 season.

In the first year of the study Smoker marked offspring of the largest salmon in the 1987 spawning returns. The offspring were released as part of the 1988 fry production at the hatchery. In addition, fertilized eggs of the largest parents in the 1988 spawning migration were collected and incubated through early development. In 1990 the first marked pink salmon should return to the hatchery. The size of marked salmon will be compared with the size of other returning pink salmon and the largest fish used as broodstock.

Smoker also directs an Alaska Sea Grant project to produce a genetic line of salmon that spawns at a time different from wild salmon. If he can produce a line of pink salmon with an internal time clock different from wild pink salmon, then spawning runs of the two stocks can be separated. Separate spawning runs would allow fisheries managers to determine the best harvest rates for both stocks, and with the same species of salmon migrating at different times, harvest seasons could be extended.

Salmon raised in hatcheries also may be more healthy and grow faster. That's the hope of Sea Grant researcher Dr. Andries Roem, who is investigating the dietary benefits of krill used to feed salmon in hatcheries.

Krill, the principal feed of whalebone whales, are tiny crustaceans that occur in huge populations in the world's oceans. Estimates indicate that 300 million metric tons of krill could be harvested annually. Besides being plentiful, krill are high in proteins, lipids, and chitin, and are a good source of flesh-coloring pigments that are highly desired by salmon culturists. Roem believes that krill may make an excellent substitute for traditional nutrient sources such as pollock and cod roe, which often are expensive and in short supply.

The success of Alaska's salmon ranching program demonstrates the benefits of such research. In the almost twenty

* *With support of the Prince William Sound Aquaculture Corporation, the Alaska Sea Grant Marine Advisory Program is producing a video program on the sound's hatcheries. The program will be available in early 1990.*

years since the state began its investment in salmon hatcheries, Alaska has become one of the world's leading producers of hatchery-reared salmon. In 1987, state and private non-profit hatcheries reared more than 840 million salmon.

Commercial and Recreational Fishermen Benefit from Aquaculture

Research benefits are further reflected in the resurgence of Alaska's commercial fishing harvest. More fishermen with modern vessels participate in the Alaska salmon fishery than ever before, catching in 1985 a record 145 million salmon. Hatcheries played a major role in their success, producing 24 percent of the salmon harvested in 1988.

Commercial fishermen aren't the only beneficiaries of aquaculture research. Recreational fishermen now enjoy some of the world's best fishing in places like the Kenai Peninsula, Kodiak Island, Prince William Sound, and Bristol Bay, thanks to hatchery programs and fish stocking efforts. Outstanding sportfishing greatly benefits the Alaska tourism industry, most notably on the Kenai Peninsula.

Alaska's thousands of miles of sheltered coastline and cold, clean waters provide ideal places to farm salmon. But a 1987 legislative moratorium bans salmon farming. Extended in 1988, the moratorium prohibits Alaskans from raising salmon in salt water or freshwater bodies with outlets to the sea. The legislature will reconsider its action in 1990.

Norway is the world's largest producer of farmed Atlantic salmon. In 1986, Norway produced more than 100 million pounds, and exported 21 million pounds to the United States. By comparison, the 1986 North American commercial catch of chinook and coho salmon was 120 million pounds.

By 1990, according to research conducted by Alaska Sea Grant economist Dr. Biing-Hwan Lin, Norway will produce about 220 million pounds of farmed Atlantic salmon for the world market.

Lin's research examined the patterns of growth, sales, and consumer demand for Norwegian farmed salmon as compared to North American sockeye, coho, and chinook salmon. His study, published in the November 1988 issue of the *Canadian Journal of Agricultural Economics*, found little competition currently exists in the marketplace between farmed and wild salmon products. He cautioned, however, that the increase in farmed salmon production could lower prices and undermine the wild salmon market.

Salmon Farming Opposed by Commercial Fishermen

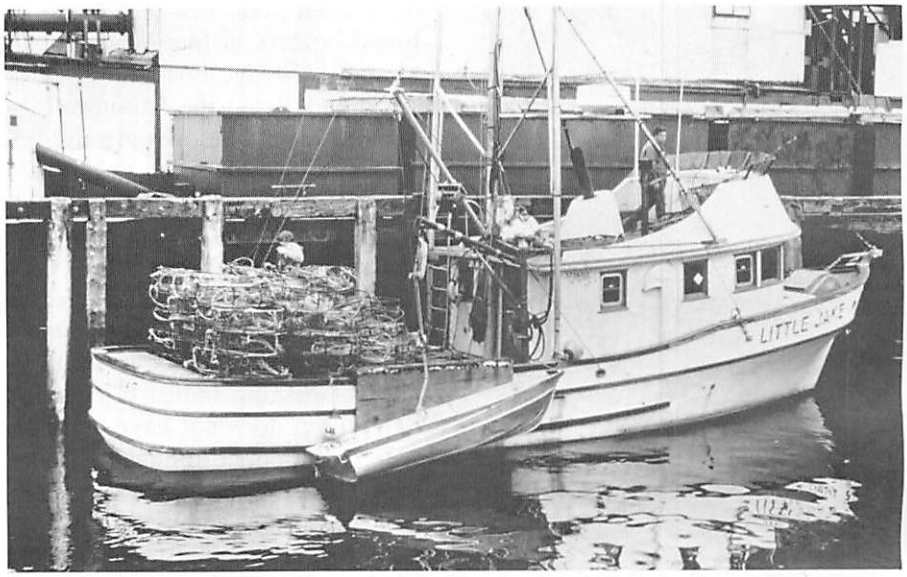
Opposition to salmon farming in Alaska is led by commercial fishermen who contend that farmed salmon may escape from their pens and transmit disease to wild stocks. They also worry that more farmed salmon will erode the market for wild salmon and threaten their livelihoods. Proponents of salmon farming disagree, insisting that disease can be controlled in a farm environment and that salmon farming is a way of diversifying the Alaska economy. At the moment, the fishermen have more influence.

Alaskans eventually will have to decide on the issue of salmon farming. Regardless of which path is chosen, important economic, social, and political impacts must be considered. Alaska Sea Grant's role is one of research and education directed at broadening knowledge of salmon ranching and farming, and of other forms of aquaculture, such as shellfish and seaweed. We have sponsored meetings where information from scientists and Marine Advisory agents and specialists has been shared with entrepreneurs, decision makers, fishermen, and other scientists. The most recent was the Fourth Alaska Aquaculture Conference, held in Sitka, Alaska, in 1987. Forty-four specialists presented information on shellfish, seaweed, and finfish aquaculture. Sitka Marine Advisory Agent Dolly Garza chaired the meeting, attended by 200 people. A conference proceedings is available from Alaska Sea Grant communications. □

Representatives from several Sea Grant programs, the National Sea Grant office, and National Council on Fishing Vessel Safety and Insurance met at Sitka, Alaska, to review a vessel safety training program co-developed by the Sea Grant Marine Advisory Program. Here, attendees float in 41-degree water, evaluating use and performance of survival suits.

Field Agents, Specialists Promote Safe, Profitable Marine Enterprises

The University of Alaska Marine Advisory Program (MAP) is Alaska Sea Grant's frontline outreach unit, with field advisory agents and specialists in eight Alaska coastal communities. Activities are planned as a series of missions. They include: management, response, commercial fisheries development, marine safety, fisheries business management, seafood technology, and aquaculture. Marine recreation was added in 1988, and a mission in coastal environmental quality is proposed to begin in 1990. Following are some highlights from 1985 through 1988.



Dungeness crabber at Petersburg, Alaska. Operators of small vessels like this face many hazards, including bad weather, human error, and equipment failures. MAP is a national leader in developing and implementing vessel safety training and survival programs for the commercial fishing industry.

Severe injuries and deaths associated with commercial fishing are not just news reports to the people of Alaska. Too often they are accounts of the last moments of neighbors, family, or friends. According to Alaska Sea Grant research, between 1981 and 1984 a total of 103 fishermen died in 53 accidents. Most perished after falling overboard or after a vessel capsized or sank. Evaluation of accidents by Alaska Sea Grant and other agencies, as well as concerned residents, revealed the universal need for safety education and training among fishermen.

Pioneering safety training efforts begun by MAP in 1973 yielded positive results, as documented in interviews with accident survivors who had received the training. However, this early work revealed three serious obstacles to establishing a training program that would be easily accessible to all fishermen:

- Agencies lacked broad expertise, such as medical preparedness, safety and survival, and naval architecture, needed for a comprehensive training course.
- Statewide training programs were too expensive, even with the combined resources of many agencies.
- Technical information was too often inaccurate or contradictory.

To overcome these obstacles, MAP led the organization of a group of state and federal agencies, private health corporations, and a private safety training company to form the Alaska Marine Safety Education Association (AMSEA).* AMSEA trains groups of volunteer instructors in central locations, and the new in-

**AMSEA members include the Alaska Department of Education, Alaska Department of Public Safety, U.S. Coast Guard 17th District, Alaska Department of Health Services, Southeast Alaska Regional Health Corporation, North Star Survival, and Sea Grant Marine Advisory Program.*

Alaska fishermen take part in emergency medical training exercises, sponsored by Kodiak Fishermen's Wives Association with help from Alaska Sea Grant Marine Advisory agents. MAP leads several projects in fishing vessel safety education in Alaska, where the commercial fishing fatality rate of 26 deaths per year is over 20 times that for all other Alaska industries combined.

structors return home to deliver training programs locally. This community-based approach is effective because courses and times can easily be adjusted to fit local traditions and schedules. AMSEA regularly upgrades instructors and the training program and provides continued technical and physical support to instructors.

In 1987-88, AMSEA trained over 100 volunteer instructors, who in turn trained more than 7,000 people nationwide. Participants from New Jersey, Rhode Island, Maine, and Oregon have traveled to Alaska to receive AMSEA training. As a result, AMSEA instructor training curricula, teaching methods, information publications, and video tapes are used in training programs in those states. Modified AMSEA training materials have been presented to recreational boaters in four workshops at an Anchorage boat show.

Funds from the Saltonstall/ Kennedy Foundation were used to develop the training program and to train intructors. However, AMSEA now faces its greatest challenge. The Saltonstall/ Kennedy Foundation no longer includes marine safety as a funding priority and the new Commercial Fishing Industry Vessel Safety Act does not have a fiscal note to support training of fishermen. The future of AMSEA raises a serious public policy issue. Should public money be used to support the training, or should an attempt be made to fund it through fees for services?

Regardless of the funding source, MAP will continue to promote and encourage safe fishing practices, and work with other groups and individuals to save lives and property in Alaska's largest and most dangerous private industry.

Seafood Technology

The commercial fishing industry is Alaska's biggest private industry, but vast potential remains untapped. Recognizing this, Alaska Sea Grant and the Marine Advisory Program help lead the way to strengthen Alaska's fishing economy. MAP's seafood technology mission provides Alaska's seafood industry with scientific information and technical assistance to help produce safe and high quality seafood, develop new products, find new ways to use both traditional and underutilized fishery resources, and improve productivity. Highlights of 1985-1988 include:

1. Development and delivery of a salmon quality education program for fishermen and seasonal workers at processing plants. Since 1983, MAP has presented workshops at over forty seafood processing companies throughout Alaska, educating more than 800 employees in the basics of seafood handling and sanitation.

2. Development of a white fish processor training program in cooperation with the Alaska Vocational Technical Institute in Seward, Alaska. This two-week, 80-hour course, with classroom lecture and in-plant training, was presented in Seward and Kodiak, Alaska. The program taught students quality control and practical skills needed to fillet and process Pacific cod.

3. Marine advisory publications produced by Alaska Sea Grant communications, including

- *Yields and Recoveries of Pacific Fish and Shellfish.* This booklet lists food yields and recoveries from processed North Pacific fish and shellfish. Several national and international trade publications have promoted this booklet, and over 600 copies were distributed the first six months it was available.
- *Guide to Northeast Pacific Rockfishes.* Regarded as the best

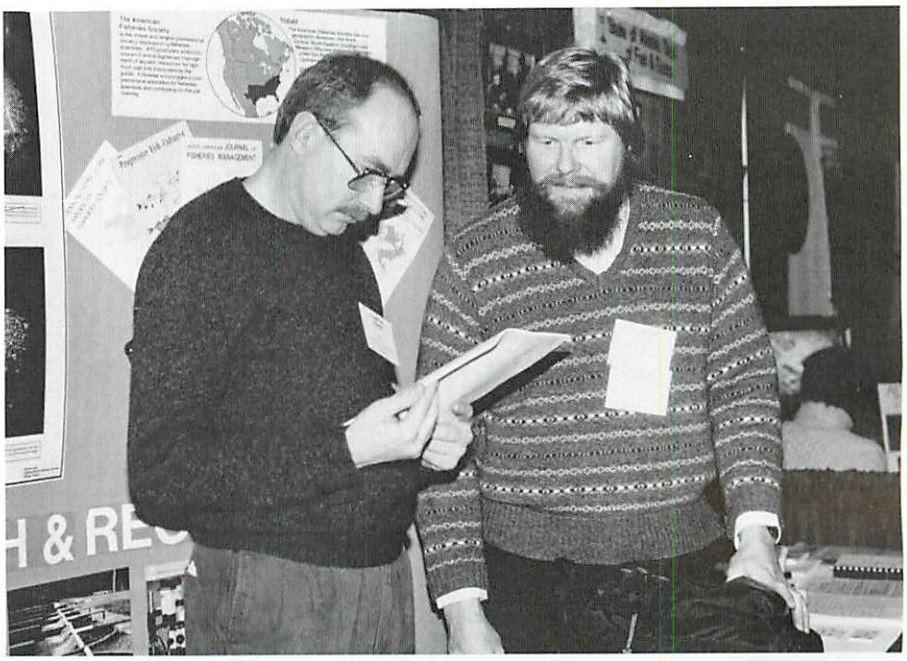
book of its kind, this easy to use, water resistent color guide describes in photos and text thirty-seven species of rockfish. Over 2,000 copies have been distributed over three years.

- *White Fish Processing Manual.* A handbook on cod and pollock processing for small-scale operators.
- *Handbook on Handling White Fish Aboard Fishing Vessels.* A guide to the principles of good handling and storage of white fish aboard fishing vessels.

4. Research by the seafood technology mission, including

- Salmon quality studies that determined how salmon shelf life is affected by: delayed chilling (1985), elevated storage temperatures (1986), and storage conditions (1988).
- Pink salmon product development (1987) that produced skinless, boneless pink salmon blocks as an alternate product form.
- Characterization of Alaska seafood processing wastes (1986-87) that determined the chemical composition and potential uses of seafood processing wastes.

5. In cooperation with Alaska Sea Grant's conferences and workshops division, MAP organized the International Symposium on Seafood Quality Determination, which brought scientists together to discuss seafood quality. This provided a unique opportunity for the Alaska seafood industry to meet and talk with seafood technologists from Europe, Japan, Australia, and Canada, and resulted in publication of the proceedings by Elsevier Science Publishers in their Developments in Food Science series.



Marine Advisory seafood quality specialist Chuck Crapo (left) and Alaska Sea Grant researcher John French representing the University of Alaska Fishery Industrial Technology Center at the Kodiak ComFish trade show. FITC research includes surimi, fish microbiology, lipids in salmon, and harvesting and processing efficiency.

Business Management and Economics

MAP has achieved significant results since 1985 in fisheries business management and economics. Of the three economic studies that have generated the most interest, two examine impacts of commercial fishing on local fishing economies, and one looks at overcapitalization in Alaska groundfish fisheries.

MAP's first study of local economic impacts of commercial fishing was conducted in Homer, Alaska, by the Homer MAP agent. Commercial fishing dominated the economy in Homer for three decades, until the 1980s when a dramatic rise in recreation and tourism began to change the economic profile. Taxes, harbor fees, government services, and business investments were increasingly affected by the quickly growing industry. As tourism and recreation began to carve out a bigger niche, commercial fishermen and community decision makers realized a need to quantify the economic value of the commercial fishing industry. Until the MAP study, the economic significance of the commercial fishing industry was not documented.

The Homer agent used government statistics and data from a survey of local fishermen, processors, and businesses to estimate gross income and number of jobs generated by the commercial fishing industry in Homer. Findings on slip number and size have been used in Homer to plan port and harbor services.

The study appears to be the first in Alaska to consider the economic impact of commercial

Hanging a gillnet is an exacting craft--the nets must be built to suit different conditions. In 1987, about 3,600 drift gillnetters and 1,900 setnetters fished along Alaska's shores. In 1987, on behalf of the Pacific Sea Grant College Program, the Dillingham MAP agent and the MAP instructional media specialist collaborated with the fishing equipment industry to produce an internationally distributed video program and workbook on how to properly rig a gillnet.

fishing at the local or regional levels. Kenai, Sitka, and Petersburg, Alaska requested similar studies. The Kenai study, recently completed by the Homer agent, will help officials determine oil spill damage.

The second MAP economic study is continuing and involves five Alaska fishing communities: Sitka, Homer, Kodiak, Cordova, and Petersburg. Going a step further than the Homer study, this study takes into account household expenditures of residents who work in the fishing industry or in businesses that support the fishing industry. The MAP business management specialist and a consulting marine economist have collected data and developed an economic model for the Kodiak study.

The study is not finished, but Kodiak fishermen and processors have already used the Kodiak model in deliberations with the North Pacific Fishery Management Council. State decision makers as well as community leaders can use the study model to make cost-benefit decisions about public investments in commercial fisheries.

In addition, the MAP study will be a vital tool in assessing economic damage caused by the Prince William Sound oil spill, in Kodiak, Cordova, and Homer.

The third MAP study examined how changes in international fisheries affect U.S. fishing businesses. With passage of the Magnuson Act in 1976, U.S. territorial waters were extended to 200 miles offshore. Phased in over several years, this eventually gave U.S. fishermen exclusive rights to a huge groundfish resource previously harvested almost entirely by foreign fleets.

U.S. business people have taken advantage of this new and lucrative monopoly, investing heavily in the offshore groundfish fishery. However, the bonanza may be peaking as too many vessels compete for a limited resource.

To predict the saturation point in the fishery and to predict financial problems and bankruptcies, the MAP business management specialist began a project to determine the "break-even fleet size." This is the size at which the fleet as a whole makes as much money as it spends. Researchers determined the mix of factory trawl and harvest-only vessels, and combined this information with data on operating costs and product prices. Then they estimated the number of vessels that the harvestable groundfish resource could support. Major factors such as product price, stock abundance, and fuel costs were varied to determine how fleet size

changed as these factors changed.

Results have been submitted to a refereed fisheries management journal, and were published in *Pacific Fisherman*, a widely read trade magazine. Findings also were presented at two scientific conferences, the Pacific Fisheries Technologists Conference in Anchorage, and the Western Groundfish Conference in Monterey, California. North Pacific Fishery Management Council staff and associated planning teams are using the data to help simulate effects of management alternatives. Banks and fishing companies have used the results and requested additional information to make lending and investment decisions. With periodic updating of cost and income figures, the break-even fleet size model should be a useful investment decision tool for years to come.

Marine Recreation and Tourism

The marine recreation mission is only two years old, but it has already logged significant successes. Efforts have primarily focused on the charter boat industry, a growing tourism industry in nearly every Alaska port. It is especially important in popular Alaska tourist destinations such as Ketchikan, Sitka, Juneau, Homer, Seward, and Kodiak.

MAP economic impact studies in Homer and Seward have provided charter operators in Alaska with useful, decision-guiding information about charter customers. Many operators have used these studies in establishing new charter companies or in revitalizing existing ones.

In 1987 and 1988, the Homer MAP agent conducted charter boat marketing seminars in ten Alaska ports. He provided information on relationship marketing, charter licensing, promotional brochure design, and charter organizations to approximately 250 people. The seminar encouraged several new charter companies to proceed with development plans. Numerous charter operators have used marketing techniques presented in the seminars.

The agent also surveyed Alaska charter operators to determine what companies were willing and equipped to serve physically disabled customers. The survey alerted operators to the potential to attract a new group of patrons and helped charter operators realize they might already be equipped to accommodate physically disabled clients. Some charter operators altered boat decks and purchased special equipment such as electric reels to help serve these special customers. The MAP project also gave charter operators a chance to publicize their operations through a marine advisory bulletin that lists survey respondents who accommodate physically disabled clients.

The MAP bulletin, *Charter Boat Services in Alaska for People with Physical Disabilities*, was widely distributed and publicized, including an article in the nationally distributed magazine *Paraplegia News*. A second edi-

Recreational boats at Juneau, Alaska. The Marine Advisory Program has responded to Alaska's rapidly growing marine recreation and tourism industry by providing business development information to the charter boat industry and by conducting studies of coastal community economies.

tion of the charter boat bulletin will be listed in the *1990 Official Vacation Planner*, a joint publication of the State of Alaska and the Alaska Visitors Association.

As Alaska's tourism and recreation industry grows, so too will MAP's mission in this field. Soon most MAP agents and specialists will become involved, building on the successful precedent set by the Homer field agent.

Video Production

Video is an increasingly important way to reach the public. Recognizing the value of a high quality video capability, MAP in 1987 created an instructional media specialist position, and hired a videographer to fill this slot. This specialist produces video programs independently or with state, university, and private organizations. Two programs have been added to the popular fisheries safety and survival series: *Marine Survival Equipment and Maintenance* and *Frostbite and Other Cold Injuries.* The latter won a Certificate for Creative Excellence from the U.S. Industrial Film and Video Festival. The video is being used by individuals and organizations such as the Kuparuk Emergency Medical Services, the Alaska State Troopers, the University of Alaska Wilderness Studies Program, and the Iditarod mushers. *Frostbite and Other Cold Injuries* also has been broadcast on several television stations in Alaska, including twice in one day during the 1989 record cold winter.

A television series, *The Alaska Resource Issues Forum*, was produced in the late 1980s. The series began as a studio production, but evolved into a more heavily produced and edited program that included interviews and other footage recorded in the field. Topics covered a wide range of issues important to Alaska, such as foreign high seas piracy of salmon, mining and the environment, Arctic National Wildlife Refuge, logging in Alaska, and salmon farming. The programs aired on the Rural Alaska Television Network and some Alaska public television stations. The Alaska Department of Commerce, Division of Commercial Fisheries, assisted in production. Program production ended in 1988, but the tapes are still used by groups and individuals.

Videos also include *Trashing the Oceans*, an eight-minute program describing the marine debris problem, its effects, and some solutions; and two training tapes, *Halibut Dressing* and *Hanging a Gillnet*.

MAP also offers a slide show on white fish processing, and produces *Alaska Marine Resource Quarterly*, a multi-page publication that focuses on marine resource issues. Recent coverage included: new seafood products and developing fisheries, the Marine Mammal Protection Act, and mariculture.

These are just a few examples of how the Alaska Sea Grant Marine Advisory Program effectively identifies industry needs, develops projects to answer those needs, and communicates useful information to the public, industry, and policy makers. □

Anyone stranded in the coastal wilds of Alaska will need to know how to collect water and make it drinkable. Sitka Marine Advisory Agent Dolly Garza has included this vital lesson in her soon-to-be-published Marine Advisory bulletin "Surviving on the Foods and Water from Alaska's Southern Shores." Other topics in the manual include selecting intertidal animal and plant edibles, survival nutrition, and wild food preparation.

Garza has concentrated her efforts on educating children in emergency preparation and shore survival. She believes "If you teach safety and survival skills to children, they will know it for life." Using grant money from the Alaska Department of Education, during the past three years she developed safety and survival teaching materials that have been used by 5th-7th grade youngsters in twenty Southeast Alaska communities. Classroom teachers are eager to acquire the AMSEA-based teaching materials and receive training in survival subjects. As a result, Garza has prepared a curriculum called "Survival Training for Alaska's Youth" for use in grade school classrooms.

Marine Advisory Offices

ANCHORAGE

Donald E. Kramer, Chairman
Seafood Technology Specialist

Deborah Mercy
Instructional Media Specialist

Craig S. Wiese
Associate Chairman
Business Management Specialist

John P. Doyle
Professor of Fisheries

Marine Advisory Program
University of Alaska
Carlton Trust Building
2221 E. Northern Lights Blvd.,
Suite 220
Anchorage, Alaska 99508-4143
(907) 274-9691

CORDOVA

Rick Steiner
Marine Advisory Agent
P.O. Box 830
Cordova, Alaska 99574
(907) 424-3446

DILLINGHAM

Paula Cullenberg
Marine Advisory Agent
P.O. Box 1549
Dillingham, Alaska 99576
(907) 842-1265

HOMER

D. Douglas Coughenower
Assistant Chairman
Marine Advisory Agent
4014 Lake Street
Homer, Alaska 99603
(907) 235-5643

KODIAK

Charles Crapo
Seafood Quality Specialist

Hank Pennington
Marine Advisory Agent
Safety Specialist

Marine Advisory Program
202 Center Street, Suite 201
Kodiak, Alaska 99615
(907) 486-3599

KOTZEBUE

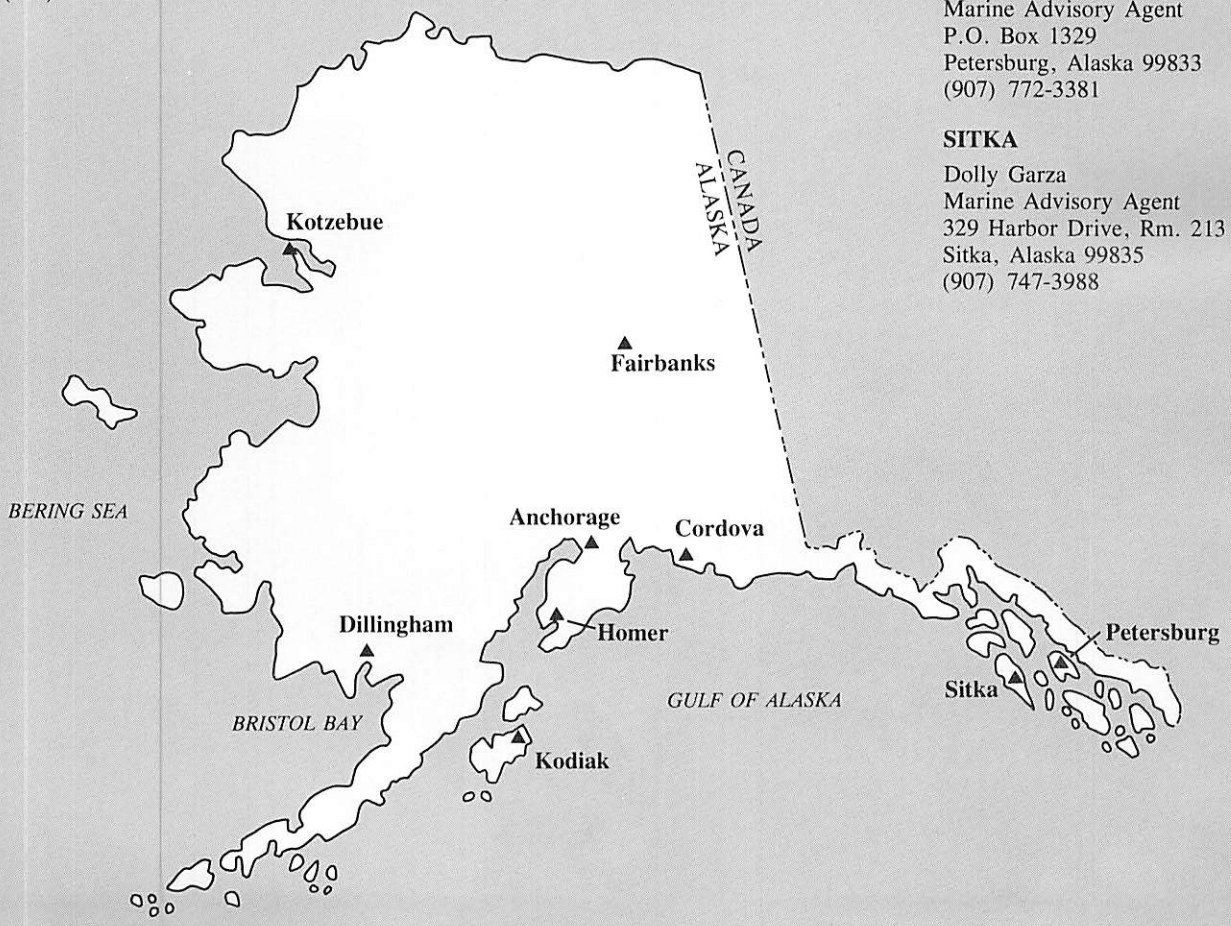
Mark Willette
Marine Advisory Agent
P.O. Box 297
Kotzebue, Alaska 99752
(907) 442-3063

PETERSBURG

Brian Paust
Marine Advisory Agent
P.O. Box 1329
Petersburg, Alaska 99833
(907) 772-3381

SITKA

Dolly Garza
Marine Advisory Agent
329 Harbor Drive, Rm. 213
Sitka, Alaska 99835
(907) 747-3988



Meetings of the Minds: Alaska Sea Grant Fosters International Communication

"If you are involved in marine fisheries in Alaska, you are involved in international issues."

— Alaska Sea Grant Director R.K. Dearborn

Walleye pollock has become a prime target of U.S. fishermen since the United States began in 1978 to legally take control of the groundfish waters within the 200-mile Exclusive Economic Zone in the Bering Sea and Gulf of Alaska. In 1988, Alaska Sea Grant sponsored an international symposium on the biology and management of this important groundfish.

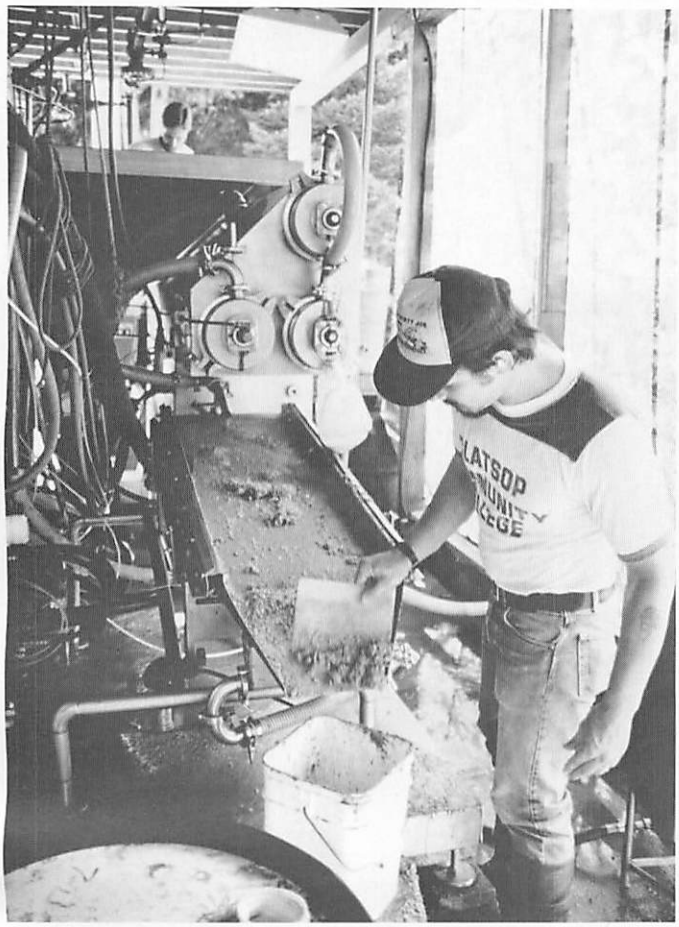
In the late 1970s, Alaska Sea Grant administrators noticed the United States lagging behind other Pacific Rim nations in fisheries science information, and they recognized these countries were in no particular hurry to share their information. At the same time, these economic competitors boasted aggressive fisheries policies while the United States countered with aggressive fishermen. In the face of escalating pressure and competition in the North Pacific fisheries, Alaska Sea Grant administrators created a program to foster international cooperation and information exchange. Thus was launched the nation's longest series of university-sponsored scientific meetings on North Pacific fisheries resources.

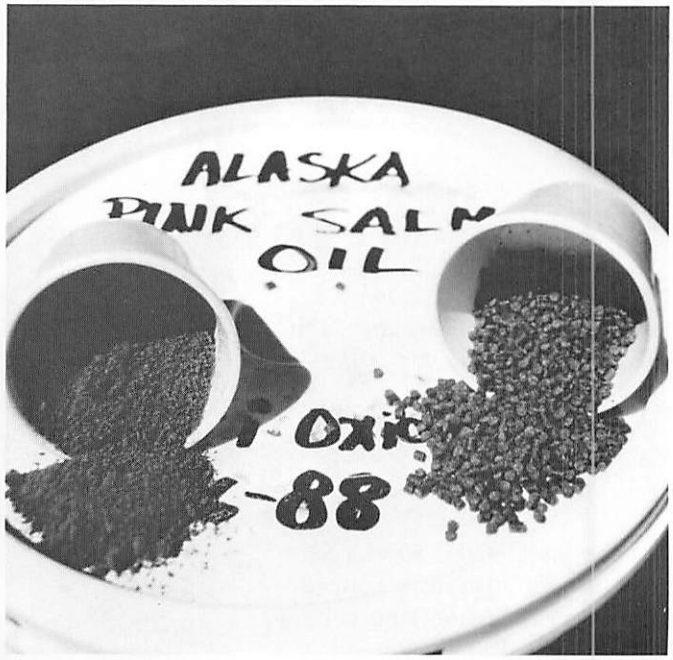
Since 1979, Alaska Sea Grant has planned and sponsored over twenty state, regional, national, and international meetings on North Pacific fisheries topics. Most meetings are carried out in cooperation with fisheries groups and agencies, and some are co-sponsored by partner Sea Grant programs.

Managers, Scientists Benefit

Topics have included scientific reviews of biological resources of the North Pacific, and international policy and management issues such as fisheries management, trade, and aquaculture. Fisheries resource managers use the presented data to build well-informed management plans. And since the gatherings are often science oriented, researchers from the United States and other countries get an opportunity to compare notes and stimulate ideas for further research. The meetings have enabled University of Alaska and other U.S. scientists to interact directly with experts from the People's Republic of China, Japan, South Korea, the Soviet Union, Poland, Chile, Argentina, Australia, New Zealand, and Canada.

The Lowell Wakefield Fisheries Symposium Series, begun in 1982, is the cornerstone of Alaska Sea Grant's information-sharing meetings. This series is co-sponsored by the National Marine Fisheries Service, North Pacific Fishery Management





High tech entrepreneurs in Astoria, Oregon, are among those businessmen developing new techniques to transform fish processing waste into marketable products. Fish parts are ground and liquified, dehydrated and heat-treated (left) to form high-protein Pasteurized Powdered Fish™, and dry pellets or tablets (above). Tests also include extraction and preservation of fish oil from Alaska pink salmon. The Alaska Fisheries Development Foundation is helping fund this promising research which, as technology is refined and markets developed, could add a new dimension to Alaska's seafood processing industry. The emerging fish by-product industry will be the topic of an international conference in 1990 co-sponsored by Alaska Sea Grant and AFDF.

Council, Alaska Department of Fish and Game, and Alaska Sea Grant. The meetings have focused on Pacific marine resources such as crab, sablefish, and pollock; and on seafood quality.

Soviets Participate

A particular coup of the Lowell Wakefield series has been the success in attracting Soviet scientists and officials. At first, arranging for Soviet attendance was difficult, and drew close scrutiny from U.S. security agencies. But now, "We don't even hear from the CIA or FBI anymore," says Brenda Melteff, Alaska Sea Grant coordinator responsible for development and coordination of Alaska Sea Grant's meetings. The progress is due largely to Melteff's success at establishing good working relationships with Soviet Embassy officials, today made even smoother by the influence of *glasnost*. Melteff notes that an increasing number of foreign governments realize the value of the Alaska Sea Grant meetings, and many now pay for their representatives' trips rather than accept Sea Grant financial assistance.

An added benefit of the scientific meetings is the publication of proceedings. These widely distributed books help disseminate hard-to-get scientific data from Soviet bloc and other countries.

One of the most significant international meetings, solely funded by Alaska Sea Grant, convened in Anchorage in 1986. At that meeting representatives of five major Pacific Rim countries, including the Soviet Union and People's Republic of China, revived the idea of an international organization to enhance cooperation in fisheries science, management, and oceanography of the North Pacific Ocean and Bering Sea. Formal government negotiations are nearly complete which would establish such an

organization, tentatively called the Pacific International Council for the Exploration of the Seas (PICES).

Alaska Sea Grant Director Ron Dearborn says the international status of meetings is due to one of two situations: Either the issue to be addressed is international, such as harvest and management of Bering Sea pollock, or the science to be discussed has been conducted by researchers from several countries, such as research on king crab or salmon.

Timely Issues Are Addressed

Often the topics of the Alaska Sea Grant meetings seem to anticipate upcoming fisheries issues. Dearborn explains that this apparent coincidence is the result of Alaska Sea Grant's good relationships and constant interactions with seafood industry and management groups, which signal potential issues and problems. For example, Alaska Sea Grant is concerned with the emerging issue of using fish harvest and processing waste. Every year, fishermen and processors discard fish parts approximately equivalent to one billion pounds of protein, an enormous loss in both nutrition and money.

This underutilization issue has been smoldering for years, spurring some hand-ringing in the industry but little action. Recognizing the problem, Alaska Sea Grant has seized the opportunity to become a leader among enlightened fisheries groups in finding ways to process and market fish harvesting and processing wastes. In cooperation with the Alaska Fisheries Development Foundation, Alaska Sea Grant is helping coordinate an April 1990 meeting called "Alaska's Billion Pounds of Protein." This international meeting will examine creative techniques to process fish wastes into marketable products such as fish food and fertilizer. The new methods will be freely available to industry, which should stimulate more seafood product manufacture in Alaska and elsewhere.

As the body of scientific information on marine resources builds, Alaska Sea Grant sponsored meetings will become more important in updating Pacific Rim scientists and resource managers, focusing current research, and inspiring new research and management programs. □

Mature chum salmon at Hidden Falls Hatchery near Sitka, Alaska. The Northern Southeast Regional Aquaculture Association, operator of the hatchery, is one of the organizations that cooperated with Alaska Sea Grant in planning the Fourth Alaska Aquaculture Conference in 1987. Attendees of the aquaculture conference represented state and federal agencies, fishermen's organizations, private businesses, and scientists. Meeting sessions concentrated on two subjects: the pros and cons of finfish culture in Alaska, and for-profit aquaculture of seaweed, shellfish, and finfish.

Communications Bolsters Public and Industry Knowledge of Ocean Resources

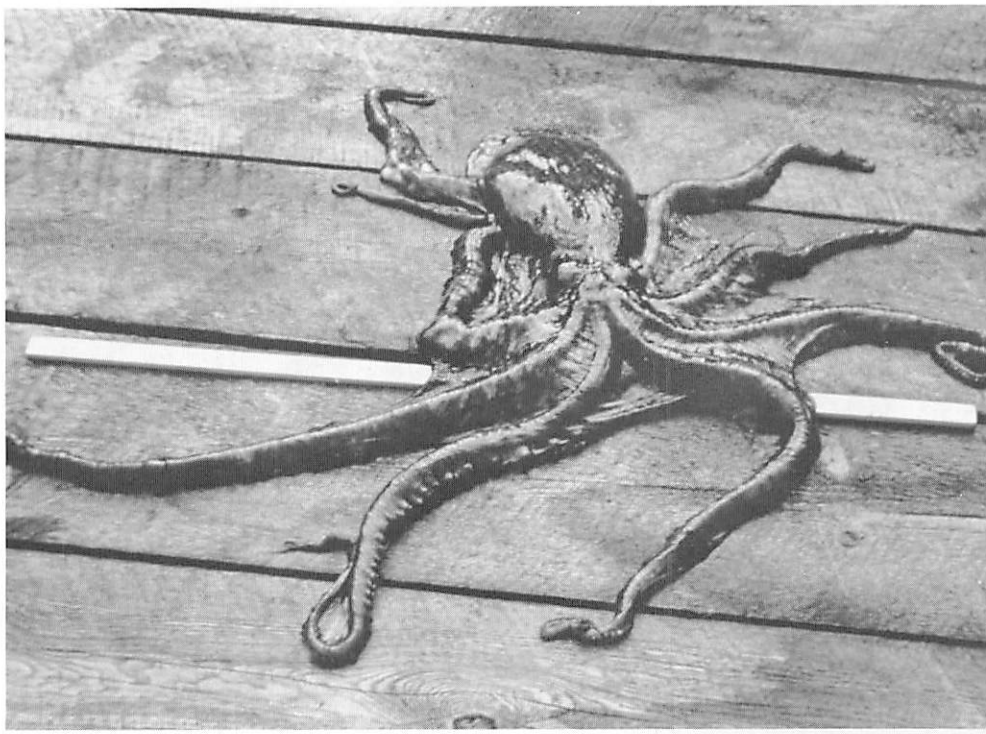
Alaska Sea Grant's public outreach is composed of two distinct but cooperative efforts. The Marine Advisory Program, headquartered in Anchorage, is our frontline outreach group. It employs field advisory agents and specialists in eight Alaska coastal locations. Public Information Services, located at the University of Alaska Fairbanks, has two divisions: Conferences and workshops, and communications. Conferences and workshops organizes scientific and technical conferences, and communications produces conference proceedings and other educational publications. Communications staff also disseminates information through news media and special projects, and represents Alaska Sea Grant at public and industry events. Following is an overview of communications' role within Alaska Sea Grant Public Information Services.

Alaska Sea Grant communicates, always listening and responding to the information needs of many groups. We listen to concerned citizens, lawmakers, academics, and policy makers as they look for ways to conserve, wisely use, and gain insights into Alaska's marine resources. We listen to school teachers who need marine education materials and to their students who need information for class projects. Perhaps most of all, we listen to the seafood industry as it looks for better and safer ways to catch, handle, preserve, and process the bounty of one of the world's most diverse and productive fisheries. And as we listen, we respond.

Helping the Marine Advisory Program

Alaska Sea Grant's communications division provides fishermen and processors with publications written by Marine Advisory personnel, produced by communications staff, and distributed by communications and the Marine Advisory Program. The publications answer such questions as: What is the best way to hang a gillnet? What are the sources for commercial loans for fishing operations? How should white fish be preserved on board a fishing vessel?

Since 1985, Alaska Sea Grant communicators edited, designed, printed, and distributed



One of Alaska Sea Grant's most popular recent Marine Advisory publications discusses the prospects for a commercially viable octopus fishery. State and national publicity has resulted in distribution of over 900 copies.

Top– A beach cleanup volunteer records quantity and type of shoreline debris found at Ketchikan, Alaska. In 1988, *Alaska Sea Grant communications* began a multi-faceted public education effort on marine debris. Highlights include a nationally acclaimed publication on marine debris, and a successful statewide beach cleanup project carried out in 1989 with the Alaska governor's office and other state groups. *Bottom–* A northern fur seal entangled in a net fragment on the Pribilof Islands. Researchers estimate that up to 30,000 fur seals die each year when they become entangled in marine debris.

thirty-three Marine Advisory Program booklets and fact sheets, all contributing to the vitality of Alaska's largest private enterprise.

Serving Scientists, Policy Makers

Alaska Sea Grant communicators respond to information needs of technical and scientific audiences. We compile, edit, and distribute proceedings of Alaska Sea Grant's unique series of international conferences on marine science and policy issues. Topics cover research on marine resources such as sablefish, salmon, and pollock, and policy issues such as international fisheries management and trade. This information is used by policy makers to plan marine resource management and by scientists to stay abreast of international developments in marine science. The communications staff also produces pre-conference materials such as announcements, agendas, and abstract booklets.

Communications produces technical reports on Sea Grant-sponsored workshops and cooperates with Sea Grant scientists to produce reports on research. These documents have specialized audiences. With advice from the authors, communicators identify audiences and notify them of the publications. New technical reports include two economic analyses of world salmon production and markets, and a report on the commercial feasiblity of octopus fishing. Recent technical workshop summaries cover a national workshop on commercial fisheries-generated marine debris and a meeting on commercial fishing vessel insurance and safe-

ty. Twenty-six technical reports have been produced since 1985.

As a service to Sea Grant researchers, the communications program paid for and distributed twenty-four refereed journal reprints. We also provided artwork for some of these journal articles.

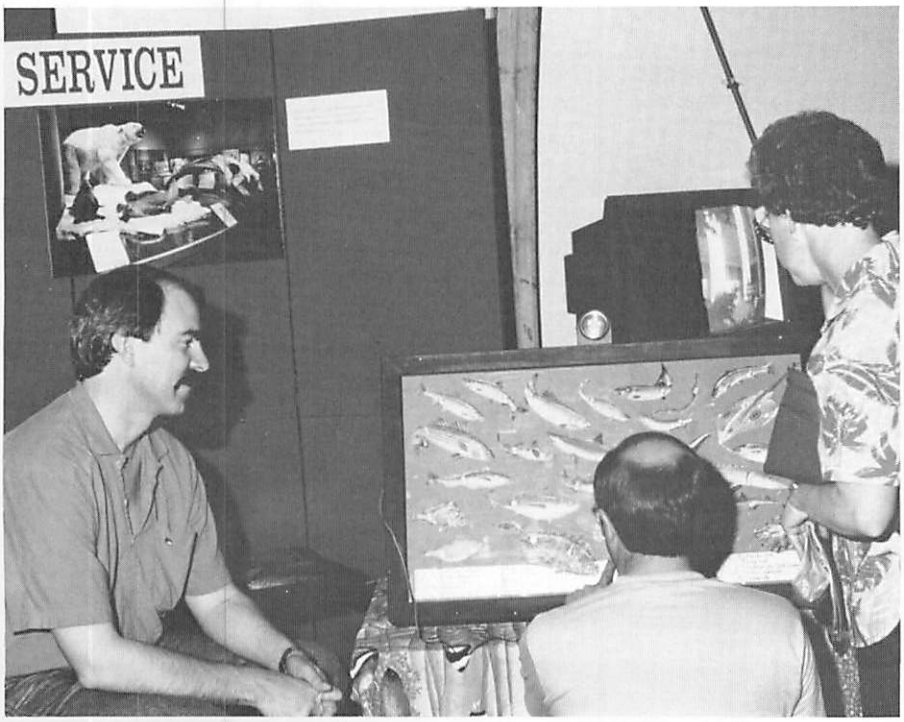
Keeping the Public Informed

Alaska Sea Grant communicators respond to the public's interest in marine resource topics through an ambitious media outreach effort and with public education materials. Since a science writer was hired in July 1988, over thirty news releases have been distributed. This has resulted in more than 120 articles in Alaska newspapers alone; more than ten articles in commercial fishing trade publications, including a two-part feature in a widely distributed trade paper; and many articles by news reporters spurred by our information. Diverse topics include the sources, effects, and solutions to the marine debris problem; economic developments in the commercial fishing industry; fishing vessel safety and accident fatalities; articles on new regulations that affect the fishing industry; and information on the Prince William Sound oil spill. Stories often refer to Alaska Sea Grant publications, which stimulate requests for our materials and thus extend benefits of Sea Grant's work. Recently produced public information materials include a brochure and two booklets on marine debris, and a richly illustrated, easy-to-read summary of a major economic study of the Alaska seafood industry.

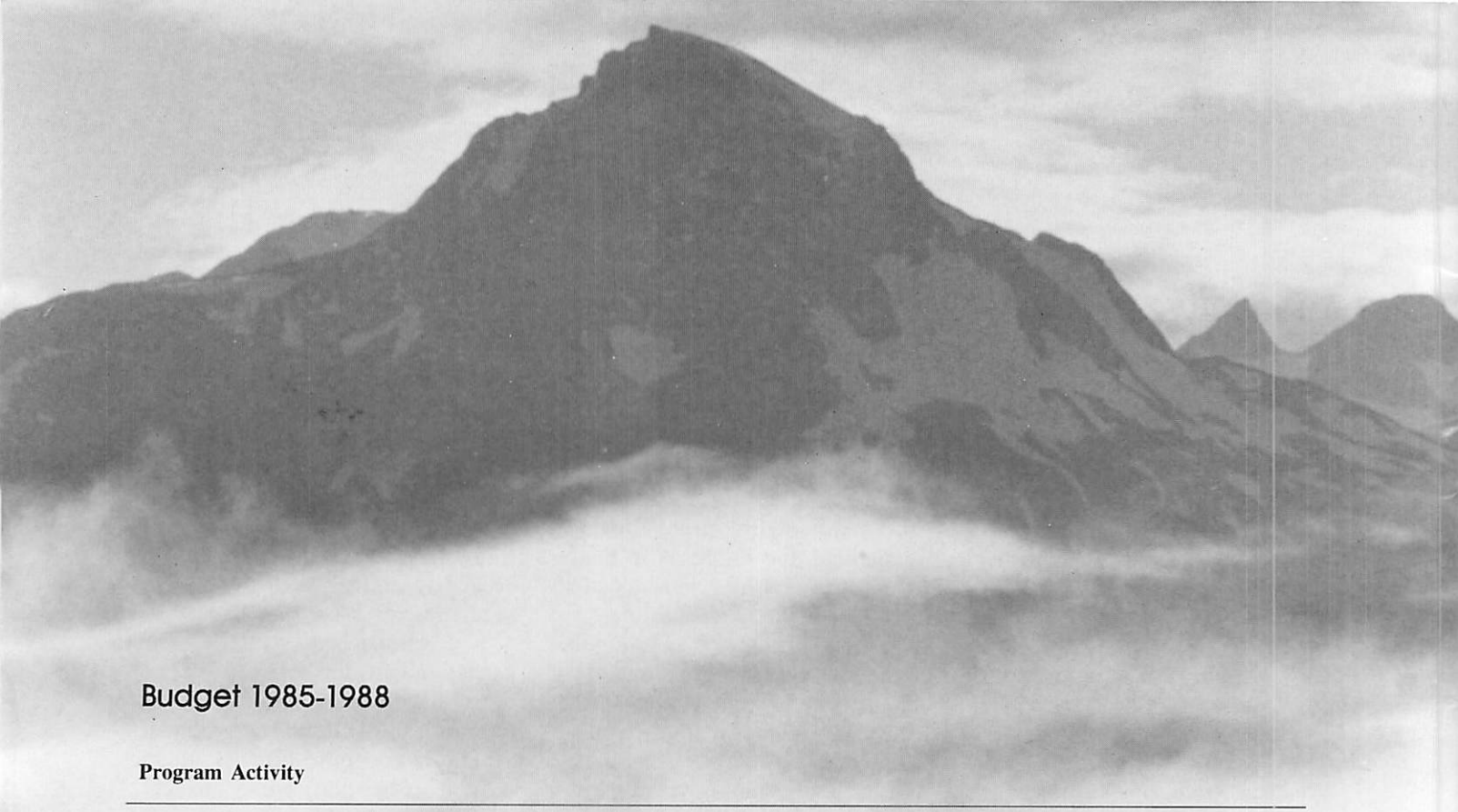
Recent figures show that communications fills orders for about 700 publications per month. Another 170 publications are distributed each month to groups and individuals who request automatic receipt of all new Alaska Sea Grant publications, and to entities such as trade magazines for promotional purposes.

Alaska Sea Grant's dissemination of information does not stop with printed materials. Communicators attend industry and public events to directly interact with fishermen, policy makers, educators, students, and interested citizens. The events often are good venues for display and distribution of Sea Grant information. Recent opportunities include an exhibit at a regional fair in Fairbanks; several displays at meetings of scientists, educators, and high school students at the University of Alaska Fairbanks; and attendance at industry-related events such as Pacific Fish Expo in Seattle, Washington; and ComFish '89 in Kodiak, Alaska, the state's largest commercial fishing trade show.

Alaska Sea Grant will continue to listen and respond to our varied audiences as we extend our proven communications activities and develop new ways to transfer information to public, business, academic, and government groups and individuals. □



Communications Manager Kurt Byers watches as 1988 Tanana Valley Fair-goers match *illustrations and fish names* on an electronic board, designed and built by communications staff.



Budget 1985-1988

Program Activity

	NA82AA-D-00044 1985		NA86AA-D-SG041 1986		NA86AA-D-SG041 1987		NA86AA-D-SG041 1988	
	Federal	Matching	Federal	Matching	Federal	Matching	Federal	Matching
Extension	537,500	1,199,200	543,683	466,973	568,258	529,152	539,716	370,412
Administration and Rapid Response	140,149	317,801	112,600	322,143	75,600	303,998	103,700	302,695
Education and Training	115,200	65,400	84,928	47,671	72,487	28,415	95,404	—
Research	519,200	—	503,080	42,054	564,798	30,184	493,166	42,804
Total	1,312,049	1,582,401	1,244,291	878,841	1,281,143	891,749	1,231,986	715,911

Cost Category

	NA82AA-D-00044 1985		NA86AA-D-SG041 1986		NA86AA-D-SG041 1987		NA86AA-D-SG041 1988	
	Federal	Matching	Federal	Matching	Federal	Matching	Federal	Matching
Salaries	625,126	644,770	615,834	303,532	574,735	281,901	592,229	389,458
Benefits	134,691	161,357	133,476	77,410	124,185	75,356	134,305	89,537
Permanent Equipment	11,470	2,100	8,500	—	12,700	—	42,800	—
Expendable Supplies	51,387	12,550	55,975	8,300	42,600	5,300	43,750	7,300
Travel	80,445	61,450	71,900	17,900	92,500	12,300	92,300	12,300
Contractual Services	272,997	82,082	220,865	43,732	295,008	24,908	188,925	25,000
Indirect	135,933	618,092	137,741	427,967	139,415	491,984	137,677	192,316
Total	1,312,049	1,582,401	1,244,291	878,841	1,281,143	891,749	1,231,986	715,911

Conferences, Workshops, and Symposia 1985-1988

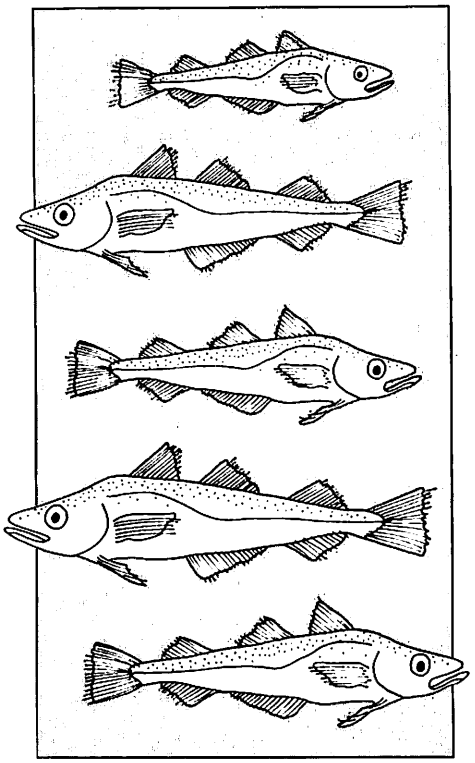
International King Crab Symposium
Lowell Wakefield Fisheries Symposium Series
January 22-24, 1985; Anchorage, Alaska
Scientific presentations and discussions on biology, management, and economics of king crab; participants from United States, Canada, Japan, Chile, Argentina
Co-sponsors: Alaska Department of Fish and Game (ADF&G), National Marine Fisheries Service (NMFS), North Pacific Fishery Management Council, The Crustacean Society

Western Groundfish Conference
February 9-12, 1986; Sitka, Alaska
Informal annual forum for researchers covering social, economic, ecological, oceanographic, and analytic studies; participants from Alaska, California, District of Columbia, Oregon, Washington

Pacific Rim Scientific Investigations and Exchanges
April 14-15, 1986; Anchorage, Alaska
Discussions on cooperative studies on North Pacific Ocean and Bering Sea resources; participants from United States, Canada, Japan, Soviet Union; observers from People's Republic of China

Workshop on Management Options for the North Pacific Longline Fisheries
April 21-25, 1986; Orcas Island, Washington
Presentations and discussions of fishery access control programs worldwide; participants from United States, Canada, Iceland, Norway, Italy, Australia, New Zealand, Japan
Co-sponsors: Oregon Sea Grant College Program, North Pacific Fishery Management Council

Workshop on Humpback Whale Photo Identification
April 30-May 2, 1986; Seattle, Washington
Discussions for development and implementation of a humpback whale photo identification program; participants from Alaska, California, Hawaii, Maine, Oregon, Washington, Canada, Mexico
Co-sponsor: NMFS National Marine Mammal Laboratory



International Rockfish Symposium
Lowell Wakefield Fisheries Symposium Series
October 20-22, 1986; Anchorage, Alaska
Scientific presentations and discussions on biology, ecology, and management of the rockfish complex; participants from Alaska, California, District of Columbia, Hawaii, Massachusetts, Oregon, Rhode Island, Washington, British Columbia, Newfoundland
Co-sponsors: ADF&G, NMFS, North Pacific Fishery Management Council

International Symposium on Seafood Quality Determination
Lowell Wakefield Fisheries Symposium Series
November 10-14, 1986; Anchorage, Alaska
Scientific and practical presentations on standardization of seafood quality indicators; participants from 15 nations and 19 states
Co-sponsors: MAP, Pacific Sea Grant College Program, Alaska Department of Environmental Conservation, National Fisheries Institute, NMFS, New York Sea Grant Institute, North Pacific Fishery Management Council, U.S. Food and Drug Adminstration, University of Alaska Foundation

National Workshop on Fishing Vessel Insurance and Safety
February 4-6, 1987; Washington, D.C.
National forum for discussions among fishermen, insurers, brokers, charter operators, safety trainers, and congressional staffers; participants from 23 states, District of Columbia, Canada, Great Britain
Co-sponsors: University of Southern California Sea Grant Program, National Council of Fishing Vessel Safety and Insurance

Fourth Alaska Aquaculture Conference
November 18-21, 1987; Sitka, Alaska
Technical presentations and hands-on demonstrations for Alaskans interested in for-profit culture of finfish, shellfish, and seaweeds; participants from Alaska, Washington, British Columbia

Northern Fur Seal Entanglement Research Workshop
January 28-30, 1988; Seattle, Washington
Discussions to review research relevant to the role of entanglement in the northern fur seal population decline; participants from Alaska, California, District of Columbia, Hawaii, Montana, Washington, Canada, Japan
Co-sponsors: NMFS National Marine Mammal Laboratory

Oceans of Plastic
February 9-11, 1988; Portland, Oregon
National workshop to discuss fishing generated marine debris and derelict fishing gear; participants from 14 states
Co-sponsors: nationwide Sea Grant network

International Symposium on the Biology and Management of Walleye Pollock
Lowell Wakefield Fisheries Symposium Series
November 14-16, 1988; Anchorage, Alaska
Scientific presentations and discussions on walleye pollock; participants from United States, Canada, Japan, Korea, Poland, Soviet Union
Co-sponsors: ADF&G, NMFS, North Pacific Fishery Management Council

Projects 1985-1988

R/02-10
Potential for Using Barriered Lakes Containing Rainbow Trout for Coho Smolt Production
Started 1983, completed 1985
R.A. Crone
Northern Southeast Regional Aquaculture Association

R/02-11
Potential for Genetic Improvement of Salmon
Started 1983, completed 1987
W.W. Smoker
A.J. Gharrett
M.S. Stekoll
University of Alaska

R/02-12
Infectivity and Pathology of *Chaetoceros* in Cultured Chinook Salmon
Started 1986, completed 1987
W.W. Smoker
T.R. Meyers
University of Alaska

R/02-13
Broodstock Improvement in a Pink Salmon Hatchery
Started 1987, continuing
W.W. Smoker
University of Alaska

R/02-14
Artificial Selection for Run Timing in Salmon Culture
Started 1988, continuing
W.W. Smoker
A.J. Gharrett
University of Alaska

R/06-19
Alaska Pollock Feeding Functions
Started 1983, completed 1985
R.L. Smith
University of Alaska

R/06-20
Alaska Dungeness Crab Biology and Parasitology
Started 1984, completed 1986
T.C. Shirley
T.R. Meyers
University of Alaska

R/06-21
Size at Maturity of Blue King Crab
Started and completed 1985
A.J. Paul
H.M. Feder
University of Alaska

R/06-22
Models of Fish Population Structure
Started and completed 1985
R.M. Fagen
University of Alaska

R/06-23
Cod and Pollock Energetics
Started 1985, completed 1987
R.L. Smith
A.J. Paul
University of Alaska

R/06-24
Temperature as a Predictor of Fishery Success in the Northern Gulf of Alaska
Started 1984, completed 1985
T.C. Royer
R.T. Cooney
University of Alaska

R/06-25
Economic Aspects of the Allocation of Fishery Resources
Started 1985, completed 1988
D.M. Larson
University of Alaska

R/06-26
Forecasting Catch and Abundance in the Salmon Net Fisheries of Alaska
Started 1986, completed 1987
T.J. Quinn
University of Alaska
P.R. Mundy
Alaska Department of Fish and Game

R/06-27
Size at Maturity for Alaskan Red King Crab
Started 1986, completed 1988
A.J. Paul
University of Alaska

R/06-28
Otolith Microstructure Investigations of Pacific Halibut
Started 1987, completed 1988
T.J. Quinn
University of Alaska

R/06-29
Handling Mortality of Dungeness Crabs
Started 1988, continuing
T.C. Shirley
University of Alaska

R/06-30
Energetics of Halibut, Yellowfin Sole, and Flathead Sole
Started 1988, continuing
R.L. Smith
A.J. Paul
University of Alaska

R/06-31
Fertilizing Effects of Salmon Escapements
Started 1988, continuing
O.A. Mathisen
University of Alaska

R/07-10
Factors Affecting Migration Timing of Bristol Bay Sockeye Salmon
Started 1983, completed 1985
T. Nishiyama
University of Alaska

R/07-11
Fisheries Oceanography--Benthic Processes
Started and completed 1987
R.K. Dearborn et al.
University of Alaska

R/07-12
Acoustic Studies of Forage Stocks in the Gulf of Alaska
Started 1988, continuing
R.T. Cooney
University of Alaska

R/08-01
Effects of Thyroid Hormone Smoltification in Salmon
Started 1988, continuing
S.O. Ebbeson
University of Alaska

R/14-09
Economic Impact of Farmed Salmon on the Alaska Commercial Fishing Industry
Started and completed 1985
B. Lin
University of Alaska

R/14-10
A Dynamic Simulation Model of the United States Pacific Halibut Fishery
Started 1987, completed 1988
A.H. Gorham
University of Alaska

R/14-11
Economic Impact Analysis for Alaska Coastal Communities
Started 1988, continuing
A.H. Gorham
University of Alaska

R/20-03
Safety Impacts of Alaska Fisheries Management
Started and completed 1987
G.P. Knapp
University of Alaska

R/30-01
Trawl Rigging for Incidental Catch Minimization
Started 1986, completed 1987
C.G. Bublitz
R.M. Fagen
University of Alaska
D. Amos
University of Georgia

R/35-06
Pacific Salmon Post-Mortem Biochemical Changes During Partially Frozen Storage
Started 1983, completed 1985
D.E. Kramer
J.S. French
J.M. Kennish
University of Alaska

R/35-07
Alaskan Seafood Microbiological Profiling
Started 1984, completed 1986
J.S. Lee
University of Alaska

R/35-08
Plant and Marine Waste Complementarity in Dairy Cattle Rations
Started 1985, completed 1986
L.B. Bruce
A.L. Brundage
University of Alaska

R/35-10
Control of Surimi Functionality Through Modification of Protein Composition
Started 1988, continuing
J.S. French
University of Alaska

R/35-11
Energy Use Assessment in Alaskan Seafood Processing Plants
Started 1988, continuing
J.C. Nash
C.G. Bublitz
University of Alaska

R/50-01
Interannual Variability of the Physical Environment and Fisheries of the Bering Sea
Started and completed 1988
H.J. Niebauer
University of Alaska

A/71-01
Alaska Marine Advisory Program
Started 1970, continuing
J.P. Doyle/D.E. Kramer
University of Alaska

A/75-01
Public Information Services
Started 1979, continuing
B.R. Melteff
T. Frady/K.M. Byers
University of Alaska

E/58-01
Food Science/Technology Bachelor of Science Program
Started 1984, completed 1986
J.S. French
University of Alaska

E/66-03
North Pacific Fishery Management Options: A Short Course
Started 1985, completed 1987
A.H. Gorham
University of Alaska

E/70-10
Sea Grant Traineeships
Started 1984, continuing
D.H. Rosenberg/R.K. Dearborn
University of Alaska

E/70-11
Sea Grant Fisheries Intern Program
Started 1984, completed 1986
D.H. Rosenberg/R.K. Dearborn
University of Alaska

M/79-01
Program Administration
Started 1970, continuing
D.H. Rosenberg/R.K. Dearborn
University of Alaska

M/81-01
Program Planning and Rapid Response
Started 1970, continuing
D.H. Rosenberg/R.K. Dearborn
University of Alaska

Graduate Students

Student	Project
Cynthia Beegle	R/06-24
Paul Burns	E/70-10
Benjamin Carney	E/70-10
Robert Day	R/50-01
Craig Farrington	R/02-12
Peter Hagen	R/06-28
Helen Hamner	E/70-10
Ron Heintz	R/02-10
Tom Henderson	E/70-10
James James	R/02-11
John Joyce	R/02-11
Michael Kelley	E/70-10
Thomas Kline	R/06-31
Christine Kondzela	R/06-20
Robert Marshall	R/06-26
Wieslaw Maslowski	R/06-26
Gregg McNeil	R/35-06
Cynthia Morrow	E/70-10
Njorge Muigwa	E/70-10
Bonita Nelson	E/70-10
Pamela Porter	E/70-10
Peter Ribbens	E/70-10
Charles Russell	R/02-13
Paul Schwartz	R/35-06
Andy Smoker	E/70-10
Elizabeth Stockmar	R/07-12
Loren Tuttle	E/70-10
B. Ward	R/30-01
Jane Whitsett	R/35-06
Mark Willette	R/06-24, R/07-10
Shynn-Ping Yeh	E/70-10
Jie Zheng	E/70-10

Publications 1985-1988
(Project number in parentheses)

Marine Advisory Bulletins
(A/71-01)

Fisherman's Record-Keeping System for Income Taxes (Neqsurtem Qemangqaillerkaa Income Tax-Aam Kalikainek)
C.S. Wiese
MAB-15, 1985, 14 pp.
Bilingual: English and Yupik

Market Structure and Marketing Potential for Kotzebue Chum Salmon
D.A. Garza
MAB-16, 1985, 120 pp.

Alaska Oyster Grower's Manual
P.V. Else and B. Paust
MAB-17, Revised 1987, 206 pp.

Care of Halibut Aboard the Fishing Vessel
D.E. Kramer and B.C. Paust
MAB-18, 1985, 30 pp.

Chilled Seawater Systems: Installation and Operation on Alaskan Vessels
C. Crapo
MAB-19, 1985, 20 pp.

Quality Handling of Hook-Caught Rockfish
B. Paust and J. Svensson
MAB-20, 1986, 18 pp.

Refrigeration Options for Small Boat Fishermen
C. Crapo
MAB-21, 1986, 18 pp.

Homer, Alaska Charter Fishing Industry Study
D.D. Coughenower
MAB-22, 1986, 44 pp.

Salmon Quality: The Effects of Delayed Chilling
C. Crapo, D.E. Kramer and J.P. Doyle
MAB-23, Revised 1988, 8 pp.

Marine Mammal Management in Alaska: State vs. Federal
D. Garza
MAB-24, 1986, 39 pp.

Guide to Northeast Pacific Rockfishes: Genera *Sebastes* and *Sebastolobus*
D.E. Kramer and V.M. O'Connell
MAB-25, Revised 1988, 78 pp.

World Salmon Farming: An Overview with Emphasis on Possibilities and Problems in Alaska
C. Kerns
MAB-26, 1986, 43 pp.

Seaweed Cultivation in Minamikayabe, Hokkaido, Japan: Potential for Similar Mariculture in Southeastern Alaska
W.M. Olson
MAB-27, 1987, 23 pp.

White Fish Processing Manual
C. Jensen
MAB-28, 1987, 75 pp.

Gillnet Hanging
P. Cullenberg
MAB-29, 1987, 17 pp.

Borrowing: A Guide for Alaska Commercial Fishermen
C.S. Wiese
MAB-30, 1987, 76 pp.

Self-Insurance Programs for the Commercial Fishing Industry: Workshop Summary Report
D. Nixon, R. Moran and C. Philbrick, eds.
MAB-31, 1987, 34 pp.

Air Shipment of Fresh Fish: A Primer for Shippers and Cargo Handlers
C. Crapo and B. Paust
MAB-32, 1987, 30 pp.

Commercial Fishing Industry Study: Homer, Alaska
D.D. Coughenower
MAB-33, 1987, 27 pp.

Salmon Quality: The Effects of Elevated Refrigerated Seawater Chilling Temperatures
C. Crapo and E. Elliot
MAB-34, 1987, 12 pp.

Charter Boat Services in Alaska for People with Physical Disabilities
D.D. Coughenower
MAB-35, 1988, 60 pp.

Handbook on White Fish Handling Aboard Fishing Vessels
J.P. Doyle and C. Jensen
MAB-36, 1988, 70 pp.

Recoveries and Yields from Pacific Fish and Shellfish
C. Crapo, B. Paust and J. Babbitt
MAB-37, 1988, 50 pp.

Education Publication
(A/75-01)

Persistent Marine Debris: Challenge and Response: The Federal Perspective
D. Cottingham
SG-ED-01, 1988, 41 pp.

Technical Reports

Proceedings of Maritime Alaska '84: The Second Conference on Maritime Commerce and Port Development
N. Mollett, ed.
AK-SG-85-01, 1985, 209 pp.
(A/75-01)

Proceedings of the Conference on Fisheries Management: Issues and Options
T. Frady, ed.
AK-SG-85-02, 1985, 429 pp.
(A/75-01)

Proceedings of the Symposium on Dungeness Crab Biology and Management
B.R. Melteff, coordinator
AK-SG-85-03, 1985, 424 pp.
(A/75-01)

Diet Development for Post-Larval Pink and Chum Salmon Held in Salt Water
C.L. Kerns
AK-SG-85-04, 1985, 48 pp.
(R/02-06)

Alaska Sea Grant College Program Annual Report 1982-1983
D.H. Rosenberg
AK-SG-85-05, 1985, 37 pp.
(M/79-01)

Some Aspects of the Reproductive Biology of the Crab *Chionoecetes bairdi*: Final Project Report
A.E. Adams
AK-SG-85-06, 1985, 10 pp.
(R/06-11)

Subsea Permafrost: Probing, Thermal Regime and Data Analyses 1975-1981
T.E. Osterkamp and W.D. Harrison
AK-SG-85-07, 1985, 108 pp.
(R/22-02)

Alaska Sea Grant College Program Annual Report 1984
AK-SG-85-08, 1985, 46 pp.
(M/79-01)

Genetic Interaction of Auke Creek Hatchery Pink Salmon with Natural Spawning Stocks in Auke Creek
A.J. Gharrett
AK-SG-85-09, 1985, 40 pp.
(R/02-05)

Trawl Fisherman's Gear Technology Manual
D. Amos
AK-SG-85-10, 1985, 74 pp.
(RR/84-01)

Alaska Sea Week Curriculum Series II: Animals of the Seas and Wetlands
B.H. Mickelson
AK-SG-85-11, 1985, 154 pp. + worksheets
(E/70-08)

Proceedings of the International King Crab Symposium
B.R. Melteff, coordinator
AK-SG-85-12, 1985, 507 pp.
(A/75-01)

Salmon Shark Manual: The Development of a Commercial Salmon Shark, *Lamna ditropis*, Fishery in the North Pacific
B. Paust and R. Smith
AK-SG-86-01, 1986, 430 pp.
(A/71-01)

Encrusting Barnacles as Ageable Tags on Gulf of Alaska *Chionoecetes bairdi* (Decapoda)
J.M. Paul and A.J. Paul
AK-SG-86-02, 1986, 28 pp.
(R/06-18)

The Marketing Relationship Between Pacific and Pen-Raised Salmon: A Survey of U.S. Seafood Wholesalers
R.V. Rogness and B.-H. Lin
AK-SG-86-03, 1986, 24 pp.
(R/14-09)

Fishery Access Control Programs Worldwide: Proceedings of the Workshop on Management Options for the North Pacific Longline Fisheries
N. Mollett, ed.
AK-SG-86-04, 1986, 374 pp.
(E/66-03)

Workshop on Humpback Whale Photo Identification: A Summary of Proceedings
T. Frady, ed.
AK-SG-87-01, 1987, 12 pp.
(A/75-01)

Proceedings of the International Rockfish Symposium
B.R. Melteff, coordinator
AK-SG-87-02, 1987, 393 pp.
(A/75-01)

Developments in Food Science: Seafood Quality Determination
D.E. Kramer and J. Liston
AK-SG-87-03, 1987, 677 pp.
(A/71-01)

Alaska Sea Week Curriculum Series V: Birds and Wetlands of Alaska
J.G. King and M.L. King
AK-SG-88-01, 1988, 84 pp. + worksheets and field guide
(E/70-08)

Summary Proceedings of the National Workshop on Fishing Vessel Insurance and Safety
AK-SG-88-02, 1988, 173 pp.
(A/75-01)

Fishing for Octopus: A Guide for Commercial Fishermen
B. Paust
AK-SG-88-03, 1988, 48 pp.
(A/71-01)

Proceedings of the Fourth Alaska Aquaculture Conference
S. Keller, ed.
AK-SG-88-04, 1988, 236 pp.
(A/75-01)

An Econometric Analysis of Atlantic Salmon Markets in the United States and France
B.-H. Lin and M. Herrmann
AK-SG-88-05, 1988, 19 pp.
(R/14-09)

The Demand for Atlantic Salmon in Canada: Issues of Functional Form and Parameter Stability
B.-H. Lin
AK-SG-88-06, 1988, 11 pp.
(R/14-09)

Oceans of Plastic: Report on a Workshop on Fisheries-Generated Marine Debris and Derelict Fishing Gear
AK-SG-88-07, 1988, 68 pp.
(A/75-01)

Aquaculture Notes
(A/71-01)

Where to Get More Information on Farming Salmon and Trout in Net Pens
C. Kerns
AN-08, 1985, 19 pp.

Where to Get More Information on Small-Scale Aquaculture
C. Kerns
AN-09, 1987, 9 pp.

Where to Get More Information on Scallop Aquaculture
C. Kerns
AN-10, 1987, 10 pp.

Where to Get More Information on Farming Marine Algae in High Latitude Waters
C. Kerns
AN-11, 1987, 54 pp.

Salmon Farming: A Profile
C. Kerns
AN-12, 1988, 9 pp.

Fish Farming: B.C.'s New Venture on the Coast
AN-13, 1988, 4 pp.

Sea Grams

Sole Trawling in the Bering Sea: Some Practical Guidelines for Operation and Reducing By-Catch of Prohibited Species
R.B. Fisher
ASG-25, 1985, 12 pp.
(A/75-01)

Preventing and Treating Back Injuries
D. Wing and B. Perry
ASG-26, 1987, 4 pp.
(A/71-01)

Tendonitis and Related Afflictions in Fishermen and Processing Workers
R. Steiner and A.M. Embick
ASG-27, 1987, 4 pp.
(A/71-01)

Catch and Release Fishing
ASG-29, 1987, brochure
(A/75-01)

Reprints

Breeding and Fertile Period for Female *Chionoecetes bairdi* (Decapoda, Majidae)
In *Journal of Crustacean Biology*, 4(4):589-594
A.J. Paul and A.E. Adams
RP-85-01, 1984
(R/06-11)

First Adult Return of Pink Salmon Tagged as Emergents with Binary-Coded Wires
In *Transactions of the American Fisheries Society*, 113(6):803-804
F.P. Thrower and W.W. Smoker
RP-85-02, 1984
(R/01-09)

Application of Van Soest Acid Detergent Fiber Method for Analysis of Shellfish Chitin
In *Journal of Dairy Science*, 68:1502-1506
R.L. Stelmock, F.M. Husby and A.L. Brundage
RP-85-03, 1985
(R/35-01)

A Genetic Examination of Spawning Methodology in a Salmon Hatchery
In *Aquaculture*, 47:245-256
A.J. Gharrett and S.M. Shirley
RP-85-04, 1985
(R/02-11)

Prevalence of the Parasitic Barnacle *Briarosaccus callosus* on King Crabs of Southeastern Alaska
In *Transactions of the American Fisheries Society*, 115(2):252-257
C.R. Hawkes, T.R. Meyers, T.C. Shirley and T.M. Koeneman
RP-86-01, 1986
(RC/84-04)

Respiration of Juvenile Pollock, *Theragra chalcogramma* (Pallas), Relative to Body Size and Temperature
In *Journal of Experimental Marine Biology and Ecology*, 97:287-293
A.J. Paul
RP-86-02, 1986
(R/06-23)

Length-Weight Relationships of Blue, *Paralithodes platypus*, and Golden, *Lithodes aequispina*, King Crabs Parasitized by the Rhizocephalan, *Briarosaccus callosus* Boschma
In *Fishery Bulletin*, 84(2):327-332
C.R. Hawkes, T.R. Meyers and T.C. Shirley
RP-86-03, 1986
(RC/84-04)

Effect of Food Intake and Temperature on Growth and Conversion Efficiency of Juvenile Walleye Pollock (*Theragra chalcogramma* [Pallas]): A Laboratory Study
In *Journal du Conseil International pour l'Exploration de la Mer*, 42:241-253
R.L. Smith, A.J. Paul and J.M. Paul
RP-86-04, 1986
(R/06-09)

Mortality of Spot Shrimp Associated with Streamer Tags
In *North American Journal of Fisheries Management*, 6(2):260-265
S.C. Jewett
RP-86-05, 1986
(RR81/82-08)

Carbon, Nitrogen and Caloric Content of Eggs, Larvae, and Juveniles of the Walleye Pollock, *Theragra chalcogramma*
In *Journal of Fish Biology*, 29:87-98
R.K. Harris, T. Nishiyama and A.J. Paul
RP-86-06, 1986
(R/06-23)

Hemolymph Responses of Alaskan King Crabs to Rhizocephalan Parasitism
In *Canadian Journal of Zoology*, 64(8):1774-1781
S.M. Shirley, T.C. Shirley and T.R. Meyers
RP-86-07, 1986
(RC/84-04)

Growth of Alaskan Blue King Crabs, *Paralithodes platypus* (Brandt), Parasitized by the Rhizocephalan *Briarosaccus callosus* Boschma
In *Crustaceana*, 52(1):78-84
C.R. Hawkes, T.R. Meyers and T.C. Shirley
RP-87-01, 1987
(RC/84-04)

Genetic Relationships Among Populations of Alaskan Chinook Salmon (*Oncorhynchus tschawytscha*)
In *Canadian Journal of Fisheries and Aquatic Sciences*, 44(4):765-774
A.J. Gharrett, S.M. Shirley and J.R. Tromble
RP-87-02, 1987
(R/06-17)

Latitudinal Variation in the Dungeness Crab, *Cancer magister*: Zoeal Morphology Explained by Incubation Temperature
In *Marine Biology*, 95(3):371-376
S.M. Shirley, T.C. Shirley and S.D. Rice
RP-87-03, 1987
(R/06-20)

Genetic Changes in Pink Salmon (*Oncorhynchus gorbuscha*) Following Their Introduction into the Great Lakes
In *Canadian Journal of Fisheries and Aquatic Sciences*, 44(4):787-792
A.J. Gharrett and M.A. Thomason
RP-87-04, 1987
(R/02-05, R/02-11)

Circuli Spacing and Annulus Formation: Is There More Than Meets the Eye? The Case for Sockeye Salmon, *Oncorhynchus nerka*
In *Journal of Fish Biology*, 32:237-245
W.E. Barber and R.J. Walker
RP-88-01, 1988
(M/80-01)

An Analysis of the Exvessel Demand for Pacific Halibut
In *Marine Resource Economics*, 4:305-314
B.-H. Lin, H.S. Richards and J.M. Terry
RP-88-02, 1988
(R/14-09)

Appendage Injury in Dungeness Crabs, *Cancer magister*, in Southeastern Alaska
In *Fishery Bulletin*, 86(1):156-160
S.M. Shirley and T.C. Shirley
RP-88-03, 1988
(R/06-20)

Effects of El Nino-Southern Oscillation and North Pacific Weather Patterns on Interannual Variability in the Subarctic Bering Sea
In *Journal of Geophysical Research*, 93(C5):5051-5068
N.J. Niebauer
RP-88-04, 1988
(RR/85-09, RR/86-06)

Estimation of Average Weight and Biomass of Pink, Chum, Sockeye and Coho Salmon in Southeast Alaska Commercial Harvests
In *Fishery Research Bulletin*, 88-07, pp. 1-52
R.P. Marshall and T.J. Quinn II
RP-88-05, 1988
(R/06-26)

Aspects of Energetics of Adult Walleye Pollock *Theragra chalcogramma* (Pallas), from Alaska
In *Journal of Fish Biology*, 33:445-454
R.L. Smith, A.J. Paul and J.M. Paul
RP-88-06, 1988
(R/06-23)

Exact Welfare Measurement for Producers Under Uncertainty
In *American Journal of Agricultural Economics*, 70(3):597-603
D. Larson
RP-88-07, 1988
(R/14-08)

Respiratory Energy Requirements of the Cod *Gadus macrocephalus* Tilesius Relative to Body Size, Food Intake, and Temperature
In *Journal of Experimental Marine Biology and Ecology*, 122:83-89
A.J. Paul, J.M. Paul and R.L. Smith
RP-88-08, 1988
(R/06-23)

Temporal Changes in the Sediment Geochemistry of Two Southeast Alaskan Fjords
In *Deep-Sea Research*, 34(5/6):913-925
S.F. Sugai
RP-88-09, 1988
(E/70-10)

Administrative Publications
(A/75-01)

Alaska Sea Grant College Program Project Directory, 1985
AK-ADMIN-12, 1985, 20 pp.

Alaska Sea Grant College Program Publications Directory, 1986
AK-ADMIN-13, 1986, 54 pp.

Alaska Sea Grant College Program Project Directory, 1986
AK-ADMIN-14, 1986, 20 pp.

Alaska Sea Grant College Program Publications Directory, 1987-1988
AK-ADMIN-15, 1987, 59 pp.

Alaska Sea Grant College Program Project Directory, 1988
AK-ADMIN-16, 1988, 20 pp.

Theses and Dissertations

Processes Controlling Trace Metal and Nutrient Geochemistry in Two Southeast Alaskan Fjords
Ph.D. Dissertation, University of Alaska
S. Sugai
SGT-85-01, 1985, 153 pp.
(E/70-10)

The Implementation and Evaluation of a Genetic Mark in a Hatchery Stock of Pink Salmon (*Oncorhynchus gorbuscha*) in Southeast Alaska
Masters Thesis, University of Alaska
S. Lane
SGT-85-02, 1984, 117 pp.
(R/02-11)

The Effects of Ocean Temperatures on the Survival of the Odd- and Even-Year Pink Salmon (*Oncorhynchus gorbuscha*) Populations Originating from Prince William Sound, Alaska
Masters Thesis, University of Alaska
T.M. Willette
SGT-85-03, 1985, 115 pp.
(R/06-24, R/07-10)

Survival, Feeding, and Growth of Juvenile Dungeness Crabs from Southeastern Alaska at Different Temperatures
Masters Thesis, University of Alaska
C.M. Kondzela
SGT-86-01, 1986, 80 pp.
(R/06-20)

Population Parameters of the Rougheye Rockfish (*Sebastes aleutianus*)
Masters Thesis, University of Alaska
B.D. Nelson
SGT-86-02, 1986, 103 pp.
(E/70-10)

Bioengineering Evaluation of Chilled Recirculating Incubation of Chum Salmon (*Oncorhynchus keta*) at Salmon Creek Hatchery, Juneau, Alaska
Masters Thesis, University of Alaska
P.E. Drury
SGT-87-01, 1987, 119 pp.
(E/70-10)

Mortality and Pathology of Juvenile Chinook Salmon (*Oncorhynchus tschawytscha*) and Chum Salmon (*Oncorhynchus keta*) Exposed to Cultures of the Marine Diatom *Chaetoceros convolutus*
Masters Thesis, University of Alaska
C.W. Farrington
SGT-88-01, 1988, 80 pp.
(R/02-12)

To order publications or a free catalog of these publications, or to be added to our new publication announcement list, contact Alaska Sea Grant Communications, University of Alaska Fairbanks, 138 Irving II, Fairbanks, AK 99775-5040. Telephone (907) 474-7086.

Marine Advisory Videos 1985-1988

Program lengths are described in minutes and seconds.

Halibut Dressing
How to clean and store a halibut on a commercial fishing vessel. 7:53.
MAPV-5, 1985

Foreign High Seas Interception
Discusses the interception of salmon by the Japanese on the high seas. 29:00.
MAPV-6, 1986

Americanization
Discusses how the commercial groundfish industry is changing within the two hundred mile zone. 59:00.
MAPV-7, 1986

Mining and the Environment
Discusses the environmental effects of mining. 29:11.
MAPV-8, 1986

Arctic National Wildlife Refuge
Discusses whether or not ANWR should be open to oil exploration and development. 59:00.
MAPV-10, 1987

Marine Survival Equipment and Maintenance
Lists, describes, and explains maintenance of four pieces of safety and survival equipment that should be kept on board a vessel. 11:12.
MAPV-11, 1987

Logging in Alaska
Discusses forest management, focusing on the Tongass National Forest in Southeast Alaska. 59:30.
MAPV-12, 1987

Hanging a Gillnet
The basics of how to hang a gillnet. 18:00.
MAPV-13, 1987

Marine Mammal Management
Discusses who should manage the marine mammal program in Alaska, and how it should be managed. 57:00.
MAPV-14, 1987

Trashing the Oceans
Describes sources of marine debris and the damage it creates. Also mentions a few solutions being tried. 8:00.
MAPV-15, 1988

Salmon Farming: Boom or Bust
Includes the arguments of scientists, homeowners, mariculturists, politicians, and fishermen over the benefits and disadvantages of salmon farms. 57:58.
MAPV-16, 1988

Frostbite and Other Cold Injuries
Defines cause, identification, prevention, and treatment for four types of cold injuries. 16:00.
MAPV-17, 1988

For more information about these videos or to order contact: Marine Advisory Program, Carlton Trust Building, 2221 E. Northern Lights Blvd., Suite 220, Anchorage, AK 99508-4143. Telephone (907) 274-9691.

UNIVERSITY OF ALASKA FAIRBANKS