University of Alaska

Alaska Sea Grant College Program

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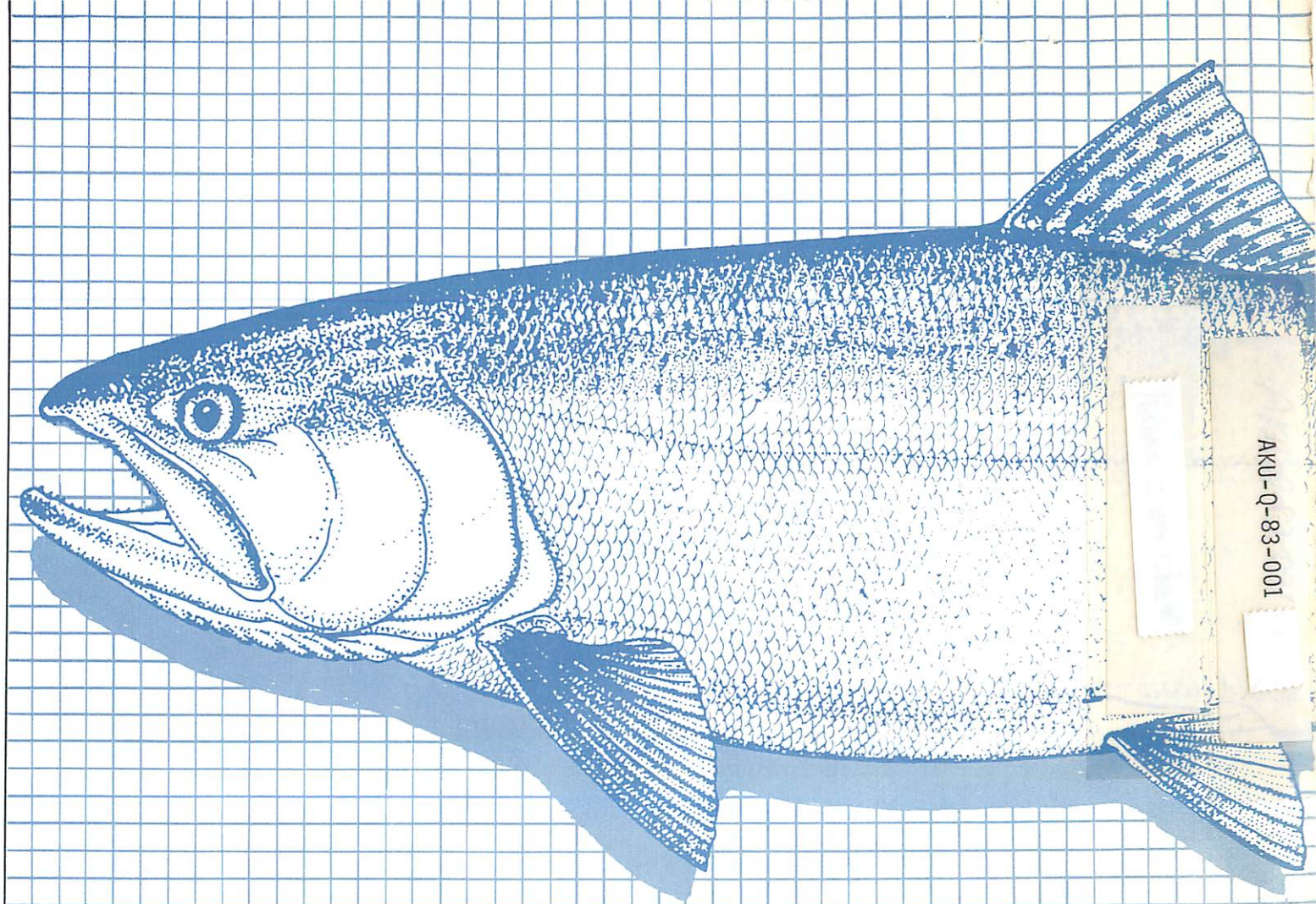
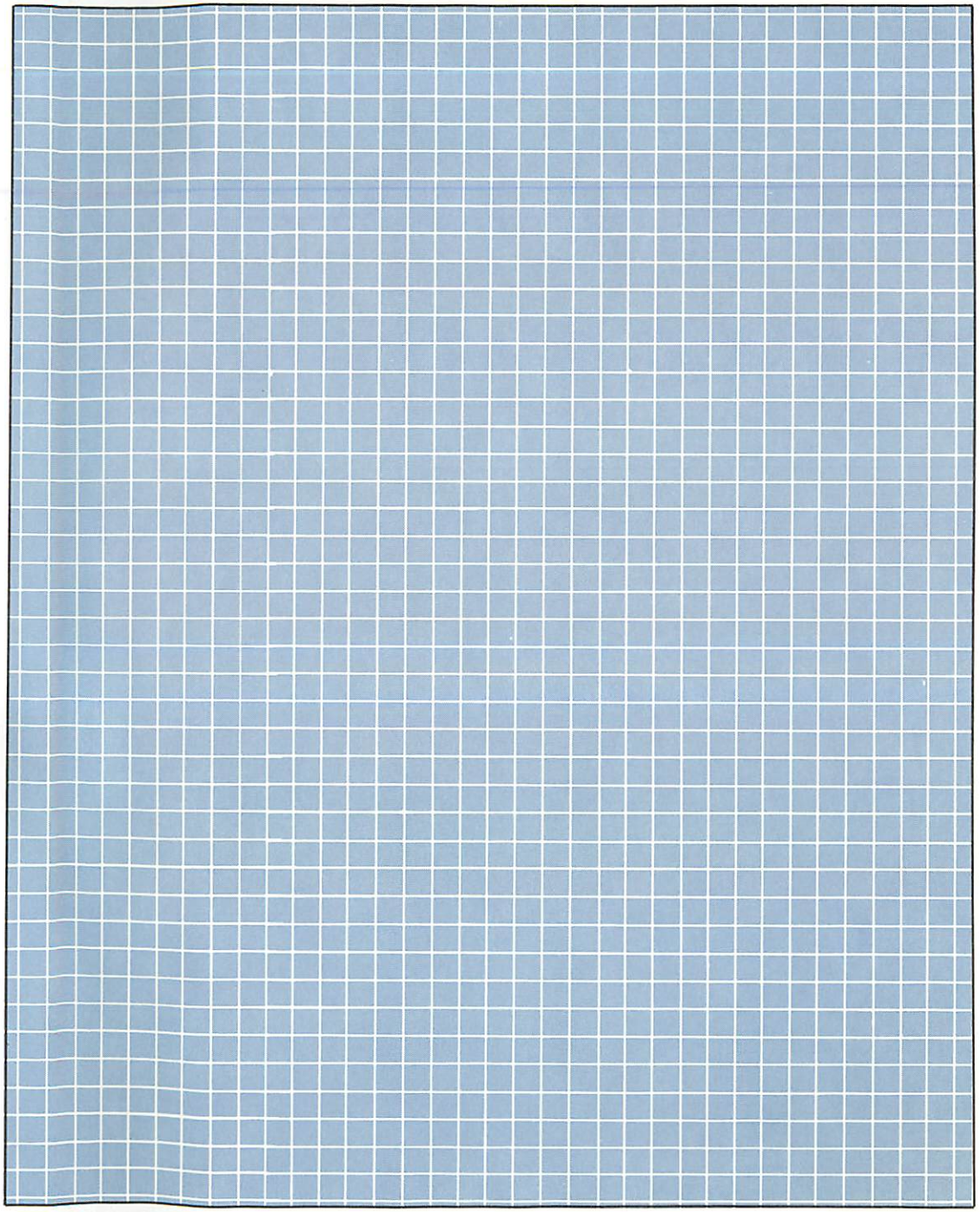


Annual Report

AK-SG-85-5

May 1985



Alaska Sea Grant College Program
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Annual Report

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Acknowledgements

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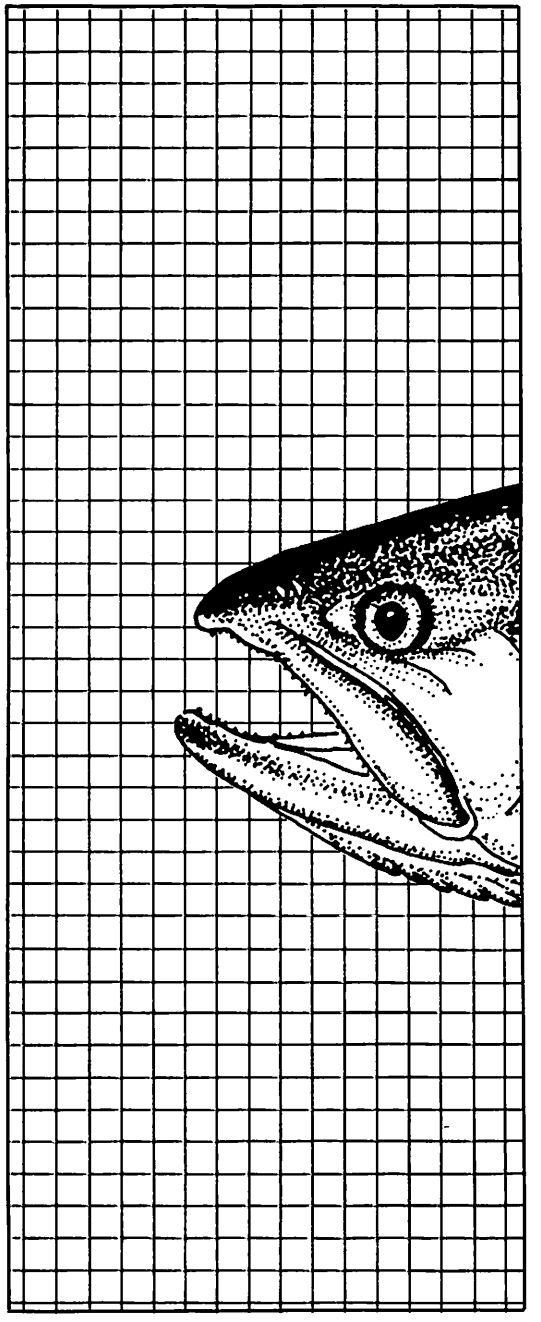
The purpose of Alaska Sea Grant is to provide the people of the state and the nation with knowledge and means to develop, use and conserve the marine resources of the state and the nation. This knowledge and means is developed through a program of teaching, research and public service.

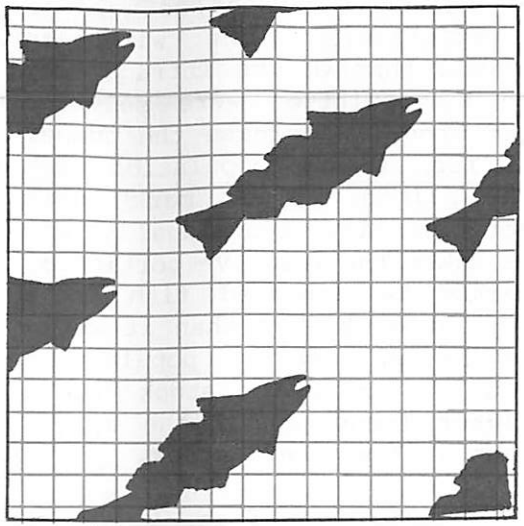
Within the University of Alaska, Sea Grant encourages faculty and staff to apply their knowledge and skills to the practical needs of understanding, developing and conserving Alaska's marine resources. The program continues to be a driving force in shaping the university's fisheries and fisheries-related programs.

Alaska Sea Grant is different from many publicly-sponsored research and education efforts in that its programs develop directly from industry needs. Projects are reviewed both by industry and academic experts before inclusion in a Sea Grant proposal. In this year's report, Sea Grant's role in improving the state's aquaculture program, strengthening salmon stocks, furthering biological knowledge about important commercial species, deciphering the give-and-take of market dynamics affecting crab pricing, putting a dollar value on Alaska's sportfishing industry, and improving processing techniques in the Alaskan setting are highlighted.

As has been the case for the past few years, Alaska Sea Grant could equally be called "fish grant". Projects have concentrated on Alaska's commercial fishery and ways to improve its use and management. Alaska's notoriously boom-and-bust economy has always reflected its natural resource base. Gold, furs, and fish have lured many to Alaska. But fishing is one of the industries that has kept people here and forms one of the more stable blocks in our rollercoaster economy. For this reason, fishing is a major part of today's economic planning that must take into account declining oil revenues and emphasize development of long-range, non-seasonal industrial income such as that generated in successful groundfish operations.



Aquaculture and Salmon Genetics Research

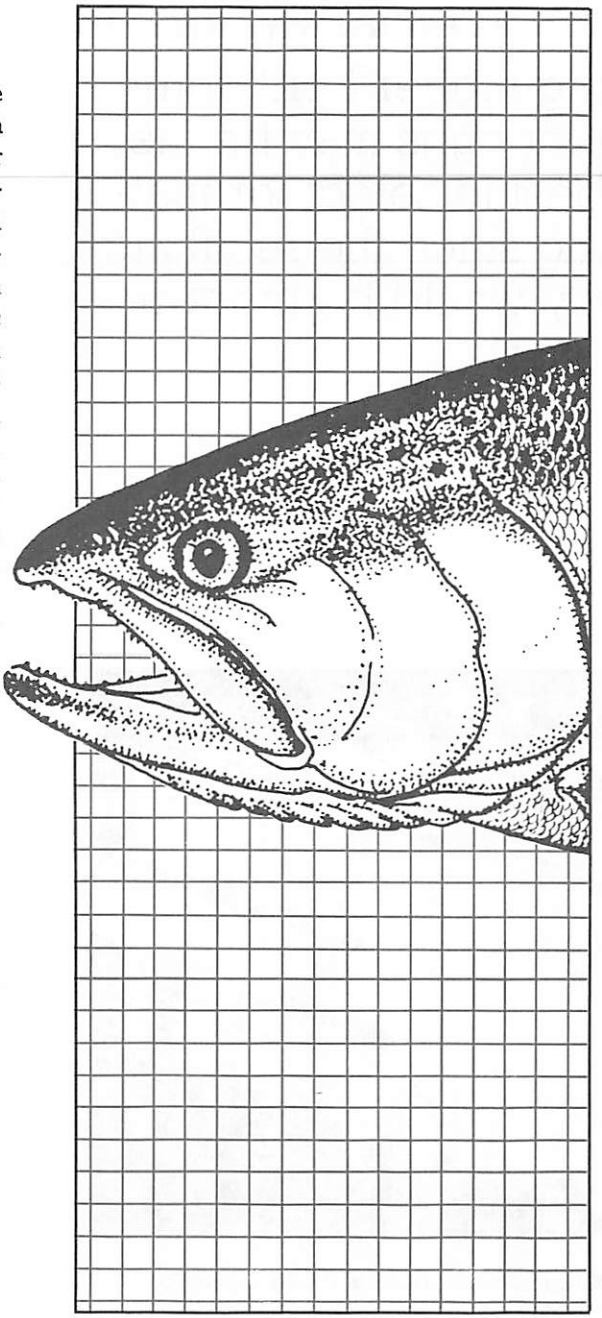


Genetic engineering has reshaped agriculture and animal husbandry in the last half-century. Food production has become more efficient, yields and survival rates have improved, farms now operate where they have never been able to exist before because of climate or soil conditions. Scientists are now using these same techniques to improve fish production in hatcheries and ponds around the world, hoping to produce more and better fish. Alaska's salmon hatchery program is benefitting from Sea Grant research as scientists apply genetic investigation techniques to identifying salmon stocks, improving hatchery-reared fish, and predicting and improving fish behavior and food quality.

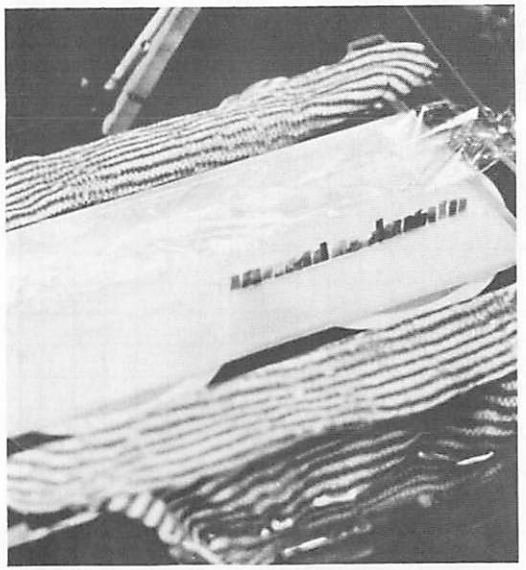
Pink salmon have not been the particular focus of salmon genetics projects in other places, but they are an important commercial and recreational mainstay in the Alaskan fisheries. To see if a species can be improved through genetic selection of traits, a good bit must be known about the quantitative genetic variation in several populations. Project R/02-11, **Potential for Genetically Improving Salmon**, is increasing what we know about this variation in some Alaskan pink salmon.

Protein isozymes in the eye, liver, heart, and white muscle of carefully bred and identified fry were analyzed by electrophoresis to characterize the frys' parents at 30 gene loci. Protein and glycogen content of liver and muscle tissue is being assayed along with egg lipid content and liver condition.

Variance in embryonic development suggests that there are differences in early and late runs that might reflect adaption to differences in Auke Creek's incubation environment. Thus, this relationship appears to be dynamic and interactive rather than an alternative cause for phenotype.



"... females producing higher lipid content eggs may be the best to select for mating since the resulting fry would be more robust."



Electrophoretic analysis of salmon protein isosomes.

A master's student associated with this project is measuring variation in embryonic development rate within and between two runs of pink salmon in Auke Creek. Documenting developmental variability between populations and between parents within populations will permit scientists to test hypotheses about the genetic contributions to such variability.

Scientists are also looking at the lipid content of eggs, presuming that large amounts of natural lipids indicate large energy reserves in the developing embryo. If this is so, females producing higher lipid-content eggs may be the best to select for mating since the resulting fry would be more robust. Another master's student is measuring consumption of endogeneous energy reserves in pink salmon fry on the hypothesis that neutral lipids are the quantitatively important energy source for developing embryos.

Hatchery projects have also increased debate over what affect returning hatchery spawners may have on nearby natural stocks. Project R/02-05, **Genetic Interaction of Auke Creek Hatchery Pink Salmon with Natural Spawning Stocks in Auke Creek,** is testing a number of experimental methods as well as interaction. Fish with an allele that occurs infrequently in a population were selected and bred to increase the number of fish in the population with the allele. This "mark" does not identify individual fish. It makes the relative portion of marked to unmarked fish in a population higher than it would be in an unmarked population. Thus, a "marked" stock has a higher frequency of the allele than an "unmarked" stock.

The returning fish will be evaluated to see if there is any marker-related mortality. The frequency of the marker allele has also been estimated for nearby naturally spawning stocks. If substantial numbers of the marked (hatchery) fish stray into the wild breeding grounds, the mark frequency in the wild population will increase. If marker frequency increases over time, the rate of increase can be used to estimate the interaction between hatchery and natural spawning stocks.

Results so far indicate that there is no deleterious effect from marking. Marker frequency seems to have decreased between

the 1982 fry and the 1981 parents. Experiments are underway to determine if this was caused by selection or if it indicates random drift.

There was a poor return of 1980 adults in 1982. There was also a decrease in marker frequency, although it was not statistically significant. The poor return could be caused by poor ocean survival of fry and/or interception of the late run by the gill net fishery. It may also be that hatchery fish were severely stressed in the hatchery before release.

The marker is heritable and will be monitored over generations. If frequencies remain stable, the effect on survival is small. If frequencies revert to pre-marking levels, there will be reason to believe the mark has an adverse effect.

So far there is no evidence of temporal or spatial straying of marker fish into other distinct breeding groups.

Another project on interbreeding experimentally removes reproductive barriers to determine what effect breeding hatchery with wild stocks will have on some traits in chum salmon. Project R/02-09, **Evaluation of a Chum Salmon Transplant,** uses chum salmon spawned at a hatchery from parents taken from three natural donor stocks. The fry were tagged and identified as descending from one of the donor stocks or as crossbreeds. The development rates of embryos during incubation were documented and compared. Age, size, and survival rates will also be compared upon return.

Data from electrophoretic sampling showed significant genetic homogeneity among the three donor stocks. This was surprising since the streams are geographically close enough to expect straying and are apparently ecologically similar enough to discourage strong selective forces from separating them. Pink salmon stocks in the same area do not have strong genetic heterogeneity, however their populations are larger and may have more straying. This heterogeneity in gene frequency for post-transplant chums will make it easier to detect how the exotic alleles affect the stock's genetic structure. There is no genetic heterogeneity between samples taken in two different years.

Development rates among fry differed from group to group. Each responded to environmental factors in timing, and there is evidence that the emergence patterns of crossbred fry may be more variable than those of purebred fry. First returns of tagged adults show a trend toward an excess of purebred fish, although more data will be gathered in 1986 and 1987.

Practical application of genetic separation techniques is the basis of Project R/06-17, **Genetic Study of Some Alaskan Chinook and the Potential Use of this Information on Stock Separation Problems.** Chinook salmon allocation and ownership is one of the most complicated social, political, and conservation problems in Pacific Northwest fisheries. Not only are some stocks desperately low, but increasing emphasis has been put on returning the same proportion of fish to each fishery as that state or country contributes to the total population of this high-value, wide-ranging fish.

Scientists have used starch gel electrophoresis to genetically characterize Washington's Columbia River chinook populations using a number of biochemically detectable genetic loci. The technique depends on the divergence between reproductively isolated populations. In the Columbia River experiments, scientists successfully characterized the stock struc-

ture of chinook populations and have used the data to determine the destination of fish caught near the mouth of the river. In this project, scientists will gather baseline data on the genetic composition of Alaska chinook populations. If sufficient diversity exists among different populations within or between regions, the starch gel technique may be useful for stock separation.

The biggest problem has been obtaining fresh or fresh-frozen tissue samples for analysis. Little is known about Alaska's chinook spawning streams, most of which are remote and turbid. There are few accurate population estimates. Samples obtained for this study through the cooperation of state and federal agencies should be representative of an area if not of discrete stocks.

Samples of eye, heart, liver, and skeletal muscle tissue were examined electrophoretically. Cursory evaluation of the data seems to indicate that there is little gene flow among southeastern Alaska populations sampled. Differences exist between populations from different drainages as well as between populations within larger drainages such as the Taku and Stikine Rivers. The Alaska population also tends to display less genetic variability than those examined on the Columbia River.

"Little is known about Alaska's chinook spawning streams which are remote and turbid . . . Samples obtained through this study . . . should be representative of an area."

Additional work will include upgrading the quality of baseline data by analyzing other samples obtained. Data on the wild population will be evaluated and scientists will look at the effect of domestication on wild chinook stocks and the genetic composition of resident hatchery fish.

In the last of Alaska Sea Grant's aquaculture projects, the second year has been completed in Project R/02-10, **Potential of a Barriered Southeast Alaska Lake Containing Rainbow Trout for Production of Coho Salmon Smolt.** In this work, scientists are determining if coho salmon smolt can be successfully stocked and raised to fry in a barriered lake, and how the smolt affect resident populations and lake conditions, and are tracking resource division among lake inhabitants.

Physical, chemical and biological descriptions of lake conditions were documented in the first year. Studies indicate that Lower Rostislaf Lake can support 2,000 coho salmon fry

per hectare of lake surface with good results. Broodstock was selected from nearby streams and coho smolt are to be introduced in 1984. Scientists will track the growth, survival and behavior of coho and changes in lake conditions and the resident invertebrates caused by the introduction of smolt.

Results will be applicable to only a few lakes because of the relatively small population of rainbow trout found in Rostislaf Lake. Nearby Osprey Lake is now the focus of studies involving resident arctic char and coho stocked in the mid-70s. Chinook fry will be introduced in July 1984. Studies scheduled for trout in Rostislaf Lake will instead be conducted on char in Osprey Lake, including measurements of how char and the lake habitat are affected by the introduced chinook salmon fry.

Commercial Fisheries Biology

Tanner crab, pollock, Pacific herring, and Bristol Bay's sockeye salmon were subjects of Alaska Sea Grant's biological research. The commercial value of these species is quite significant to Alaska fisheries. Tanner crab harvests have become increasingly important since decline of Alaska's king crab harvest. Bristol Bay's sockeye salmon run is the world's largest. Herring and pollock fisheries off Alaska are already a lucrative part of the foreign fishing activity and represent the most likely expansion of the domestic fishing effort.

The tanner is Alaska's mid-sized crab, smaller than a king but larger than the Dungeness, averaging a little under five lbs. Although its commercial importance is rising, knowledge about molting and thus growth-age relationships is sketchy. Without this information, recruitment to the fishery is difficult to assess.

Molting frequency of sublegal-sized crab is an important element of determining recruitment. Molting frequency of legal-sized crab is important to predict size and shell condition of crabs available to the fishery. Tagging studies have proven however that retention of man-made tags is not always possible through a molt.

Tagging is expensive and tags attached to tissue sometimes inhibit growth.

Project R/06-18, **Molting Frequency of Tanner Crab** investigates the use of barnacles as natural tags to determine molting frequency. Although knowing the age of a barnacle settled on the carapace of a crab will not account for the time between molt and settling, neither does a man-made tag. The barnacles pose no physical threat to the crab and as crabs are delivered to processors, the barnacles can be rapidly and inexpensively analyzed to es-

tablish trends in molt frequency. Reproductive longevity of females could also be estimated since females stop molting after reaching a mature size.

Field samples of barnacles from commercially captured tanner crab were taken at Sand Point, around Kodiak and in Cook Inlet. Size and age analysis of those samples continue. In most sub-areas sampled, barnacles were found attached to a significant portion of the crab, frequently 50 percent of the sample. A fairly good idea of barnacle species and age in the northeast Gulf of Alaska has developed through this work. An identification key for barnacles on tanner crab is complete. Results so far indicate that barnacles can be a non-subjective carapace-aging guide throughout much of the northeastern Gulf of Alaska.

Alaska's pollock are an enormous domestically underused species. By weight, more Alaska pollock are landed yearly than any other species in the world. Currently, Alaska's pollock are harvested by foreign fleets and a small but growing number of domestic joint venture operations. The high-value fisheries like salmon and crab now support as many fishermen as they are likely to, and pollock is one possibility for a new and sustained domestic fishery.

The National Marine Fisheries Service manages Alaska's pollock, depending largely on population structure and dynamics models. These models require data on feeding rates, energetics, and their response to environmental factors.

Project R/06-19, **Alaska Pollock Feeding Functions**, investigates pollock food intake and resulting growth. The experimental fish are held in aquariums at temperatures characteristic of the Bering Sea and fed a pollock diet. Scientists hope to establish relationships among food intake, growth rate, fork length, body weight, and ambient temperature.

Fish were captured in a shrimp pot and held until feeding and behavior normalized. A regular feeding schedule was established and measurements of length and weight taken. Several starvation experiments were conducted.

Data on ration (as a percent of body weight) and resulting growth (as a percent of body weight) allowed calculation of gross conversion efficiency. Similar calculations were made comparing ration and condition factors, conversion efficiency and initial body weight. The relationship between growth and ration was calculated for 30g to 60g fish, but equations generated need further refinement to improve their predictive qualities.

Growth rate plateaus at very high ration are normal. However, the pollock in this study did not exhibit such a plateau. Further experiments will clarify relationships between maximum food intake, fish size, and ambient temperature. Evidence suggests that the condition factor depends on ration as an independent variable. Starvation experiments showed condition decline is uniform as is weight loss. Analysis of maximum food intake, growth and conversion efficiency to initial body weight has yielded only a few data points. However, the scant data show growth rate declining apparently with increasing body size. Conversion efficiency seems to decline with decreasing body size. Additional work will sharpen understanding of these relationships, and examine the role of fish size, temperature and food type.

Pacific herring are targeted in three Prince William Sound fisheries: bait, sac-roe and her-

ring-roe-on-kelp. The bait and sac-roe are the most economically important. Present management assumes that at least two stocks are harvested, one that migrates from the Gulf of Alaska into Prince William Sound for the sac-roe fishery, and another that winters in Orca Bay for the bait fishery.

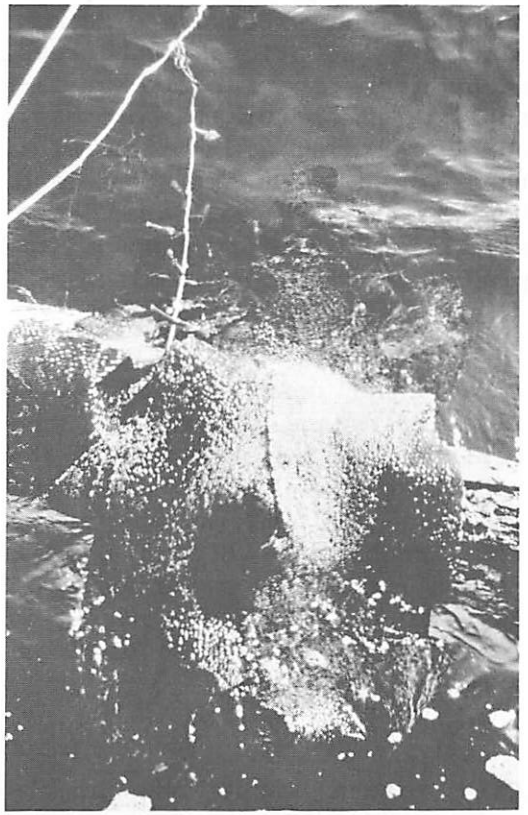
Project R/06-15, **Herring Stocks in Prince William Sound, Alaska** is investigating whether the two fisheries indeed harvest from different populations, whether the herring exploited in either fishery are from different stocks, and whether the stocks are the same from year to year.

Researchers collected data by starch gel electrophoresis and scale pattern analysis. Allelic frequency data for the biochemical genetic loci examined had sufficient genetic variability to be used for stock identification. Analysis of the data however shows no biochemical genetic evidence for the existence of more than one stock. The inability to separate samples through discriminant analysis however, does not prove they are from a homogeneous population. Preliminary analysis of the scale data provides no indication that two or more discrete stocks are being harvested in eastern Prince William Sound. Scales were taken by scraping rather than from selected places on the fish. Efforts have been made to improve data quality by transformations based on the overall size and shape of each scale. Transformed data have not provided a resolution.

Although neither of the comparisons have shown evidence of more than one stock, the results do not prove that they are from the same stock. Additional master's thesis work will examine similar biochemical genetic data for other major herring stocks in the northern Gulf of Alaska, spawning timing, and year-class strength to see if there is a reasonable alternative hypothesis to the existence of a single Prince William Sound stock.

On the other side of Alaska, Bristol Bay's sockeye salmon fisheries bring in around $150 million each year. Environmental data alone have proven insufficient to determine when salmon will move into Bristol Bay. Predicting when those fish will start their run into the bay is a skill that can mean a great deal to waiting fishermen and fishery managers.

"Although neither comparisons have shown evidence of more than one (herring) stock, the results do not prove that they are from the same stock."



Prince William Sound herring roe on kelp. Photo by Kathy Rowell

The fish are well-distributed around the Bering Sea, and maturing fish gather in three major areas as they migrate back to Bristol Bay--the basin, the continental slope and the continental shelf. Each sub-area has a particular water temperature regime, and quality and quantity of food, so growth and maturation appear to be differently influenced in each area. Project R/07-10, **Factors Affecting Migration Timing of Bristol Bay Sockeye Salmon** clarifies relationships between water temperature, food availability, the maturation process, and ascending migration for these fish. The physical and biological data collected here will be used to form a model for predicting migration timing.

First, the condition of final ripening stage salmon in the Bering Sea were examined to establish maturation condition and ascending migration timing relationships. Second, peak return dates in major Bristol Bay rivers were related to temperature and the zooplankton biomass.

Peak return dates are highly correlated among the four rivers studied: the Kvichak, Naknek, Egegik and Ugashik. The correlation is stronger between the neighboring two rivers than it is between the distant ones.

Salmon move from the basin area to the shelf areas as maturation progresses. The temperature relation changes at 5.4 degrees C. When the basin temperature is lower than 5.4 degrees C, the shelf temperature is colder than the basin temperature. When the basin temperature is warmer than 5.4 degrees C, the shelf temperature is higher than the basin temperature. This indicates that the effect of thermal environment on maturing salmon will be different at temperatures higher and lower than 5.4 degrees C. Peak return dates to the rivers studied are earlier in warmer years. Variability in peak return dates is greater when the temperature is above 6.0 degrees C. This suggests that thermal condition of the basin does not simply explain return timing in warmer years. It also appears that when younger fish predominate in the population, return date is delayed in warmer years. Shelf temperature and return timing have been found to have an inverse relationship. A wide variation in return data occurs when the temperature exceeds 6 degrees C.

Results suggest that predicting peak return dates from sea surface temperatures is more reliable in years with intermediate and cold temperature ranges. Predictability diminishes when higher temperatures cause greater variation in return dates.

The maturity index of age 2.2 sockeye salmon during final ripening (June-July) in the basin and shelf areas were compared. The average maturity index (ranging from 1.8 to 7.0 in females and 0.5 to 4.2 in males) increased steadily as sockeye migrated from basin to shelf. The maturity index tends to be higher in warm water years.

Female gonad development was compared between the basin and the shelf. Ovary maturity was designated from Stage II (oil and globule) to Stage VI (migratory nucleus stage). Stage V and VI predominated in both geographic areas. Stage composition of the population varied with year and by area. On the shelf, warm years had more of the stage VI females than cold years. Stage II females were only a small portion of the total population, but were significantly a higher fraction in cold years. The water temperature, growth rate, and ma-

Bristol Bay gillnetters line up to deliver red salmon catch.

"... Predicting red salmon return dates from sea surface temperatures is more reliable in years with intermediate and cold temperature ranges."

turity index were regressed to the peak return date. When temperature and maturity index were used as predictors in multiple linear regressions, the correlation became higher than in linear regressions with a single predictor.

Basin temperature in warm years is regressed to peak return data, but the relation is not established in cold years. Zooplankton biomass is correlated to peak return data in the basin, but not on the shelf. The regression with temperature and zooplankton biomass in the basin area is highly significant in cold years, but not in warm years.

Originally investigators hypothesized that returns were triggered by salmon maturity, which is directly influenced by water temperatures. They also suggested that sea water temperature influences on food abundance and growth determined the maturity condition, and thus triggered timing. Both factors are present simultaneously along the migration route.

Evidence supports the first part of the hypothesis, but not the second. In cold years water temperature causes slow growth, slow maturation and late return of salmon despite the higher zooplankton biomass. In warm years, high temperature accelerates growth and maturation, causing early returns in spite of a lower zooplankton biomass. Food abundance therefore does not seem to control growth and maturation.

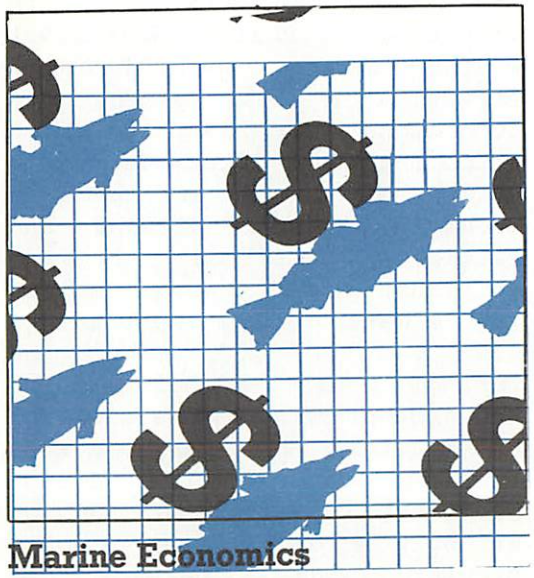
An alternative hypothesis is proposed, that additional weather factors could have an effect. In cold years, sea conditions are rough with a predominance of cloudy days. In warm years, skies are calm and clear. Light conditions and spatial relations between zooplankton and sockeye salmon in the water may be important.

During prolonged cloudiness, the photoperiod is less distinct and sunlight is dispersed across the surface of the ocean. Zooplankton will not be so strongly aggregated at a particular depth, perhaps diminishing food availability for salmon and reducing feeding efficiency. In warmer years, the opposite could be true.

Further, on the difference in maturation rates in cold and warm years, reduced penetration of light into the ocean may slow maturation. It may take longer for salmon to get the threshold level of light intensity, wavelength and photoperiod that

control maturation through the salmon's endochrinological processes.

Another factor under consideration is the amount of fresh water discharge in the vicinity of the natal rivers. Such discharge may influence migration in relation to osmoregulation.



Marine Economics

Alaska's king and tanner crab on the international market and Alaska's burgeoning recreational fishery drew the attention of Alaska Sea Grant's economists.

In Project R/14-07, **A Spatial Equilibrium Trade Model for King and Tanner Crab Fisheries,** economists are looking first at how variables like tariff and non-tariff barriers, income, exchange rate, and noncompetitive markets influence international trade in king and tanner crab.

Demand and supply in countries with established king and tanner crab markets were first estimated. Interaction among countries with markets will then be established and the impacts of trade variables quantified using a spatial equilibrium model.

Two journal articles have been produced discussing the theoretical issues of how to handle disequilibrium techniques in models. A second report, describing the world market for king and tanner crab is in progress. This will include the recent developments of surimi crab substitute products and the affects of the Alaska king crab stock collapse. The paper will be presented in collaboration with Tsune Kusakawa of Tokai University at a king crab conference in January 1985.

Joint efforts on this project have obtained a database from Chile that documents every king crab sale to the United States from 1979 to 1983. Chile is rapidly ascending in king crab marketing, taking up the slack caused by Alaska's king crab stock decline. The data will enable researchers to empirically test theories regarding the relationship between vertical integration and market power as well as theories concerning price determination at the firm level.

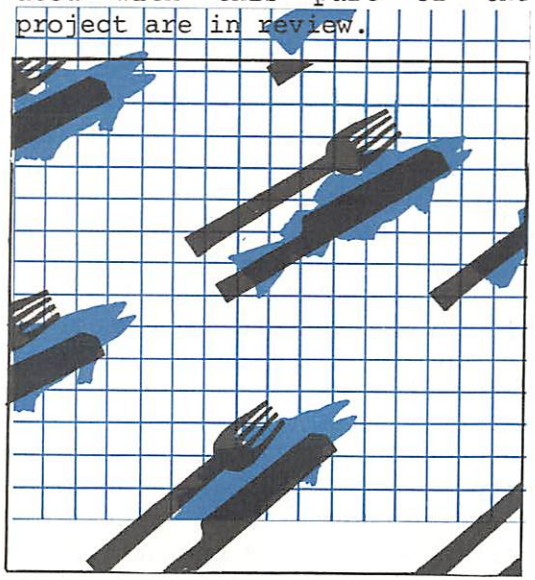
Alaska's recreational fisheries are another growing economic influence, both through tourism and increased resident sportfishing. Very little data on the economic impact of recreational fisheries or their value to the angler exists, yet sport fishermen are increasingly vocal in salmon allocation discussions among commercial fishermen and management agencies. Project R/14-08, **An Economic Evaluation of Recreational Salmon Fishing in the Kenai-Russian River Region,** focussed on one of the most hotly disputed allocation areas in Alaska. Data from sport fishermen on these rivers was used first to compare two of the most common methods for putting a value on recreational fishing. If this was possible, results would improve application of these methods to the Alaskan fisheries. Second, the project produced the first information useful for determining the value of Alaska's salmon in the recreational fisheries, data important to allocation decisions and land use planning. During the project, Sea Grant

staff worked closely with the Alaska Department of Fish and Game and the U.S. Forest Service.

A paper has been written on empirical divergences between the two valuation methods, compensating and equivalent variation. A major effort involved improved inclusion of time and time constraints in methods when evaluating an angler's decision on how long to stay at a recreational site. New work has specified the costs of time as a multivariate function including arguments of time spent at the site, household income, and travel time. A conceptual framework with a set of structural equations that can be solved in reduced form for estimation has also resulted.

Data collection continued by mail survey. Responses were analyzed to estimate the recreationist's willingness to pay for angling and willingness to accept payment for angling. Empirical estimates have been developed for all three fisheries in the study: Willow Creek Pink salmon, Bristol Bay red salmon, and Kenai River king salmon. Researchers helped Alaska Department of Fish and Game personnel learn the recreational valuation process so they could expand the project to other rivers and other recreational activities.

Assistance was also given to the U.S. Forest Service's development of a trade-off model for timber, fisheries and wildlife in southeastern Alaska. Reports on workshop activities associated with this part of the project are in review.



Seafood Science and Technology Research

Quality improvement is at the base of Alaska Sea Grant's seafood technology projects. In one, scientists are trying to help make cleaner shellfish processing waste water pay off by developing new products from reclaimed waste products. In the other, scientists are testing a method of holding Pacific salmon to see if it reduces bacterial spoilage and how the holding method might affect later freezing.

Project R/35-05, **Shellfish Waste Biotechnology**, is investigating chemical processes for converting the polysaccharide chitin into a valuable chemical commodity. Chitin is a major component of shellfish carapace and therefore of shellfish processing wastewater. Environmental Protection Agency standards now require a cleaner effluent from processing plants, increasing the amount of shellfish waste reclaimed during processing. The reclaimed chitin can be converted into chitosan, a highly useful polymer with many industrial and medical applications.

The enzyme chitin deacetylase can convert chitin to chitosan. This project is investigating ways to make that conversion inexpensive and efficient. Some microorganisms have been found to produce the enzyme through normal cellular functions, particularly M. rouxii. Cultivation of these microorganisms seemed one possible way to produce quantities of the enzyme cheaply.

Recent results in this and other studies have shifted emphasis from single enzyme bioconversion

"Tests on *M. rouxii* suggest that chitin deacetylase production is intimately associated with and is leached from mycelia."

Alaskan crab fisheries produce tons of processing waste that could render valuable chitosan.

of chitin to chitosan, to multiple enzyme or whole microorganism bioconversion. Work has continued on biochemical methods to purify and characterize the chitin deacetylase extracted from M. rouxii. However emphasis is now on studies of the cellular functions of chitin deacetylase in the organism rather than on increased chitin deacetylase production. By determining when and why M. rouxii produces the enzyme, better design for the bioconversion of shellfish chitin will result. Tests on M. rouxii suggest that chitin deacetylase production is intimately associated with and is leached from the mycelia. A hypothesis concerning the role of chitin deacetylase in the synthesis of new cell wall material in M. rouxii has been developed and evidence to support this hypothesis is being gathered. The time frame of chitin deacetylase production in germinating M. rouxii spores has been determined. These results will be compared with that of cyclic adenosine monophosphate (cAMP) in germinating sporangiospores of M. rouxii.

Enzymatic production of chitosan from shellfish wastes will probably require use of whole organisms or enzyme mixtures. The relatively low yields and high extraction costs of chitin deacetylase from M. rouxii tend to favor use of the whole organism. However, continuing studies to determine the role of chitin deacetylase in M. rouxii spore germination and studies to biochemically purify and characterize this enzyme are providing substantial information applicable to the implementation of microbial systems for shellfish waste treatment. While enzymatic chitin deacetylation of shellfish wastes has proven to be more difficult than enzymatic deproteinization of fish wastes using proteases, the information gathered so far indicates that economical treatment methods can be developed.

Recently, considerable interest has developed in using partially-frozen storage to hold fish before final processing. Successful use of this method to hold fish that were later canned showed that the storage methods reduced bacterial spoilage, belly-burn, and darkening of the visceral cavity in ungutted fish while still producing an acceptable product.

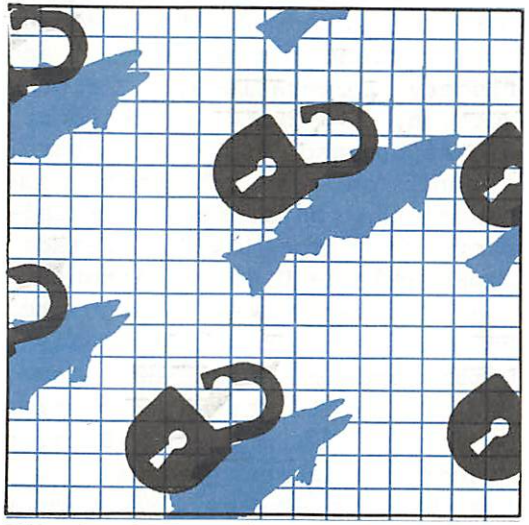
Project R/35-06, **Postmortem Biochemical Changes in Pacific Salmon During Partially Frozen Storage,** examines how the holding process influences nucleotides, lipids and proteins. These are elements that particularly related to frozen fillet quality and shelf life.

Work to date has focussed on how the analysis would be conducted, resulting in some convenient methods for evaluating nucleotide, lipid and protein changes.

Data has been collected for nucleotide analysis on coho salmon. That data will be expressed as concentrations before interpretation. Lipid analysis is proceeding as a six-step study to investigate the effect of time and temperature changes on the quantities of major lipid factions in the muscle tissue of sockeye and coho salmon. Sockeye salmon have been tested for over half of the study steps planned. Calculations are not yet complete.

Sockeye and coho held at 2 degrees C, -2 degrees C, -4 degrees C, and -20 degrees C were tested for flavor, odor, tenderness and juiciness to estimate quality changes for Pacific salmon steaks. A portion of each steak was evaluated by eight trained taste panel members. Data is being analyzed to determine shelf life at each temperature.

A literature search and test protocol have been completed to document protein and amino acid changes. A pilot study is underway to evaluate the baseline levels and the extent of changes to be expected during the upcoming part of this study.

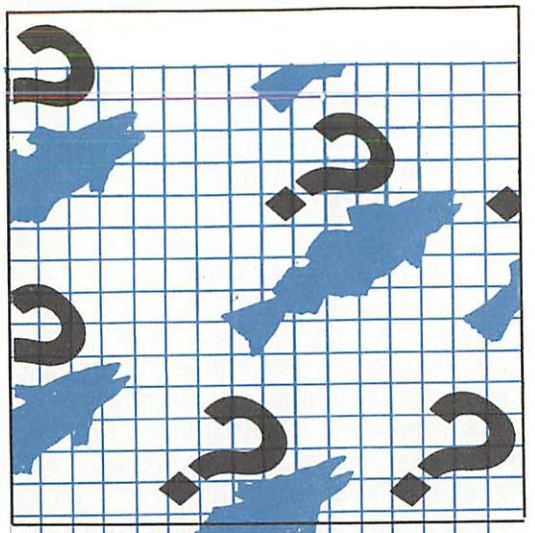


Marine Education

Project E/70-08, **Alaska Sea Week,** a K-6 curriculum series acquainting students with Alaska's close relation to the sea, continued for its fourth year. The original Sea Week program concentrated on southeastern Alaska. In the years Sea Grant has sponsored the project, it has grown to include all regions of the state. Part of that expansion has been teacher training and program development. The other major part has been development of a new guidebook series including information on all Alaska marine areas. Last year, investigators took Sea Week into the northern and western arctic. This year, they returned to southeastern and southwestern Alaska, and to the urban areas of Fairbanks and Anchorage. Work on completing the new set of Sea Week books continued.

A leadership course was offered in the spring, and summer field courses were conducted. Thirty southwest Alaska teachers met in Seward for a three-day workshop on biological and social studies, Sea Week lessons and resources, field trip leadership, and in-service leadership. A week-long marine and aquatic biology course attracted 18 students from around the state. It was conducted in Cordova and co-sponsored by the University of Alaska, Juneau, Prince William Sound Community College and Alaska Sea Grant.

The Sea Week coordinators also made presentations on the project at a number of national and regional professional meetings.



Information and Advisory

Project A/75-01, **Public Information Services,** links Sea Grant with the marine and academic communities through conferences, publications and other public communication projects.

Conferences were sponsored on marine archeology, sablefish and the biological interactions between marine mammals and commercial fisheries in the southeastern Bering Sea. Alaska Sea Grant published proceedings for each conference.

The Alaska Marine Archeology Workshop attracted 50 participants from the U.S. and Canada to Sitka. Jointly sponsored by the Alaska State Office for History and Archeology, Sheldon Jackson College and the University of Alaska Museum, and Alaska Sea Grant, conference presentations discussed how to inventory and house artifacts and Alaska's marine archeological resources, as well as legal and other issues.

The International Sablefish Symposium was held in Anchorage March 29-31. As sablefish become commercially more important, knowledge of biology must also increase to insure good management. Technical papers were presented at this meeting on current management and fishery operations, reproduction, stock assessment, migration and stock structure. A panel on research needs completed the conference. Participants from the U.S.A., Canada, Japan and the U.S.S.R. attended. The conference was co-sponsored by Alaska Sea Grant, the Alaska Department of Fish and Game, the National Marine Fisheries Service, the North Pacific Fishery Management Council, and the Pacific Fishery Management Council.

The Workshop on Biological Interactions Among Marine Mammals and Commercial Fisheries in the Southeastern Bering Sea brought 80 scientists together in a meeting co-sponsored by Alaska Sea Grant, the Marine Mammal Commission and the North Pacific Fishery Management Council. Ten invited papers and seven contributed papers were presented. Working sessions on marine mammal interactions with salmon, herring, groundfish and shellfish pinpointed additional research and information needed to assess the extent to which mammals use these resources.

The communications staff designed booths, displays, and information packets for Fish Expo '83 and Ketchikan Seafest. The Alaska Fisheries booth at Fish Expo '83 was a joint effort among Alaska Sea Grant, the United Fishermen of Alaska, the North Pacific Fishery Management Council, the Alaska Seafood Marketing Institute, and the Alaska Department of Fish and Game. Booth displays featured information on the University of Alaska's fisheries training and education programs, the Marine Advisory Program's salmon quality and safety efforts, and practical fisheries research.

Planning began for 1984 conferences that will include meetings on king and Dungeness crab, fisheries management issues and options in the Alaska region, and maritime facility development. Sea Grant will also have booths at the Kodiak Marine Trade Show, a local health

fair, the Tanana Valley State Fair, and the Anchorage Alaska-Mar Trade Show.

Publications for this period included 11 technical reports, 5 articles for professional journals, three marine advisory bulletins and one Sea Gram. One Sea Grant supported graduate student completed a thesis. Publications are detailed on Page 29. Sea Grant also supported publications for the Fishery Industrial Technology Center.

Articles by the communications staff were used by the Anchorage, Kodiak, Cordova and Juneau daily papers as well as Alaska Native News, the Tundra Times, NUNA, and the Alaska Education News.

Pilot programs for a regular radio show were produced and Alaska Public Radio stations agreed to use the series. Work on the final product has been put on hold due to staff changes and administrative delays.

The Alaska Marine Advisory Program (A/71-01) continued to concentrate its efforts in salmon quality improvement and bottomfish industry development. Specific missions for this year were management, response, commercial fisheries development and assistance, marine safety, fisheries business management, seafood technology and aquaculture.

"The Alaska Fisheries booth at Fish Expo'83 was a joint effort among Alaska Sea Grant, the United Fishermen of Alaska, the North Pacific Fishery Management Council, the Alaska Seafood Marketing Institute and ADF&G."

Marine Advisory Program (MAP) management revised its long-range plan over this period. An existing harbor and port project was dropped. Plans to add a recreational agent's position were accelerated because of the swift increase in Alaska's anglers. An assistant program leader was discussed, but funding for the position was not available. In an effort to overcome professional isolation among field staff, semi-annual staff meetings, bi-weekly teleconferences, and annual training sessions were continued. A new policy of bringing agents to Anchorage for at least one week each year to work with management and program specialists was instituted.

The response mission allows the project to react to needs that develop during the proposal period. Marine Science Camps targeting inland students are a continuing part of this mission. Response funds were also used to sponsor an intensive one-week workshop for MAP staff on fisheries business management.

The Commercial Fisheries Development and Assistance mission concentrated on groundfish industry development and western Alaska fisheries development. MAP pursued an active program, working with villages in western Alaska to develop local fisheries. Gillnetters in Norton Sound learned to hang nets and other techniques in workshops sponsored by MAP. These workshops increased participation and profit in the recently opened herring fishery for that area.

In cooperation with the Bering Sea Fisherman's Association, a commercial halibut fishery was initiated and nurtured with MAP effort. The fishery made a substantial contribution to the local cash economy and has stayed well within the cultural bounds of local Yupik Eskimos.

MAP efforts began to support a whitefish fishery in Selawik, resulting in over $200,000 in seed money directed into the venture. A quota was established and fishing is expected to begin in 1984.

Other MAP workshops and educational efforts in western Alaska have resulted in successful sale of sheefish from Kotzebue Sound, improved market quality of salmon from Kotzebue Sound and Norton Sound, and a general increase in knowledge of underused fisheries resources.

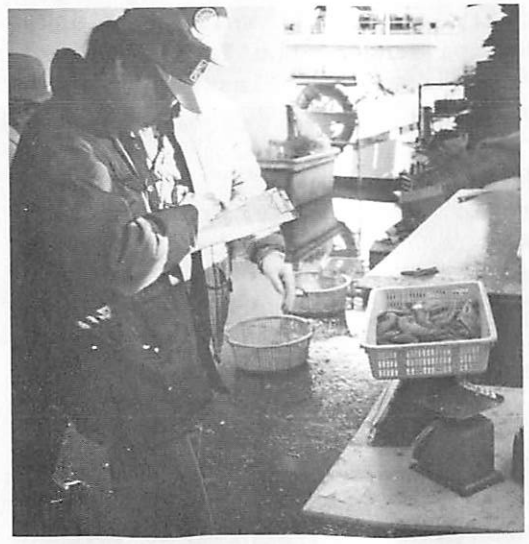
Fishermen sell herring roe to Japanese buyers in Bristol Bay. Buyers determine the roe content of herring delivered, sometimes not to the satisfaction of fishermen. Resulting misunderstanding, hard feelings and lost fishing time became an increasing problem.

MAP instituted a herring roe percentage determination project at the request of the Bristol Bay Marketing Cooperative. Members wanted to know more about how buyers determined roe content. A simplified process was developed and workshops were held in Dillingham, Togiak and Naknek to teach fishermen about the technique, followed by a Sea Gram explaining how to determine roe percentage.

These efforts have significantly reduced tension between buyers and fishermen. Fishermen now have a better understanding of the process and can ask the buyers about their techniques. There are fewer disputes and more fishing time and profits have resulted.

Bristol Bay has very few navigational aids, particularly in major estuaries such as

"MAP instituted a herring roe percentage determination project at the request of the Bristol Bay Marketing Cooperative. Members wanted to know more about how buyers determined roe content."



Japanese buyer weighs herring roe. Photo by D. Douglas Coughenower.

Kvichak and Nushagak where annual changes in the bar conditions are hazards for even experienced navigators. MAP has initiated an agreement with the University of Alaska Geophysical Institute through which LANDSAT data will be used to produce new fishing district charts for Bristol Bay. They will indicate the low tide shallow areas and the major channels.

Because Alaska has a number of fish species that local processors don't market, fishermen are quite interested in direct marketing these species. Marine advisory staff monitored this movement closely and stepped in to provide needed information on packaging, shipping and sales strategies, quality control and business management. The number of direct marketers in Southeast has risen to several hundred. Many MAP clients who once shipped less than 500 lbs of product per day can now easily handle 10,000 lbs per day. Most notable activity has been in rockfish. MAP has helped organize packaging demonstrations, a major shipping conference and adoption of various sales strategies.

Because many of these efforts were on underused species, MAP helped conduct test fisheries, fishing demonstrations, gear adaptation and research.

MAP has also become involved with applying remote sensing oceanographic data to the needs of commercial fishermen. The program's various projects in this area are in cooperation with the University of California, the Jet Propulsion Laboratory, the National Weather Service and the National Earth Satellite Service.

Salmon power trollers and purse seiners stand to gain the most from this information. In cooperation with Alden Electronics Company, a MAP project is trying to determine if radio facsimile reception of remotely sensed data such as sea surface temperatures, water colors and mixed layer depth would improve the efficiency of a fishing vessel.

To offset high unemployment in Alaska's king crab processing industry, MAP helped two companies obtain grants for worker training under the Dislocated Worker Program. These funds were used to train workers to handle groundfish species on the processing line. MAP efforts in cooperation with Prince William Sound processors and fishermen resulted in fall catches of more than 100 tons of food herring. Traditional herring fisheries in that area are for sac roe, roe-on-kelp and bait. In the same area, MAP also helped get the first deliveries of Prince William Sound rockfish to Cordova and razor clams to Oregon, two other new fisheries.

The marine safety project addresses the chronic safety problems in the Alaska region: accident prevention and response after accidents.

In this year, MAP looked at delivering safety training on a broader basis, new approaches to delivery, and continued evaluation of accident causes and responses.

As part of this, a four-part video tape series on marine safety and survival was completed with the assistance of the Marine Advisory Program, the University of Alaska Cooperative Extension Service, the U.S. Coast Guard and the University of Alaska Instructional Telecommunications Service. The programs are each about 20 minutes long and discuss hypothermia, cold-water near drowning, sea survival and shore survival. The series is accompanied by classroom workbooks and a teacher's guide. The series has won several professional awards for excellence and is now part of a national traveling exhibition of instructional films. Plans have been

made to add another program to the series, this one on frostbite and immersion foot.
MAP also continued its 4-H marine safety training for young Alaskans. Vessel stability has been an increasing problem as crab fisheries decline and fishermen re-rig crab boats for bottomfishing. MAP invited Dr. Bruce Adee of the University of Washington to conduct a number of vessel stability workshops both in Alaska and at Fish Expo '83.

The Fisheries Business Management mission helps marine businessmen to improve their management and financial planning skills. Through workshops, short courses and publications, the staff teaches these skills along with tax preparation and standard financing skills.

Many fishermen do not have the financial analysis skills needed to assess the economic feasibility of a major capital investment in their business. Loan officers are often not familiar with the ways a fishing business may differ from other businesses. In many cases the fisherman-lender relationship is based on misunderstanding.

Break-even and catch estimating procedures were developed for commercial fishing operations, distributed through publications and used in workshops. The Alaska Commercial Fisheries and Agriculture Bank and the Alaska State Loan Office are now requiring potential borrowers to submit break-even analyses, based on the format developed by MAP, with their loan applications.

Commercial fishermen in villages along the Yukon and Kuskokwim Rivers in western Alaska were sending records of their gross income to the Internal Revenue Service. They were being taxed on their gross rather than their net income. This was mostly because fishermen did not know about basic income tax regulations or fundamental business concepts. MAP continues a series of workshops in the area to help local fishermen submit accurate tax statements with the appropriate paperwork back-up. Three workshops are presented in each village visited. Information thus gathered can not only be used by the fisherman for tax purposes but also for business planning.

The Seafood Technology mission provides support and expertise to the Alaska processing industry to improve product quality and operational efficiency. Work this year has included academic planning for the first seafood technology degree program to be offered at the University of Alaska. The first two years of the program are completed at the university's Anchorage campus. The second two years are completed at Oregon State University.

Large salmon runs since 1979 have led to increased use of fresh or frozen product rather than canned. This has in turn created some quality and image problems for Alaska salmon on both foreign and domestic markets. MAP staff members monitored operation of the first vessels using champagne ice systems rather than dry holds. Holding fish this way resulted in a very high-quality product and increased harvest. This process is expected to become the fleet norm.

Other salmon quality efforts include a handling slide show used by western Alaska processors to train new employees, articles, and workshops. The quality of Kotzebue Sound salmon has significantly increased as a direct result of these efforts.

Paralytic Shellfish Poisoning (PSP) and fishmeal production were the focus of two projects completed over this period.

Alaska Sea Grant has funded several PSP-related projects, most of which worked to define the problem in Alaskan waters. PSP is a major public health and economic problem in Alaska, and a major impediment to developing a commercial clam fishery. PSP is also a threat in other major world fisheries, therefore this work has broad application.

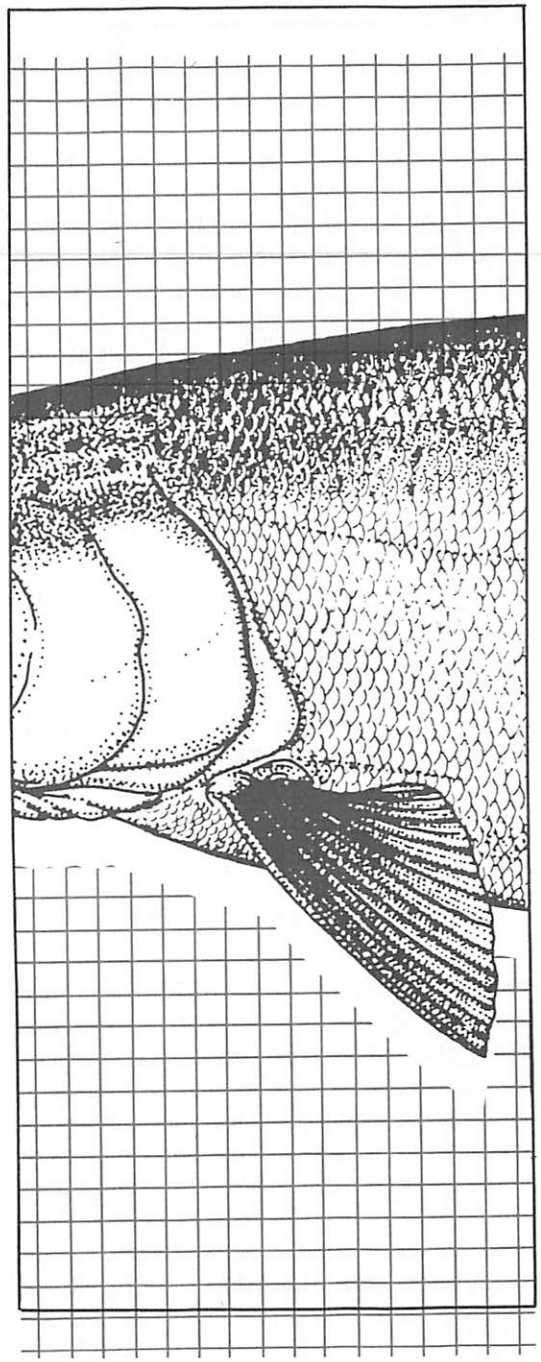
Earlier work identified a number of types of PSP-causing dinoflagellates found in Alaska, all members of the Protogonyaulax genus. In project R/06-16, **The PSP Toxin Content of Shellfish and the Identification of Usable Clam Beds by Cyst Mapping in Southeast Alaska,** scientists took this work further. Protogonyaulax have a cyst stage in the bottom sediment before blooming. PSP toxicities of resting stage cysts were compared. Six novel toxins were found to accompany the six known toxins. The newly-found compounds have very low potency, but are easily hydrolyzed into the other six and therefore constitute a reservoir of latent toxicity that may not be detected with conventional assay methods.

Further, toxicity of Protogonyaulax cells varied greatly with growth conditions. It is higher under conditions found in nature than in culturing conditions used in a lab. The amount of toxin that can be supplied to shellfish from a given number of Protogonyaulax is therefore much greater than previously thought.

Scientists next looked at cyst-stage dinoflagellate presence in the substrate near clam beds. They wanted to see if a certain density of cysts in the sediments had a relationship to the toxicity of resident shellfish.

Cyst-mapping was used to locate and estimate the density of cysts in a given area. Sediment was gathered, sieved to concentrate the cyst faction, and then incubated to determine the number of cysts.

Cyst mapping by this technique is difficult and time-consuming. The resulting data must be handled carefully. The method does have advantages over more traditional phytoplankton studies or shellfish bioassay.



Cyst densities in sediment are expected to be relatively constant over time. The other methods are known to have dramatic temporal fluctuations. The cyst mapping method requires a one-time survey and although slow and expensive it may be more cost-effective than methods requiring extensive and extended sampling.

Reliable sediment sampling for these purposes is also difficult. There is no reliable estimate for surface area or depth of each sample grab. Further it is impossible to estimate how much easily resuspendable matter (ESM) is lost between the time the sample grab leaves the bottom and the material gets to the boat. Some toxicity is associated with this faction of the sample, but the percentage of toxicity associated with it is small.

The effects of dilution on calculation of cyst density remains a problem. Sporadic germination of the viable cysts may result from some variable in incubation method or may reflect true homogeneity in the samples.

Viable benthic dinoflagellates tend to concentrate in pockets on the sea bottom. Shellfish in these cyst-rich pockets, however, do not necessarily become highly toxic. Toxicity in mussels does not correlate with cyst densities, and it is questionable whether mussels can assimilate the toxin from cysts. Butter clam toxicities however, mirror the wide distribution of benthic cysts but not necessarily in quantitative terms.

A three-year project evaluating the use of crab meal in livestock rations has been completed, Project R/35-04, **The Nutritional Evaluation of Alaskan Marine By-Products with Special Reference to Provide Practical Livestock Ration Formulation.** Alaska's shellfish processors generate about half of the country's shellfish waste. Meal plants make some of this by-product into crab meal. It costs around $.30 per lb while the more commonly used protein supplement, soybean oil meal, costs Alaskan farmers $.55 per lb. Scientists used the meal as a protein supplement in rations for lactating dairy cows, beef cattle, and market swine. After determining the nutritional acceptability of the substituting crab meal for other types of protein supplement, they tested the resulting meat and milk products for consumer acceptability.

Dairy cattle successfully used the meal as a protein supplement. The quantity of crab meal fed was restrained more by animal performance than by consumer acceptability of the milk produced. Total feed intake was highest for cows fed 15 percent crab meal concentrate with milk and meat production and weight gain the same as that for animals fed no crab meal. Milk resulting from animals fed different concentrations of crab meal were equally acceptable to consumers in taste tests.

Beef cattle were better able to use crab meal protein if kept in a barn with a controlled environment. Animals kept with minimal shelter, did not do as well when fed crab meal supplements. It was thought that animals under environmental stress needed higher quality protein, but it was also found that with increased hay consumption, these animals gained weight in winter even when fed crab meal. Swine feeding experiments have shown the animals can use crab meal as the only protein supplement, if it is finely ground. However, there have been consumer complaints about fishy-tasting pork from some hogs. More study needs to be done to determine where consumer tolerance levels are for fish fat content of pork meat.

Alaska Sea Grant's management is divided into two missions: program administration, and program planning and rapid response.

Program Administration (M/79-01) provides program coordination and direction to the three major Sea Grant functions: education, research and advisory services. Alaska Sea Grant also continues to direct a cohesive interdisciplinary group within the statewide system of higher education, working to solve Alaska's many marine resource problems.

Sea Grant management continues to work closely with the university's newest fisheries unit, the Fishery Industrial Technology Center, contributing to facilities and program planning and providing publication support. Funding was received to establish the Alaska Fisheries Research Center as an integral part of the university and Sea Grant management handled initial planning. Alaska Sea Grant also continued to provide information and technical support to the North Pacific Fishery Management Council.

Program Planning and Rapid Response (M/81-01) is a limited amount of funding used to meet short-term program and information needs. In accordance with board of regents policy, funds are also set aside in this project to cover possible salary increments or promotions that may occur during the grant period.

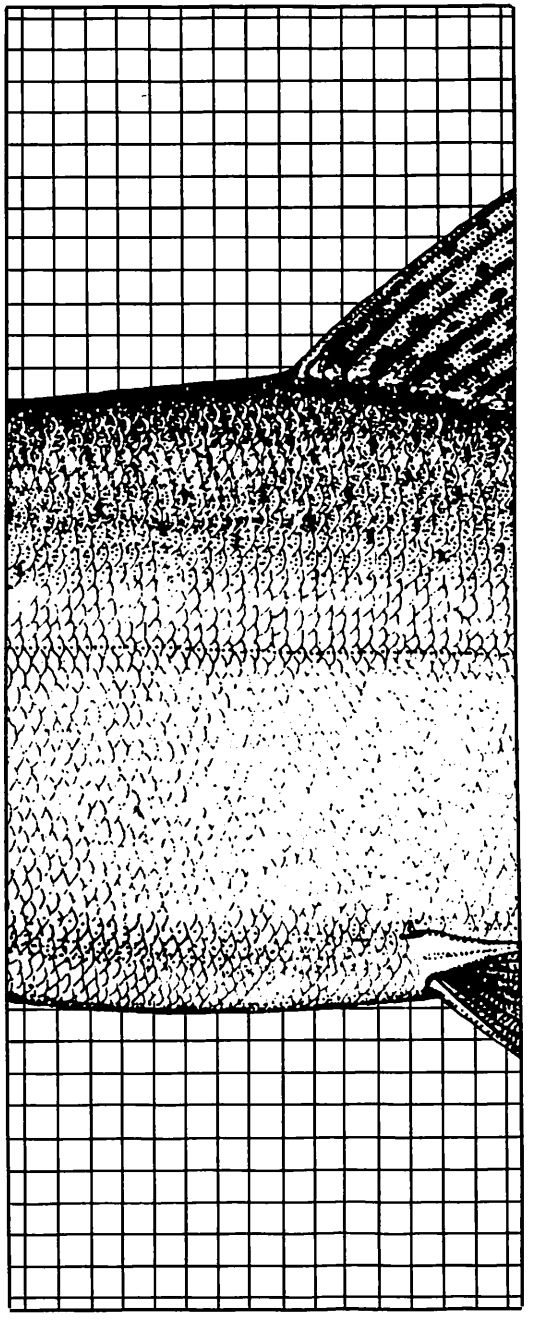
Eleven rapid response projects were funded during this period:

RR/83-01 **Genetic Interaction of Auke Creek Hatchery Pink Salmon with Natural Spawning Stocks in Auke Creek.**

This is a continuation of Project R/02-05. These funds provided additional graduate student support to complete work begun during this project.

RR/83-02 **Reproductive Cycle and Gonad Recovery in Green Sea Urchin**

The reproductive cycle of Strongylocentrotus droebachiensis was monitored for one year in southern Kachemak Bay, lower Cook Inlet, Alaska. Yields were relatively high from August



through March. During the same periods, gonads were firm and easily removed from the test. In late November, male gonads removed from the test were soft and leaked sperm. Female gonads remained firm and could be removed intact until January. Gonad weights were highest in March, declining to lowest values following the annual spawning in April.

The results of this one-year survey suggest that the harvest period for green sea urchin roe in lower Cook Inlet is from September through November.

RR/83-03 **Incubation Technology**

Development rate of salmonid embryos and alevins is well-known to be temperature dependent. In fact, stages of development are often measured in terms of temperature units. The Salmon Creek Hatchery in Juneau, Alaska is raising chum salmon for the commercial gillnet fishery in Taku Inlet.

Hatchery managers have found that the water temperatures at the hatchery are considerably warmer than natural incubation temperatures throughout incubation. Warm incubation temperatures cause early stages of embryonic development to proceed rapidly, causing the alevins to emerge from incubators in January. Emergent fry face harsh conditions in estuaries this time of year. Rearing in the hatchery until natural conditions improve is prohibitively expensive. One solution may be to chill incubation water to slow the development process.

This study investigates the bioengineering requirements for and the effects of a chilled recirculation incubation system on chum salmon at Salmon Creek Hatchery. Chum salmon are being incubated under production conditions in a chilled recirculation system. Progress of these embryos will be compared with that of embryos being raised at the hatchery under ambient conditions. After these comparisons, a full-scale production system can be designed if development of the chilled embryos is normal but slower.

RR/83-04 **Biochemical Genetic Analysis of Aleutian Island Pink Salmon**

During summer of 1982, the Commercial Fisheries Division of the Alaska Department of Fish and Game surveyed the Aleutians Islands to determine the presence and abundance of even-year pink salmon stocks. Before this, information on these fish was fragmentary. In this study, the genetic composition of a number of these stocks is described. Results are then compared with those reported for adjacent stocks in Bristol Bay and around Kodiak Island.

These data represent a unique opportunity to study a number of populations that are not often accessible to man. Spawning and rearing habits have not been substantially influenced by human activity. While the sample sizes of the collections were not large enough to resolve small genetic differences among the collections, they were adequate to show that genetic compositions of populations throughout the length of the Aleutian Chain are similar. It also appears that Aleutian populations are different from the Bristol Bay populations to which they were compared. Little difference was observed between Kodiak Island and Aleutian populations, however previous studies indicated considerable heterogeneity among Kodiak Island collections and this study did not have as many loci available for comparison of the Kodiak area as it did for the Bristol Bay samples.

Samples from the geographic center of the study area, Umnak and Unalaska Islands, may reflect influences from all the

"This project provides direct evidence that tanner crab reproductive maturation is achieved before either full expression of secondary sexual characteristics or significant increased weight of the reproductive tract."

Female tanner crab produce up to 130,000 eggs per clutch. Here the egg-holding cavity is exposed to reveal two egg clumps. Photo by Tricia Olsen

other areas. The sample sizes were small and cannot resolve small differences. Apparent similarities between collections from the eastern islands and the other regions may be artifacts of sample sizes.

To get a clearer understanding of the relationships between the Aleutian Island stocks and the other nearby regions, it would be necessary to examine collections from two or three sites on Kodiak Island as well as additional collections from Bristol Bay the Alaska Peninsula.

RR/83-05 **Reproductive Biology of Tanner Crab, Chionoecetes bairdi**

Since 1982, this project has continued to gather scientific data on the reproductive biology of tanner crab as a continuation of R/06-11.

The data was used to help the Alaska Department of Fish and Game and the North Pacific Fishery Management Council make informed management decisions. In the latest effort, data associated with the process of maturation was examined. The major topics of interest were: formation of spermatozoa and their packaging in spermatophores; development of secretory functions in the reproductive tract; production of viable embryos through mating; total spread of the males first pleopods versus width (290 crabs); male chela size versus carapace width (530 crabs); male reproductive tract weight versus carapace width (430 crabs); male reproductive tract weight versus claw size.

Both the male reproductive tract weight and claw size were found to be highly variable for most carapace width sizes, falling generally into one of four categories:

1. Small claws, small gonads
2. Small claws, large gonads
3. Large claws, small gonads
4. Large claws, large gonads

Individuals with regenerated claws were not used in this study. All four groups were represented by reproductively successful individuals. This project provides direct evidence that reproductive maturation is achieved before either full expression of secondary sexual characteristics, or significant increased weight of the reproductive tract.

Minimum size at maturity for the laboratory population of males was 55 mm. No reproductively active males 65 mm or larger failed.

RR/83-06 **Troll Log Book Program**

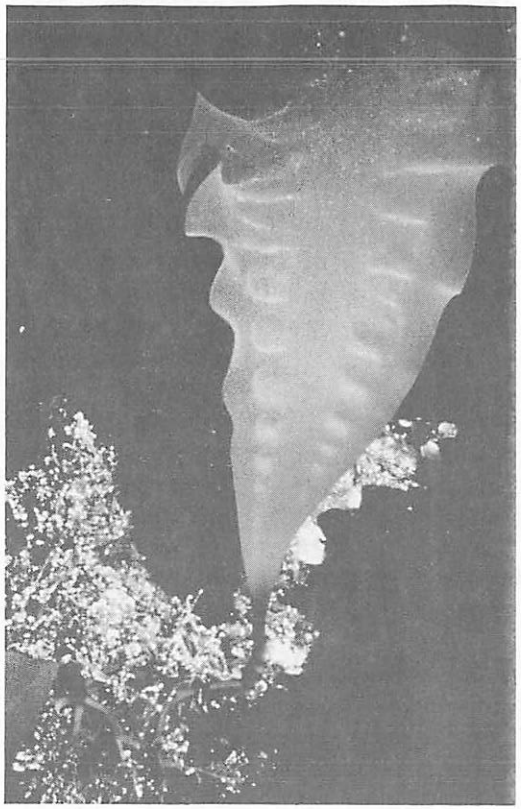
In 1976, the Alaska Trollers Association began a log book program with the assistance of the National Marine Fisheries Service and the Alaska Department of Fish and Game, both of which have responsibility for managing troll salmon fisheries.

Alaska Sea Grant has been updating and printing the logbooks, maintaining confidentiality of program participants, and providing funds for use of the University of Alaska computer facility for data analysis.

Between November 1982 and November 1983, 136 books were returned, of which 116 were analyzed. These represented 7,045 fishing days. Resulting data was sent to participants and published as a final report on the project.

RR/83-07 **International Seaweed Conference**

In 1980, the Alaska Sea Grant Program gave high priority to a project which was to study the impact of commercial harvest of the seaweed Fucus on the plant and on herring resources. This project was not included in the final proposal due to funding restrictions although it did have high priority.



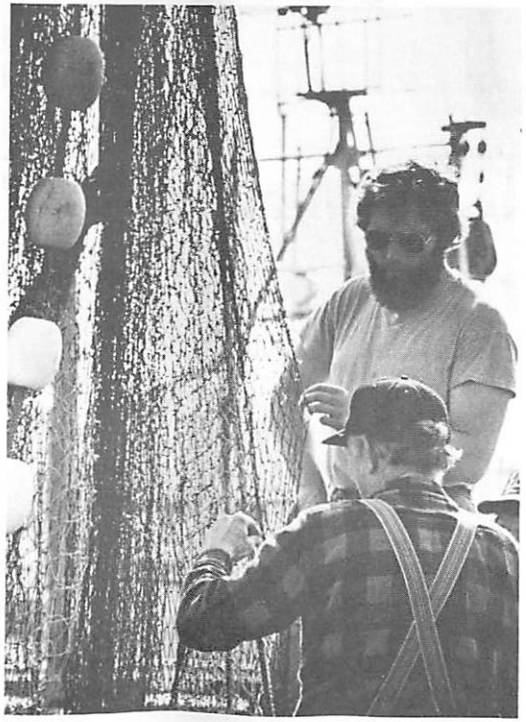
"World interest in commercial seaweed harvest is focussing on Alaska. Alaska's clean waters have a high potential for producing good-quality commercial seaweed."

The Alaska Department of Fish and Game was quite interested in the project and funded part of the proposed effort. Two years later, some results are available.

World interest in commercial seaweed harvest is focussing on Alaska. Alaska's clean waters have high potential for producing good-quality commercial seaweed.

It is therefore important that these international interests are likewise informed of our concerns and expertise in seaweed management. The International Seaweed Symposium is held every three years in various locations around the world. The 11th meeting was held June 19-25 in Qingdao, China. The results of the seaweed research funded by the Alaska Department of Fish and Game were presented at this meeting in a paper entitled, "Intraspecific competition and the management of the Bristol Bay herring-roe-on-fucus fishery". Rapid response funding helped cover part of the travel cost for the principle investigator to make the presentation.

" . . . Results indicate that while vessel owner-operators were generally covering their out-of-pocket expenses in 1981 . . . , economic returns from fishing were not sufficient to attract new investment."



Between 400 and 500 participants attended, representing about 30 countries. Over 300 papers were presented, nearly one-quarter of these dealing with the cultivation and/or harvest of seaweeds for commercial purposes. About one- third dealt with biology and taxonomy of commercially important species. The remaining papers covered industrial application of seaweeds and seaweed products, pharmaceuticals, and use of algae for bio-gas production.

RR/83-08 **An Economic Profile of the Southeast Alaska Salmon Industry**

The Fisheries Conservation and Management Act (FCMA) requires the federal government to take significant action to conserve, manage and develop marine resources along the U.S. continental shelf. There has been no systematic effort, however, to evaluate the economic and social impacts of exploiting these resources.

Salmon fisheries are the economic backbone of southeastern Alaska. Although they have always accounted for a significant portion of income in the region, this is even more the case in recent years, since a decline in the other major employer, the forest product industries. Almost nothing is known about the basic economic performance of this salmon industry. Information on prices is collected regularly, but virtually nothing is known about the costs of production and resulting cash flows and profits in either the harvesting or processing sectors.

Data obtained from a 1982 mail survey of fishermen who participated in the 1981 southeastern Alaska hand troll, power troll, drift gillnet, and purse seine salmon fisheries were summarized and analyzed. Profiles of "typical" vessels in each fishery were prepared, based on mean values of investments, costs, earnings, and effort. Cluster analysis was used to define major sub-groups of vessels within each fishery, based on differences in their physical characteristics (length, horsepower, gross tonnage, age, and market value). Profiles of vessels in major sub-fleets of each fishery were also prepared and presented.

The study's results indicate that while vessel owner-operators were generally covering their out-of-pocket expenses in 1981 (except in the hand troll fishery), economic returns from fishing were not sufficient to attract new investment . A

particularly important element is the opportunity cost of capital. This cost may be less than the prevailing market rate because of the illiquidity of the fishing investment. When opportunity costs were assumed to be 10 percent of the investment, which is fairly common, the returns to labor and management were negative; at a lower rate (5 percent), which may better reflect the illiquidity of the investment, the return to labor and management was generally positive for the power troll and purse seine fishery. However, even at the 5 percent opportunity cost rate, only the purse seine fishery yielded a return to labor and management that might equal or exceed the opportunity cost of labor and management. Needless to say, the results here as in other studies, are sensitive to the rate of interest chosen for the opportunity cost of capital, both because of potential illiquidity of the investment and the large amounts of capital tied up in fishing as well as the financial risk involved with fishing.

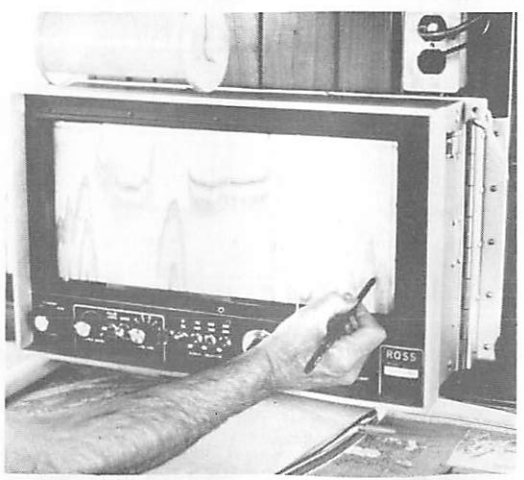
RR/83-09 **Student Participation in the International Sablefish Symposium**

The International Sablefish Symposium was held in Anchorage March 29-31, 1983. Scientists from Japan, Canada, the Soviet Union, and the United States attended. Discussion included current research and future study needs. This project provided funding for four graduate students at the University of Alaska's School of Fisheries and Science to attend that meeting.

Students were asked to submit a letter of interest indicating why they should be considered, how the experience would assist them in their studies or future jobs, and how the university and School of Fisheries would benefit. Based on submissions, students William Bechtol, Michael Cable, Keith Pahlke and David Mesiar were selected.

RR/83-20 **Hydroacoustic Workshop**

Hydroacoustic methods are in general use for assessing Alaska's fishery resources. Trained individuals to use these techniques are needed by various management agencies. Under this project, graduate students, University of Alaska, Juneau faculty members, researchers at Auke Bay Lab, and Alaska Department of Fish and Game personnel were introduced to integration of hydroacoustic signals in real-time.



Echosounder.

"... under this project personnel were introduced to integration of hydroacoustic signals in real-time."

Lectures were offered April 25-29, 1983 at the university's Juneau campus. Participants also attended sessions aboard the R/V MAYBESO. Basic field calibration procedures and integration techniques were covered.

RR/83-11 **Planning Conference on Nutrient Cycling in Sockeye Nursery Lakes in Bristol Bay**

During the last two decades, a number of significant studies have been conducted on the lake eutrophication process, both rate and extent, generated by the addition of nutrients (phosphate and nitrates) via sewage discharge. In lakes producing sockeye salmon, rotting sockeye carcasses are a constant source of nutrient enrichment, especially evidenced by luxurious growth of periphyton and the associated assemblage of zooplankters. Studies on the increased production following volcanic ash fall have been done in both Kachemak Bay and Bristol Bay.

Consequences of the demonstrated nutrient deficiency of oligotrophic sockeye salmon nursery lakes have been outlined in a series of fertilization experiments, notably in British Columbia. The results of these studies are sometimes spectacular and sometimes result in failures or increased food predators. Systematic wide-scale use of lake fertilization will become one of the standard salmon enhancement tools in Alaska. This project supported a planning conference to develop a research plan for a study of the nutrient cycling in the sockeye nursery lakes in Bristol Bay.

In the resulting plan, the importance of decaying carcasses of returning adults to the nutrient composition of oligotrophic freshwater salmon will be studied. Years of studies already suggest that nutrient supplies to these lakes control larval fish mortality. Synoptic sampling of bacteria, periphyton, and phytoplankton growth will be used to evaluate their relative importance to benthic and planktonic consumers. The percentage of carbon, nitrogen, and sulphur derived from decomposition of adults at the various trophic levels of the food chain will be determined to quantify the marine linkages with freshwater systems.

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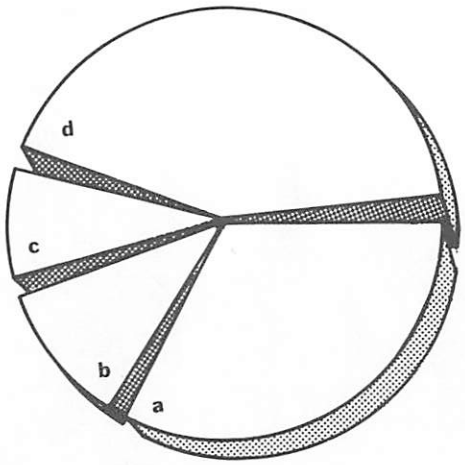
1982-1983



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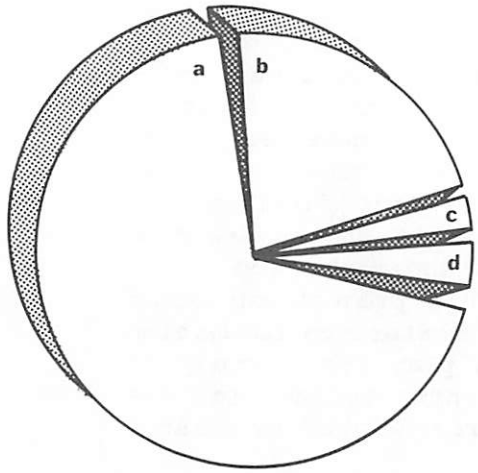
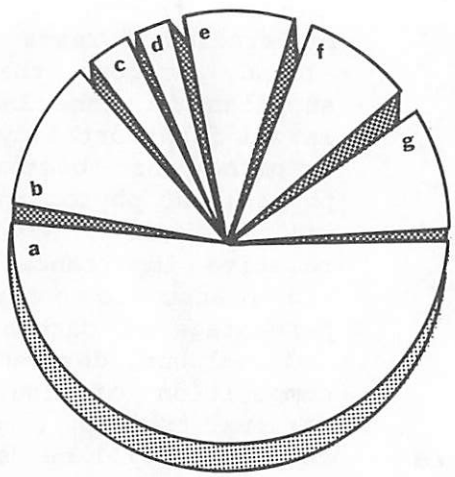


Matching

	Activity	Federal Funds	Matching Funds
a.	Extension	$ 461,589	$1,088,654
b.	Administration and Rapid Response	160,153	338,497
c.	Education and Training	104,238	37,526
d.	Research	610,962	67,187
		$1,336,942	$1,531,864

	Category	Federal Funds	Matching Funds
a.	Salaries	$ 711,329	$ 581,154
b.	Benefits	142,493	129,961
c.	Permanent Equipment	49,147	879
d.	Expendible Supply	46,635	17,693
e.	Travel	117,793	54,372
f.	Contract	117,714	109,242
g.	Indirect	151,831	638,563
		$1,336,942	$1,531,864



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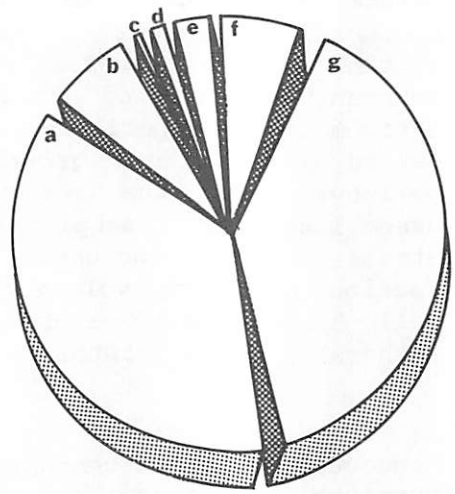
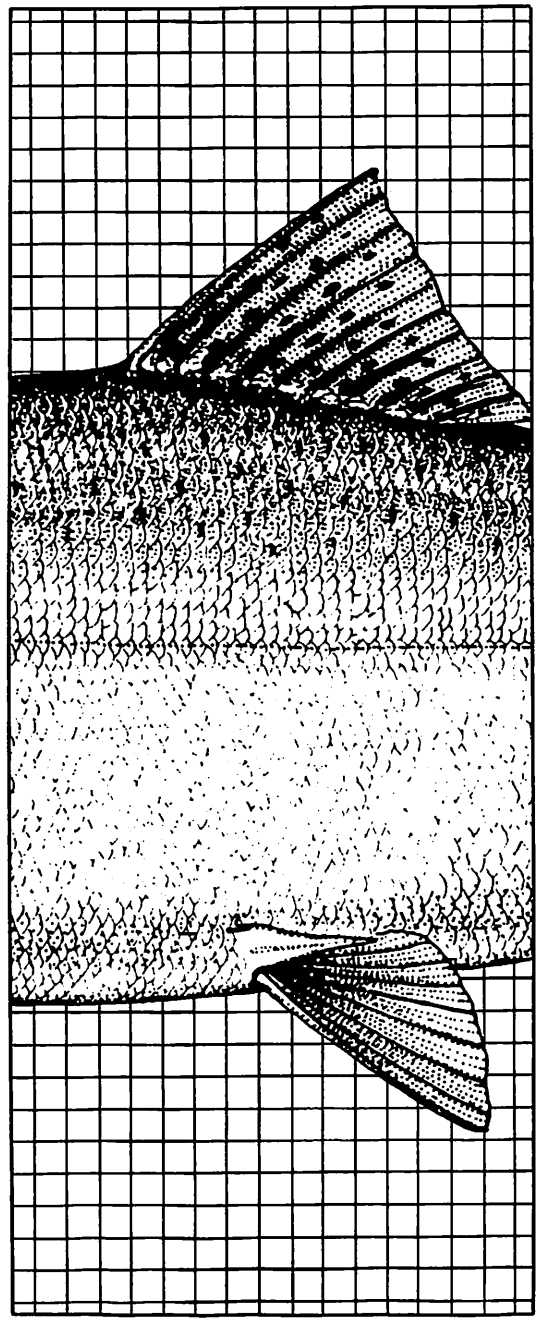


Matching

Table 1. Publications 1982-83

	TECHNICAL REPORTS
AK-SG-82-7 R/06-10	Alaska's Underutilized Species, Vol. III, Sea Urchin
AK-SG-82-8 A/75-01	Proceedings of the Third Alaska Aquaculture Conference
AK-SG-82-9 A/70-01	Smoked Fish Manual
AK-SG-82-10 A/75-01	Proceedings of the International Symposium on the Genus Chionoecetes
AK-SG-82-11 A/75-01	Final Report, 1981 Troll Logbook Program
AG-SG-83-1 R/06-11	Some Aspects of the Reproductive Biology of the Crab Chionoecetes bairdi
AK-SG-83-2 A/75-01	Proceedings of the International Seafood Trade Conference
AK-SG-83-3 M/79-01	Facilities and Personnel Projections, 1982-1990, FITC
AK-SG-83-4 M/79-01	Fishery Industrial Technology Center, Kodiak, Alaska, FTC-81 cod
AK-SG-83-5 R/06-08	Uptake of Cadmium by Marine Bacteria and Transfer to a Deposit Feeding Clam
AK-SG-83-6 E/70-08	Sea Week Book I: Discovery
AK-SG-83-7 E/70-08	Sea Week Book II: Fish and Fisheries



AK-SG-83-8
A/75-01
Proceedings of the International Sablefish Symposium

AK-SG-83-9
A/75-01
Proceedings of the Alaska Marine Archeology Workshop

REPRINTS

RP-83-1
R/35-03
Use of Hydrocyclones to Treat Seafood Processing Wastewaters

RP-83-2
Male Parent Size, Sperm Storage and Egg Production in the Crab Chionoecetes bairdi (Decapoda, majidae)

RP-83-3
M/81-01
Food of the Tanner Crab near Kodiak Island, Alaska

RP-83-4
M/70-06
Transport of Dissolved Organic Carbon, Nutrients, and Trace Metals from the Wilson and Blossom Rivers to Smeaton Bay, Southeast Alaska

RP-83-5
E/70-06
Mating Frequency and Viability of Stored Sperm in the Tanner Crab Chionoecetes bairdi (Decapoda, majidae)

ADVISORY BULLETINS

MAB 15
A/70-01
Fisherman's Record-Keeping System for Income Taxes

THESES

SGT-83-1
R/35-02
The Removal of Suspended Solids from Seafood Processing Wastewaters using Hydrocyclones

SGT-83-2
R/02-05
A Biochemical Genetic Analysis of Pink Salmon (Oncorhynchus gorbuscha) from Selected Streams in Northern Southeast Alaska

SGT-83-3 R/35-03 Wastewater Treatment and By-Product Recovery in Seafood Processing Using Coagulant Addition

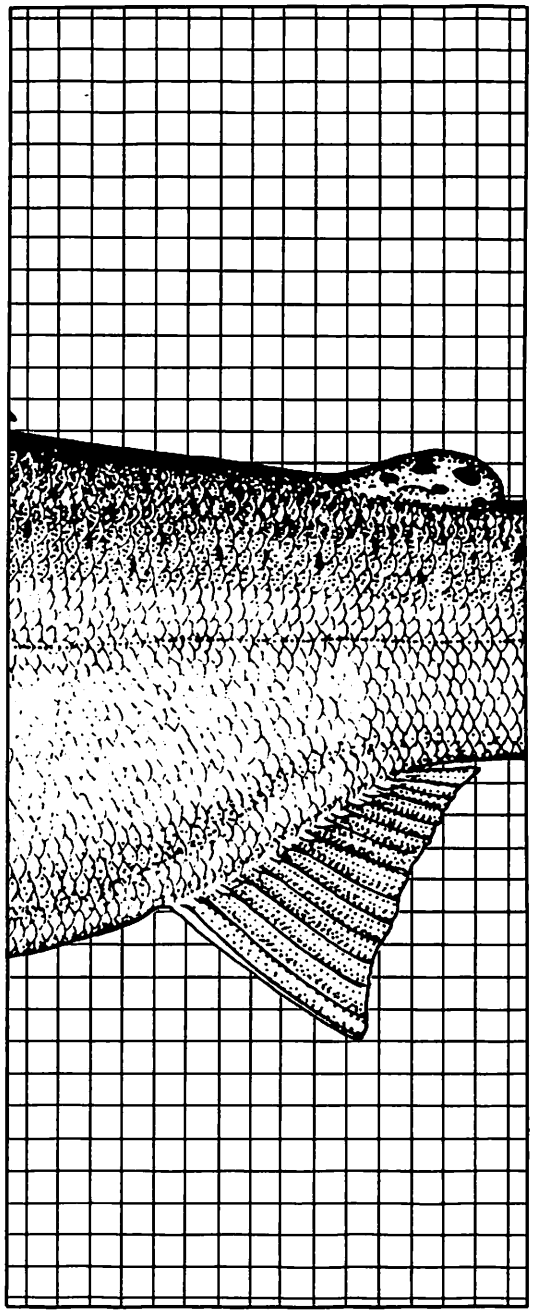
SGT-83-4 R/02-08 Quantitative Genetics of Chum Salmon, Oncorhynchus keta

SGT-83-5 R/06-04 Toxins and Toxicity of Protogonyaulax for the Northeast Pacific

PROJECT	STATUS 1983
R/02-05 Genetic Interaction of Auke Creek Pink Salmon with Natural Spawning Stock in Auke Creek Anthony J. Gharrett School of Fisheries and Science University of Alaska, Juneau	EX
R/02-09 Evaluation of a Chum Salmon Transplant Willam W. Smoker Frank P. Thrower School of Fisheries and Science University of Alaska, Juneau	EX
R/02-10 Potential of a Barriered Southeast Alaska Lake Containing Rainbow Trout for Production of Coho Salmon Smolt Richard A. Crone Northern Southeast Regional Aquaculture Association Sitka, Alaska	NS
R/02-11 Potential for Genetically Improving Salmon Willam W. Smoker Anthony J. Gharrett Michael S. Stekoll School of Fisheries and Science University of Alaska, Juneau	NS

NS-New Start; CG-Continuing Project; EX-Extended Project (to provide time for completion; CP-Completed Project

PROJECT	STATUS 1983
R/06-15 Herring Stocks in Prince William Sound, Alaska Anthony J. Gharrett C.E. Burkey School of Fisheries and Science University of Alaska, Juneau	EX
R/06-16 The PSP Toxin Content of Shellfish and the Identification of Usable Clam Beds by Cyst Mapping in Southeast Alaska Paul B. Reichardt Chemistry Department University of Alaska, Fairbanks	CP
R/06-17 Genetic Study of Some Alaskan Chinook Populations and the Potential Use of This Information on Stock Separation Problems Anthony J. Gharrett School of Fisheries and Science University of Alaska, Juneau	CG
R/06-18 Molting Frequency of Tanner Crab Howard M. Feder Augustus J. Paul Institute of Marine Science University of Alaska, Fairbanks	NS



PROJECT	STATUS 1983
R/06-19 Alaska Pollock Feeding Functions Ronald L. Smith Institute of Marine Science University of Alaska, Fairbanks	NS
R/70-08 Alaska Sea Week Belle H. Mickelson Alaska Sea Grant College Program University of Alaska	EX
A/75-01 Public Information Services Brenda R. Melteff Teri L. Frady Alaska Sea Grant College Program University of Alaska	CG
M/79-01 Program Management Donald H. Rosenberg Alaska Sea Grant College Program University of Alaska	CG
M/81-01 Program Planning and Rapid Response Donald H. Rosenberg Alaska Sea Grant Program University of Alaska	CG

PROJECT	STATUS 1983
R/07-10 Factors Affecting Migration Timing of Bristol Bay Sockeye Salmon Tsuneo Nishiyama Institute of Marine Science University of Alaska, Fairbanks	NS
R/14-07 A Spatial Equilibrium Trade Model for King and Tanner Crab Fisheries Abby H. Gorham Alaska Sea Grant College Program University of Alaska	CG
R/14-08 An Economic Evaluation of Recreational Salmon Fishing in the Kenai-Russian River Region Fisheries Douglas M. Larson Alaska Sea Grant College Program University of Alaska	EX
R/35-04 The Nutritional Evaluation of Alaskan Marine By-Products with Special Reference to Provide Practical Livestock Ration Formulation Arthur L. Brundage Frederick M. Husby Agricultural Experiment Station University of Alaska, Fairbanks	CP

PROJECT	STATUS 1983
R/35-05 Shellfish Waste Biotechnology Edward J. Brown Institute of Water Resources University of Alaska, Fairbanks	CG
R/35-06 Postmortem Biochemical Changes in Pacific Salmon During Partially-Frozen Storage Donald E. Kramer Alaska Marine Advisory Program University of Alaska, CCREE John S. French John M. Kennish Chemistry Department University of Alaska, Anchorage	NS
A/70-01 Alaska Marine Advisory Program John P. Doyle Alaska Marine Advisory Program University of Alaska, CCREE	CG

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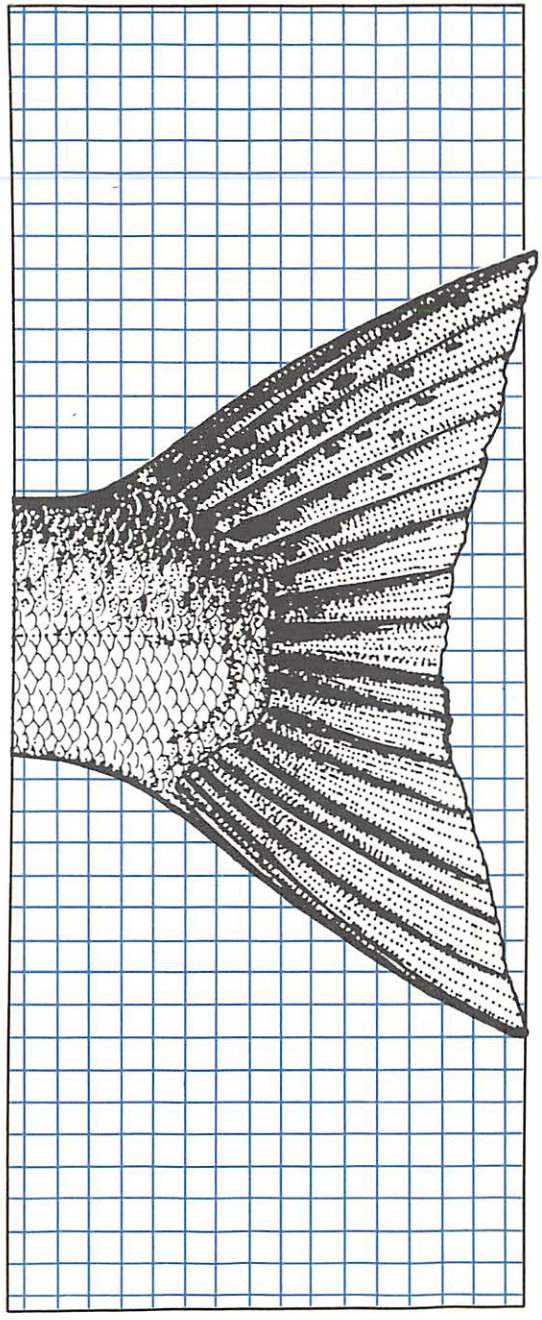

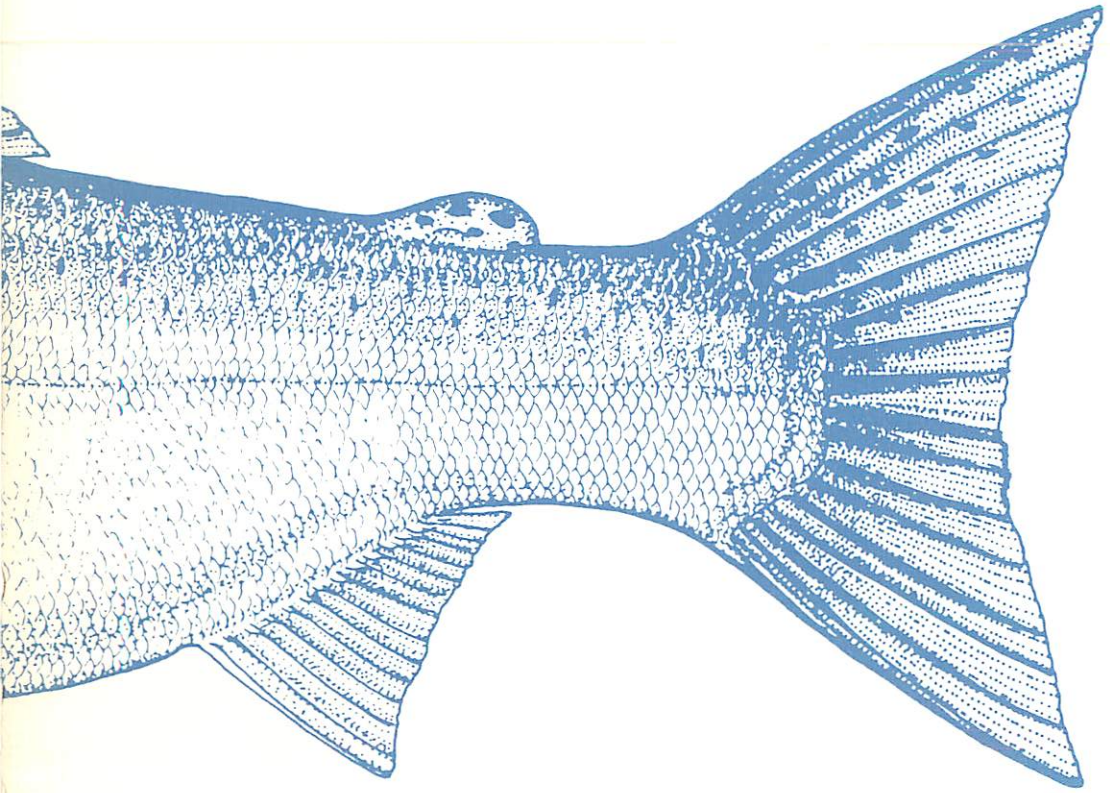

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