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On the Columbia River, where much of the habitat has been lost, and the series of dams poses a severe barrier to downstream migration of juvenile salmon, most people believe that we must have hatcheries. I am not convinced. The most successful salmon stock on the Columbia is the wild spawning chinook of the Hanford Reach, the one free flowing section of the main river. If we devoted all of the resources that now go into hatcheries on the Columbia to improving the downstream passage of fish, and to habitat protection, we might be quite surprised what the natural spawning fish would do if given a chance.

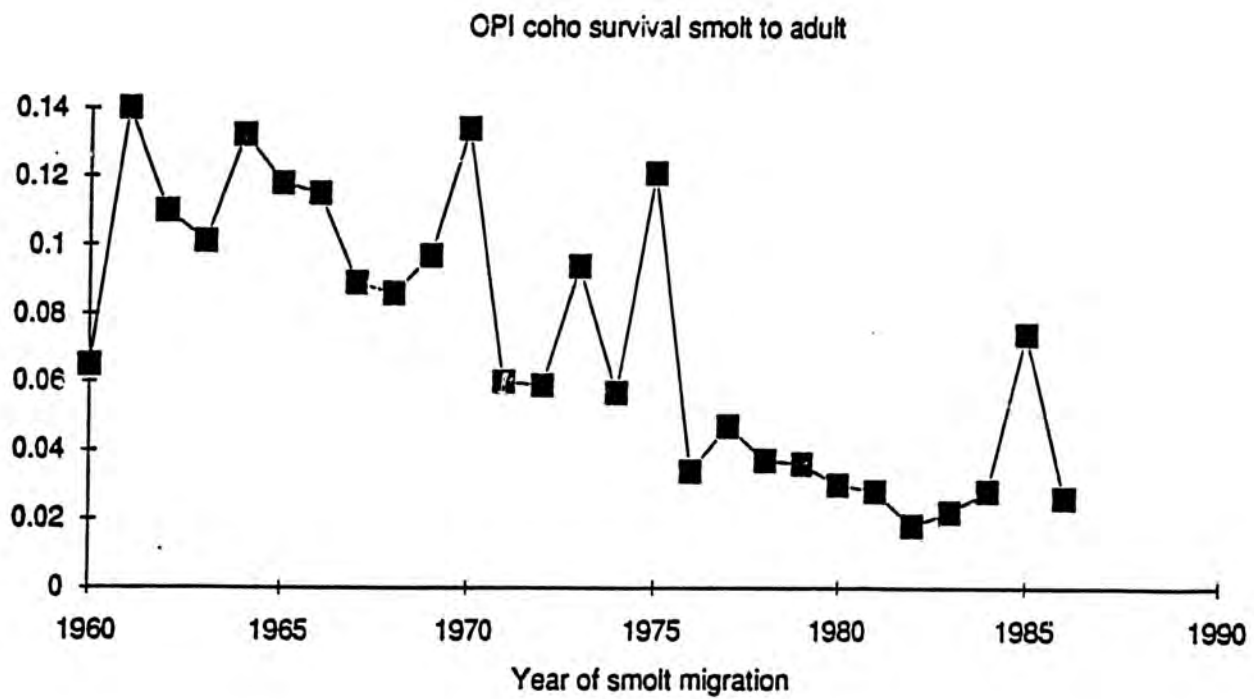
I do believe we should declare a moratorium on building of new hatcheries. We have taken an enormous gamble with our children's heritage. Now we must find out what we are doing to the wild fish, how to preserve them, and rebuild them. Michael Goodman has proposed that hatcheries must have a federal license that is reviewed periodically. Hatcheries that don't produce adult fish, and those that cause serious adverse impacts on wild fish would be shut down. I believe this is an excellent proposal.

As I look out my window at another group of school children touring our hatchery I wonder what kind of salmon their children will see. Will their world be one of high technology, with genetically engineered fish returning to computer controlled hatcheries, or will we maintain and improve our wild streams? Will their classes visit streams instead of hatcheries? Instead of imitating hatcheries by rearing fish in classrooms will the school children of the future adopt sections of streams for protection, know what wild spawning salmon need and make sure they have it?

Further Readings

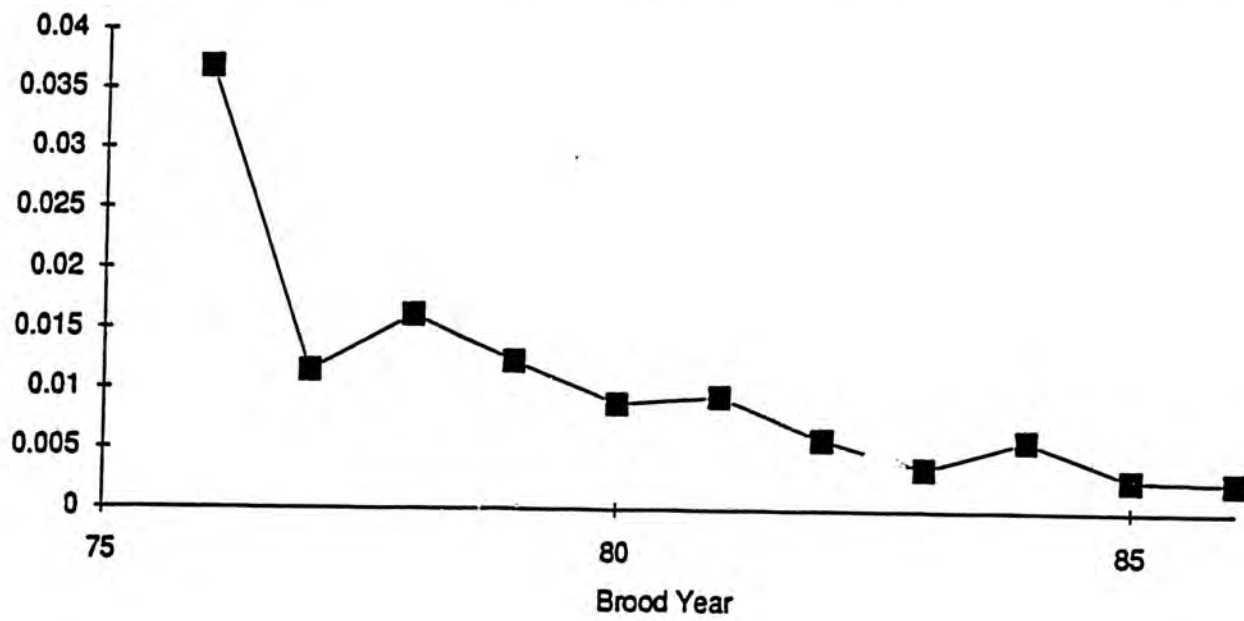
Those interested in knowing more about wild and hatchery fish should read "Mountains in the Clouds" by Bruce Brown, "We're going wild" a 30-year transition from hatcheries to habitat" by Ray J. White Trout Magazine, Summer 1989, and "Preserving the genetic diversity of salmonid stocks: a call for federal regulation of hatchery programs" by Michael L. Goodman, in Environmental Law Vol 20.

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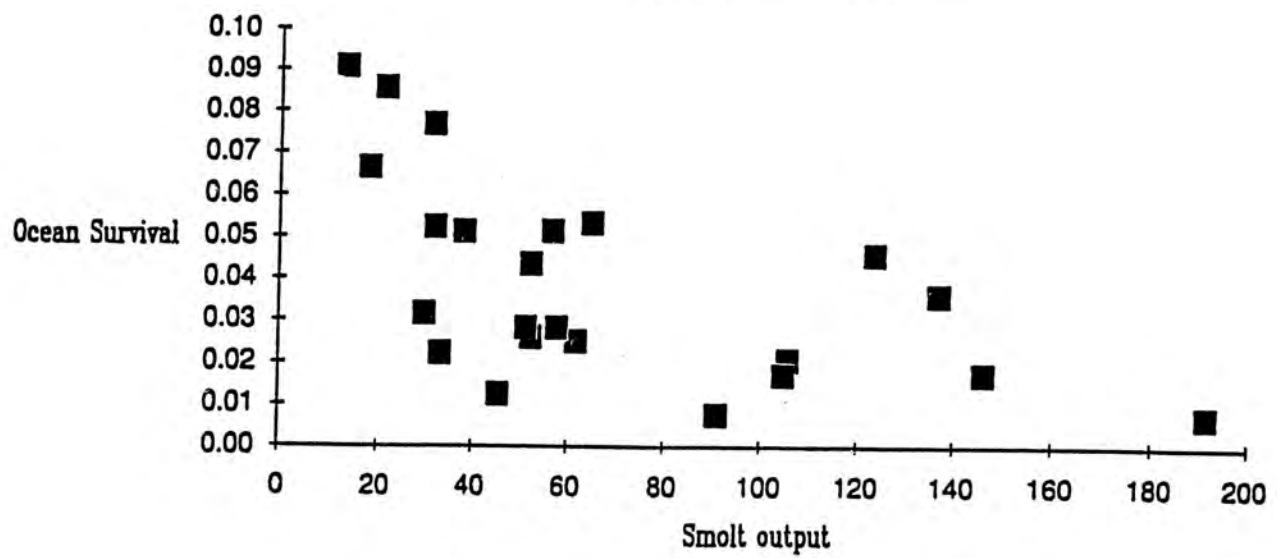
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Canadian Hatchery Chinook Contribution Rate



BABINE.XLC

Babine lake 1959-1981



Taming T·H·E Wild Salmon

As natural stocks dwindle, aquatic farming holds new promise—and problems—for fish production

BY JON VARA

THE STELLWAGEN BANK SEASCAPE is representative of most views of this watery planet: an unbroken sweep of ocean water and sky. On this October morning, however, the view is not a distant one. There are 3-to-6-foot seas running, and a thick mist, leaking cold drizzle, hangs close to the water.

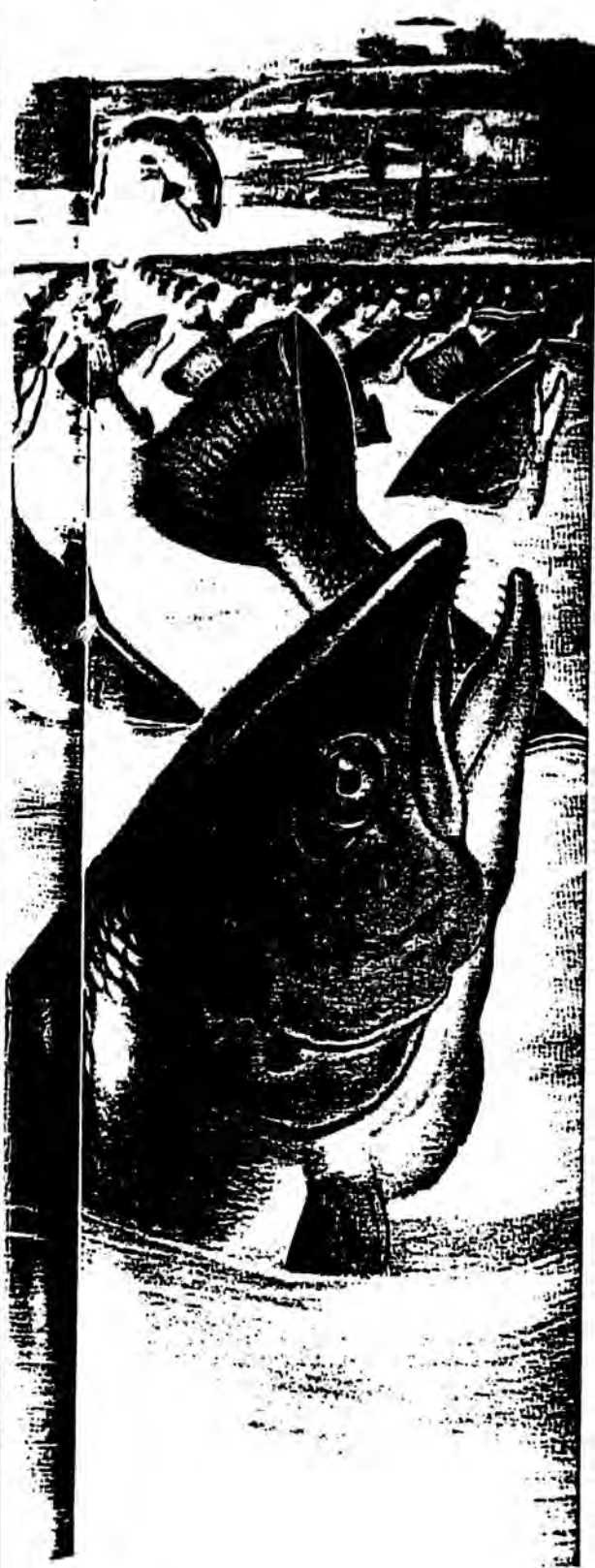
"It's not much of a day," Captain Frank Mirarchi had said as the *Christopher Andrew* eased out of Scituate Harbor, two hours before dawn. Mirarchi has a bad cold. A little more wind and rain, he says, and he could have stayed at home in bed with a clear conscience. Unprepossessing as it is, however, the day is too valuable to squander. Once winter sets in, Mirarchi knows, he'll be doing well to fish two or three days a week.

Stellwagen Bank—or Middle Bank, as it is better known to fishermen—is a submerged shoal that trends north from the northern terminus of Cape Cod. Mirarchi has been steering a course along the eastern slope of the bank for three hours, the funnel-shaped trawl net bumping unseen over the seabed, 120 feet below.

Long enough, he decides. He throttles back the engine—an action that instantly brings crewman Peter Downes scrambling from a bunk below—and climbs into his foul-weather gear. Mirarchi operates the winches and Downes manipulates heavy cables, chains and ropes through a practiced series of steps that culminates 15 minutes later as the overhead winch on the gallows frame winds in the last of the netting and brings the cod end—the baglike closed end of the funnel-shaped bottom trawl—up the steep stern ramp and onto the deck.

The trawl contains about 600 pounds of mixed fish. A third of it consists of skates, sea robins and undersized market species. They reset the trawl. Fish picks in hand—implements that resemble a policeman's nightstick with a 20-penny nail driven crosswise through the end—Mirarchi and Downes wade into the flopping mound of fish and begin sorting it by size and species.

ILLUSTRATION BY BEVAN LEISTER



In the process, some surprising objects come to light. There's a tangled 50-pound wad of gill netting, loaded with the limp, bone-white skins of long-dead dogfish. There are several aluminum beer cans and a clear-plastic soda bottle. From deeper in the pile, Mirarchi brings up an upholstered boat seat, an air-filter element from a diesel engine and a swatch of heavy nylon netting torn from a snagged trawl. The latter, he notes, is of a type no longer in general use.

"That's the old fine mesh," he says. "Just about everything that went into it stayed in the bag until you brought it up."

The net Mirarchi is using today, by contrast, is tied with 5½-inch "conservation mesh," which enables many undersized fish to escape. Large ones—unable to wriggle through the mesh—remain behind.

Relatively large ones, that is. Most of the yellowtail flounder, dab and gray sole in this bag weigh well under a pound. The largest of the cod looks as if it might go 8 or 10. There are no haddock in the net, and virtually none on Middle Bank.

It hasn't always been that way. It was not so long ago, Mirarchi says, that you could catch haddock with a hook and line just outside the harbor. Fifty-pound cod were not uncommon.

"Twenty years ago," he says, "we used to get 100-pound halibut out here. I've only seen two halibut this year, and neither one of them was over 10 pounds."

There are observers who say that fishermen like Frank Mirarchi may be going the way of the great schools of wild fish they once hunted. With cod and haddock in a steady decline over the past decade, fishermen are now harvesting species that for generations were considered unmarketable garbage—an assortment of bottom dwellers formerly considered too ugly to eat, including cusk, wolffish, hake and ocean

pout. While American consumers learn to accept these offerings, Japanese seafood buyers have already established outposts up and down the coast to pay premium prices for fresh fish as well as such exotica as sea urchins and morfish livers.

"Remember those old Tarzan movies?" Mirarchi asks. "Sometimes I feel like we're the guys with the spears. We're the guys who carry the ivory out of the jungle on our heads."

A FEW HUNDRED MILES UP THE COAST, Dan Marshall is scraping the bottom of a plastic feed bin with a hand scoop. He tosses a cup or two of pelleted feed to the salmon milling about the cage at his feet. They flash bright silver in the late-morning sun. There's an occasional splash. A foot-long salmon breaks the surface and skips across the water for a few feet, leaving a creamy trail of foam.

He squints, studying the speed at which they gobble the pellets. Another scoop of feed, more commotion in the water. Another pause.

"I don't know, Howie," Marshall says, finally. "They look awful good to me. I think you can push it up a third, you know, a third of a bag, this afternoon."

It's another day on the farm at Sea Farm Maine, in Lubec, Maine. Sea Farm Maine's acreage is a 25-acre plot of seawater in Johnson Bay, and its crop consists of about 200,000 Atlantic salmon.

The young salmon flashing in the sun at our feet began life at an inland hatchery, where fertilized eggs from carefully selected brood fish are hatched and nurtured in tanks of specially purified water for about a year, until the onset of smoltification—a physical change that indicates their readiness to move to salt water. The young fish—typically about 8 inches in length—lose the distinctive barred markings characteristic of their freshwater phase and assume a silver color. They also exhibit a change in behavior: instead of facing into the pumped current of water that swirls through the circular tanks, they turn and begin to swim with the current—a course, instinct tells them, that will lead to the sea.

The modern hatchery smolt, however, has a much quicker seaward trip than its wild counterpart—in the back of a truck equipped with an oxygen-injection system to keep the fish alive and healthy along the way.

If all goes well, Marshall explains as he patrols the steel catwalk running down the center of the floating pen, the year-old smolts, weighing an average of 3 ounces or so, will reach market size of 8 to 10 pounds within 18 months of entering seawater.

Several times a year, each pen of fish must be "split," a laborious process in which the fish are sorted by hand to separate them into groups of uniform size. Splitting is necessary, Marshall explains, because the salmon don't grow at the same rate.

"If you leave the bigger ones and the smaller ones together," he says, "you end up with a runt problem." For the same reason, it's essential to start with smolts of uniform size from the hatchery. "They establish a pecking order right from the beginning, and fish that start out small never have a chance to catch up."

Day in and day out, however, feeding the fish is the most time-consuming job—a delicate chore that calls for care and experience. If feed is distributed too slowly, the most aggressive, dominant fish will get more than their share. If feed pellets are simply shoveled into the cages, however, much of it will sink through the mesh bottom of the cage before the

Wild fish are cleaned at sea, but the boat may not dock for a week. Farmed fish get to market in less than a day.





fish have a chance to eat it. Consequently, every ounce of the day's allotment of feed pellets must be broadcast, scoop by scoop, across the entire surface of each cage. When done properly, it's a fluid, graceful movement, reminiscent of sowing seed grain by hand on a prepared field.

"You've got to be careful with feed," Marshall says. "Feed makes up almost half our operating cost."

As he explains, however, each unit of feed goes a long way. "When we started here, our feed conversion was around 2 to 1. But we've managed to fine-tune that down to less than 1.5 to 1."

Figures like those are enough to make a landlocked agronomist sit bolt upright and blink hard. Broiler chickens, for example, typically convert feed at an efficiency of around 5.5 to 1, meaning that 5.5 pounds of feed are required to produce each pound of edible poultry. Pigs convert feed at a ratio of 7 to 1. Beef cattle clock in at about 15 to 1.

As thrifty as salmon are, some farmed fish do even better. Mahimahi, for example—a pelagic fish native to the Pacific, now being cultured in Hawaii—seems to be the current champion. Under controlled conditions, researchers have achieved the apparently supernatural feed-conversion rate 0.62 to 1—equivalent to making 10 pounds of fish from 6.2 pounds of fish food.

FISH OF VARIOUS KINDS have been raised in farm ponds in Europe and Asia for centuries. In North America, aquaculture is a relatively new phenomenon, with rapidly expanding production of farmed shrimp, trout, catfish, striped bass, mussels and coho and chinook salmon, two species native to the West Coast.

The Atlantic salmon industry, however—the first such enterprise to reach a worldwide market—got its start during the mid-1960s, when Norwegian researchers began to experiment with raising fish in dammed saltwater estuaries, and later in shore-based tanks through which seawater could be circulated with pumps. By the mid-'70s, these early efforts

Broadcasting feed over the pens at Sea Farm Maine, a salmon farm whose "fields" are the waters off the coast of Maine.

had been superseded by the floating-cage-culture system used today.

The demand for salmon has traditionally been strong in northern Europe, and the industry grew rapidly. In 1976, Norwegian growers produced about 2,000 metric tons of salmon; by 1989, the figure had increased to more than 120,000 tons. Along the way, a strong export market developed—thanks to the Norwegian Salmon Marketing Council, which spawned promotional literature by the ton—and fresh salmon began flowing to the rest of Europe, North America and the Far East, especially Japan.

By the early 1980s, the Norwegians were exporting not only salmon, but the technology to grow them. Norwegian-financed salmon farms began to proliferate in Scotland, Ireland, the Pacific Northwest, Atlantic Canada and—most recently—Maine. Sea Farm Maine, in fact, is a subsidiary of Sea Farm Inc., a corporation whose ownership is 50 percent Norwegian.

The industry's rapid growth has not been entirely smooth. During the early- and mid-1980s, many Norwegian farms suffered heavy stock losses from disease. To combat such problems—which were associated with the buildup of fish wastes and uneaten feed in the surrounding water—limits were placed on farm size and stocking density. (Those limitations, in fact, had much to do with the diaspora of Norwegian capital that led to the opening of salmon farms in North America.)

Norway's water-quality problems also served as an object lesson on the importance of good site selection. Today's salmon farmers recognize the importance of a strong tidal flow—an attribute often described, with unintended irony, as "flushing action"—in maintaining healthy fish.

Sea Farm Maine—like those elsewhere in the region—is

admirably sited in this respect. A pair of 20-foot tides—the highest in the nation—scrub out its cages each day. It's conceivable that water pollution will someday become a problem on this side of the Atlantic, as some critics charge. For the time being, however, it's a problem that remains mostly theoretical.

The potential for longer-term—and much more far-reaching—environmental effects has received far less attention. Foremost among them is the question of feed. Ironically, the growth of aquaculture—long looked to as the best hope for increasing the world's supply of protein—may actually reduce the amount of protein available to the world's hungry.

That is because farmed carnivorous fish, such as salmon, require large amounts of high-quality protein in their diets. And for the foreseeable future, at least, that protein is going to continue to come from the ocean, in the form of ground, dehydrated fish, known as fish meal. When the issue of protein is examined closely under a strong light, in fact, the impressive feed-conversion numbers typical of aquaculture assume a different perspective.

A beef steer, for example, feeds on grass for most of its life, converting lignocellulose—undigestible to humans—into usable protein. Even during the last four to six weeks before slaughter, when fed corn, soybeans or other higher-quality feed, the protein content of a beef animal's feed is relatively low.

SALMON, BY CONTRAST—in common with shrimp, trout, striped bass and other highly profitable farmed species—require a large proportion of high-quality protein throughout the entire 18 months it takes them to reach market size. By weight, salmon feed is typically about half protein, of which three-fourths or more is derived from fish meal. And since the dry, pelleted feed contains very little water—much less than the fish themselves—the cultured fish receive the protein in a highly concentrated form.

To express that another way, each pound of farmed salmon, shrimp or other carnivorous fish represents roughly three pounds of wild ocean fish as feed. Cheap fish meal is to modern aquaculture what cheap chemical fertilizer is to a land-based corn or soybean farm: the essential input that makes all the wheels turn.

At present, most of the world's fish meal comes from small plankton feeders, such as herring and menhaden, although some meal is also produced from cannery waste and other fishing industry by-products. In accordance with the basic laws of biology, plankton-feeding fish are far more abundant than the larger predacious fish that feed on them.

That is not the same thing as saying that they will always be abundant. Given their habit of gathering in huge, dense schools, in fact, the sardinelike species that serve as the raw material for fish meal are highly susceptible to overfishing.

One of the first species to be exploited for large-scale fish-meal production, for example, was the abundant North Sea herring. Herring had long been heavily fished for human consumption, but with the additional pressure of the meal industry—which began operation in the early 1900s—stocks declined steadily until the mid-1950s, when they collapsed altogether. They have yet to recover fully, although limited fishing has resumed.

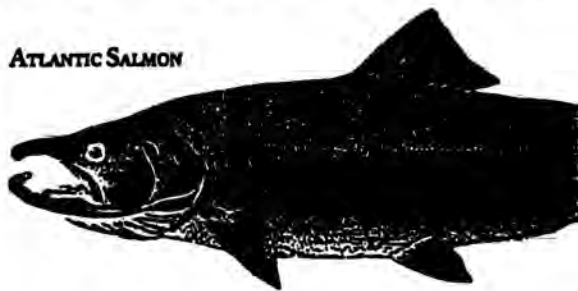
The loss of the North Sea herring fishery was instrumental in luring European factory ships across the Atlantic—beginning in the 1960s—to harvest the rich herring grounds

Fresh From the Farm

Crawfish and mussels, alive-alive-o!

MAN HAS BEEN RAISING EDIBLE FISH for at least four millennia, but one of the first records of what might be called a truly modern approach to aquaculture comes from the Roman historian Pliny. According to Pliny, the nobleman Lucius Murena excavated a series of 'fish reservoirs' on his summer estate during the first cen-

ATLANTIC SALMON



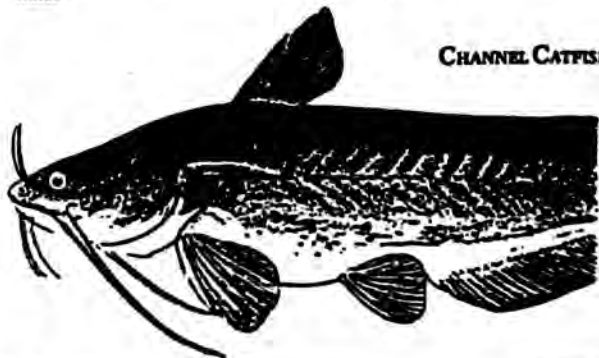
tury B.C., at a cost exceeding that of his house. It apparently proved to be a worthwhile investment, however; Pliny noted that the fish the ponds eventually produced were sold for four million sesterces.

The same forces that nudged Lucius Murena into the fish farming business—the desire to produce and sell a farm product at a profit, and the willingness to make a heavy capital investment in order to do so—are identical to those driving the burgeoning aquaculture industry today. While small-scale subsistence fish farming is still the rule in much of Africa and Asia, modern, large-scale aquafarms are ultimately more concerned with cash than with fish.

As a result, recent research and development efforts have tended to focus on species that fetch a high price in the marketplace. Atlantic salmon is the most familiar example, but certainly not the only one. The following list is by no means all-inclusive, but it does mention those aquaculturally produced species that the American consumer is increasingly likely to encounter at the supermarket.

Catfish accounts for half of all United States aquacultural production. Last year's total catfish harvest came to nearly 350 million pounds, with three-fourths of it coming from the state of Mississippi. (Catfish, in fact, is now the state's single most valuable agricultural export.) Mild, white, grain-fed catfish fillets can be found fresh in supermarkets all over the United States and well into Canada. Prices are generally comparable to that of cod or other white fish.

CHANNEL CATFISH



Tilapia: One of the few commercially farmed fish that thrives on an all-vegetable diet, tilapia are extraordinarily efficient protein producers. Long a favorite in the Third World, they have often – if unfairly – been regarded as trash fish elsewhere.

That appears to be changing, however. The mild, white-meat fillets of farm-raised tilapia, like catfish, are good-tasting and versatile, fitting into many types of recipes. Several large-scale aquafarms are now producing tilapia in quantity. One of the largest is Solar Aquafarms, Inc., which cultures, processes and markets its "Golden Tilapia" line in Sun City, California. Its passive-solar-heated tanks maintain optimum temperatures year-round. By mid-1991, Solar Aquafarms expects to produce 8 million pounds of tilapia, marketed mostly as skinless, boneless fillets.

Trout: Rainbow trout – a close relative of the Atlantic salmon – is one of the mainstays of the U.S. aquaculture industry, with about 57 million pounds produced annually. Idaho accounts for nearly two-thirds of the total, with most of the remainder coming from North Carolina, California and Wisconsin.

Trout farming has been an established business for the better part of a century, but trout farmers have been quick to take advantage of recent advances in biotechnology. Many growers now treat their

to stock the ponds are captured from the wild and that the wild shrimp rely on the coastal mangrove forest for breeding habitat.

Mussels, clams and oysters: The United States is the world's largest consumer of oysters, and as the environmental conditions in the Delaware and Chesapeake Bays – traditionally the major sources of wild oysters – continue to deteriorate, farmed oysters will capture an increasing share of the market. In 1987, domestic production of clam, oyster and mussel meats totaled at least 30 million pounds.



SCALLOP

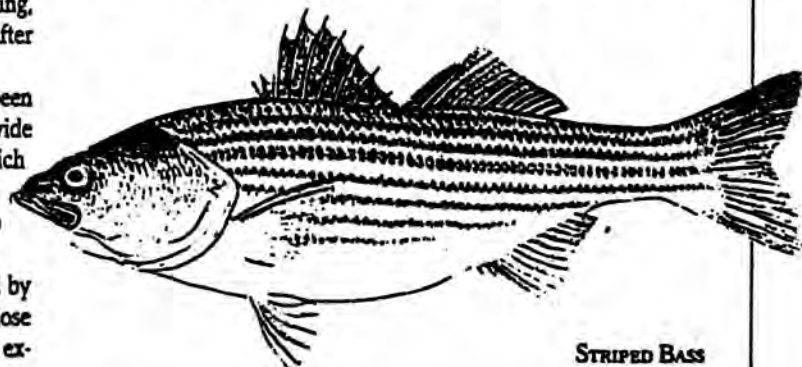


MUSSEL

The biggest obstacle to expansion of the shellfish farming industry is the availability of lease sites with acceptable water quality, since shellfish will absorb any contaminants present in the water in which they are raised. As a result, closed-tank systems will probably become increasingly important in the years to come.

MANY OTHER SPECIES will be added to this list in the near future. Norwegian and Canadian researchers, for example, are working furiously to develop economical culture systems for Atlantic halibut. Given the current retail price for halibut – which routinely fetches \$6 to \$7 a pound, when it is available at all – they have considerable incentive to succeed. The Norwegians are already marketing modest quantities of farm-raised halibut, and it may be available in quantity by the end of the decade. Cod culture lies further in the future, but research is already well under way on both sides of the Atlantic.

Hybrid striped bass show promise, as well, with a number of producers successfully raising them in landlocked freshwater tanks.



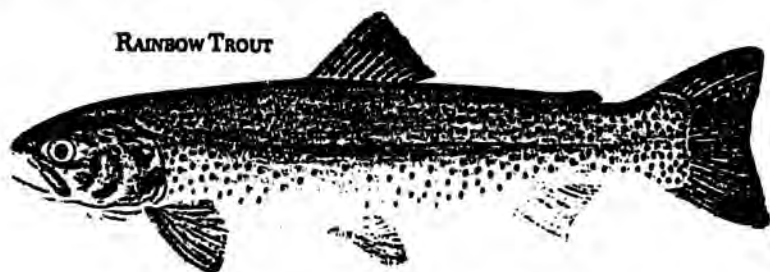
STRIPED BASS

A strong market already exists for striped bass – one which has gone increasingly unsatisfied in recent years, with the closure of the commercial striped-bass fishery.

Other species to watch include the troutlike arctic char, sea scallops, American lobsters and sablefish, or blackcod.

–J.V.

RAINBOW TROUT



breeding stock (although not the market fish themselves) with hormones to produce a strain of all-female progeny, which grow faster and yield better-quality flesh.

Crawfish – or, if you prefer, crayfish – are native to much of the United States, but only two species are currently raised for food on a significant scale. Louisiana provided at least three-fourths of 95 million pounds harvested last year – and consumed about the same proportion. As those figures suggest, crawfish is largely a regional specialty. About half of the total farmed yield comes from small, semicultivated ponds, and in rotation with rice farming, where the crawfish graze the stubble remaining in the fields after the rice harvest.

Shrimp: Shrimp is America's favorite seafood. Demand has been growing steadily for years, although the wild harvest worldwide has been static for the past decade or so. Farmed shrimp – which accounts for about a fourth of the world's total shrimp consumption – has made up the balance, and will continue to do so for the foreseeable future.

That has led to a worldwide boom in farmed shrimp, led by China, Taiwan, Ecuador and Indonesia. Ecuador, with its close proximity to the U.S. market, is our biggest supplier. Shrimp exports now account for about a fifth of that country's export income – more than bananas and cacao combined, and twice as much as coffee.

The rapid growth of the shrimp industry has had some unpleasant side effects, however. In Ecuador, thousands of acres of coastal mangroves have been destroyed to furnish land for shrimp ponds – an ironic development, given that most of the "seed" shrimp used

Lethal Liaisons

When the wild meet the tame, genetic disaster may occur

IF FISH MARKETERS ARE REJOICING in the success of aquaculture, marine biologists have some deep concerns about the rapid growth of fish farming, fearing that the relationship between wild and farmed salmon may prove disastrous to the untamed strains. The problem, in essence, is one of intermingling – a process biologists call genetic introgression – between wild and domesticated strains of fish.

According to Dr. John M. Anderson of the Atlantic Salmon Federation in St. Andrews, New Brunswick – an organization that works with the breeding of domestic strains, as well as conservation of wild salmon – the process through which Atlantic salmon find their way from their home rivers to their winter feeding grounds and back is not completely understood. Current thinking, however, suggests that it is a two-part process that combines instinct and learning. The ability to navigate in the open ocean is almost certainly genetically transmitted. It could hardly be otherwise, since salmon unerringly find their way across hundreds or thousands of miles of ocean to a place they have never known.

The same genetic mechanism works in reverse when it leads the fish back to the right stretch of coastline generation after generation. But a salmon does not instinctively know its home river when it gets there; it has to learn to recognize it through a process described as "imprinting."

During the year or more that they spend in the fresh water of their home rivers, before entering the sea for the first time, the young salmon develop a permanent memory of the composition of the tributary where they hatched – its mineral content, the organic matter it contains, and perhaps other chemical markers. After smoltifying, the immature salmon head for the sea. On that downstream journey, it is believed, their last taste of fresh water provides the clue that enables them to find the same river mouth again when they return – a year or two later – to spawn.

Farmed salmon smolts, by contrast – which travel from the hatchery to the sea by truck – never imprint on a particular river system. As a result, those that escape into the ocean, as some inevitably do, behave erratically. Many may find their way to the same offshore winter feeding grounds used by wild salmon, and come back onshore during the spring spawning run. Lacking home rivers of their own, however, they may enter any river system in the area to spawn, more or less randomly.

By reproducing in the "wrong" river system, these homeless salmon tend to muddy the genetic waters. Although their progeny will imprint on the river system in which they hatch, they may lack

Farmed salmon have some genetic traits that are good for the market, but they lack others needed for survival in the wild.



the inherited ability to find their way from the winter feeding grounds to within "tasting range" of their adopted home river. The plight of such fish is analogous to that of a motorist who knows which exit to look for but can't find the correct highway.

Even wild salmon are not perfect navigators, of course. There has always been a certain amount of genetic exchange between

river systems through the medium of stray fish. Salmon farming, however, has increased the number of strays—and potential strays—exponentially. That is a particular cause for concern where wild salmon populations are sparse to begin with—as is the case in all of the Northeastern U.S. In the event of a major “spill” at a farm—which might involve thousands of fish—the relatively small wild population might find itself genetically overwhelmed.

All of that would be cause for alarm even if it were a matter of large-scale intermingling between populations of thoroughly wild fish. What causes fisheries biologists even greater concern, however, is that many farmed fish are by now several generations from the wild, having been selectively bred for certain characteristics.

One trait that salmon farmers seek to avoid, for example, is “gril-sification,” in which the salmon mature sexually at the end of their first year in salt water, at an average weight of 4 to 6 pounds. Because the market wants 8-to-10-pound fish, and because salmon gain weight very slowly after sexual maturity—when most of their energy goes into gonadal development—that costs the grower money. As a result, concerted efforts are being made to eliminate the trait from hatchery brood stock.

In the wild, however, early-maturing strains apparently have an advantage in some areas. In parts of Newfoundland, 90 percent or more of the wild fish mature after one winter at sea. If that naturally selected trait were diluted through contact with domesticated strains, the survival rate of the wild salmon in those areas could be compromised.

Those are more than theoretical possibilities. At a meeting held in Loen, Norway, in April 1990—attended by scientists and managers from most North Atlantic countries with salmon interests—it was established that escaped farmed salmon are indeed breeding successfully in the wild. In some Norwegian rivers, in fact, over half of the adults present during the spawning season are farmed fish. There is also evidence that suggests that farmed fish construct their gravel nests—or “redds”—somewhat later than the wild fish, disturbing preexisting redds in the process.

At the Loen conference, a number of possible countermeasures were considered. The designation of aquaculture-free zones in the vicinity of threatened wild stocks is one possibility, as is the sterilization of farmed stock at the hatchery. The establishment of gene banks—thus retaining the genetic diversity of wild fish for the future—was also supported. Finally, researchers stressed the importance of controlling the transportation of farmed stock from one region to another, to prevent the spread of disease or parasites. (It is generally agreed that the disappearance of wild salmon from 33 Norwegian rivers can be attributed to a species of freshwater parasite, *Gyrodactylus salaris*, transmitted

from imported Swedish hatchery stock.) As William Hershberger—a fisheries biologist at the University of Washington—states, “We just don’t know much about the kinds of problems genetic mixing can lead to, since most farmed animals are already extinct in the wild.” It would be ironic if *Salmo salar*’s comeback at the market heralded its disappearance from the wild.

—J.V.

in the Gulf of Maine, on Georges Bank, and as far south as Cape Hatteras. That influx quickly reduced the Gulf of Maine stocks by half—nearly killing off the Maine sardine industry—and devastated the stocks of Georges Bank, where catch totals fell from nearly 400,000 tons in 1967 to 40,000 tons in less than 10 years.

None of those past excesses—or many others not mentioned—can be blamed on the aquaculture industry. By far the largest share of the world’s fish-meal supply is used in poultry feed. By most estimates, aquacultural feeds now account for about 10 percent of the total. As world aquaculture continues to grow, however, so will the demand for feed. The U.S. Department of Agriculture estimates that at least a quarter of the world seafood production will be farmed by the end of the decade, better than doubling its current contribution. No one knows what that will mean to the world’s oceans.



Farm-raised salmon are netted, then dropped in the “knock-out tank,” where they are immobilized with carbon dioxide.

“It makes me a little nervous,” says Susan Goldhor, a zoologist who serves as a consultant to the fish and shellfish processing industry. “You have to question the wisdom of putting so much pressure on the bottom of the food chain.”

An alternative, of course, is to cultivate that end of the food chain directly. Raising plankton-feeding fish—or fish that feed on larger aquatic plants—does away with the need for such intensive protein mining. Shellfish like clams, mussels and oysters feed on microorganisms filtered directly from seawater, as do some finfish, such as tilapia. Carp—one of the most heavily produced fish, which has been raised in ponds in Europe and Asia for centuries—thrives on an all-vegetable diet.

The economics of aquaculture, however, are such that the products with the highest cash value are those like shrimp, salmon and other species with very high protein demands. Predictably, that is where development has been most rapid (see “Fresh From the Farm,” page 34).

THREE CENTURIES AGO, when Atlantic salmon ran up Northeastern rivers by the hundreds of thousands, they were sometimes used to fertilize corn. Indentured servants often insisted on contract clauses limiting

DEAN ABRAMSON

Let Them Eat Dogfish

"Fish" no longer means cod or haddock

WATCH OUT FOR THIS ONE," fisherman Frank Mirarchi says. He tosses a writhing, snapping, 3-foot long wolffish into a sorting bin.

A decade ago, wolffish were routinely thrown back over the side or converted into fish meal. This one, however, will be eaten, probably by a restaurant patron who orders fish chowder, a fish fillet sandwich or the generic deep-fried fish dinner. Cod or haddock—which is what the unqualified word "fish" used to mean in the Northeast—are almost always marketed by name these days. That has left the generic white fish category to former trash species, such as hake, cusk, ocean pout and wolffish. Before long, in fact, the category may be broadened even further, to include several species of small sharks known collectively as dogfish.

A sizable portion of the dogfish catch is destined for Europe, where, Mirarchi explains, it will become a salty, smoked snack food called *schillelocken*—or "golden curls"—that is a popular beer-hall treat in Germany. Most, however, will be served as just plain fish. English fish-and-chips establishments have been big users of dogfish for many years. To encourage the opening of a domestic market, the U.S. Department of Commerce—which determines which names may legally be attached to fish species in the marketplace—recent-



Today's catch may include many species formerly considered trash fish.

ly gave the okay for retailers to present dogfish under the more appealing name "cape shark."

"I won't tell you it's the best fish in the world," Mirarchi says, "but if it's handled right, it can taste pretty good."

But even if cape shark catches on in a big way, it may prove impossible to keep the market supplied for long. Dogfish are abundant today because fishermen on this side of the Atlantic have worked hard at not catching them for the better part of 500 years. They have extremely low reproductive rates, take many years to attain sexual maturity, and school by sex for much of the year. As a result, large mature females—the preferred raw material for *schillelocken*—are easily harvested in bulk. Until they're gone, at least; that's why the Europeans are buying them here. —J.V.

the amount of salmon in their diets.

That is hardly the case today, when most of the Atlantic salmon raised in Maine—as in most North American salmon farms—ends up at white-tablecloth eating establishments. Restaurateurs have embraced it—along with shrimp, striped bass, rainbow trout, oysters, mussels and a lengthening list of other aquacultural products—for a number of reasons. Unlike many wild species, which are highly seasonal, farm-raised seafood is available throughout the year. While wild-caught seafood may be less expensive than its farm-raised counterparts during seasons of abundance, year in and year out the farmed product often comes out ahead.

Even more important, from the standpoint of the restaurant trade especially, farmed fish tend to be consistent in both size and quality. That tends to reduce preparation time, simplify menu planning and increase the number of satisfied patrons.

In the traditional seafood industry, by contrast, quality is spotty, at best. At the wholesale level, most fish and other seafood is marketed in about the same manner as corn, soybeans or other nonperishable commodities. Under the current system, most fish is bought and sold sight unseen. The fish at the bottom of the iced fishhold—which may be a week old or more by the time a boat ties up at the dock—commands the same price as the fish on top of the pile, which may have been caught that morning.

That system made a certain amount of sense 20 years ago, when fish was regarded as a cheap substitute for chicken wings or hamburger. But today, with fresh cod often selling for almost as much as sirloin steak, it has become a liability. Frank Mirarchi feels that it is costing the traditional fisheries customers.

"You stand at the dock in New Bedford," he says, "and plenty of times you'll see baskets of fish sitting in the sun in the middle of a cloud of flies. The fisherman doesn't get any more for quality fish than he does for garbage, so quality doesn't matter to him. That kind of attitude goes right down the line. The supermarket starts out with fish that's a week old; they don't want to get stuck with it. They rinse it in brine every night to keep it from smelling too bad. A week later somebody buys it, and they wonder why it tastes awful."

The salmon in Sea Farm Maine's cages, by contrast, follow an express, straight-line path to market. In October, Sea Farm Maine will begin harvesting the 8-to-10-pound salmon that have been putting on weight in its floating cages for the past year and a half. The big silvery fish are netted and quickly transferred to the "knockout tank"—a 4-foot square plastic box filled with seawater that has been saturated with carbon dioxide gas—which quickly immobilizes them. The veins that supply blood to their gills are severed, and they are dropped into a second tank filled with water and crushed ice to "bleed out," a process that improves the texture and flavor of the flesh.

Those initial steps occur at the cages in Johnson Bay. The slaughtered fish will then be loaded onto one of two converted mackerel schooners—the *Grayling*, built in 1917, or the *Medrick*, three years older—for transfer to the R.J. Peacock Canning Company plant, a mile away. There they will be gutted, washed and packed in ice-filled waxed cartons for shipment. Twelve to 16 hours after emerging from the water, Sea Farm Maine's salmon—marketed under the Sterling Brand label—will be ready for early-morning

buyers at the Boston fish market.

If the fishmongers and restaurateurs are eager to see aquaculture flourish, they are not alone. Economists see a potential boost to our balance of trade. (The United States currently imports 60 percent of its seafood, which accounts for a trade deficit of \$3.3 billion.) Politicians see jobs. Cooks and consumers see cheaper, better-quality seafood. The traditional fishing service and supply industries—purveyors of rope, foul-weather gear, floats, netting and similar products—have experienced little difficulty in adjusting to the needs of aquaculturists.

All but forgotten in this feast of economic development are the commercial fishermen themselves, to whom aquaculture represents the same sort of enclosure of the commons that occurred on land centuries ago. Sea Farm Maine, for example, pays the state of Maine about \$1,000 a year for the exclusive right to a 25-acre column of seawater and the underlying seabed in Johnson Bay. Assuming that all the conditions are met, the lease will remain in effect for 10 years.

Ron Smolowitz is a fishing-industry consultant and columnist for the trade publication *Commercial Fisheries News*. He worries that the increasing emphasis on aquaculture will imply, to some, that the ocean itself is expendable.

"That's wrong," he says. "We still haven't begun to manage the ocean for food production."

A potential long-term solution, Smolowitz feels, is to start thinking of the continental shelves as range or pastureland, rather than hunting grounds. That might mean trying to eliminate some species, while fostering or introducing others.

"People say, 'No, you can't do that, you'll alter the ecological balance.'" He pauses. "What do they think is happening out there right now?"

FROM THE BEGINNING, people have wanted to see wild Atlantic salmon as one of the main beneficiaries of salmon farming. The reasoning was simple: it should be cheaper to grow salmon than to catch it. According to Economics 101, wild-caught salmon should be wholly unable to compete with its farm-raised counterpart, and the heavy fishing pressure on this species would be relieved.

Unfortunately, it hasn't worked out that way. The world's wild harvest has hovered at somewhere between 5,000 and 8,000 metric tons annually for the past few years (farmed Atlantic, by way of comparison, accounted for 170,000 metric tons), and the wild salmon has no trouble finding buyers.

Because the word "wild" plays so well in the marketplace, in fact, wild salmon commands a premium price—often two or three times that of farmed fish. That is ironic, since the farmed product—thanks to more careful handling and faster shipment to market—usually is equal to or better than wild salmon, as blind taste tests have repeatedly shown.

"At first glance," says a State of Maine development publication, "the advantages of aquaculture would appear to be disadvantages for wild product. Closer inspection of seafood markets, however, indicates a probable favorable effect—at least in the longer term—on wild-product markets."

Perhaps. In the shorter term, though, traditional fishermen are not lining up to become fish farmers. That does not surprise Dan Marshall.

"Fishermen are basically hunters," he observes. "They know more about the ocean than you or I ever will, but they don't know much about raising animals." The bottom line, according to Marshall, is that it's easier to teach a farmer to run a skiff and an outboard motor than it is to teach a fisherman the finer points of feed conversion and disease control.

Marshall himself is the proof of that. Before he took the job managing Sea Farm Maine's operation, he spent a number of years as a farm manager for DeCoster Farms, Maine's largest producer of eggs and broiler chickens. Burton Blanch, the president of the Cobscook Bay Finfish Association, is a former dairy farmer who turned to salmon farming in 1985.

Like their landlocked brethren, fish farmers have one overriding worry: overproduction and low prices. The price of salmon, Dan Marshall observes, has been dropping for several years. "The days of \$2-a-pound profits are over," he says. "If we make 50 cents a pound this year, I'll be happy."

Still, he is optimistic about the future. A vigorous secondary processing industry, he says, will do much to stimulate demand.

"I saw that happen in the poultry business," he says. "Sales were flat for years, and then someone came up with the idea of chicken nuggets, and business took off."

Last year, Marshall and young Bobby Peacock of the R.J. Peacock Canning Company experimentally sliced some smaller salmon—too small for normal market outlets—into steaks with a bandsaw and packed them in sardine cans. Marshall gave me a can to try, and it was good.

"I think you're going to see a lot more of that kind of thing," he says. "You'll see salmon in microwave packages, and I think you'll see it in Weight Watchers' meals. The whole industry is still at the caveman stage."

Jon Vara is a regular HARROWSMITH COUNTRY LIFE contributor who lives in Marshfield, Vermont.



As the price of farm-raised salmon drops—and profits decrease—canneries like the R.J. Peacock Co. in Maine are experimenting with marketing strategies to stimulate demand.



Alaska State Legislature



SENATOR
ARLISS STURGULEWSKI

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(907) 561-7615

While in Juneau
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JUNEAU, ALASKA 99811
(907) 465-3818

Senate

MEMORANDUM

May 14, 1991

TO: Senator Dick Eliason, Chairman
Senate Special Committee on Fisheries

FROM: Senator Arliss Sturgulewski
Senate District F

RE: State fish hatchery issues

Thank you for calling together the Special Committee on Fisheries to examine issues regarding fish hatcheries in Alaska. In order to help the committee identify issues for further discussion I am submitting the following questions for consideration. These are certainly not exhaustive but hopefully will fit in the "big picture" in a constructive way.

MARKETING

The 1990 salmon harvest set a record of 154.8 million fish caught exceeding the previous record harvest of 153.7 million fish in 1989. Some estimates are that hatchery salmon may be 20-25% of the total statewide harvest and that in some specific regions the harvest may be as high as 70-90% for some specific species. What are the ramifications of the hatchery salmon impact on the marketing of salmon in general and on wild salmon in particular? What is the state's role in marketing salmon? What is the global market impact of salmon hatcheries throughout the world and specifically what is the effect on Alaska's salmon?

May 14, 1991

Page 2

MANAGEMENT

Does the increased salmon harvest over the past decade require a review of management policies regarding the enhancement of wild salmon and the production of hatchery salmon? Should the state encourage the maximum production of state and private hatcheries or should there be regional differences by species and quantity? Is there an optimum number of hatcheries or fish production? Is there an optimum number of salmon either wild or hatchery or a combination that should be produced by region, throughout the state or ocean-wide? What is the carrying capacity limit for salmon by area?

STATE POLICY

During the past administration in 1987 and 1988 the Commission of Fish and Game attempted but failed to develop a fisheries policy for the state. For example: it stated the following two hatchery objectives among others: 1) Encourage investment by private enterprise in the enhancement, development and economic utilization of the fisheries resources. 2) Conduct a comprehensive and economically sound enhancement program involving public and privately operated facilities and other enhancement projects. Are these policy statements current and valid or should they be reviewed?

ALLOCATION

Should there be a review of the current allocation system of salmon? As the utilization of commercial, sport and subsistence groups change over time and public and private hatchery production increases would any other allocation system be appropriate? What is the relationship between hatchery production and current subsistence laws and regulations?

GENETICS

What impact does the state supported system of salmon hatcheries, including both state operated and private non-profit hatcheries, have on the health of our wild stocks of Alaska salmon? Is there any long term generic damage that may result from the interaction of a hatchery raised salmon with natural stocks? What impact do new techniques such as floating salmon hatcheries have on Alaska's wild stocks?

Alaska State Legislature



SENATOR
ARLISS STURGULEWSKI

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Alaska State Legislature

SENATOR RICHARD I. ELIASON

President of the Senate

P.O. Box V
Juneau, Alaska 99811
(907) 465-3755

May 22, 1991

Senator Lyman Hoffman
Box V
Juneau, AK 99811

Dear Senator Hoffman:

As you know, the Senate Special Committee on Fisheries, of which you are a member, is beginning a review of Alaska's fisheries enhancement programs, particularly hatchery programs. The first phase of this project is the creation of an ad hoc group of House and Senate staff members who will conduct an information-gathering and research project during the upcoming interim.

While this hatchery research project will be under the auspices of the Senate Fisheries Committee, I would like to appoint your legislative aide, Molly McCammon, to serve as the coordinator for the staff work over the summer months. My aide Mary McDowell, plans to return to the office in late fall and will be involved again at that point, but we would very much appreciate your making Molly available to head up this initial research phase. Molly is very well qualified for this responsibility and the other staffers who will be working on the project look forward to working under her coordination.

Please let me know as soon as possible if this plan meets your approval. This review by the Fisheries Committee is timely and important to the future of fisheries enhancement. I appreciate the work that you and your staff are willing to do on it.

Sincerely,

A handwritten signature in dark ink, appearing to read "Dick", written over the word "Sincerely,".

Senator Dick Eliason, Chairman
Senate Special Committee on Fisheries

ADDITIONS TO HATCHERY ISSUES LIST

ADF&G structure -- should FRED Division be so separate from Comm. Fish., Sport fish, and subsistence Divisions? Enough coordination among the divisions?

Under PNP operations -- add "methods for making cost recovery" -- explore other ways to recover costs that will help encourage oversite by fishermen, etc.

Under Marketing -- add Role of ASMI. Also where do hatchery fish fit into fish quality improvement efforts?

Broaden scope of review to include all fisheries enhancement efforts in Alaska, not only hatcheries.

Explore the impacts of opening up of subsistence to everyone on hatchery and wild stocks.



**COOK INLET
AQUACULTURE ASSOCIATION**

HC 2, BOX 849
SOLDOTNA, AK 99609-9707
(907) 283-6761

June 3, 1991

Senator Dick Eliason
P.O. Box V
Juneau, Alaska 99811

Dear Senator Eliason:

Cook Inlet Aquaculture Association is pleased that you have chosen to review the State's private nonprofit aquaculture program during the interim. It has been more than 15 years since the program began and a review is certainly in order.

CIAA would like to participate in the review process. We probably possess information and insights which would expedite program review. Please call on us if we may be of service.

Sincerely,

Thomas E. Mears,
Executive Director

Draft

June 24, 1991

Dear Interested Alaskan:

I am writing to you because of your involvement and interest in the state's hatchery and enhancement program. The Legislature is currently undertaking a thorough review of this program. Our intensified efforts have been underway for nearly two decades now, and we believe it is time to look back to where we started, see where we are at today, and determine where we want to go with the program in the future, ranging from fine-tuning to possible re-direction.

The work on this project is primarily being done by legislative staff, with the assistance of the Legislative Research Agency and the Department of Fish and Game. The project's chief coordinator is Molly McCamr is on loan from Senator Lyman Hoffman for this project, a reached at 465-4453 or P.O. Box V, Juneau, AK 99801. If you have any questions, comments, or concerns, be sure to contact her directly.

I am enclosing for your information a copy of the project work plan, a list of all the persons involved in the research, and a tentative time schedule.

Some people have expressed concern about what the intent of this group might be. I want to put your fears at rest. The first stage of this process is to gather information about the program and identify the various issues, concerns, and conflicts. We're counting on your help with this process. Once we get a draft report of this information, we'll be looking to all of you to help us develop possible options for strengthening, improving, and possibly re-directing the program. I cannot emphasize enough how strongly we believe that your participation in this process is vital. At this point, you can be involved by reviewing the enclosed work plan, and contacting Molly or the individual team leaders with specific comments. We're also looking at holding an intensive workshop to discuss the future of the hatchery program sometime in the fall. Once a final report is issued, I plan to hold extensive formal hearings on it before the Senate Special Committee on International and Domestic Fisheries next legislative session.

I hope you are as excited about this project as I am. There is a lot of support for the hatchery program. I think a review of this nature can only make it better.

Sincerely,

Senator Dick Eliason



Alaska State Legislature

SENATOR RICHARD I. ELIASON

President of the Senate

P.O. Box V
Juneau, Alaska 99811
(907) 465-3755

June 28, 1991

^F1^

Dear ^F2^:

I am writing to you because of your involvement and interest in the State's hatchery and enhancement program. The Legislature is currently undertaking a thorough review of this program. Our intensified efforts have been underway for nearly two decades now, and we believe it is time to look back to where we started, see where we are today, and determine where we want to go with the program in the future, ranging from fine-tuning to possible redirection.

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Sincerely,

Senator Dick Eliason

^N

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Mr. Cohen^R

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Mr. Eugene W. Richards
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Mr. Bart Watson

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Ms. Martha Jack

Angoon Aquaculture Assn., Inc.

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Prince William Sound Aquaculture Corp.

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Mr. John McMullen, Special Projects

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Dr. Jack M. Van Hying

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Mr. Jason Wells, Project Director

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Mr. Tom Mears

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Mr. McCallum^R

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Mr. Oliver Holm, President

Kodiak Regional Aquaculture Assn.

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Mr. Carl L. Rosier, Commissioner

Department of Fish and Game

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Commissioner Rosier^R

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Mr. Jeff Koenigs, Director

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Mr. Brad Bailey
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Mr. Bailey^R

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Kodiak Longliners Assn.

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Owners^R

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Members^R

⌘

Cordova District Fishermen Unit
P. O. Box 939
Cordova, AK 99574^R

Members^R

⌘

Bristol Bay Herring Marketing Co.
P. O. Box 1710
Dillingham, AK 99576^R

Members^R

⌘

North Pacific Fish Association

P. O. Box 796

Homer, AK 99603^R

Members^R

^E

Alaska Draggers Association

P. O. Box 991

Kodiak, AK 99615^R

Members^R

^E

Kodiak Regional Aquaculture Assn.

P. O. Box 3407

Kodiak, AK 99615^R

Members^R

^E

Fish Industrial Technical Center

Pouch K

Kodiak, AK 99615^R

Members^R

^E

Marine Advisory Program

3 Bunnell

303 Tanana Drive

Fairbanks, AK 99701^R

Members^R

^E

Alaska Mariculture Assn.

130 Seward Street, Suite 504

Juneau, AK 99801^R

Members^R

^E

United Southeast Alaska Gillnetters

P. O. Box 021186

Juneau, AK 99802^R

Members^R

^E

Marine Advisory Program

P. O. Box 1329

Petersburg, AK 99833^R

Members^R

^E

Marine Advisory Program
1297 Seward Avenue, Room 207
Sitka, AK 99835^R
Members^R

⌘

Deep Sea Fishermens Union
of the Pacific

5215 Ballard Avenue N.W.
Seattle, WA 98107^R

Members^R

⌘

Fishing Vessel Owners Assn.

Room 232, Bldg C-3

Fishermens Terminal

Seattle, WA 98119^R

Members^R

⌘

Alaska Independent Fish
Marketing Association

700 - 14th Street

Bellingham, WA 98225^R

Members^R

⌘

Bristol Bay Driftnetters

3605 Arctic #742

Anchorage, AK 99503^R

Members^R

⌘

NANA Seafoods

(NANA Taguigmitat)

Box 49

Kotzebue, AK 99572^R

Members^R

⌘

Western Alaska Co-Op
Marketing Association

P. O. Box 213

Dillingham, AK 99576^R

Members^R

⌘

Setnetters Assn of Bristol Bay

P. O. Box 4311

Homer, AK 99603^R

Members^R

^E

Kodiak Longline Vessel Owners

P. O. Box 135

Kodiak, AK 99615^R

Owners^R

^E

United Fishermens Marketing Assn.

P. O. Box 1035

Kodiak, AK 99615^R

Members^R

^E

Peninsula Marketing Association

P. O. Box 248

Sand Point, AK 99661^R

Members^R

^E

Mr. Fred Chase, Vice Chairman

Wildlife Safeguard

1257 New Richardson Highway

North Pole, AK 99705^R

Mr. Chase^R

^E

Alaska Trollers Association

130 Seward Street, Suite 213

Juneau, AK 99801^R

Members^R

^E

C and E D

P. O. Box D

Juneau, AK 99811^R

Members^R

^E

Alaska Longline Fish Association

P. O. Box 1229

Sitka, AK 99835^R

Members^R

⌘

SEACOPS

700 Water Street Upper

Ketchikan, AK 99901^R

Members^R

⌘

Alaska Shellfish Growers Assn.

P. O. Box 1499

Wrangell, AK 99929^R

Members^R

⌘



Alaska State Legislature

SENATOR RICHARD L. ELIASON

President of the Senate

P.O. Box V
Juneau, Alaska 99811
(907) 465-3755

July 2, 1991

Mr. Rick Lauber
Pacific Seafood Processors Assn.
321 Highland Drive
Juneau, AK 99801

Dear Mr. Lauber:

I am writing to you because of your involvement and interest in the State's hatchery and enhancement program. The Legislature is currently undertaking a thorough review of this program. Our intensified efforts have been underway for nearly two decades now, and we believe it is time to look back to where we started, see where we are today, and determine where we want to go with the program in the future, ranging from fine-tuning to possible redirection.

The work on this project is primarily being done by legislative staff, with the assistance of the Legislative Research Agency and the Department of Fish and Game. The project's chief coordinator is Molly McCammon. She is on loan from Senator Lyman Hoffman for this project, and can be reached at 465-4453 or P. O. Box V, Juneau, AK 99811. If you have any questions, comments or concerns, be sure to contact her directly.

I am enclosing for your information a copy of the project work plan, a list of all the persons involved in the research and a tentative time schedule.

Some people have expressed concern about what the intent of this group might be. I want to put your fears at rest. The first stage of this process is to gather information about the program and identify the various

July 2, 1991

Page Two

issues, concerns and conflicts. We're counting on your help with this process. Once we get a draft report of this information, we'll be looking to all of you to help us develop possible options for strengthening, improving, and possibly redirecting the program. I cannot emphasize enough how strongly we believe that your participation in this process is vital. At this point, you can be involved by reviewing the enclosed work plan, and contacting Molly or the individual team leaders with specific comments. We're also looking at holding an intensive workshop to discuss the future of the hatchery program sometime in the Fall. Once a final report is issued, I plan to hold extensive formal hearings on it before the Senate Special Committee on International and Domestic Fisheries next legislative session.

I hope you are as excited about this program as I am. There is a lot of support for the hatchery program. I think a review of this nature can only make it better.

Sincerely,



Senator Dick Eliason



Alaska State Legislature

SENATOR RICHARD I. ELIASON

President of the Senate

P.O. Box V
Juneau, Alaska 99811
(907) 465-3755

July 2, 1991

Mr. Alec Brindle
Ward Cove Packing Company
Box C - 5030
Seattle, WA 98105-0030

Dear Mr. Brindle:

I am writing to you because of your involvement and interest in the State's hatchery and enhancement program. The Legislature is currently undertaking a thorough review of this program. Our intensified efforts have been underway for nearly two decades now, and we believe it is time to look back to where we started, see where we are today, and determine where we want to go with the program in the future, ranging from fine-tuning to possible redirection.

The work on this project is primarily being done by legislative staff, with the assistance of the Legislative Research Agency and the Department of Fish and Game. The project's chief coordinator is Molly McCammon. She is on loan from Senator Lyman Hoffman for this project, and can be reached at 465-4453 or P. O. Box V, Juneau, AK 99811. If you have any questions, comments or concerns, be sure to contact her directly.

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July 2, 1991

Page Two

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I hope you are as excited about this program as I am. There is a lot of support for the hatchery program. I think a review of this nature can only make it better.

Sincerely,

A handwritten signature in cursive script, appearing to read "Dick Eliason".

Senator Dick Eliason

STATE OF ALASKA

DEPARTMENT OF FISH AND GAME

OFFICE OF THE COMMISSIONER

WALTER J. HICKEL, GOVERNOR

P.O. BOX 3-2000
JUNEAU, ALASKA 99802-2000
PHONE: (907) 465-4100

July 19, 1991

The Honorable Dick Eliason
Alaska State Legislature
P.O. Box V
Juneau, AK 99811

Dear Senator Eliason:

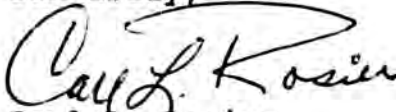
Thank you for your June 28 letters to myself and Fisheries Rehabilitation, Enhancement and Development (FRED) Division Director, Dr. Jeff Koenings, concerning the Legislature's ongoing Hatchery Research Project.

In my May 10 letter to you, I accepted your invitation for department staff to participate in this endeavor and gave the FRED Division the lead role in developing a working relationship with legislative staff assigned to this project. In the interim, there have been several meetings between Molly McCammon and Dr. Koenings and between legislative and Alaska Department of Fish and Game (ADF&G) staffs to both coordinate the research effort and to identify time schedules and issues. The work plan you provided includes many of the comments and suggestions of ADF&G staff, and additional information has been and continues to be provided by department staff to legislative work group coordinators when requested.

I am pleased to see there will be ample opportunity for public participation, and I understand the work plans and schedule have been sent out to private nonprofit operators, aquaculture associations, and interested gear groups. I agree that there is a lot of support for the hatchery program, as it has proven to be a very successful program since its inception nearly 20 years ago. This is a large research project of great importance to this department. The FRED Division will continue coordinating information retrieval and technical review.

Thank you for keeping me informed of the research group's progress, and be assured my department will cooperate fully.

Sincerely,



Carl L. Rosier
Commissioner

cc: Jeff Koenings

WESTERN ALASKA COOPERATIVE MARKETING ASSOCIATION

1

(907) 842-5592 • BOX 213 • DILLINGHAM, ALASKA 99576

August 12, 1991

Senator Dick Eliason
PO Box V
Juneau, Alaska 99811

Dear Senator:

We certainly are overjoyed to see that finally the State of Alaska is going to review the aquaculture programs that are in place and hopefully will start to redirect this program.

We feel that this existing aquaculture program is creating the excess wild stock salmon on the market which in turns has decreased our marketable salmon into a economic disaster situation.

We will be drafting our comments to Ms Molly McCammon's attention and we certainly look forward to some sort of resolution to this major problem.

Thank you for adding our organization's name to your listing.

Sincerely,



for Harvey Samuelson,
President



Alaska State Legislature

Official Business

MEMORANDUM

P.O. Box V
State Capitol
Juneau, Alaska 99811

TO: Senator Dick Eliason

FROM: Molly McCammon, Coordinator *Molly*
Legislative Hatchery Research Project

DATE: August 30, 1991

RE: Status report on research project

Work on the Legislative Hatchery Research Project has been proceeding all summer. The following is the status of each of the four work groups:

I. History & Development of Hatcheries. Legislative Research has completed a legislative history of the hatchery program. I'll be sending you a copy separately. A second report summarizing salmon production trends and policies worldwide, by country, and in Alaska should be done next week.

II. Economics & Marketing. This group decided to leave the marketing issues to the Governor's Salmon Strategy Task Force. Instead we have been focusing on economic issues to determine what impact hatchery production has on prices and revenues and what effect increased hatchery production will have. We are in the process of developing a proposal for some additional research, and once Ginny Fay returns from vacation, we need to discuss this with you in further detail.

III. Fisheries Management. Reports are due next week on biological and genetics issues (Leg Research) and on the role of regional aquaculture associations (Joe Ambrose in Rep. Taylor's office). We have been waiting until the season is over before focusing on the management issues and conflicts section. The Fish Board has scheduled a two day workshop in mid-September and has our group on their agenda.

IV. Roles and Responsibilities in Statewide Enhancement Program. Barnaby Dow and I have been interviewing a lot of people regarding the planning process and will have an initial report done in about two weeks. Kate Tesar will have a draft report on hatchery funding completed before she leaves for her new career as a lobbyist.

Conclusion: We are slightly behind schedule, with our original goal of a draft report in early September now postponed to early October. The two big issues that need further discussion and your input are the economic studies and a possible forum or workshop in order to get more public involvement. I've asked Sheila if we could set up a telephone call mid to late next week if your time and schedule permit.



Alaska State Legislature

House of Representatives

BEN GRUSSENDORF
SPEAKER

P. O. Box 928
SITKA, ALASKA 99835
(907) 747-8458

WHILE IN JUNEAU
POUCH V
JUNEAU, ALASKA 99811
(907) 485-3824
(907) 485-3720

MEMORANDUM

TO: Senator Dick Eliason
Senate President

FROM: Rep. Ben Grussendorf
Speaker

DATE: September 26, 1991

RE: Research Contracts for the Hatchery Work
Project

I have reviewed your suggestions for the proposed research contracts for the hatchery work project and have no objection to your use of Senate funds for these contracts.

ALASKA STATE LEGISLATURE SENATE

SENATOR RICHARD I. ELIASON

PRESIDENT OF THE SENATE
LABOR & COMMERCE COMMITTEE
RESOURCES COMMITTEE
RULES COMMITTEE
CHAIRMAN, SPECIAL COMMITTEE ON
DOMESTIC & INTERNATIONAL
COMMERCIAL FISHERIES



P.O. BOX 143
SITKA, ALASKA 99835

P.O. BOX V
JUNEAU, ALASKA 99811
(907) 465-4916

FAX (907) 465-4928

September 11, 1991

Senator-designee Shirley Craft
Legislative Council
2048 C South Rural Road
Tempe, Arizona 85282

*OK per Craft -
Shirley
by Joan Hope
9/27/91*

Dear Ms. Craft:

As you are probably aware, legislative staff, under the auspices of the Senate Special Committee on International and Domestic Fisheries, have been conducting an intensive review of the state's fish enhancement program. This review was initiated at the end of last session as a result of an increasing number of issues raised regarding the management of hatchery production, and the best options for spending declining state dollars. Certainly this past fishing season has made such a review even more timely and pertinent.

A major element of the research group's work plan (Attachment A) is to determine the economic impacts of the salmon enhancement program. Staff have thoroughly reviewed existing economic studies and have determined that further research is needed in order to help us determine the net benefits and costs of the salmon enhancement program. Five principal research components (Attachment B) have been identified for a total cost of \$58,000:

1) Hatchery Cost and Production Model to be conducted in-house, \$0.

2) Biological Population Model to be conducted by Dr. Jeremy Collie, University of Alaska Southeast, \$10,000.

Sept. 11, 1991
page two

3) Salmon Demand Model to be conducted by Dr. John Boyce,
University of Alaska Fairbanks, \$18,000.

4) Fishing Cost Model to be conducted by Dr. Matthew Berman,
University of Alaska Anchorage, Institute For Social and Economic
Research, \$20,000.

5) Model Synthesis to be conducted by Dr. Terry Smith,
University of Alaska Anchorage, Institute for Social and Economic
Research, \$10,000.

We are working with the University administration to reduce the overhead component of these contracts and thereby reduce the total cost of this project. However, we are anxious to get started and would like your support to go ahead with funding. If tentative approval of funding can be obtained from Legislative Council members by about September 20, then work could begin by October 1, the first four components would be completed by mid-December, and we would have an overall report by February 1, 1992. Formal action to approve the expenditure of Senate leadership funds on these contracts would be slated for the Legislative Council's next meeting.

I would like your support as a member of the Legislative Council in approving the transfer of the funds needed for this project to the Special Fisheries Committee in order to contract for this work. If you have further questions on the actual project, please contact either the overall project coordinator Molly McCammon at 465-4453, or the Economics Working Group leader Ginny Fay at 465-3711.

I would appreciate hearing from you as soon as possible.

Sincerely,



Senator Dick Eliason, Chairman
Senate Special Committee on Domestic
and International Fisheries

Alaska State Legislature

Chair, Resources Committee
Vice-chair, Transportation Committee
Member, Rules Committee
Member, Committee on Committees

District A
Ketchikan, Wrangell, Petersburg,
Hyder, Myers Chuck, Kupreanof



Senator Lloyd Jones

352 Front Street
Ketchikan, AK 99901
907 225-9082
Fax: 907 225-8546

P.O. Box V
Juneau, AK 99811
907 465-3743
Fax: 907 465-3922

MEMORANDUM

October 3, 1991

TO: Senator Dick Eliason
Senate President

FROM: Senator Lloyd Jones *LJ*

SUBJECT: **Hatchery Research Project Funding**

I understand that there is a proposal which will be before Legislative Council to appropriate \$58,000 out of leadership monies to fund a package of several marketing/economic studies. These studies would be in conjunction with the hatchery research project which was authorized by the Senate Special Committee on Fisheries last session.

I want to let you know that I will support this funding request when it comes before Legislative Council.

ALASKA STATE LEGISLATURE

SENATE STATE AFFAIRS,
CHAIR

ETHICS COMMITTEE,
CHAIR



Senator Pat Pourchot

ANCHORAGE
P.O. BOX 104836
ANCHORAGE, AK 99510
(W) (907) 581-7823
(H) (907) 338-2425

JUNEAU
P.O. BOX V
STATE CAPITOL
JUNEAU, AK 99811
(907) 465-3712

MEMORANDUM

TO: Sen. Dick Eliason, Chair
Senate Special Committee on
Domestic and International Fisheries

DATE: Sept. 30, 1991

FR: Senator Pat Pourchot, Member
Legislative Council

RE: Legislative Hatchery Work Project

This is to indicate my approval for the expenditure of Senate leadership funds on a research contract for the Legislative Hatchery Work Project.



Official Business

Alaska State Legislature
Senate

Office of The Majority Leader

Rick Halford
P.O. Box V
State Capitol
Juneau, Alaska 99811
Phone (907) 463-4958

P.O. Box 190
Chugiak, Alaska 99567
Phone (907) 694-4958

M E M O R A N D U M

TO: Senator Dick Ellason
Senate President

FROM: Senator Rick Halford *RH*

RE: Expenditure of leadership funds for salmon enhancement research

DATE: 10/9/91

Senator Ellson:

I have no objection if you should decide to expend \$58,000 in leadership funds to cover additional research to determine the economic impacts of the salmon enhancement program.

State of Alaska

House Majority Leader
COMMITTEES
HOUSE JUDICIARY
HOUSE RULES
HOUSE STATE AFFAIRS
SPECIAL COMMITTEE
MILITARY AND VET. AFFAIRS
LEGISLATIVE COUNCIL



Representative Max F. Gruenberg, Jr.
District 11
Spenard, Upper Midtown Anchorage

P.O. Box V
JUNEAU, AK 99811
(907) 465-3718
465-4968/4986
(SESSION)

3111 C STREET, SUITE 440
ANCHORAGE, AK 99503
(907) 561-7621

MEMORANDUM

DATE: October 9, 1991

TO: Senator Dick Eliason

FROM: Representative Max F. Gruenberg, Jr. *Max*

SUBJECT: Senate Special Committee on International and
Domestic Fisheries Funding

In your September 11, 1991 letter you asked for my support, as a member of the Legislative Council, for funding several committee projects totalling \$58,000. I am in support of this funding.

Alaska State Legislature
Senate

Office of The Majority Leader

Official Business

Rick Halford
P.O. Box V
State Capitol
Juneau, Alaska 99811
Phone (907) 465-4958

P.O.Box 190
Chugiak, Alaska 99567
Phone (907) 694-4958

M E M O R A N D U M

TO: Senator Dick Eliason
Senate President

FROM: Senator Rick Halford *RH*

RE: Expenditure of leadership funds for salmon enhancement
research

DATE: 10/9/91

Senator Eilson:

I have no objection if you should decide to expend \$58,000 in leadership funds to cover additional research to determine the economic impacts of the salmon enhancement program.

STATE OF ALASKA
House of Representatives
District 27

Representative Cliff Davidson
Chairman
House Resources Committee



Box V, Juneau, AK 99811
(907) 486-2487
Box 746, Kodiak, AK 99615
(907) 486-8250

MEMORANDUM

TO: President Richard Eliason
Alaska State Senate

FROM: Representative Cliff Davidson
Vice-Chair, Legislative Council

DATE: October 16, 1991

SUBJECT: Leg. Council approval of expenditure of funds over \$5,000.

As the acting Chairman of the Legislative Council, this memorandum is to register my approval of the transfer of \$58,000 of Senate leadership funds to the Senate Special Committee on International and Domestic Fisheries in order to contract for work to study the state's fish enhancement program as specified in your September 11 memorandum to Legislative Council members.

Please contact my office at 486-8250 if you have any questions.

Thank you.

STATE OF ALASKA
House of Representatives
District 27

Representative Cliff Davidson
Chairman
House Resources Committee

Box V, Juneau, AK 99811
(907) 465-2487
Box 746, Kodiak, AK 99615
(907) 486-8250

MEMORANDUM

TO: President Richard Eliason
Alaska State Senate

FROM: Representative Cliff Davidson
Vice-Chair, Legislative Council

DATE: October 16, 1991

SUBJECT: Leg. Council approval of expenditure of funds over \$5,000

As the acting Chairman of the Legislative Council, this memorandum is to register my approval of the transfer of \$58,000 of Senate leadership funds to the Senate Special Committee on International and Domestic Fisheries in order to contract for work to study the state's fish enhancement program as specified in your September 11 memorandum to Legislative Council members.

Please contact my office at 486-8250 if you have any questions.

Thank you.



Juneau Center for Fisheries and Ocean Sciences

School of Fisheries and Ocean Sciences
University of Alaska Fairbanks
11120 Glacier Highway
Juneau, Alaska 99801

(907) 789-4441 Office
(907) 789-4447 FAX

31 October 1991

The Honorable Senator R.I. Eliason
Alaska State Legislature
P.O.Box V (MS 3100)
Juneau, Alaska 99811

Dear Senator Eliason:

The workshop on the "Biological Interactions of Natural and Enhanced Stocks of Salmon" will soon start. I want to thank you for making travel funds available, which have enabled us to invite a large number of experts. Enclosed is a copy of the Agenda which is final except for a few minor changes or additions. Also enclosed is a copy of the final Prospectus distributed to the participants.

I shall keep you informed on our progress.

Sincerely yours,

Ole A. Mathisen
Professor of Fisheries

Oct. 30, 1991

TENTATIVE AGENDA
Workshop on the
"Biological Interactions of Natural and Enhanced
Stocks of Salmon in Alaska"

Saturday, November 9

Participants arrive during the day.

6:00-7:30 pm Welcoming reception, at the Powder House
 (transportation provided).

All the planary meetings are held in the Masonic Hall (located at the north end of First Street). The daily schedule is as follows:

7:45 - 8:30 a.m. Continental Breakfast (at the Masonic Hall)
 8:30 - 10:00 a.m. First Morning Session
 10:00 - 10:30 a.m. Coffee Break
 10:30 - 12:00 Second Morning Session
 1:30 - 3:00 p.m. First Afternoon Session
 3:00 - 3:30 p.m. Coffee Break
 3:30 - 5:00 p.m. Second Afternoon Session

Sunday, November 10

First Morning Session - 8:30-10:00 a.m.

Opening remarks:

1. G.L. Thomas, Director Prince William Sound Science Center
2. Goals of the Conference - Ole Mathisen, Univ. of Alaska-Juneau
3. Prince William Sound Aquaculture Corporation - John McMullen, President
4. State Genetic Policy - Jim Seeb, Alaska Dept. of Fish & Game

Session 1 -- Ocean carrying capacity
10:30-12:00

1. *A theoretical evaluation of the carrying capacity of Prince William Sound, Alaska for juvenile Pacific salmon.*
 R. Ted Cooney
2. *Density dependent changes in chum salmon, *Oncorhynchus Keta*, returning to Iwate Prefecture, Japan.* Hitoshi Ida
3. *Factors affecting marine growth of Bristol Bay sockeye salmon.*
 Don Rogers

Agenda - Page 2

4. *Interaction in natural carrying capacity limitations for natural and enhanced stocks of salmon.* Percy Washington

Session 2 -- Management of mixed stocks

1:30-3:00 p.m.

1. *Trends in abundance of hatchery and wild stocks of pink salmon in Cook Inlet, Prince William Sound and Kodiak, Alaska.*
Doug Eggers
2. *Management of mixed enhanced and wild salmonids in British Columbia.* (B.E. Riddell unable to attend - replacement???)
3. *Gene frequencies and the management of Pacific Salmon: Identification of wild and hatchery fish in mixed fisheries.*
Jim Seeb

Session 3 -- Summary and general discussion

3:30-4:30 p.m.

Evening Seafood dinner at the Reluctant Fisherman
Social hour, 6:30 p.m.; Dinner, 7 p.m.

Monday, November 11

Session 4

8:30-10 am -- **Basic Genetic Structure**

1. *Conservation of genetic diversity in salmonid fishes: why, what and how.* P.W. Allendorf
2. *The productive value of stream distances for estimating genetic relationship in salmonid species.* Fred Utter
3. *Population structure of chum salmon.* Lisa Seeb
4. *The importance of fine genetic structures in natural populations.* Tony Gharrett

Session 4 continued

10:30-12:00

5. *Quantitative genetic variation of life history traits in pink salmon.* William Smoker
6. *Genetic stock identification of Yukon River chum and chinook salmon.* Richard Wilmot

Agenda - Page 3

7. *Genetic stock identification of Bristol Bay area salmon.* Rebecca Everett.

Session 5 -- Straying

1:30 - 2:00 pm

1. *Homing, straying and the interaction between wild and enhanced stocks of salmon.* T.P. Quinn
2. (TBA) Sven Ebbesson (unable to attend -- paper to be distributed?)

Session 6 -- Long Term Case Histories

2:00-3:00 pm

1. *Interactions between wild and cultured Atlantic salmon -- A review of the experience in Norway.* Tor Heggberget
2. *The status of wild and hatchery propagated Swedish salmon stocks after 40 years of hatchery releases in the Baltic rivers.* Torleif Eriksson

Session 6 continued

3:30-5 pm

3. *The status of the Snake River chinook.* Ernest Brannon
4. *The Soviet experience in the field of salmon interactions.* Mikhail Glubokovsky
5. General discussion

Tuesday, November 12

Field trip to Wally Norenberg Hatchery at Esther Island (western Prince William Sound) -- *Weather dependent, this may be delayed until Wednesday.*

Wednesday, November 13**Session 7 -- Interactions in Prince William Sound**

8:30-10 am

1. *Historical production of wild and enhanced stocks of pink salmon in Prince William Sound.* Sam Sharr

Agenda - Page 4

Session 7 continued

10:30-12 noon -- Interactions in Prince William Sound

Session 8 -- Interactions in Southeast Alaska

1:30-3 pm

- 1. Chinook Enhancement in Southeast Alaska. Bill Heard**
- 2. An Overview of the Pink, Chum and Coho Enhancement programs in Southeast Alaska. Don Amend**

Session 8 continued

3:30-5 pm -- Interactions - General discussion

Thursday, November 14

Session 9 -- Interactions regarding other species, especially sockeye

8:30-10 am

Session 9 continued

10:30-12 Noon

Session 10 -- The Working Party: Writing sessions divided into sub-groups

1:30-5:00 pm

Friday, November 15

Session 11 -- Approval of document

8:30-12 Noon

Afternoon

Departures



Juneau Center for Fisheries and Ocean Sciences

School of Fisheries and Ocean Sciences
University of Alaska Fairbanks
11120 Glacier Highway
Juneau, Alaska 99801

(907) 789-4441 Office
(907) 789-4447 FAX

WORKSHOP ON THE BIOLOGICAL INTERACTIONS OF NATURAL AND ENHANCED STOCKS OF SALMON IN ALASKA

History and Background

Hatchery operations of salmon and trout have been in progress for more than a century in Europe, North American and North Asia. For a long time little impact was felt on the natural stocks because the operations were small in scale and generally unsuccessful due to lacking biological understanding of the reproductive process and survival mechanisms in salmonid species. This has changed in Alaska, especially during the last couple of decades. Some enhancement project involving artificial propagations have produced startling results and the scope of operations are now large enough to profoundly affect natural stocks, the economic aspects of fishing and processing, and marketing.

However, no statements have been written to evaluate biological impacts which is one of the basic tasks of the proposed workshop. It is also a reflection on Alaska's present concern to preserve the natural heritage with which the State is endowed and that changes, some of an irreversible nature, must have the approval of all segments of the population.

Plans for a workshop on the biological interactions of natural and enhanced fish stocks in Alaska was initiated a year ago. It follows international meetings on this topic in Norway (1990, Institute of Nature Conservation), in Canada (1991, Department of Fisheries and Oceans), in Moscow, Idaho and Pullman Washington (1991, NATO), and in Hakodate (1991, University of Hokkaido). The impact of enhanced salmon on natural stocks was identified as one of five most important natural resources issues to the Greater Prince William Sound Area in a 1990 conference sponsored by the Science Center.

During the 1991 Alaska legislative session, the high abundance of salmon and low ex-vessel prices created caused concern about salmon enhancement projects throughout the State, of which the impacts of enhanced salmon on natural stocks is an important consideration. Four hatchery research project study groups were established by the Alaska State Senator Eliason, to research various questions regarding interactions between the fisheries for natural and enhanced stocks of salmon. The mission

of these groups is to prepare background material for a full scale debate by the Alaska State Legislature next spring. This workshop is independent of these legislative study groups, but complementary because it focuses in depth on the biological questions related to salmon enhancement.

Definitions and Constraints

1. Salmon enhancement is used synonymously with Ocean Ranching.
2. Pen farming of salmonid species will not be included.
3. Lake fertilization or other indirect enhancement measures such as habitat manipulation also fall outside the mandate.

Purpose

Non-profit hatchery operations and ocean ranching was legalized by the Alaska State Legislature in 1972. This occurred at a time when natural production was at a low point which also coincided with a low point of ocean temperatures. The purpose was to supplement the natural production and especially to smooth out some of the existing interannual variability. But the mandate by the Legislature to the regulatory agencies was to manage for the natural stocks and this became a Public Policy.

In the beginning this was not a problem as long as the ocean ranching took place on a limited scale. In recent years with favorable survival conditions both natural and enhanced stocks have reached unprecedented magnitudes. In some areas of successful hatchery operations natural populations have declined. Thus, the major question for the workshop is to examine:

"The Biological Basis for Maintaining Strong Coexisting Stocks of Natural and Enhanced Salmon Populations in Alaska"

In this short statement is embodied all the biological problems of the Alaskan salmon populations involving behavior and straying, cross breeding and survival rates, ocean carrying capacity and harvest rates.

Objectives

1. To examine and evaluate the relevant genetic and behavioral characteristics of natural and enhanced stocks of salmonid fishes as they relate to hatchery issues in Alaska.
2. To consider life, mortality, or survival tables for fresh water, estuarine, coastal jet, and oceanic environments, linked in space and time, for natural and enhanced stocks of salmon in Alaska.

3. To examine relevant groupings of time series case histories of interactions of natural and enhanced stocks of salmon outside Alaska.
4. To explore limits to the carrying capacity of the ocean environment in the Gulf of Alaska.

Organization

The workshop will convene a small group of experts by invitations in Cordova, Alaska under the auspices of the Prince William Sound Science Center and the School of Fisheries and Ocean Sciences at the University of Alaska, Fairbanks. The participants fall into three categories: International experts, National experts outside Alaska, and experts from inside Alaska. Many of the participants will be asked to prepare papers on topics related to the workshops objectives.

These invited papers will be circulated for peer review, edited by the workshop chairpersons, and submitted for a special issue (workshop proceedings) publication.

In recognition of the complexity of this issue and the limited amount of synoptic information to evaluate it, unanimous conclusions and recommendations are not anticipated so the underlying risk functions of different courses of action must be considered.

The workshop will be organized around 5 separate Sessions:

1. The basic genetic structures of salmon stocks.
2. Time series of hatchery data and experiments from non-Alaskan sources.
3. Interactions Issues in Alaska

This session will be organized by three species groupings (pink-chum, sockeye, chinook-coho) or by two geographic areas, Prince William Sound and Southeast Alaska. Kodiak and Cook Inlet information will be used if appropriate. This latter alternative might be advantageous due to the interaction between grouping of species.

4. Carrying Capacity of the Ocean
5. Summary of Results and Conclusions with some Recommendations for Future High Priority Directed Research.

A Discussant will be appointed for each Session with the assignment of drafting a Report to be presented in the final session.

Following the Workshop these reports will be polished off and assembled whereafter a small Review and Editorial Group will meet in Juneau or elsewhere for completion of the final Group Report. The individual session reports or final report will be treated as the invited papers: circulated for peer review, edited, and submitted with the invited papers as a special issue (workshop proceedings) publication. A scientific journal will be sought as the publisher, pending quality of the papers.

Methods

The workshop will be convened on November 10 and run continuously through the 15th. Expenses will be provided to all international guests and to those North American participants that require it.

Products

December 1991: A final report on the Workshop sessions.

June 1992: Submission of the Workshop Proceedings as an issue of a scientific journal.

Sponsorship

This workshop is sponsored by the Prince William Sound Science Center (PWSSC) and the School of Fisheries and Ocean Sciences (SFOS) University of Alaska, Fairbanks.

Co-chairpersons are Dr. A. Ole Mathisen, SFOS, and Dr. G.L. Thomas, PWSSC. The list of contributors include: Alaska Department of Fish and Game, Pacific Seafood Processors Association, Pew Charitable Trust, Prince William Sound Aquaculture Association, Sealaska Corporation, and University of Alaska Fairbanks.



P.O. Box 705
Cordova, AK 99574
(907) 424-5800 FAX: (907) 424-5820

**Workshop on the
"Biological Interactions of Natural and Enhanced
Stocks of Salmon in Alaska"**

DATES: Sunday, Nov. 10 - Friday, Nov. 15, 1991

AT: Masonic Hall and the Prince William Sound Science Center
Cordova, Alaska

ORGANISERS: Prince William Sound Science Center and the
School of Fisheries and Ocean Sciences,
University of Alaska

OBJECTIVES:

1. To examine and evaluate the relevant genetic and behavioral characteristics of natural and enhanced stocks of salmonid fishes as they relate to hatchery issues in Alaska.
2. To consider life, mortality, or survival tables for fresh water, estuarine, coastal jet, and oceanic environments, linked in space and time, for natural and enhanced stocks of salmon in Alaska.
3. To examine relevant groups of time series case histories of interactions of natural and enhanced stocks of salmon outside Alaska.
4. To explore limits to the carrying capacity of the ocean environment in the Gulf of Alaska.

The major question for this workshop is to examine:

"The biological basis for maintaining strong coexisting stocks of natural and enhanced salmon populations in Alaska."

AGENDA

The workshop will convene a small group of experts from the international community, from elsewhere in North America and from inside Alaska. During the first two days of the workshop, which are open to the general public, papers will be presented on topics related to the workshop's objectives. A tentative list of the speakers and their topics is attached.

The latter days of the workshop will involve the experts in small group work sessions and a writing session. A summary of the

results and any conclusions reached will be approved at the final workshop session Friday morning, Nov. 15.

A final report on the workshop will be completed in December 1991. The papers presented will be circulated for peer review, edited by the workshop chairpersons and submitted for publication in June 1992.

WORKSHOP

CHAIRPERSONS: Ole Mathisen, *School of Fisheries, University of Alaska, Juneau, Alaska*
G.L. (Gary) Thomas, *Director, Prince William Sound Science Center, Cordova, Alaska*

The list of contributors includes:

The Pew Charitable Trusts
Alaska Department of Fish & Game
Pacific Seafood Processors Association
Prince William Sound Aquaculture Corporation
Sealaska Corporation
School of Fisheries and Ocean Science, University of Alaska
Prince William Sound Science Center

For further information: Nancy Bird, (907) 424-5800 or
FAX 424-5820

Tentative list of Workshop Participants and their Topics

Conservation of genetic diversity in salmonid fishes: why, what and how.

W.W. Allendorf, Division of Biological Sciences, Missoula, Montana

An Overview of the Pink, Chum and Coho Enhancement programs in Southeast Alaska.

Don Amend, Southern Southeast Regional Aquaculture Association, Ketchikan, Alaska

The status of the Snake River chinook.

Ernest Brannon, University of Idaho, Moscow, Idaho

A theoretical evaluation of the carrying capacity of Prince William Sound, Alaska for juvenile Pacific salmon.

Ted Cooney, School of Fisheries & Ocean Sciences, University of Alaska, Fairbanks, Alaska

~~Ewen Ebbesson, Institute of Marine Science, University of Alaska, Seward, Alaska - unable to attend~~

Trends in abundance of hatchery and wild stocks of pink salmon in Cook Inlet, Prince William Sound and Kodiak, Alaska.

Doug Eggers, Chief Fisheries Scientist, Alaska Dept. of Fish & Game, Juneau, Alaska

Torleif Eriksson, Swedish Univ. of Agricultural Sciences, Department of Aquaculture, Umea, Sweden

The importance of fine genetic structures in natural populations.

Tony Gharrett, School of Fisheries, University of Alaska, Juneau, Alaska

The Soviet experience in the field of salmon interactions.

Mikhail Glubokovsky, Institute of Marine Biology, Far East Branch, Vladivostok, USSR

Chinook Enhancement in Southeast Alaska.

Bill Heard, National Marine Fisheries Service, Juneau, Alaska

Interactions between wild and cultured Atlantic salmon --

A review of the experience in Norway.

Tor Heggberget, NINA, Norsk Institutt for Naturforskning, Trondheim, Norway

Density dependent changes in chum salmon, *Oncorhynchus keta*, returning to Iwate Prefecture, Japan.

Hiroshi Ida, Kitasato University School of Fisheries Sciences, Sanriku-cho, Kesen-gun, Japan

Ole Mathisen, Director, Fisheries School, University of Alaska,
Juneau, Alaska

John McMullen, President, Prince William Sound Aquaculture
Corporation, Cordova, Alaska

*Homing, straying and the interaction between wild and enhanced
stocks of salmon.*

T.P. Quinn, Fisheries Research Institute, University of
Washington, Seattle, Washington

~~Management of mixed enhanced and wild salmonids in British
Columbia.~~

~~B. E. Riddell, Dept. of Fisheries and Ocean, Biological Sciences
Branch, Nanaimo, British Columbia, Canada~~ *replacement
being
sought*

Factors affecting marine growth of Bristol Bay sockeye salmon.

Don Rogers, Fisheries Research Institute, University of
Washington, Seattle, Washington

Gene frequencies and the management of Pacific Salmon:

Identification of wild and hatchery fish in mixed fisheries.

Jim Seeb, Alaska Dept. of Fish & Game, Anchorage, Alaska

Population Structure of Chum Salmon

Lisa Seeb, Alaska Dept. of Fish & Game, Anchorage, Alaska

Sam Sharr, Research Biologist, Alaska Dept. of Fish & Game,
Cordova, Alaska

Bill Smoker, School of Fisheries, University of Alaska,
Juneau, Alaska

Gary Thomas, Director, Prince William Sound Science Center,
Cordova, Alaska

*The productive value of stream distances for estimating genetic
relationship in salmonid species.*

Fred M. Utter, National Oceanic and Atmospheric Administration
(NOAA), Seattle, Washington

Percy Washington, GAIA NW Inc., Seattle, Washington

Additions

Rebecca Everett, USFWS

Richard Wilmot USFWS

TENTATIVE AGENDA
Workshop on the
"Biological Interactions of Natural and Enhanced
Stocks of Salmon in Alaska"

Saturday, November 9

Participants arrive during the day.

6:00-7:30 pm Welcoming reception, at the Powder House
(transportation provided).

All the plenary meetings are held in the Masonic Hall (located at the north end of First Street). The daily schedule is as follows:

7:45 - 8:30 a.m. Continental Breakfast (at the Masonic Hall)
8:30 - 10:00 a.m. First Morning Session
10:00 - 10:30 a.m. Coffee Break
10:30 - 12:00 Second Morning Session
1:30 - 3:00 p.m. First Afternoon Session
3:00 - 3:30 p.m. Coffee Break
3:30 - 5:00 p.m. Second Afternoon Session

Sunday, November 10

First Morning Session - 8:30-10:00 a.m.

Opening remarks:

1. G.L. Thomas, Director Prince William Sound Science Center
2. Goals of the Conference - Ole Mathisen, Univ. of Alaska-Juneau
3. Prince William Sound Aquaculture Corporation - John McMullen, President
4. State Genetic Policy - Jim Seeb, Alaska Dept. of Fish & Game

Session 1 -- Ocean carrying capacity
10:30-12:00

1. A theoretical evaluation of the carrying capacity of Prince William Sound, Alaska for juvenile Pacific salmon.
R. Ted Cooney
2. Density dependent changes in chum salmon, *Oncorhynchus keta*, returning to Iwate Prefecture, Japan. Hitoshi Ida
3. Factors affecting marine growth of Bristol Bay sockeye salmon.
Don Rogers

Agenda - Page 2

4. *Interaction in natural carrying capacity limitations for natural and enhanced stocks of salmon.* Percy Washington

**Session 2 -- Management of mixed stocks
1:30-3:00 p.m.**

1. *Trends in abundance of hatchery and wild stocks of pink salmon in Cook Inlet, Prince William Sound and Kodiak, Alaska.* Doug Eggers
2. *Management of mixed enhanced and wild salmonids in British Columbia.* (B.E. Riddell unable to attend - replacement???)
3. *Gene frequencies and the management of Pacific Salmon: Identification of wild and hatchery fish in mixed fisheries.* Jim Seeb

**Session 3 -- Summary and general discussion
3:30-4:30 p.m.**

Evening Seafood dinner at the Reluctant Fisherman
Social hour, 6:30 p.m.; Dinner, 7 p.m.

Monday, November 11

**Session 4
8:30-10 am -- Basic Genetic Structure**

1. *Conservation of genetic diversity in salmonid fishes: why, what and how.* F.W. Allendorf
2. *The productive value of stream distances for estimating genetic relationship in salmonid species.* Fred Utter
3. *Population structure of chum salmon.* Lisa Seeb
4. *The importance of fine genetic structures in natural populations.* Tony Gharrett

**Session 4 continued
10:30-12:00**

5. *Quantitative genetic variation of life history traits in pink salmon.* William Smoker
6. *Genetic stock identification of Yukon River chum and chinook salmon.* Richard Wilmot

Agenda - Page 3

7. *Genetic stock identification of Bristol Bay area salmon.* Rebecca Everett.

Session 5 -- Straying

1:30 - 2:00 pm

1. *Homing, straying and the interaction between wild and enhanced stocks of salmon.* T.P. Quinn
2. (TBA) Ewan Ebbesson (unable to attend -- paper to be distributed?)

Session 6 -- Long Term Case Histories

2:00-3:00 pm

1. *Interactions between wild and cultured Atlantic salmon -- A review of the experience in Norway.* Tor Heggberget
2. *The status of wild and hatchery propagated Swedish salmon stocks after 40 years of hatchery releases in the Baltic rivers.* Torleif Eriksson

Session 6 continued

3:30-5 pm

3. *The status of the Snake River chinook.* Ernest Brannon
4. *The Soviet experience in the field of salmon interactions.* Mikhail Glubokovsky
5. General discussion

Tuesday, November 12

Field trip to Wally Norenberg Hatchery at Esther Island (western Prince William Sound) -- Weather dependant, this may be delayed until Wednesday.

Wednesday, November 13**Session 7 -- Interactions in Prince William Sound**

8:30-10 am

1. *Historical production of wild and enhanced stocks of pink salmon in Prince William Sound.* Sam Sharr

Agenda - Page 4

Session 7 continued

10:30-12 noon -- Interactions in Prince William Sound

Session 8 -- Interactions in Southeast Alaska

1:30-3 pm

- 1. Chinook Enhancement in Southeast Alaska. Bill Heard**
- 2. An Overview of the Pink, Chum and Coho Enhancement programs in Southeast Alaska. Don Amend**

Session 8 continued

3:30-5 pm -- Interactions - General discussion

Thursday, November 14

**Session 9 -- Interactions regarding other species, especially
sockeye**

8:30-10 am

Session 9 continued

10:30-12 Noon

**Session 10 -- The Working Party: Writing sessions divided into
sub-groups**

1:30-5:00 pm

Friday, November 15

Session 11 -- Approval of document

8:30-12 Noon

Afternoon

Departures

ALASKA STATE LEGISLATURE SENATE

SENATOR RICHARD I. ELIASON

PRESIDENT OF THE SENATE
LABOR & COMMERCE COMMITTEE
RESOURCES COMMITTEE
RULES COMMITTEE
CHAIRMAN, SPECIAL COMMITTEE ON
DOMESTIC & INTERNATIONAL
COMMERCIAL FISHERIES



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November 12, 1991

Commissioner Glenn Olds
Alaska Department of Commerce and Economic Development
P.O. Box D
Juneau, AK 99811

Dear Commissioner Olds:

As you know, in May the Senate Special Committee on International and Domestic Fisheries initiated an extensive review of the Alaska salmon enhancement program. The purpose of the study is to review the program's history and legislative intent, current status, and future direction. As part of the Legislative Hatchery Research Project, an Economics and Marketing study group was developed to provide information to the legislature on the economic impacts of enhanced salmon production. The group is to help determine

- if the current levels of Alaska salmon harvests are over-or under-supplied from a world-market perspective and
- if increased hatchery production of salmon will lower prices, fishing and processing revenues, and the total net value of Alaska's salmon fisheries.

The initial task of the economics and marketing group was to review completed research and identify specific topics requiring additional research, a portion of which would be completed through contracts. Based on this review, the economics and marketing group proposed five principal research components as follows:

- 1) a hatchery production and cost model,
- 2) a fish population model linked to fishing effort and harvests,
- 3) a demand model for Alaska salmon in world markets,
- 4) a fishing cost model, and
- 5) a computer software system to combine the four models.

Commissioner Olds
November 12, 1991
Page 2

This proposal was based also, in part, on discussions between legislative staff working on the Legislative Hatchery Research Project and members of your staff working with the Salmon Strategy Task Force. In order to avoid duplication in research efforts, it was agreed that the legislative study would focus on economic analyses while the Salmon Strategy Task Force, through the Department of Commerce and Economic Development, would focus on marketing analyses.

To date, it appears that the efforts have succeeded in being complimentary. To continue to avoid duplication, I would like to inform you that on November 1 the Legislative Council approved funding for the proposed legislative research contracts. We expect to award the contracts by November 15. The results of these analyses will provide valuable information on worldwide markets and demand for Alaska salmon as well as an assessment of the Alaska salmon enhancement program. Preliminary results of the research will be available in April 1992. We will keep you informed on the progress of the research.

Thank you for your cooperation in these important research efforts.

Sincerely,



Senator Dick Eliason, Chairman
Senate Special Committee on Domestic and International Fisheries

NORTHERN



SOUTHEAST REGIONAL AQUACULTURE ASSOCIATION, INC.

(907) 747-6850

1308 SAWMILL CREEK ROAD

SITKA, ALASKA 99835

FAX (907) 747-1470

December 3, 1991

Mr. Clem Tillion
Special Assistant to
the Governor on Fisheries
P O Box A
Juneau, AK 99811-0101

Dear Mr. Tillion:

Last year the Alaska Board of Fisheries charged the two Regional Aquaculture Associations in Southeast Alaska (NSRAA & SSRAA) with the task of developing an allocation plan for enhanced salmon on a Southeast-wide basis. In response to the Board of Fisheries charge, both NSRAA and SSRAA appointed a troller, gillnetter, and a seiner from our Boards to serve on a Southeast-wide Allocation-Task Force.

In the process of assembling the data and facts pertinent to formulating an allocation plan it became painfully evident that the existing data is subject to a high degree of variability because we, as a State, have not required marking of all hatchery stocks, nor has the State maintained an adequate mark recovery program. It is our understanding that much of the mark recovery effort for Southeast is financed by the U.S./Canada Treaty Commission. Things would be even worse if U.S./Canada funding were not available.

We would like to recommend that the State of Alaska make a commitment to a mark recovery program for Southeast Alaska. Real numbers of fish cannot be established without a marking and recovery program. The cornerstone of any plan we come up with, is the accuracy and consistency of catch data.

Thank you in advance for your consideration.

Sincerely,

Dave Pitcher, Chairman
Southeast Allocation Task Force

NORTHERN



SOUTHEAST REGIONAL AQUACULTURE ASSOCIATION, INC.

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Thank you in advance for your consideration.

Sincerely,

Dave Pitcher, Chairman
Southeast Allocation Task Force

NORTHERN



SOUTHEAST REGIONAL AQUACULTURE ASSOCIATION, INC.

(907) 747-6850

1308 SAWMILL CREEK ROAD

SITKA, ALASKA 99835

FAX (907) 747-1470

December 3, 1991

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Special Assistant to
the Governor on Fisheries
P O Box A
Juneau, AK 99811-0101

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Thank you in advance for your consideration.

Sincerely,

Dave Pitcher, Chairman
Southeast Allocation Task Force



Alaska State Legislature

SENATOR RICHARD I. ELIASON

President of the Senate

P.O. Box V
Juneau, Alaska 99811
(907) 465-3755

MEMORANDUM

TO: Gordon Harrison, Director
Legislative Research Agency

FROM: Senator Dick Eliason 
President of the Senate

DATE: December 9, 1991

SUBJECT: Legislative Review of the Alaska Salmon Enhancement Program

Thank you for your agency's work on the Legislative Review of the Alaska Salmon Enhancement Program. As you probably know, the Legislative Council approved funding for the review's economic studies. The economic portion of the research is being conducted by the University of Alaska Fairbanks (UAF), Department of Economics. Part of this research includes a survey of hatchery operation.

My staff contacted you earlier this year regarding the hatchery survey with which we would like your assistance. We hope to have the survey to you for mailing early the week of December 9.

In addition, Linda Snow of your staff provided us with information regarding sources of economic data for the salmon demand analysis. Dr. Mark Herrmann of UAF has asked us if he could contact Ms. Snow with additional follow-up questions. We have referred him to your agency for assistance.

Thank you again for your continued cooperation.



Alaska State Legislature

SENATOR RICHARD L. ELIASON

President of the Senate

P.O. Box V
Juneau, Alaska 99811
(907) 465-3755

December 9, 1991

Dr. Keith Criddle, Chair
Department of Economics
University of Alaska, Fairbanks
Fairbanks, AK 99775-0580

Dear Dr. Criddle:

Thank you for submitting a proposal for an economic analysis of the Alaska Salmon Enhancement Program. As you know, the Senate Special Committee on Domestic and International Commercial Fisheries received proposals from the University of Alaska - Anchorage (UAA), Institute of Social and Economic Research, and the University of Alaska - Fairbanks (UAF), Department of Economics. A team of economists including: Kurt Schelle and Dr. Ben Muse with the Alaska Commercial Fisheries Entry Commission; Jeff Hartman with the Alaska Department of Fish and Game - F.R.E.D. Division; Dr. Gardner Brown with the University of Washington; Dr. James Hastie with National Marine Fisheries Service (NMFS); and Ginny Fay a Legislative Analyst for the Senate Fisheries Committee, reviewed and ranked the proposals.

While both of the sets of proposals were strong, the decision was made to award the contracts to the University of Alaska, Fairbanks (UAF). Two major factors contributed to this decision. The first is Dr. Mark Herrmann's more extensive experience and expertise in salmon demand modeling. The second is the UAF, School of Management's waiver of the administrative overhead; this waiver will allow almost three additional months of research time devoted to the project.

Both fishing cost model proposals received relatively "low marks" by most of the reviewers. This is largely attributable to the higher level of risk to obtaining reliable results from relatively "novel" empirical approaches to estimating marginal fishing costs. As a result, as terms of this contract, we would like additional information on your default research approach and your researcher to keep committee staff fully apprised on research progress.

Dr. Keith Criddle
December 9, 1991
Page Two

Thank you again for submitting a proposal and we look forward to working with you as the research progresses.

Sincerely,

A handwritten signature in cursive script, appearing to read "Dick Eliason". The signature is written in dark ink and is positioned above the printed name.

Senator Dick Eliason



Alaska State Legislature

SENATOR RICHARD L. ELIASON

President of the Senate

P.O. Box V
Juneau, Alaska 99811
(907) 463-3755

December 9, 1991

Dr. Lee Gorsuch
University of Alaska, Anchorage
Institute of Social and Economic Research
3211 Providence Drive
Anchorage, AK 99508

Dear Dr. Gorsuch:

Thank you for submitting a proposal for an economic analysis of the Alaska Salmon Enhancement Program. As you know, the Senate Special Committee on Domestic and International Commercial Fisheries received proposals from the University of Alaska - Anchorage (UAA), Institute of Social and Economic Research, and the University of Alaska - Fairbanks (UAF), Department of Economics. A team of economists including: Kurt Schelle and Dr. Ben Muse with the Alaska Commercial Fisheries Entry Commission; Jeff Hartman with the Alaska Department of Fish and Game - F.R.E.D. Division; Dr. Gardner Brown with the University of Washington; Dr. James Hastie with National Marine Fisheries Service (NMFS); and Ginny Fay a Legislative Analyst for the Senate Fisheries Committee, reviewed and ranked the proposals.

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Thank you again for your interest in the Committee's research and submitting a proposal. A special thanks to Dr. Terry Smith for his assistance coordinating the proposal submission.

Sincerely,

A handwritten signature in dark ink, appearing to read "Dick Eliason", is written over the word "Sincerely,".

Senator Dick Eliason



Alaska State Legislature

SENATE

Official Business

P.O. Box V
State Capitol
Juneau, Alaska 99811

December 9, 1991

To: Tamara Cook, Director
Division of Legal Services

From: Senator Dick Eliason, Chairman 
Senate Special Committee on Domestic and International Commercial Fisheries

RE.: Reimbursable Services Agreements with the Alaska Commercial Fisheries Entry Commission and the University of Alaska Fairbanks

Per your conversation with committee staff on December 6, I am providing more detailed information regarding the contractual language required for the data transfer between the Commercial Fisheries Entry Commission (CFEC) and the University of Alaska Fairbanks, Department of Economics (UAF). The Senate Special Committee on Domestic and International Fisheries is contracting for economic analyses of the Alaska salmon enhancement program. The research to be conducted requires access to CFEC data files.

State CFEC confidentiality statutes (AS 16.05.815) specify that access to confidential data files is restricted to employees of the Alaska Department of Fish and Game (ADF&G) and CFEC, or contractors of ADF&G or CFEC. In addition, a portion of the economic research to be done by UAF requires some preliminary computer analysis by CFEC staff. Therefore, the Senate Committee, through the Legislative Affairs Agency (LAA), is entering into an RSA with the CFEC for the data analysis and a subcontract for the economic studies (attachments).

As terms of this agreement with CFEC, we have agree to provide contractual language specifying confidentiality requirements. The points to include in this agreement are:

- researchers must abide by confidentiality requirements as specified in AS 16.05.815;
- confidentiality compliance must be to the standards set by the Commercial Fisheries Entry Commission;
- reports to the legislature, as well as any other publications including professional journals, must comply with confidentiality statutes and standards; and
- all CFEC data must be returned to CFEC when the project is completed.

Thank you for your assistance.

Attachments

ALASKA STATE LEGISLATURE SENATE

SENATOR RICHARD I. ELIASON

PRESIDENT OF THE SENATE
LABOR & COMMERCE COMMITTEE
RESOURCES COMMITTEE
RULES COMMITTEE
CHAIRMAN, SPECIAL COMMITTEE ON
DOMESTIC & INTERNATIONAL
COMMERCIAL FISHERIES



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JUNEAU, ALASKA 99811
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Oct. 2, 1992

Mr. Ken Roberson
Gulkana Hatchery
P. O. Box 47
Glenallen, Alaska 99588-0047

Dear Mr. Roberson:

I would like to thank you and your staff for the considerable time and effort you have devoted to completing the salmon enhancement production and costs surveys. These surveys were sent to you over the last few months as part of the legislative review of the Alaska salmon enhancement program. The economic benefit-cost analysis of the program is nearing completion as a result of your assistance and cooperation. The members of the Senate Special Committee on Domestic and International Commercial Fisheries are looking forward to reviewing these results and sharing them with you. The information from this economic review will help the legislature in the development of public policy considerations to ensure that the salmon enhancement program can continue to be a successful program.

Thank you again for your significant time and cooperation.

Sincerely,

A handwritten signature in cursive script, appearing to read "Dick", is written above the typed name.

Senator Dick Eliason, Chairman
Special Committee on Domestic and
International Commercial Fisheries

ALASKA STATE LEGISLATURE SENATE

SENATOR RICHARD I. ELIASON

PRESIDENT OF THE SENATE
LABOR & COMMERCE COMMITTEE
RESOURCES COMMITTEE
RULES COMMITTEE
CHAIRMAN, SPECIAL COMMITTEE ON
DOMESTIC & INTERNATIONAL
COMMERCIAL FISHERIES



P.O. BOX 143
SITKA, ALASKA 99835

P.O. BOX V
JUNEAU, ALASKA 99811
(907) 465-4918

FAX (907) 465-4928

Oct. 2, 1992

Mr. Gary Wall
Fort Richardson Hatchery
P. O. Box 5-337
Fort Richardson, Alaska 99505-0337

Dear Mr. Wall:

I would like to thank you and your staff for the considerable time and effort you have devoted to completing the salmon enhancement production and costs surveys. These surveys were sent to you over the last few months as part of the legislative review of the Alaska salmon enhancement program. The economic benefit-cost analysis of the program is nearing completion as a result of your assistance and cooperation. The members of the Senate Special Committee on Domestic and International Commercial Fisheries are looking forward to reviewing these results and sharing them with you. The information from this economic review will help the legislature in the development of public policy considerations to ensure that the salmon enhancement program can continue to be a successful program.

Thank you again for your significant time and cooperation.

Sincerely,

A handwritten signature in cursive script, appearing to read "Dick".

Senator Dick Eliason, Chairman
Special Committee on Domestic and
International Commercial Fisheries

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SITKA, ALASKA 99835

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(907) 485-4916

FAX (907) 485-4928

Oct. 2, 1992

Mr. Darrell Keifer
Elmendorf Hatchery
716 Steel Street
Anchorage, Alaska 99501

Dear Mr. Keifer:

I would like to thank you and your staff for the considerable time and effort you have devoted to completing the salmon enhancement production and costs surveys. These surveys were sent to you over the last few months as part of the legislative review of the Alaska salmon enhancement program. The economic benefit-cost analysis of the program is nearing completion as a result of your assistance and cooperation. The members of the Senate Special Committee on Domestic and International Commercial Fisheries are looking forward to reviewing these results and sharing them with you. The information from this economic review will help the legislature in the development of public policy considerations to ensure that the salmon enhancement program can continue to be a successful program.

Thank you again for your significant time and cooperation.

Sincerely,

A handwritten signature in dark ink, appearing to read "Dick".

Senator Dick Eliason, Chairman
Special Committee on Domestic and
International Commercial Fisheries