Applications of Age & Measurement Data for Atlantic Salmon Scales Using Image Analysis

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Abstract

Accurate age and growth information is essential for the successful management of any fish population. The NEFSC's Atlantic Salmon Research and Conservation Task (ASRC) uses Optimas 6.5.1 to efficiently extract growth and age information from Atlantic salmon scales. Optimas is an image analysis software program that enables measurements to be extracted from digital or real time video images. For endangered Atlantic salmon populations we typically age the fish using scales and then quantify scale growth by extracting a series of measurements including circulus spacing, annulus spacing, and focus morphology (the center portion of the scale). These variables are used in studies involving comparative growth and maturation, discrimination between naturally reared and hatchery reared fish, and stock discrimination. The ASRC Image Analysis lab provides a means to quantify the age and growth data collected from Atlantic salmon populations. This information is essential for understanding the age structure, complex life history, and ecology of these fish to better manage and restore these depleted populations.

Conclusions

- Using Optimas in the ASRC Image Analysis lab provides a means of collecting the age, origin, and growth data needed to accurately manage the endangered Atlantic populations in Maine.
- The ASRC Image Analysis lab provides a means to quantify the age and growth data collected from Atlantic salmon populations.
- This information is essential for understanding the age structure, life history, and ecology of these fish to better manage and restore these depleted populations.
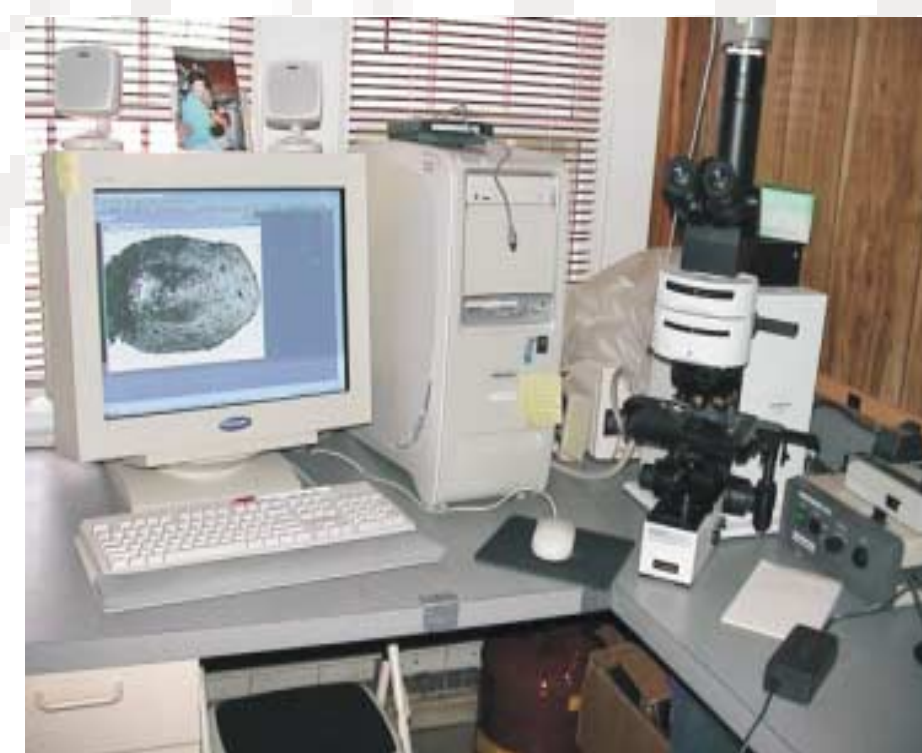
Introduction

- Aging, collecting growth data, and determining origin of Atlantic salmon scales is important to the successful management of the population.
- Optimas 6.5.1 provides a convenient means to extract the data needed to age and measure Atlantic salmon scales and share that data with others.
- Data collection encompasses both endangered and non-listed Atlantic salmon populations.

Figure 1. ASRC image analysis lab: computer interfaced with microscope.

Methods

- Scales sampled from salmon are assigned a Join ID that links them to other ASRC databases.
- These scales are then mounted between two slides for image processing.
- Scales are viewed through a microscope interfaced with a computer where the image may be enhanced using Optimas 6.5.1. (Figure 1)
- Scale images are acquired from a live video capture or a saved or scanned image.
- Features of interest are identified and measured (examples include: **Circulus spacing**, **annulus spacing**, **radius length**, **focus area**, **focus circularity**, **focus perimeter**, and **focus breadth**.) (Figure 2)
- A subsample of scale images are saved for auditing and electronic exchange.

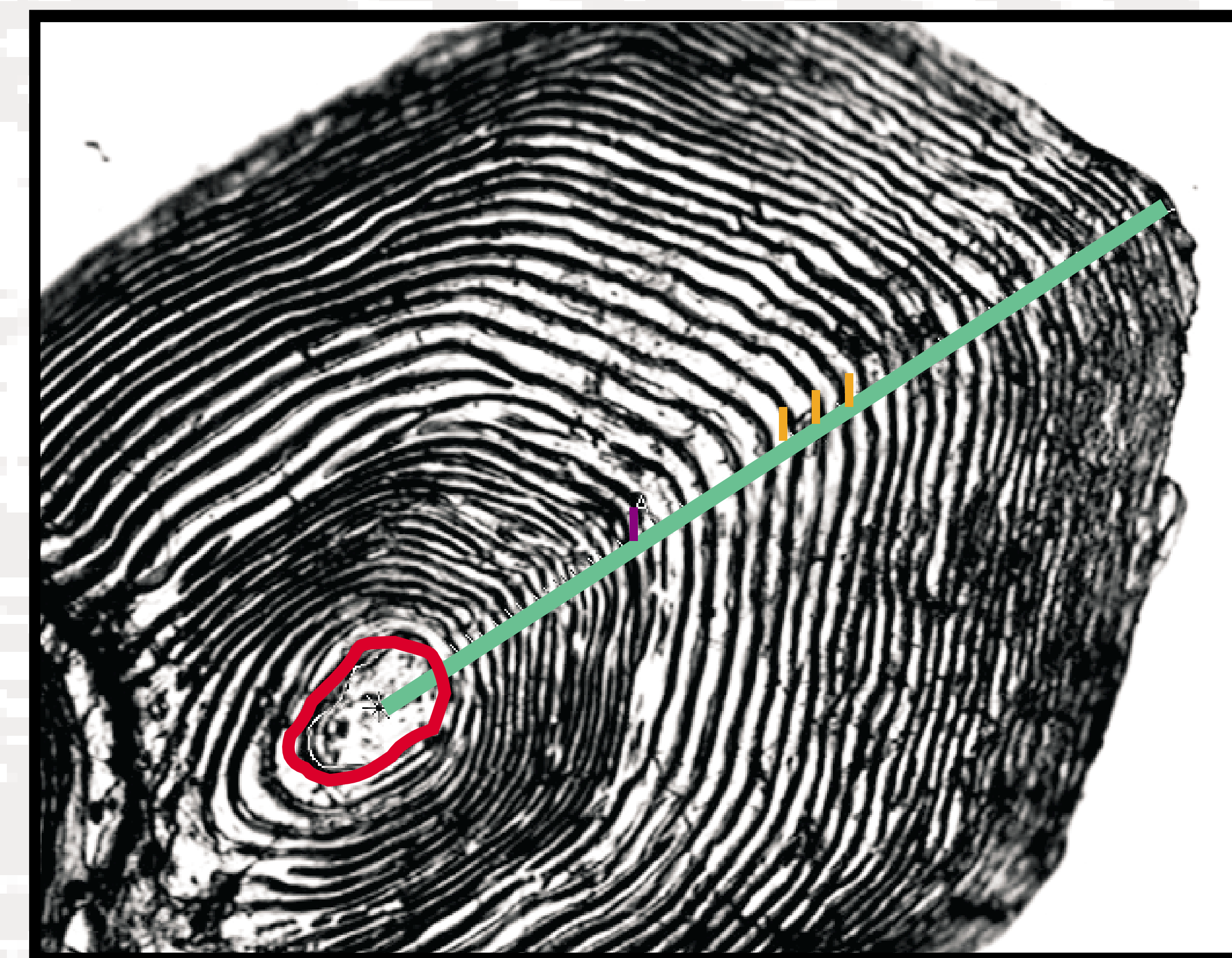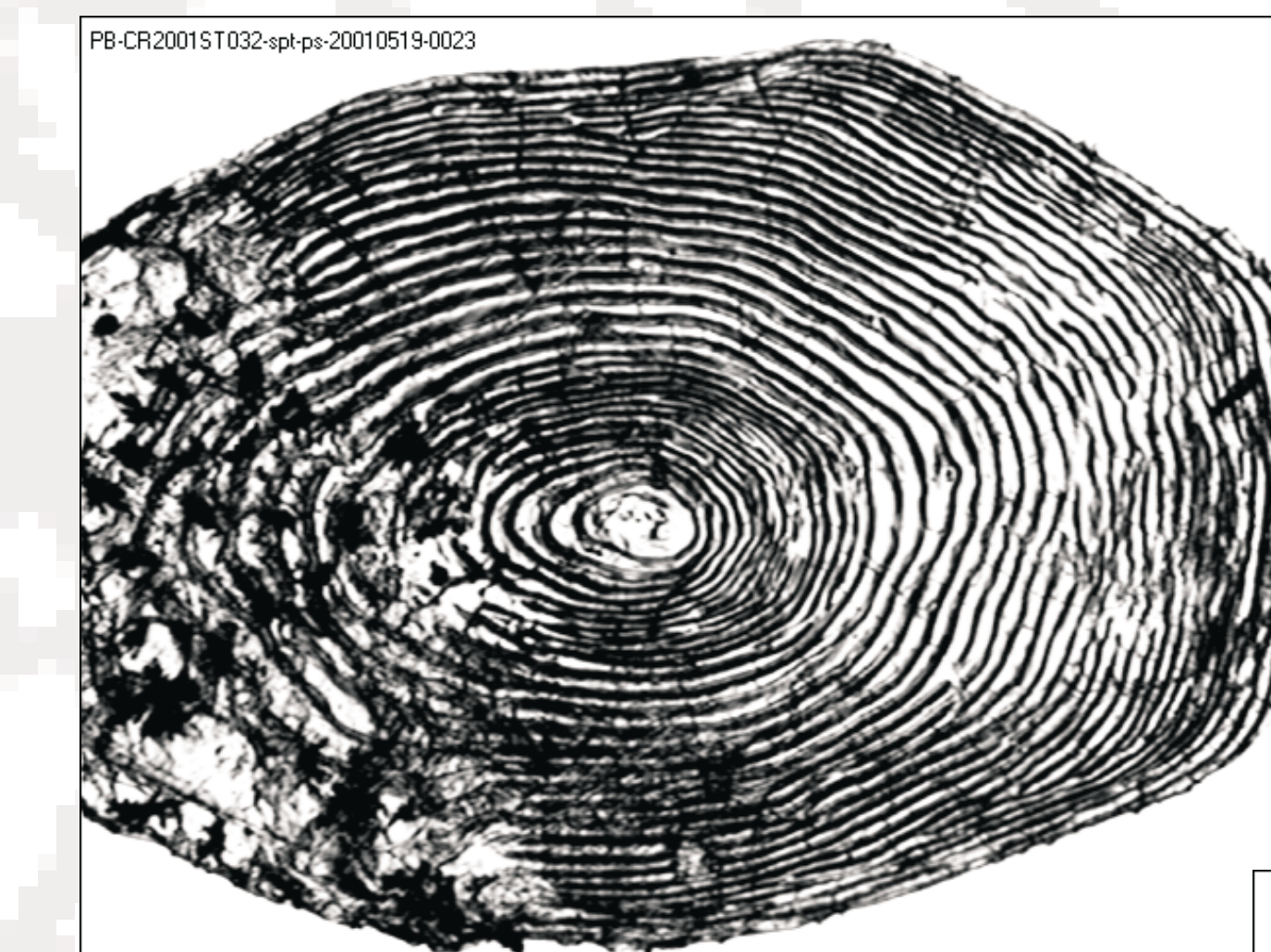### Cluster Using Avg. Circulus Spacing for 10 Circuli Pairs

Greendale
West1
West2a
Win/Cook
West5
Wardsboro
Rock

0.004　0.006　0.008　0.010

Figure 4. Differences in growth signatures between salmon populations in different tributaries on the West River (part of the CT river system in VT).

Figure 2. Illustrates focus location (in red), circuli locations (in orange), annulus location (in purple), and radius location (in turquoise) on a saved scale image.

Results

- Rearing origin data is used to assess the number of naturally reared individuals from hatchery-reared individuals (i.e. aquaculture, fry-stocked, parr-stocked, smolt-stocked, and brood-stocked individuals) (Friedland & Esteves 1994). (Figure 3)
- Growth data is collected from each scale to assess the differences between distinct population segments, seasonal affects, and environmental affects. (Figure 4)
- Growth data is also used in comparative growth and maturation studies (Friedland & Haas 1996; Friedland *et al*. 1996)
- Age data collected allows us to accurately partition sampled individuals by year class. Archived age data is essential to a variety of ongoing Atlantic salmon conservation-minded research projects.

Naturally Reared
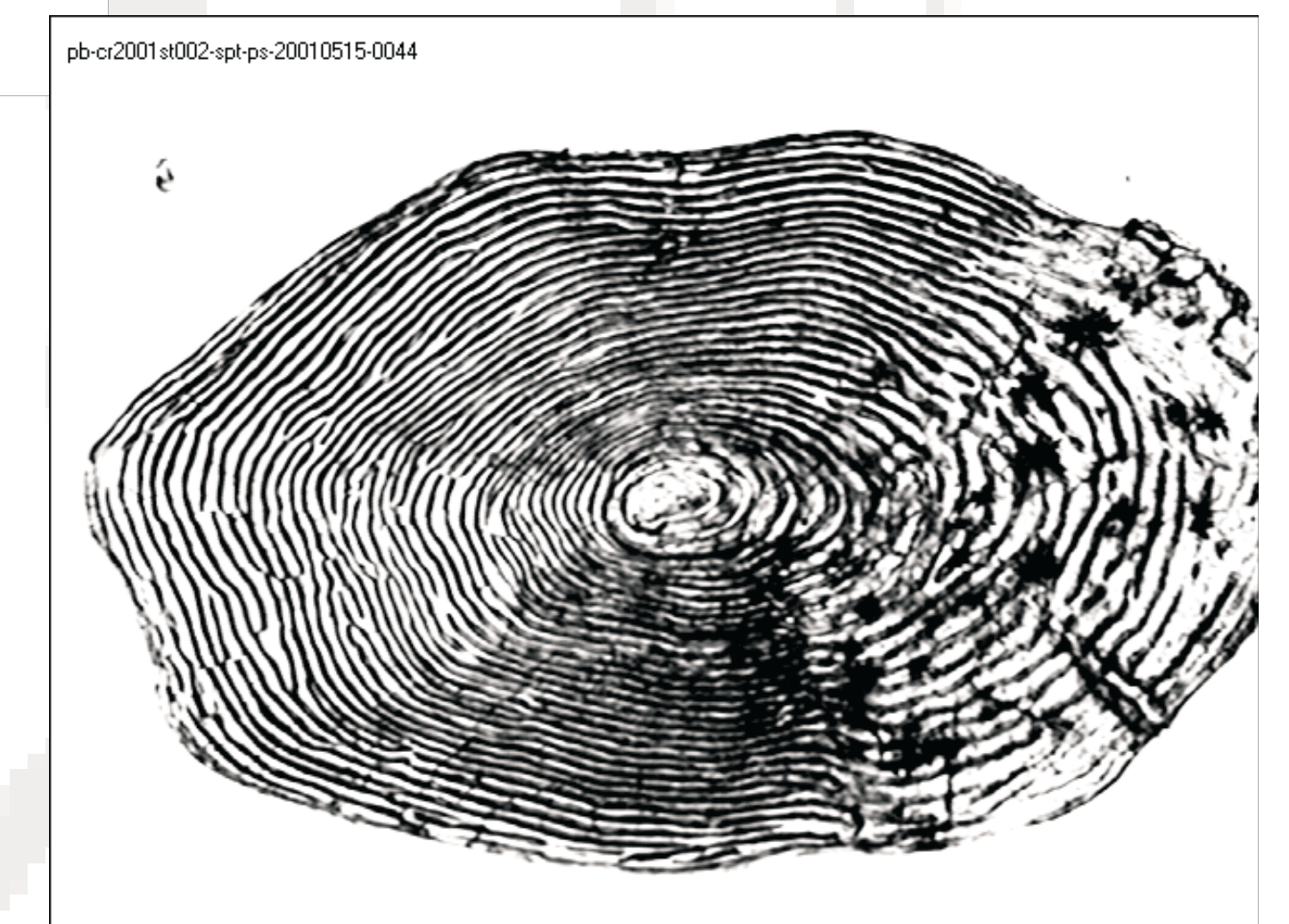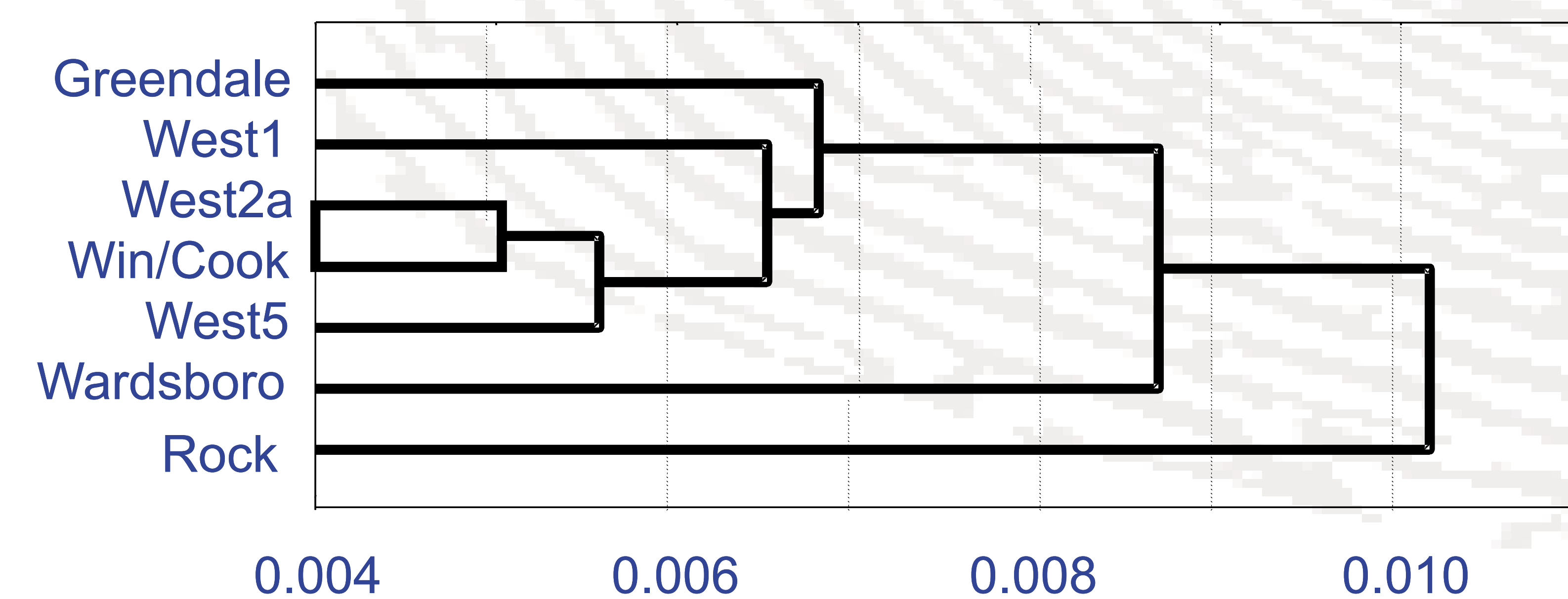Fork Length 172 mm

Hatchery Suspect
Fork Length 188 mm

Figure 3. Two Atlantic salmon smolt scale samples taken from a rotary screw trap on the Penobscot River in Maine. One is of suspected hatchery origin and one is of naturally reared origin.

References

Friedland, K.D. and C. Esteves. 1994. Discrimination of Norwegion farmed, ranched, and wild-origin Atlantic Salmon, *Salmo salar* L., by image processing. Fisheries Management and Ecology 1:117-128.

Friedland, K.D. and R. E. Haas. 1996. Marine post-smolt growth and age at maturity of Atlantic salmon. Journal of Fish Biology 48:1-15.

Friedland, K.D., R. E. Haas, and T. F. Sheehan. 1996. Post-smolt growth, maturation, and survival of two stocks of Atlantic salmon. Fishery Bulletin 94(4):654-663.