BROODSTOCK RESTORATION PROGRAMS AT MANCHESTER MARINE EXPERIMENTAL LABORATORY PUGET SOUND, WASHINGTON

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The possible extinction of individual races of salmonids is an increasing concern of management biologist. Habitat degradation, coupled with overfishing and pollution, led to the near total loss of Atlantic salmon (Salmo salar) stocks in the United States Southern New England streams by the mid 1800s. Some west coast Pacific salmon stocks (Oncorhynchus spp.) are presently facing the same fate. These stocks represent unique spawning populations which were historically and economically important to the region. Although these runs are threatened, habitat restoration and improved management practices could allow these runs to eventually rebuild.

While long-term possibilities for re-establishing threatened runs appear to be improving, a substantial, reliable source of eggs must be assured before the objective of the restoration efforts can be realized. Adult returns from eggs of threatened runs can be as low as a few tenths of a percent (in the case of Atlantic salmon). Thus, it could take many years under the most favorable conditions to naturally build up depressed stocks to a point where there are eggs available on a large scale for stream restocking or for expanded hatchery rearing.

Another approach is a captive broodstock program where progeny from threatened stocks are reared to maturity and these eggs used to enhance the natural runs. Captive broodstock should produce a minimum of 5% egg to adult spawner (e.g. 500 adult spawners/10,000 eyed eggs started), thus a large number of eggs can be available for enhancement purposes at the end of the first spawning cycle. This ability to quickly produce a substantial egg supply makes captive broodstock programs a necessary adjunct to serious restoration efforts.

During the past decade, the National Marine Fisheries Service (NMFS) has implemented captive broodstock programs aimed at producing stable supplies of eggs for the restoration of threatened runs of both Atlantic and Pacific salmon. Because of the moderate climate and seawater temperature range in Puget Sound (6-15°C), NMFS's Marine Experimental Laboratory near Manchester, Washington was chosen as the seawater culture site for these programs. Presently, four stocks of Atlantic salmon (bound for southern New England restoration programs) and six stocks of chinook salmon, Oncorhynchus tshawytscha, (four brood years of Columbia River upriver bright stock and two brood years of Puget Sound White River spring chinook stock) are being maintained at the laboratory.

Small numbers of eggs from a selected stock, usually between 10,000 and 20,000 eggs subsampled from as many mating pairs as possible (to preserve genetic diversity), are shipped to the Marine Experimental Laboratory's satellite station near Seabeck, Washington for freshwater rearing. These fish are transferred to floating marine net-pens at the Manchester site as 0-age, 1, or 2-year old smolts (depending on species and stock) and grown to maturity. Mature fish are moved back to the freshwater station for spawning, and ultimately eyed eggs are shipped to the targeted restoration programs.

A necessary adjunct to these production programs is a parallel research study that includes experiments on fish health, nutrition, rearing strategies, and acclimation of smolts to the marine environment.

Fish Health

Most freshwater mortality in Atlantic salmon occurs early, during the delicate alevin and swim-up stages, and again as fish begin to smolt. Disease problems encountered during the freshwater rearing of chinook and Atlantic salmon are bacterial, primarily Myxobacteria sp. and Aeromonas sp., and documented in the literature, thus requiring little or no further investigation.

After transfer to the marine net-pens, the salmon are subject to new, previously undescribed diseases as well as those already described in the literature. Several new marine diseases are currently under investigation; these include two protozoon parasites; an undescribed systemic fungal pathogen, and an infectious anemia of chinook salmon.

Nutrition

Semi-moist, high lipid (>15%) diets provide optimum acceptability for first feeding fry and are preferred for early fry rearing. Various dry and moist rations have proven effective for freshwater grow-out. However, a moist pelleted (OMP-type) diet is commonly used throughout smolt rearing.

Most broodfish in marine net-pens are fed a staple diet of moist and/or semi-moist pellets. Some chinook salmon stocks are periodically fed supplements of fresh frozen herring and krill. During the fall of 1982, our research demonstrated that maturing Atlantic salmon which were fed a ration with 30% whole krill had a substantially higher post-stress survival than a control group which was fed a standard commercial pelleted diet without krill. Further research is planned to test the effects of dietary changes on the pre-spawning survival and egg viability of chinook salmon.

Rearing Strategies

Husbandry methods common to most salmon hatcheries are routinely used at our facilities. However, ongoing research indicates that modification of some common procedures may be beneficial. For instance, traditional methods favor leaving fish totally exposed during outside rearing. Our results suggest that the addition of shade providing covers will increase growth, survival, and food conversion.

Cover types, of which most approximate the shading fish would naturally seek at a particular size, appear the most beneficial. Surplus

U.S. Army camouflage netting is routinely used at our freshwater rearing station. This netting produces a mottled shading effect which imitates the natural shading of stream side cover and appears to be the preferred cover type in freshwater rearing. Behavioral observations indicate most fish voluntarily stay under camouflaged portions of tanks, indicating a strong preference for covered versus open rearing situations.

During broodstock rearing, seawater net-pens are shaded with black vinyl covers. These both reduce net fouling and, more importantly, provide a naturally darkened environment (without shade the fish would be unnaturally confined to the zone of maximum illumination). The black vinyl covers provide the low light environment that seawater salmonids naturally seek. This duplication of the natural system provides a more acceptable environment for fish rearing.

Smolt Acclimation

Recently, a pipeline was constructed at Manchester that extends to the marine rearing facilities at the end of a 350-foot pier. Beaver Creek water is pumped into the sea cages that are sided with sheet vinyl, and an artificial freshwater lens is created. This system allows us to gradually acclimate smolts to full strength seawater and has substantially reduced losses due to osmoregulatory shock and handling stress. We are also investigating the use of this system as an alternative to moving nature fish back to freshwater facilities.

During early November of 1983, we began spawning our first brood stock. Approximately 300 mature 1979 brood Atlantic salmon were transferred from seawater net-pens to freshwater holding facilities in September. This first take will be shipped as eyed eggs to southern New England for restoration of the Merrimack and Connecticut Rivers.