AN EMERGING INDUSTRY

Status Report

Commercial Salmon Culture In Puget Sound

By Conrad V. W. Mahnken

The marina 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 m³ 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 27 and 54 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 artifical diets in ponds or raceways.

At some hatcheries in the Pacific Northwest, returning adult salmon produce more eggs and sperm than needed to maintain full production. Cent legislation in Washington State made it possible for private growers to purchase these surplus eggs from hatcheries (operated by the state) for commercial sea farms.

In an effort to reduce costs, commercial salmon farmers on the West Coast are rearing the juvenile fish in fresh water to increase or accelerate their initial growth. Shortening the water growing period by increasing water temperature has made economic operation possible in operation, maintenance labor.

When the water is heated to 12.8 degrees Centigrade, subyearling salmon will grow to 20 g smolt in eight months after hatching, compared to the 12 to 14 months at hatcheries where unheated water is used. Heating water systems also make it possible to stagger production for optimum hatchery space. Thus, by confining growth in saltwater pens, it is possible to grow marketable, pan-sized coho salmon little as 14 months from the time they are taken.

Scientists at the Northwest Fisheries Center are conducting experiments on rearing systems, feed, and disease control. Improved feeding systems and disease control, improved rearing methods have resulted in increased yields on existing farms and are expected to improve oncoming farms. Improved rearing methods have resulted in increased yields on existing farms and are expected to improve oncoming farms.

THE COMMERCIAL FISH FARMER, 1975
Commercial Farms

The development of intensive culture techniques has led to four Puget Sound salmon growers — Domsea, Washington, Weyerhaeuser Company, Pacific Ocean Fish Farms, and Pacific Ocean Fish Farms — to produce salmon on a commercial scale has greatly reduced mortalities in the saltwater net pens 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 Compybacterium, 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.

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. After that, 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.

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.

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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.

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Good Sites Required

The areas of Puget Sound provide the environmental conditions for the rearing of Pacific salmon in netpens, but not of natural protection from prevailing northwesterly winds in winter eliminates most of these areas as good sites for salmon farms. In addition, permission to construct a farm at a chosen site is subject to increasing scrutiny by public agencies and adjacent landowners. A combination of restrictive zoning regulations at the local level and specific environmental requirements has resulted in a reduction of sites available for float-net farms. Other factors which must be considered in locating an acceptable site for salmon aquaculture are: boat traffic, ownership of adjacent land, and access to the site. Of these, site accessibility is the most important in effecting an economical operation. Service docks are expensive to build, and approval for construction is difficult and time-consuming in most existing shoreline development basins.

As a result, most farms are situated far from the shoreline and serviced from land-based facilities. The logistics of 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.

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 seaweed waste by weight. Thus, 16,800 mt of seaweed 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.

Restrains 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 salmon farming appears to be encouraging in the State of Washington. The small space requirements and many geographic areas where salmon culture 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.