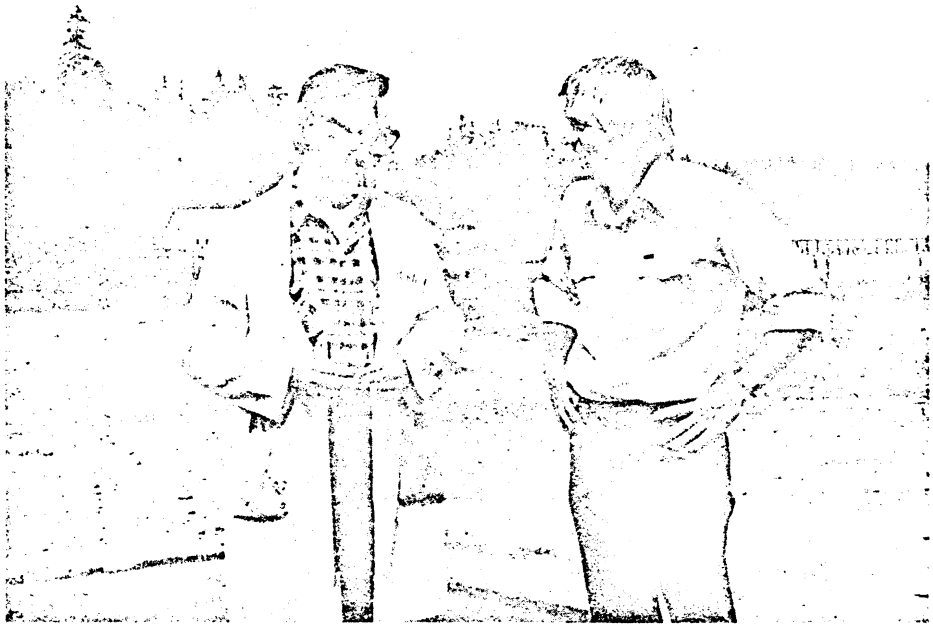
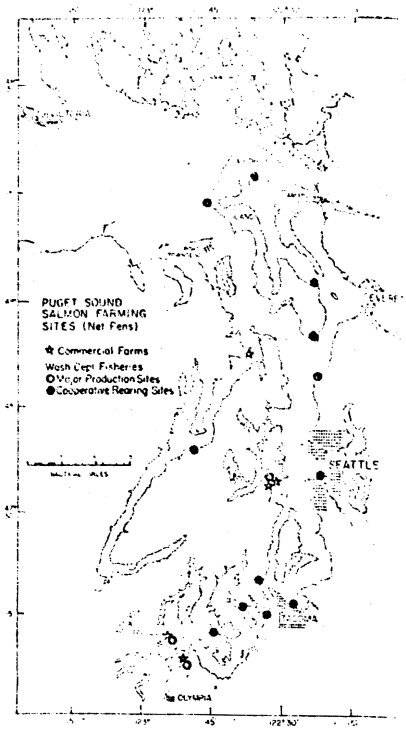
Status Report

Commercial Salmon Culture In Puget Sound

By Conrad V. W. Mahnken



Anthony J. Novotny (left) and Conrad V. W. Mahnken: National Marine Fisheries Service research scientists who have made a major contribution to the development of the salmon farming industry in the Pacific Northwest.



Location of salmon culture facilities in Puget Sound, Washington.

The marine culture of salmon and trout is not new.

Rainbow trout and Atlantic salmon are being cultured in seawater in the Scandinavian countries and the British Isles. Rainbow trout and, to a limited extent, Pacific salmon are also being cultured in sea water in Japan.

Although some of these cultured fish are reared in ponds, most are reared in floating cages (netpens). In recent years, commercial salmon farms producing coho and chinook salmon have been established at several sites within central and southern Puget Sound in the State of Washington.

The first experiments in Puget Sound on the culture of fish in floating net pens were carried out on Pacific salmon by personnel of the Northwest Fisheries Center in 1969. These initial experiments showed that it was possible to rear coho salmon from 15 to 340 g in six to eight months and to maturity in an additional 10 to 12 months.

During 1971-72, a cooperative pilot-scale experiment was carried out by the U. S. Government represented by the Northwest Fisheries Center of the National Marine Fisheries Service, and by private industry. More than 60 metric tons of salmon were grown near Manchester, Washington and the Center's Aquaculture Experiment Station in four net pens totaling 7,000 m(3) in volume. The role of the Center has been to promote a rapid and smooth transition from the experimental pilot-scale farm to full-scale commercial production.

As a result, four commercial salt water salmon farms producing coho and chinook salmon have been established, using the floating net-pen techniques developed by the National Marine Fisheries Service. Coho salmon is the species of greatest interest because of its resistance to disease and willingness to accept pelleted dry feed.

Adult coho salmon spawn in the fall and early winter, and their eggs hatch in the spring. The juveniles remain in fresh water for a year or more before migrating downstream to the sea. Most coho salmon in Puget Sound mature in three years when, weighing between 2.7 and 5.4 kg, they return to their home (that is, natal) streams to spawn. At hatcheries, which in some areas substitute for their natural spawning environment, juvenile salmon are reared on artif diets in ponds or raceways.

At some hatcheries in the Pa Northwest, returning adult salmon vide more eggs and sperm than needed to maintain full production. cent legislation in Washington State made it possible for private growe purchase these surplus eggs from h eries (operated by the state) for com cial sea farms.

In an effort to reduce costs, com cial salmon farmers on the West C are rearing the juvenile fish in he freshwater to increase or "accele their initial growth. Shortening the f water growing period by increa water temperature has made econo possible in operation, maintenance labor.

When the water is heated to 11 12.8 degrees Centigrade, subye coho salmon will grow to 20 g smol in eight months after hatching, com to the 12 to 14 months at hatc where unheated water is used. H water systems also make it possi stagger production for optimum u hatchery space. Thus, by comp growth in saltwater pens, it is poss grow marketable, pan-sized coho little as 14 months from the time eg taken.

Scientists at the Northwest Fis Center are conducting experiment pen-cultured salmon to provide in tion on rearing systems, feed, m and disease control. Improved

...re technology will promote commer... development and public manage...nt of salmon resources.

Commercial Farms

...development of intensive culture ...niques has led to four Puget Sound ...ness ventures aimed at producing ...sized salmon in netpens — Domsea ...ms. Inc.; Weyerhaeuser Company; ...axin Sea Farms, and Pacific Ocean ...ms.

Saltwater production of pan-sized ...mon in the United States during the ...-74 growing season was about 350 ...ric tons. The bulk of this production ...e from Puget Sound netpens, pri...ily from one grower — Domsea ...ms. Production from this grower alone ...eeded the total 1973 harvest of Atlan... salmon from Norwegian farms, esti...ated to be 270 metric tons.

In the 1974-75 season, the total esti...ated production of the United States ...ll exceed 740 metric tons, of which 435 ...ric tons will be grown in floating net...ens in Puget Sound, Washington.

Production of pan-sized salmon con...ues to increase at a steady rate. In ...4, egg sales of the Washington ...partment of Fisheries exceeded 11 ...lion. From these eggs, growers will ...duce more than 4 million fingerling ...ts destined to be reared in netpens.

When extrapolated to weight at harvest, this could result in a harvest of more than 900 metric tons of dressed fish in the 1975-76 growing season.

Although production is increasing, there are factors which are limiting commercial production. Interviews with salmon growers in Puget Sound pointed to such factors as disease, availability of sites, high cost of feed, institutional barriers and husbandry practices.

Disease: A Serious Problem

Most growers believe that saltwater diseases are the most serious threat to successful commercial salmon farming. For example, mortality in netpens has been from 35 to 100 percent per year prior to the development of vaccines.

The disease organism that causes the greatest concern is the bacterium, **Vibrio anguillarum.** The organism first appears in young salmon in the netpens in Puget Sound in May — usually when the water temperature reaches 9-degrees C. **Vibrio anguillarum** grows best as the water temperatures rise in the summer, increasing the chance for large losses. The incidence of disease among the salmon will usually subside sometime in October as the water temperature in the netpens drops.

Recent research by Northwest Fisheries Center scientists has focused on the prevention of vibriosis by immunizing the fish with vaccines prepared from the killed and washed cells of **Vibrio anguillarum.** The vaccine is either injected into the fish or added to the diet and fed to the young salmon prior to their entry into saltwater.

The use of **Vibrio** vaccines in experiments on a commercial scale has greatly reduced mortalities in the saltwater netpens but is still experimental. The total cost for injected vaccines, including labor, is $3,050 to $3,250 per million fish.

Two other diseases, furunculosis and kidney diseases, can also cause serious loss of salmon in saltwater. Furunculosis, caused by **Aeromonas salmonicida,** is a serious problem, appearing in epidemic proportions in summer. Like vibriosis, it can sometimes be treated successfully with antibiotics. Kidney disease, produced by **Cornybacterium,** is a chronic bacterial infection of salmon that prevails during the winter and is most serious with larger fish after their first winter in seawater. There are no known effective therapeutic agents.

(continued on page 11)

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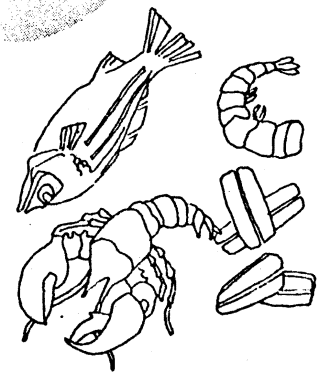

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Good Sites Required

[illegible] areas of Puget Sound provide [illegible] environmental conditions for the [illegible] of Pacific salmon in netpens, but [illegible] of natural protection from prevailing [illegible]nterly winds in winter eliminates [illegible] of these areas as good sites for [illegible]on farms. In addition, permission to [illegible]struct a farm at a chosen site is sub[illegible] to increasing scrutiny by public [illegible]cies and adjacent landowners. A [illegible]mination of restrictive zoning regula[illegible]s at the local level and specific en[illegible]mental requirements has resulted in [illegible] reduction of sites available for float[illegible] pens.

Other factors which must be con[illegible]ered in locating an acceptable site for [illegible]mon aquaculture are boat traffic, [illegible]wnership of adjacent land, and access [illegible] the site. Of these, site accessibility is [illegible]e most important in effecting an eco[illegible]mical operation. Service docks are ex[illegible]nsive to build, and approval for con[illegible]uction is difficult and time consuming [illegible]nder existing shoreline development [illegible]s

As a result, most farms are situated [illegible]way from the shoreline and serviced [illegible]om land-based facilities. The logistics [illegible] supplying farms is cited by growers as an economic deterrent to the operation. For example, Squaxin Farms in southern Puget Sound must transport the majority of their staff a distance of more than a mile daily to and from the farming operation. The logistics of feed delivery alone requires the transportation of 1,000 mt annually to a site to produce 500 mt of fish.

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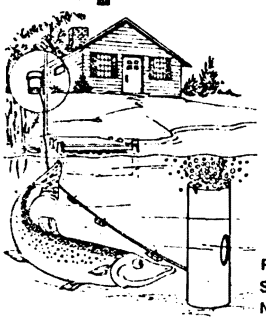

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High Cost Of Feed

The availability and cost of salmon feed, which consists largely of marine-protein products, could become a serious limiting factor to the success of the industry. These marine-protein products are used for a wide variety of animal feed (poultry, mink, trout, pet foods, etc.). Worldwide competition for these products for animal feed as well as for future human consumption may act to drive the availability down and the prices up.

Estimated commercial production of salmon in Puget Sound by the four growers by 1990 is 21,000 mt of round fish annually. Although highly speculative, this production, if met, will require more than 42,000 mt of pelleted feed (at 2:1 feed conversion). The present type of pelleted feed — Oregon Moist Pellet (OMP) — consists of about 40 percent seafood waste by weight. Thus, 16,800 mt of seafood wastes would be required by 1990 — more than twice the amount available from Oregon in 1972. Increased demand for these products, plus limited availability, will cause a scarcity of processed fish feed. National Marine Fisheries Service scientists are currently conducting research to develop alternate sources of protein to stabilize or reduce the cost of feed.

Restraints And Competition

Institutional restraints, in the form of leases for public tidelands and seabeds, and competing uses could limit the efficiency of salmon farms in Puget Sound and reduce their economic feasibility.

The Washington Department of Fisheries, an agency intimately involved in the permit process, ranks institutional barriers high on the list of limiting factors. New legislation regulating use of shorelines, a growing awareness of environmental quality by the citizen, and a realization that the netpens of salmon farms might be "unsightly" to adjacent landowners, will place increasing burdens on prospective growers who wish to secure approval for new farm sites.

Recent concern for the aquatic environment by governmental agencies has led to an increasingly complex set of regulations. The effect of these regulations is being felt by salmon growers who must now show proof that the environment surrounding a proposed culture site will not be adversely affected by the production of fish.

Even with the above problems, development of water resources for sea farming appears to be encouraging in the State of Washington. The small space requirements and many geographic areas where salmon mariculture may be feasible justifies confidence that institutional barriers which may develop can be overcome.

Husbandry Must Be Improved

Improved husbandry practices for floating production units are needed to effect optimum fish survival, growth and feed conversion. Numerous technical problems remain to be solved — such as optimum timing and size of smolts at entry into saltwater, carrying capacity of netpens, photoperiod manipulation for improved growth, and the optimum amount of feed (ration) for most efficient conversion.

Growers have expressed considerable concern over inventory discrepancies at time of harvest. It is not unusual to sustain 25 to 30 percent discrepancy, most of which they attribute to inventory control techniques and engineering design. Possible causes of loss are escape of fish through holes or by jumping; disease; predation by birds and spiny dogfish, and cannibalism. The construction of smaller, more manageable production pens has reduced losses, but a better means of inventory control is still needed.

Economic Viability

The technical feasibility of saltwater culture of salmon in netpens has been demonstrated, but some serious technical constraints still hinder economic viability. The possibility of reducing production costs through additional technology, diversification, and combination with supplemental enterprises appears to be substantial, however.

Accurate data on the profitability of rearing salmon in netpens will not be available for some time —perhaps three to five years. Whether expected returns at present retail prices are adequate to attract private investment depends on the potential for future reduction in production costs and risk, longer term market prospects, competing investment opportunities, and capital availability and cost.

Market demand and price prospects for pan-sized salmon are particularly difficult to appraise now. While production costs have risen, wholesale price for frozen, pan-sized salmon has dropped from about $1.60/pound in 1973 to $1.40/pound in 1974, reflecting the national trend of decreasing seafood prices.

The success or failure of the salmon farming industry may well hinge on the development of imaginative marketing programs, stressing the uniqueness of the pan-sized salmon. ★