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Maine Department of Marine Resources Suspected Aquaculture Origin Atlantic Salmon Identification and Notification Protocol

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Introduction

Aquaculture salmon are commercially reared Atlantic salmon not intended for restoration of Atlantic salmon populations in Maine waters. This document specifies Maine Department of Marine Resource's identification and notification protocol for suspected aquaculture origin Atlantic salmon. The protocols are designed to provide a standardized identification method and streamlined notification process that heightens awareness for trap tenders to minimize upstream passage of aquaculture origin Atlantic salmon from entering upstream spawning areas; and prevent removal of non-aquaculture origin salmon. Designation of a suspect aquaculture Atlantic salmon is based on scale analysis and it is not definitive. Conservative judgment should be exercised. **If a DMR Biologist cannot determine the origin of the salmon, the salmon should be passed upstream.** Regional Atlantic salmon biologists should review these protocols with their staff and other entities operating adult trapping facilities annually. The process is outlined below and reference materials, including scale images are provided.

Atlantic salmon captured during fish trapping or collection activities and classified in the field as an aquaculture suspect shall be removed from the river, biologically sampled, photographed, and sacrificed. Additional scales will be taken for archives and tissue samples will be taken for fish health and genetics screening, according to agency sampling protocols in place at the time of capture. The carcass of such fish shall be frozen and held for six months for other analyses that may be undertaken at a later date.

The decision to remove a suspect salmon will only be made by a DMR Biologist that has been trained to identify and process a suspected aquaculture origin salmon, and not by other agencies, seasonal staff, contract workers, or other adult trap operators. In some cases, it may be necessary to train a primary trap operator other than a DMR biologist to evaluate scale samples and make a determination. If a DMR Biologist is not available to examine a suspect salmon, the salmon shall be retained in the trap until appropriate staff can arrive at the site to examine the salmon. Every effort shall be made to resolve these situations expediently. If it is not possible to retain the salmon in question until DMR can respond then the salmon should be marked and released downstream. **.**

Identification of Suspected Aquaculture Atlantic Salmon

Potential aquaculture escapees are identified in a two-step process; first on the basis of fin condition and body form (Figures 1 – 11), then through scale analysis (Figures 13 – 15). Fin deformities typically occur in salmon reared in captivity at high densities. The magnitude of fin deformities typically increases with increased exposure to the captive rearing environment: hatchery fish that are released to the wild as smolts for restoration purposes typically exhibit slight to moderate fin deformities. Fish that remain in captivity to adulthood before escaping or being released usually have more advanced fin deformities and exhibit a distinctive "broom" shape to the caudal fin, one or more of the paired fins (typically the pectoral fins) are deformed, and one of the opercula (gill covers) may be short.

Aquaculture escapees may also exhibit a high body mass to body length ratio (K factor, Figure 10) relative to wild and restoration salmon which are more streamlined. The description “football shaped” has been used to describe a farm raised fish. Aquaculture escapees may also have abrasions and cuts resulting from exposure to net pens (Figure 11).

Fin deformities are not diagnostic for fish origin and analysis of a scale sample is required to make a determination of the fish’s origin. Experienced biologists can recognize the uniform scale growth patterns that are typical of captive reared salmon (Figure 15). Scales of wild and restoration sea-ranched salmon are distinguished by seasonally variable growth patterns (Figures 13 – 15). Although growth patterns of captive reared adults for restoration may be quite similar to aquaculture fish, tags or fin clips typically applied to USFWS salmon prior to release can distinguish them from aquaculture escapees. The aquaculture industry may also elect to mark a portion of their stocks and familiarization with current fish marking/stocking data sets (both aquaculture and restoration stocking) is essential to accurately interpret marks and tags observed at traps. Typically, the right ventral fin clip is used by aquaculture, but most aquaculture fish are not marked.

Subsequent tissue analysis may provide confirmation of fish origin; however, it can be inconclusive. The DNA pedigrees of all aquaculture salmon reared in sea-cages in Maine waters are established by the aquaculture industry and those data are provided to the USFWS for the purposes of establishing a genetic based marking program for all fish stocked in US marine pen sites in Maine. After a suspect aquaculture origin fish is captured, DNA samples (fin clips) are taken from aquaculture escapees and provided to the USFWS for analysis. If a match is identified, the fish can be traced to a specific sea-cage location. If no match is identified then the fish did not escape from a sea-cage located in Maine waters, and likely originated in Canada.

Step-wise Procedure

Step 1 Evaluate the physical appearance of each adult Atlantic salmon that is handled (Figures 1 – 11). If the physical appearance of the fish is consistent with a typical wild or restoration Atlantic salmon it should be passed upstream. If the physical appearance is in not consistent with a wild or restoration Atlantic salmon, proceed with steps 2 - 4.

Step 2 If the physical characteristics are consistent with those of an aquaculture escapee, scan fish for marks and tags, and collect a scale sample. A scale sample must be collected to help determine fish origin; morphology and fin condition alone are insufficient evidence of rearing history. The presence of marks and tag may also indicate the fish origin.

Step 3 Accurately catalog the scale sample with complete capture data (Figure 12).

Step 4 Hold the suspect fish in a tank (preferred option) or return it to the trap until a trained DMR biologist has reviewed the scales (Figures 13 – 15) and made an origin determination. If a trained DMR biologist is not available and the suspect fish cannot be held for an extended period of time; collect scales, apply an adipose fin punch and retain the chad for DNA analysis, apply a T-bar tag, and release the fish downstream. Catalog scales and fin punch, document the chain-of-custody, and transfer the sample to DMR.

Step 5 If a trained DMR biologist determines that the scale pattern is consistent with that of a wild or restoration Atlantic salmon or the pattern is inconclusive then the Atlantic salmon should be passed upstream. If the scale pattern is unequivocally that of an aquaculture Atlantic salmon (Figure 15), proceed to steps 6 and 7.

Step 6 If the scale pattern is consistent with aquaculture origin Atlantic salmon a DMR biologist will euthanize, photograph, and necropsy the fish.

- Fin and tissue samples for DNA and fish health analyses will be collected per USFWS' *Procedures for the Collection of Tissues form Fish for Pathogen Analysis* and sent to the John Coll of the USFWS for analysis (Appendix I).
- Four additional fin tissue samples will be collected according to standard operating procedure for genetic analysis; of which, two will be included in the shipment to John Coll for Meredith Bartron of the USFWS and two will be reserved for delivery to Cooke Aquaculture.
- All samples (fish health and genetic) from a single suspect should contain a common Fish ID number (i.e. JoinID_Tag in DMR adult salmon database consisting of: location code-trap type-life stage-date-fish number, example PN-1MAINST47.50-FT-ADL-20121005-0004) for tracking along with a datasheet containing the collection information (collection date, location, sex, person sampling, and any other important information), and shipped in an insulated container with an ice pack using an overnight carrier (i.e. FedEx Express). Maine DMR's chain-of-custody form should be used anytime samples or whole fish are transferred between entities.
- The euthanized fish will then be wrapped, labeled with the Fish ID with all capture information and Biologist's contact information, and placed in a freezer. Fish will be retained in the freezer for a period no less than six months to permit additional testing of the carcass if required

Step 7 The responding DMR Biologist should initiate the notification protocol according to the subsection below.

Maine Department of Marine Resources (DMR) Division of Sea Run Fisheries & Habitat Distribution Notification Protocol for Suspected Aquaculture Origin Fish

This contact list is for notification of involved parties when a suspected[1] aquaculture origin (AQS) fish has been identified following DMR protocol.

The Phase 1 contact list shall be notified by the responding DMR biologist following a scale reading with uniform growth patterns typical of a cultured salmon. Notification shall not be initiated based upon physical appearance only. The Phase 1 contact list includes DMR employees and adult dam operators only.

The responding DMR biologist shall send an email to the Phase 1 contact list as follows:

> *On [insert date] a suspected aquaculture origin Atlantic salmon was captured on the [insert river name] at [trap location]. Based on scale analysis, DMR determined that the fish was likely of aquaculture origin and removed it. The determination of the Atlantic salmon as a suspected aquaculture was based on DMR standard operating protocols and is not definitive. The Atlantic salmon was photographed, processed for pathogen/disease testing and tissue samples were collected for genetic analysis. This information is confidential. Do not disseminate.*
>
> *Length and weight of the suspect salmon*
> *Total Length* _____ *[units]*
> *Fork length* _____ *[units]*
> *Weight* _____ *[units]*
>
> *[Insert your signature and contact information]*

In the second phase, the Maine DMR Policy Development Specialist (PDS) will notify all involved parties (Phase 1 and Phase 2). Non-involved parties and the public will be notified, as appropriate, through DMR staff in Augusta, likely by the PDS or Director of Communications.

[1] Designation of a suspect aquaculture is based on physical appearance and scale analysis and is not definitive. This is a precautionary approach with the intent of heightening awareness of trap operators to reduce the risk of passing aquaculture salmon upstream.

Phase 1 List (Adult Salmon Trap Operators)

Maine Department Marine Resources

- Commissioner Pat Keliher; 287-9972; patrick.keliher@maine.gov
- Jeff Nichols; 624-6569; jeff.nichols@maine.gov
- Carl Wilson; 633-9517; carl.wilson@maine.gov
- Jon Lewis; 633-9594; jon.lewis@maine.gov
- Marcy Nelson; 633-9502; marcy.nelson@maine.gov
- Oliver Cox; 941-4487; oliver.n.cox@maine.gov
- Ernie Atkinson; 434-5921; ernie.atkinson@maine.gov
- Mitch Simpson; 941-4465; mitch.simpson@maine.gov
- Paul Christman; 624-6352; paul.christmas@maine.gov
- Michael Brown, 624-6341; michael.brown@maine.gov

Brookfield Renewable Energy Group

- Robert Richter (Kennebec and Androscoggin); 877-8386; Robert.Richter@brookfieldrenewable.com
- Matt LeBlanc (Saco); 282-3380; Matthew.P.LeBlanc@brookfieldrenewable.com
- Richard Dill (Penobscot &Union); 207-852-2993; Richard.Dill@brookfieldrenewable.com

Essex Hydro

- Calvin Neal (Sebasticook); 659-0015; bentonfalls@essexhydro.com

Phase 2 List

Maine Department of Environmental Protection

- Commissioner Paul Mercer; 207-287-2812; paul.mercer@maine.gov
- Mike Loughlin; 207-941-4578; Mike.Loughlin@maine.gov

Maine Department of Inland Fish and Wildlife

- Commissioner Chandler Woodcock; 207-287-5205; chandler.woodcock@maine.gov
- James Connolly; 287-5259; james.connolly@maine.gov

United States Fish and Wildlife Service

- Sherry White; 413-253-8500; sherry_white@fws.gov
- Peter Lamothe; 207-469-6701 (Ext. 232); peter_lamothe@fws.gov
- Wende Mahaney; 207-866-3344 (Ext 118); wende_mahaney@fws.gov
- John Coll; 570-726-6611 (Ext. 221); john_coll@FWS.gov
- Meredith Bartron; 570-726-4247 (Ext. 155); meredith_bartron@fws.gov
- Eric Holmes; 207-469-6701; eric_holmes@fws.gov

National Marine Fisheries Service

- Kim Damon-Randall; 978-282-8485; kimberly.damon-randall@noaa.gov
- David Bean; 207-866-4172; david.bean@noaa.gov
- John Kocik; Phone: 207-866-7341; john.kocik@noaa.gov
- Scott Adams; 207-664-0508; scott.adams@noaa.gov

Cooke Aquaculture

- Jennifer Robinson; 207-853-6081; Jennifer.Robinson@cookeaqua.com
- Greg Lambert; 207-446-6295; greg.lambert@cookeaqua.com
- Nell Halse; 506-694-4908; nhalse@cookeaqua.com

Army Corps of Engineers

- Jay Clement; 207-623-8367; jay.l.clement@nae02.usace.army.mil

St. Croix International Waterway Commission

- Heather Almeda, 506-466-7550, staff@stcroix.org

New Brunswick Department of Agriculture, Aquaculture, and Fisheries

- Kathy Brewer-Dalton; 506-444-5102; Kathy.brewer-dalton@gnb.ca
- Peter Cashin; 506-453-8363; Peter.Cashin@gnb.ca
- Karen Coombs; 506-755-4282; Karen.coombs@gnb.ca

Nova Scotia Department of Fisheries and Aquaculture

- Bruce Hancock; hancobh@gov.ns.ca

Newfoundland and Labrador Department of Fisheries and Aquaculture

- Elisabeth Barlow; elizabethbarlow@gov.nl.ca

Illustrations of Atlantic salmon fins, fin deformities and scale examples.

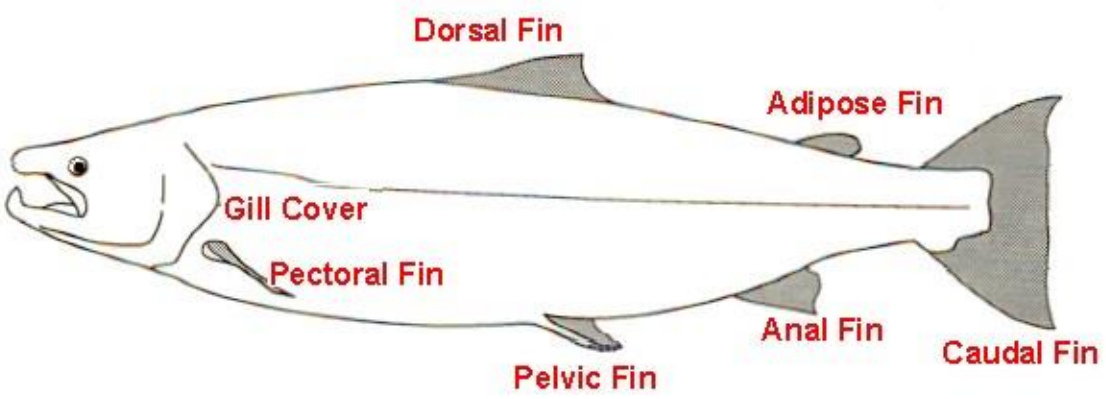


Figure 1. location and names of fins on an Atlantic salmon.

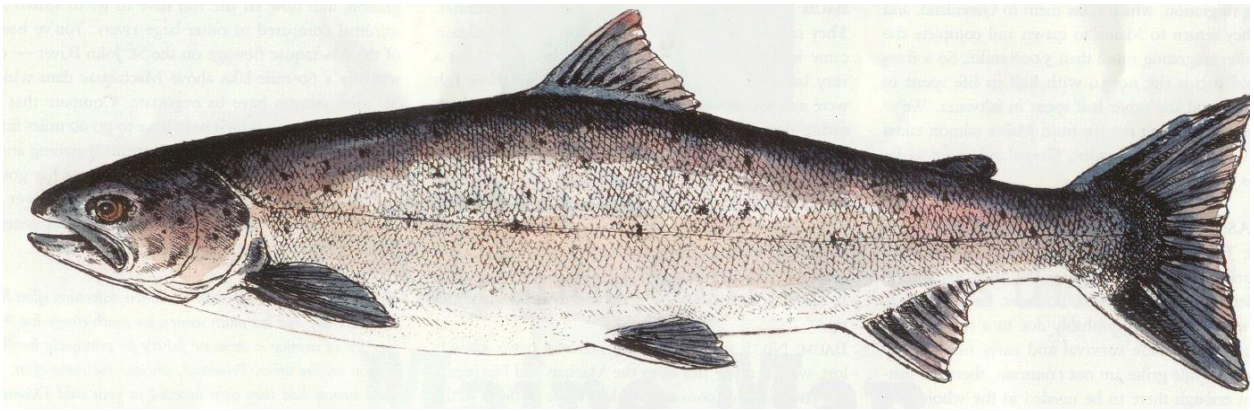


Figure 2. Illustration of wild Atlantic salmon with perfect fins (fin condition = 0).

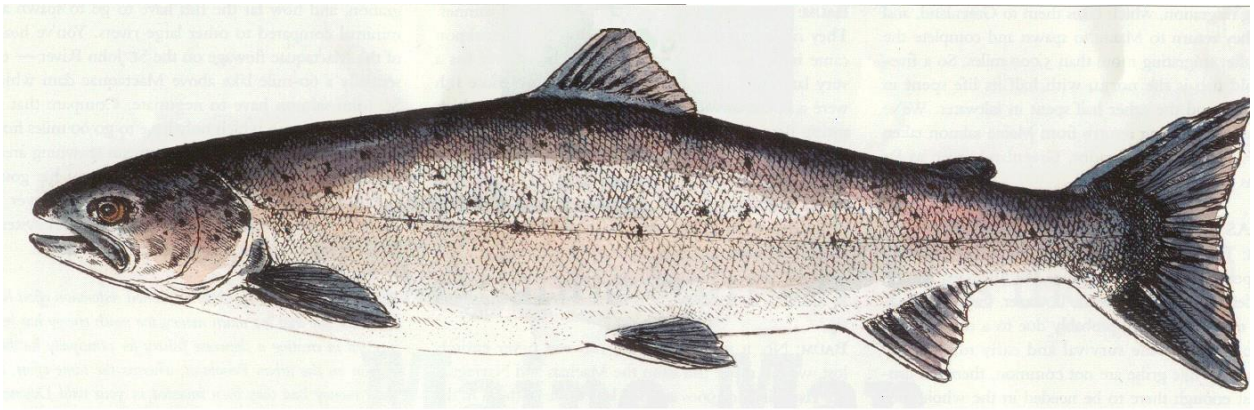


Figure 3. Illustration of hatchery-origin Atlantic salmon with slightly deformed dorsal fin (fin condition = 1), other fins appear normal.

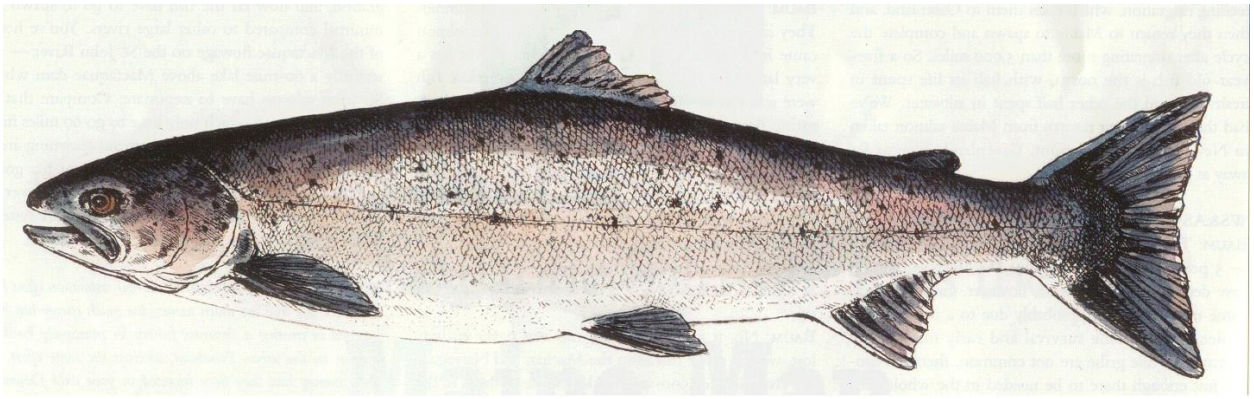


Figure 4. Illustration of hatchery-origin Atlantic salmon with deformed dorsal fin (fin condition = 2), other fins appear normal.

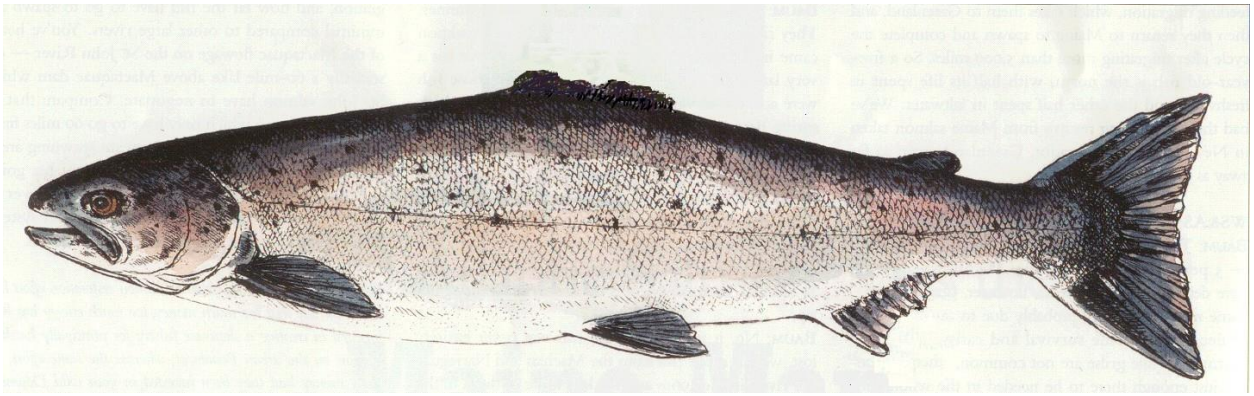


Figure 5. Drawing of hatchery origin Atlantic salmon with severely deformed dorsal fin (fin condition = 3) and deformed anal fin (fin condition = 2), other fins appear normal.

Figure 6. Normal appearing pectoral fin.

Figure 7. Deformed pectoral fin.

Figure 8. Wild multi sea-winter Atlantic salmon (MSW) – Note shape of tail and condition of fins.

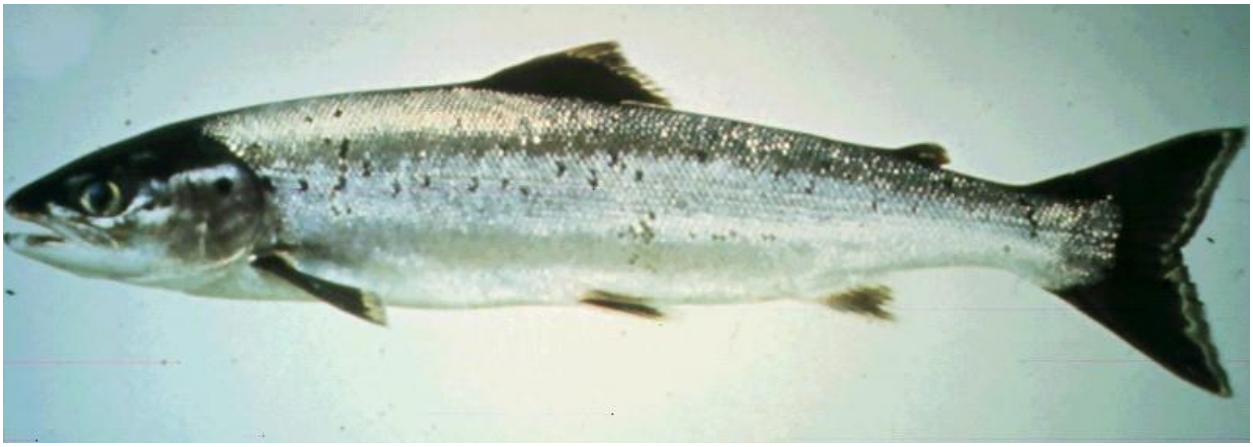


Figure 9. Wild one sea-winter Atlantic salmon (grilse) - Note condition of fins, which are free of deformities and body size proportions.

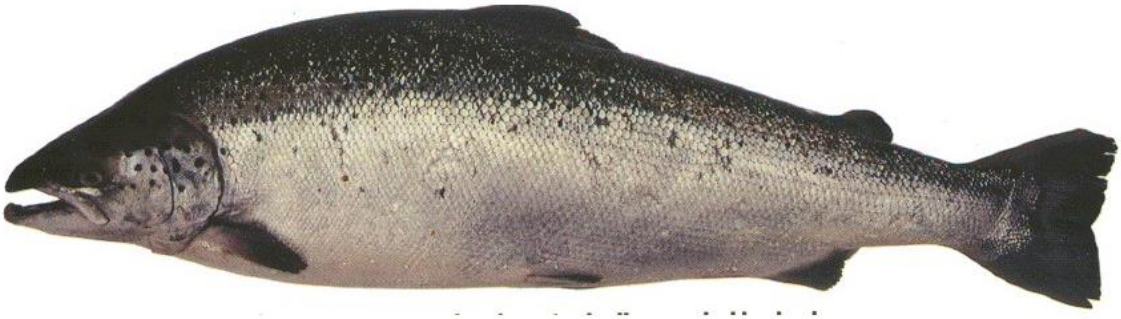
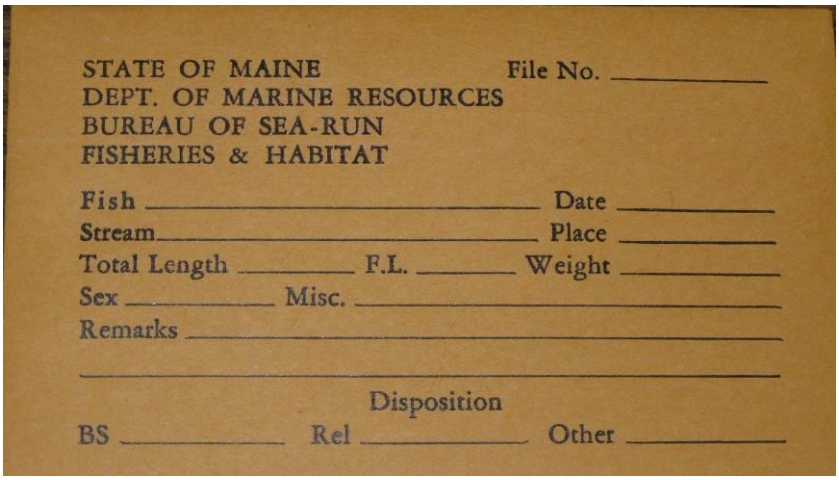


Figure 10. Aquaculture Salmon – Note 'broom' tail shape, multiple deformed fins and unusual length/weight ratio.

Figure 11. Suspected aquaculture escapee – Note 'broom' tail shape, deformed dorsaled and pectoral fins.


STATE OF MAINE File No. _____
DEPT. OF MARINE RESOURCES
BUREAU OF SEA-RUN
FISHERIES & HABITAT

Fish _____ Date _____
Stream _____ Place _____
Total Length _____ F.L. _____ Weight _____
Sex _____ Misc. _____
Remarks _____
_____

Disposition

BS _____ Rel _____ Other _____

Figure 12. Scale envelope used by DMR to store scale samples and document date, location, length and weight associated with the scales.

Figure 13. Illustration of typical wild Atlantic salmon scale.

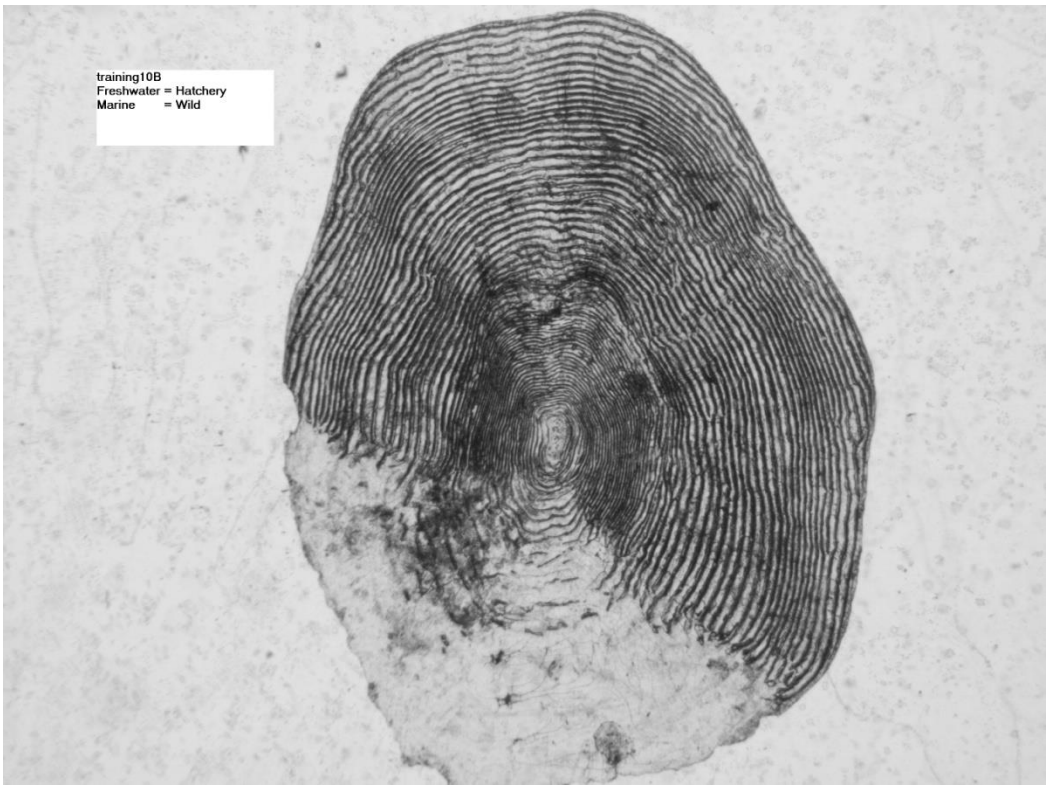


Figure 14. Illustration of typical hatchery smolt origin (restoration) Atlantic salmon.

Figure 15. Illustration of a typical commercially raised Atlantic salmon. Note the even growth rate across the scale.

Appendix I

Procedures for the Collection of Tissues form Fish for Pathogen Analysis

Sampling for disease will consist of the following:

1. Bacterial culture from kidney on BHIA agar. (agar slants and disposable loops provided);
2. Portion of kidney and spleen tissues (together, from same fish) in sterile buffered saline (tubes and HBSS provided) for virus testing;
3. Portion of kidney tissue for bacterial kidney disease (immunology test) and/or molecular assay(s);
4. Gill tissue in whirlpak or ziploc bag for whirling disease parasite.

Sampling for fin tissues will consist of the following:

1. Three 1.5 ml tube with 95% non-denatured ethanol (1 for John and 2 for Meredith);
2. Two 1.5 ml tube with 95% non-denatured ethanol for Cooke Aquaculture.
3.

All samples (fish health and genetic) should contain a common Fish ID number for tracking along with a data sheet on collection information (collection date, location, sex (if able to determine), person sampling, and any other important information), and shipped in an insulated container with an ice pack using an overnight carrier (i.e. FedEx Express) to:

John Coll
US Fish and Wildlife Service
Fish Health Center
400 Washington Ave
Lamar, PA 16848
ph: 570-726-4247 x 221

Containers/ice packs will be returned via "regular" mail. The genetic vials can be sent in the same shipment, and will be transferred to the USFWS Conservation Genetics Lab. Please notify Meredith Bartron, ph: 570-726-4247 x 155, Meredith_Bartron@fws.gov that genetic samples are being sent.