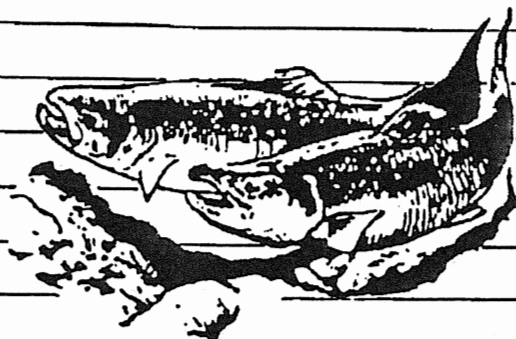


Research

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Predator Avoidance Response in Atlantic Salmon

We speculated that the lack of cover in hatchery raceways and ponds might eventually lead to the loss of any inherent predator-avoidance response. To test this hypothesis, we conducted a series of experiments to determine if parr of Atlantic salmon (*Salmo salar*) given the opportunity to complete a predator-avoidance response while being cultured in a hatchery would retain the ability to seek cover and avoid predators when stocked in the wild.

Salmon Parr Were Held Under Different Rearing Regimes

Atlantic salmon fry were obtained from Craig Brook National Fish Hatchery, Maine, and tested in a laboratory at the University of Maine. We used a 3 × 2 design, and held parr for 47 days. Separate groups of fish were reared with different external activity levels (none, human disturbance, fright with a bird model) and different levels of environmental complexity (black substrate, PVC pipe as cover, no cover).

Atlantic salmon were observed individually and in groups after being introduced into a large

experimental chamber monitored with a video camera. Cover was provided by patches of black substrate or 5-inch-long huts made from PVC pipes cut longitudinally.

After 20 minutes acclimation, a model of a kingfisher (*Megaceryle alcyon*) was "flown" over the tank to observe the fright reaction of the fish and allow us to measure the shelter-seeking tendency of the fish.

Salmon Use Cover if Able to Complete Antipredator Response

Parr that had been reared with active human disturbance and no cover—the typical hatchery situation—did not react to the overhead appearance of the predator bird model. Fish that had been disturbed by a bird model during rearing later sought cover after disturbance by the model. Fish in groups were significantly more active than were individual fish ($P < 0.0001$) but spent less time in cover after an encounter with the predator model than did individual fish.

Fish that had cover available during rearing used dark substrate or cover more than did fish

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reared without cover ($P < 0.001$). Salmon with behavior most similar to wild parr were those with cover available during hatchery culture and with randomized overhead disturbance.

Implications for Hatchery Operations and Atlantic Salmon Restoration

In the hatchery, Atlantic salmon may be disturbed, but without the availability of cover in raceways, fish are unable to complete the fright response. Our results suggest that survival of stocked salmon fry and parr might be improved if the antipredator response is still present at the time of stocking.

The results indicate that, under laboratory conditions, Atlantic salmon retain this response if they are provided with some type of cover during the culture phase and if they are frightened on a daily basis by a model of a bird flying over the raceway or actually disturbing the surface of the water.

Although extensive structures or other types of artificial cover may interfere with raceway flow

and cleaning, a series of removable forms could be used. The results suggest that even a dark-and-light pattern painted on the bottom of a raceway may be effective. If hatchery procedures can be modified to increase survival of stocked juvenile Atlantic salmon, losses due to double-crested cormorants (*Phalacrocorax auritus*) and other predators could be potentially reduced. The next step in testing these findings would be to follow fish reared under normal and modified hatchery conditions to observe their behavior and measure their survival after they are stocked into natural waters.

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