

Northeast Salmon Team Fact Sheet Collection

Scale Pattern Analysis

In Maine, Atlantic salmon are produced in two very different ways and raised (i.e. *reared*), under several distinctly different conditions. Some offspring are the result of natural reproduction between adults returning to Maine's rivers. Others are produced under Maine's conservation hatchery program from river-specific *broodstock* (in this case, fish collected from rivers classified as supporting endangered or threatened populations). Still others are produced by Maine's commercial aquaculture industry from broodstock that, until recently, could be of any origin, including European.



hatchery production

natural reproduction



USFWS photo

Naturally reared Atlantic salmon spend all or most of their juvenile life in Maine's rivers. These individuals are either born in a river via natural reproduction or released (i.e. *stocked*) as fry to coincide with the emergence of wild-spawned fry from redds. *Hatchery reared* fish are raised in federal hatcheries as part of the conservation hatchery program and stocked as parr or smolts into Maine rivers. *Farmed* Atlantic salmon are raised through adulthood at commercial aquaculture sites (privately owned freshwater hatcheries and marine net-pens) and harvested for human consumption when they are fully-grown. However, cases of chronic and large unintentional escapements of Atlantic salmon from these commercial sites have been documented. The presence of these farmed escapees and their offspring in Maine's rivers poses a potentially significant risk to Maine's biologically and genetically unique populations.

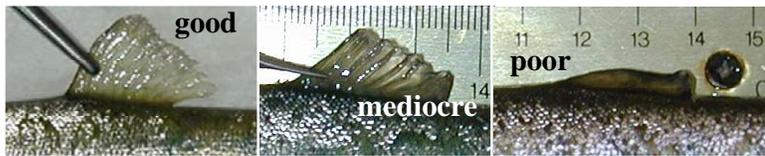
Who is this fish? Although a portion of hatchery reared parr are given identifiable fin clips and many smolts are marked with Visual Implant Elastomer (VIE) tags specific to stocking date and site, not all are marked and these marks can be lost over time (retention of VIE tags is only 50%). Additionally, stocked fry are not administered a distinguishing mark or clip prior to release. When NEST researchers capture unmarked fish in a natural environment for study, the first question asked is "who is this fish?"

Luckily, all Atlantic salmon have unique characteristics (i.e. "natural" marks) that provide information for fishery scientists and managers. For example, parasitic loads and the isotopic signature of *otoliths* (the inner ear bones) can inform scientists of a fish's region of origin. An individual's unique genetic makeup also provides a natural identifier. Because a fish's fins can become deformed when constantly in contact with concrete hatchery tanks, fin deformities provide an indication of rearing conditions. Scales are particularly informative, providing a natural record of age, rearing and growth-related information. Although each of these natural marks have limitations (some require lethal sampling or currently unavailable baseline data), they are all useful in pinpointing the identity of individuals captured in Maine's rivers or at sea.



Atlantic salmon reared in hatchery tanks (lower left) live under very different conditions than those experienced by naturally reared individuals (upper right).

NEST obtains data from Atlantic salmon smolts, postsmolts and adults captured by various field methods, including rotary screw trapping and pelagic trawling. At the time of capture, NEST researchers record a fish's length and weight, check for marks and fin deformities, take several scales for age/origin determination and obtain samples for analyses of genetics, disease, and physiology from certain individuals.



Observed dorsal fin condition and deformities are noted.

Some of the questions NEST is trying to answer by sampling Atlantic salmon in freshwater and marine environments include:

- How do stocked fry, parr and smolts contribute to adult returns?
- Which rearing and stocking strategies (e.g. location and timing of release) under the conservation hatchery program are best?
- How can age, origin, rearing history and growth rate of Atlantic salmon captured from the wild be determined most accurately?

Scale pattern analysis is one technique NEST is using to address these questions. The answers to these questions will help NEST better manage and craft recovery strategies for Maine's threatened and endangered populations of Atlantic salmon.



NEST researcher, Ruth Haas-Castro, analyzes an Atlantic salmon scale using computer software.



Counting a scale's *annuli*, identified by patterns of widely and narrowly spaced *circuli* (rings), enables NEST researchers to effectively age Atlantic salmon captured in the wild. Knowing the age structure of populations is an important aspect of managing any species. A fish's body length at the time of capture and its scale measurements can be used to determine when it underwent *smoltification* (i.e. the process whereby a tolerance for salinity is developed). Lastly, scales provide information about a fish's origin. The patterns found on a captured fish's scales can be analyzed and its similarities compared to known scale patterns from hatchery and naturally reared specimens using computer image analysis and statistics software. By using scale patterns to identify whether or not its growth rate was indicative of hatchery or natural rearing conditions, NEST researchers can predict the origin of a captured individual. These predictions can be further verified by observed dorsal fin condition or other marks.



NEST is currently expanding its scale pattern analyses to help learn more about returning adults and also to distinguish among naturally reared (fry stocked or wild spawned), parr stocked and smolt stocked individuals.