Paddlefish age determination for the commercial fisheries

Final Report
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by

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Introduction

The North American paddlefish *Polyodon spathula* (Acipenserformes: Family Polyodontidae) is a large, ancient fish species native to the Mississippi and Missouri river basins and several Gulf Coast drainages (Carlson and Bonislawsky 1981; Gengerke 1986). Although paddlefish populations persist in portions of 26 states, their peripheral range contracted in the 20th century (Gengerke 1986; Graham 1997). Mere remnant populations remain in several states where they were once abundant (Bettoli et al. 2009). A combination of overfishing and inadequate harvest management has also contributed to the decline of paddlefish in many localities (Hoxmeier and DeVries 1996; Jennings and Zigler 2000).

Nationally, increased emphasis on national or regional inter-jurisdictional management and stock assessment has expanded through the activities of inter-jurisdictional working groups (National Paddlefish and Sturgeon Steering Committee 1993) and especially the Mississippi Interstate Cooperative Resource Association (MICRA; Grady et al. 2005; Mestl et al. 2005).

Although there are some well-documented recent successes in managing paddlefish recreational fisheries in several states, there are more serious needs to improve paddlefish stock assessment and management for the commercial fisheries. In all eight commercial fishing states, however, sustainable paddlefish harvest management is hindered by the lack of a coordinated management approach, including well integrated state management plans that mesh with each other for stocks overlapping jurisdictions. Meaningful harvest management is also greatly impeded by a shortage of age-specific data necessary for reliable stock assessments (Sharov et al. 2013). These shortcomings are potentially serious for the long term conservation of the species as a wild fish in its native habitats. In terms of export of caviar, the lack of reliable stock assessments also typically fails to provide the OSA the necessary evidence of non-detrimental effects of the fisheries.

It has become increasingly important to document sustainability of paddlefish fisheries to ensure the well-being of this ancient species and also for meeting non-detrimental findings by the U. S. Fish and Wildlife Office of Scientific Authority for obtaining export permits for caviar under CITES. As a result, efforts are underway for a multi-year cooperative stock assessment and management planning project for paddlefish commercial fisheries. The proposed monitoring program is based on working with commercial harvesters in each state to cost-effectively sample paddlefish as they are harvested from the fisheries. The intent is to develop and implement a cooperative paddlefish management and stock assessment program for the region, a paddlefish management plan for each individual state (multi-state plans as conditions warrant), a coordinated stock assessment protocol consistent among all states, a paddlefish data base for each state suitable for stock assessment and modeling and compatible in format with those of other states, peer reviewed publications submitted from each state and cooperatively, and paddlefish informational material for distribution in each state and the region.

As a first step toward this goal, in 2014, the Association of Fish and Wildlife Agencies sponsored a start-up project to provide age determination of dentary samples from the commercial fisheries (approximately 300 per state or harvest management unit, depending on availability). This information is also viewed as a first step toward developing stock assessment protocols and increasing cooperation and discussions among the states in pursuit of broader management planning objectives and regional stock assessments, to be completed as adequate funds become available. Objectives and activities were designed to align closely with the Sharov et al. (2013) report, also funded by AFWA, in several ways. The AFWA Report:

1. described commercial paddlefish fisheries as data poor, because age data were not available for modern full age-structured stock assessments analyses, such as statistical catch-at-age analysis.
2. recommended mortality be estimated annually, and accurate age structure data is needed to estimate mortality.
3. recommended that data collection be improved, including age-structure of the catch.
4. recommended conducting more age validation studies. Accurate ages are critical for management.
5. recommended the use of biological reference points and harvest control rules, and age structure of the catch information is required to implement these recommendations.

Toward those longer term objectives, the primary objective of this project was to provide age determinations for paddlefish samples provided by the states with commercial fisheries.

Methods

Harvest data and samples were obtained primarily from the commercial fisheries through field sampling. Samples were sent from 7 states: Alabama, Arkansas, Indiana Kentucky Mississippi, Missouri, and Tennessee. No other data than the dentaries were used in age determination assessments. Dentaries were identified with an individual tag number that identified each fish uniquely.

The dentaries were cleaned, cut, and the ages were determined at the University of Idaho using established protocols (Scarnecchia et al. 1996; Scarnecchia et al. 2006, 2007). Thin cross sections were cut with a Buehler Isomet low-speed saw and sections read under a projection microscope with the aid of an Image-Pro Plus system. Digital photographs were made of each section. Sections were aged using a 2-person double-blind protocol, along with a tolerance for minor disagreement. In this protocol, each of two readers (designated primary and secondary readers) aged the sections separately. In the first round, for age 10 or less, ages of both readers had to be exact. For ages 11-20, ages had to be within one year, with the primary reader's age accepted. For ages 21-30, ages had to be within 2 years, with the primary reader's age accepted. Ages not meeting these criteria were aged independently again using the same tolerances and approach. If ages still differed beyond tolerance limits, ages were aged jointly and the final age assigned by the primary reader. Final ages were entered into a data base for each state along with a photograph of each samples.

Results and Discussion

In all, 2,436 samples were aged (Table 1). Final age in excel format have been mailed to each state, and the photographs of sections have been prepared for shipping to each state on DVDs. State managers will have a chance to evaluate the results and may share data bases as the situations warrant, at their discretion.

Overall ages ranged from less than 5 to more than 30. Mean and median ages differed by state. Some of the oldest fish were from Alabama and Mississippi; ages from Tennessee, Kentucky, Arkansas and Missouri tended to be younger than those from the Alabama and Mississippi. Older fish were characterized by several closely-packed annuli near the section edge; this pattern was suggestive of fish in their prime spawning period (Scarnecchia et al. 2007). These packed annuli were lacking in the younger fish; this pattern was suggestive of fish in their immature or early reproducing period (Scarnecchia et al. 2007; See photos).

Age determination presented several challenges. No other information (length, weight, maturation state) was used to aid in estimating age. False annuli were common in samples from all states. False annuli could occur in early years (1-7) leading to overestimates of age of young fish. In general, it was assumed that false annuli were less prevalent or absent in later years. In many cases, false annuli were easily to identify. In others some additional experience with the particular stock will be useful in future years. The use of additional data from each fish (length, weight, maturation) along with the dentaries would have improved the accuracy of age estimation in samples with large numbers of false annuli. Additional years of data from each stock will result in improved age determination accuracy in the future. Validation is an important step, and should be pursued, but will not solve all aging issues. This study should be viewed as an initial step in developing reliable age determination methods for the stocks in various states.

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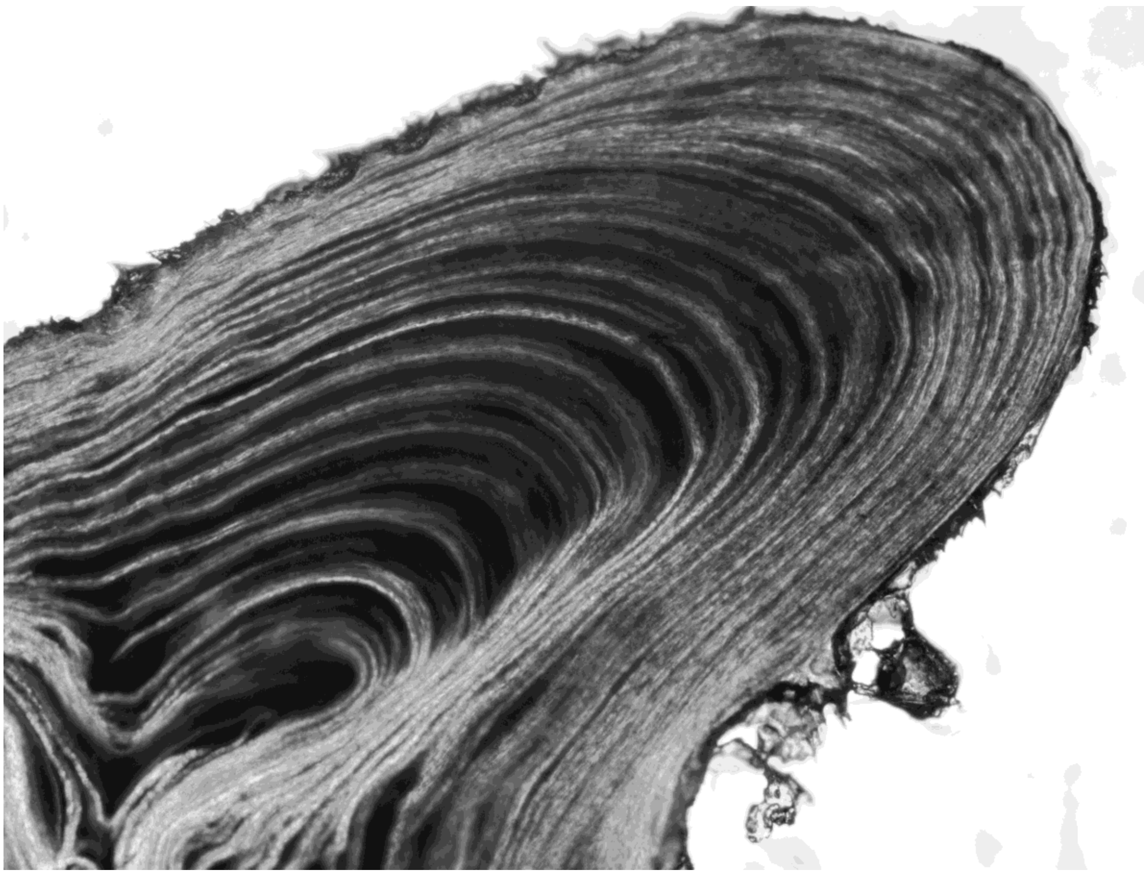
Examples of dentary sections from the states:

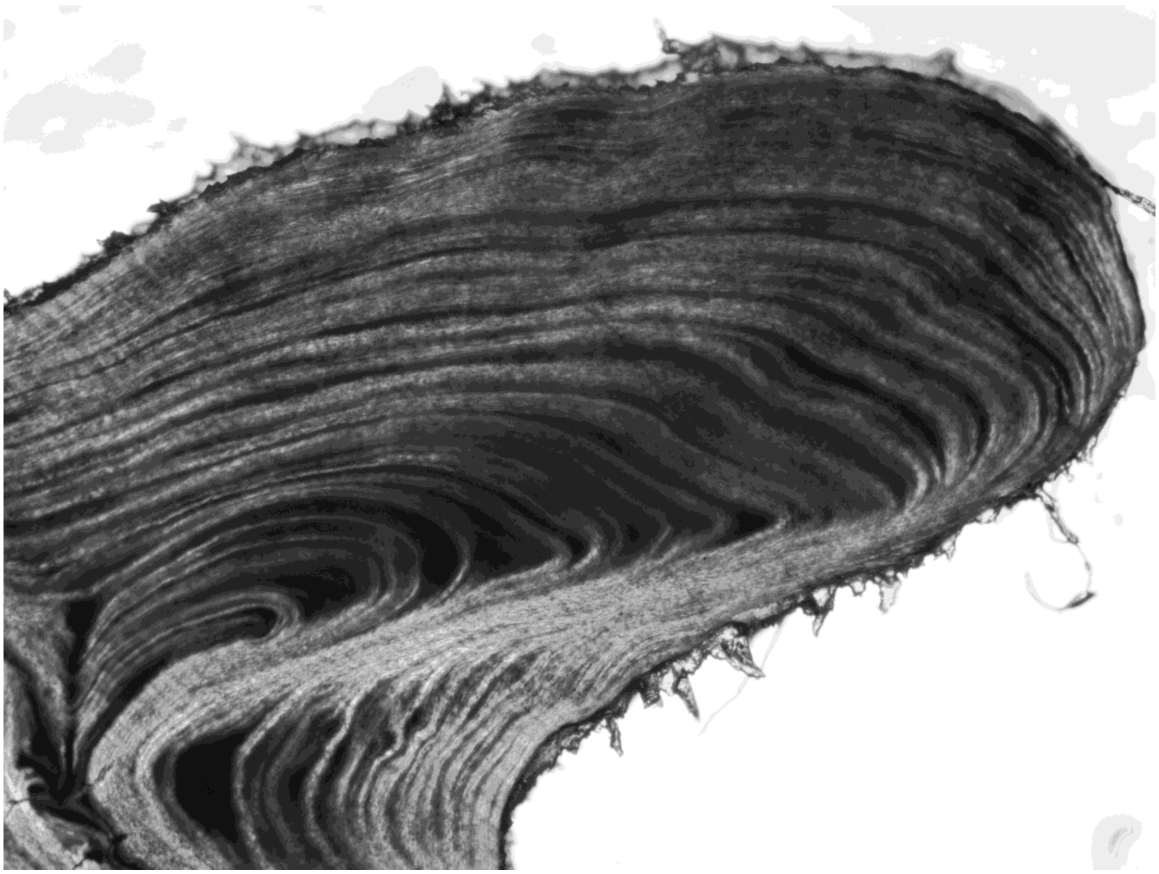
Alabama:

Fish ID=UAR-66 (02-12-2015, Sex=F, Age=25, EFLflat= 953 mm, EFLcurve=965 mm, Wt=13.8 kg) Note slow growth last several years. This pattern was common in Alabama samples.



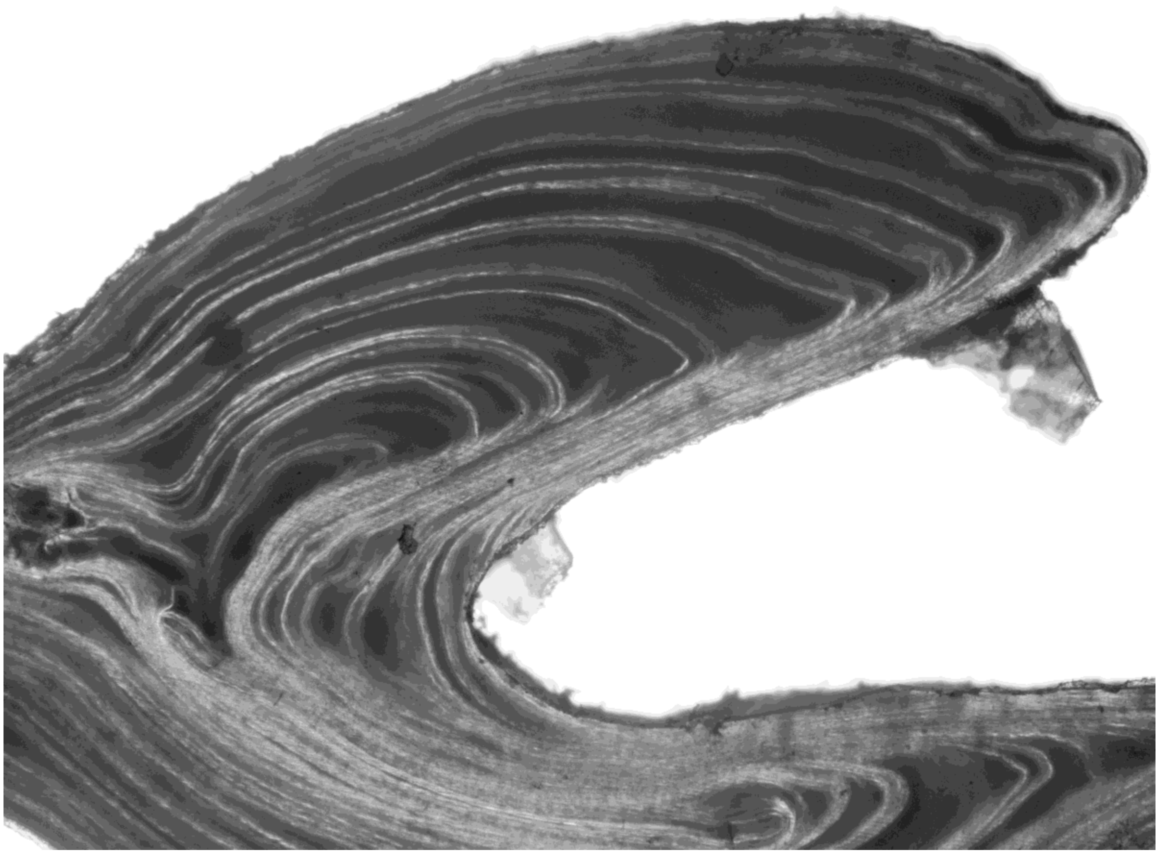
Alabama:

Fish ID=UAR-69 (02-12-2015, Sex=F, Age=24, EFLflat= 943 mm, EFLcurve= 960mm, Wt=11.8kg). Note slow growth last several years. Closely packed annuli were counted near edge.



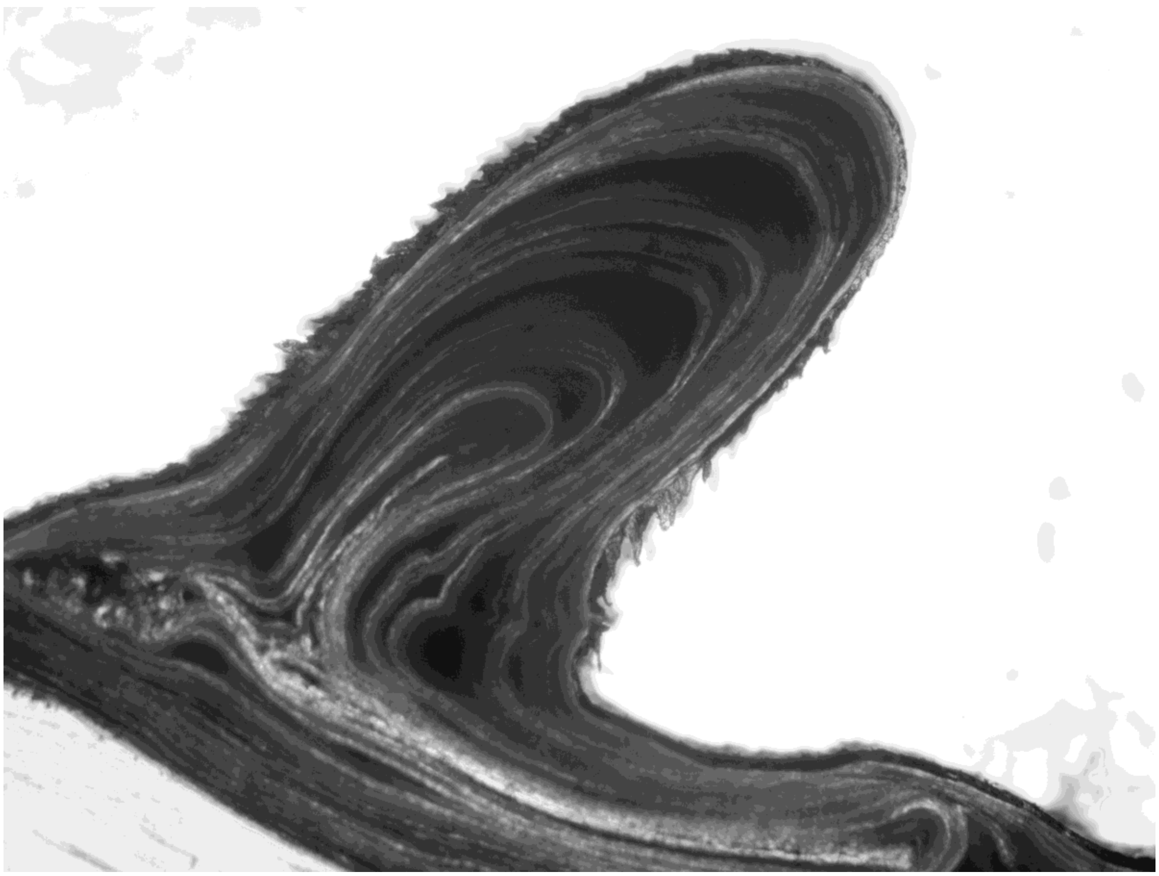
Arkansas:

Fish ID=WR018 (12-18-2013, Sex=F, Age= 12, Body length=911mm, Wt=9.95 kg). Note strong pattern of doublets. Doublets are fairly straightforward to identify in the first 4-5 years; more difficult thereafter. The angles of the sections result in different appearances of doublets.



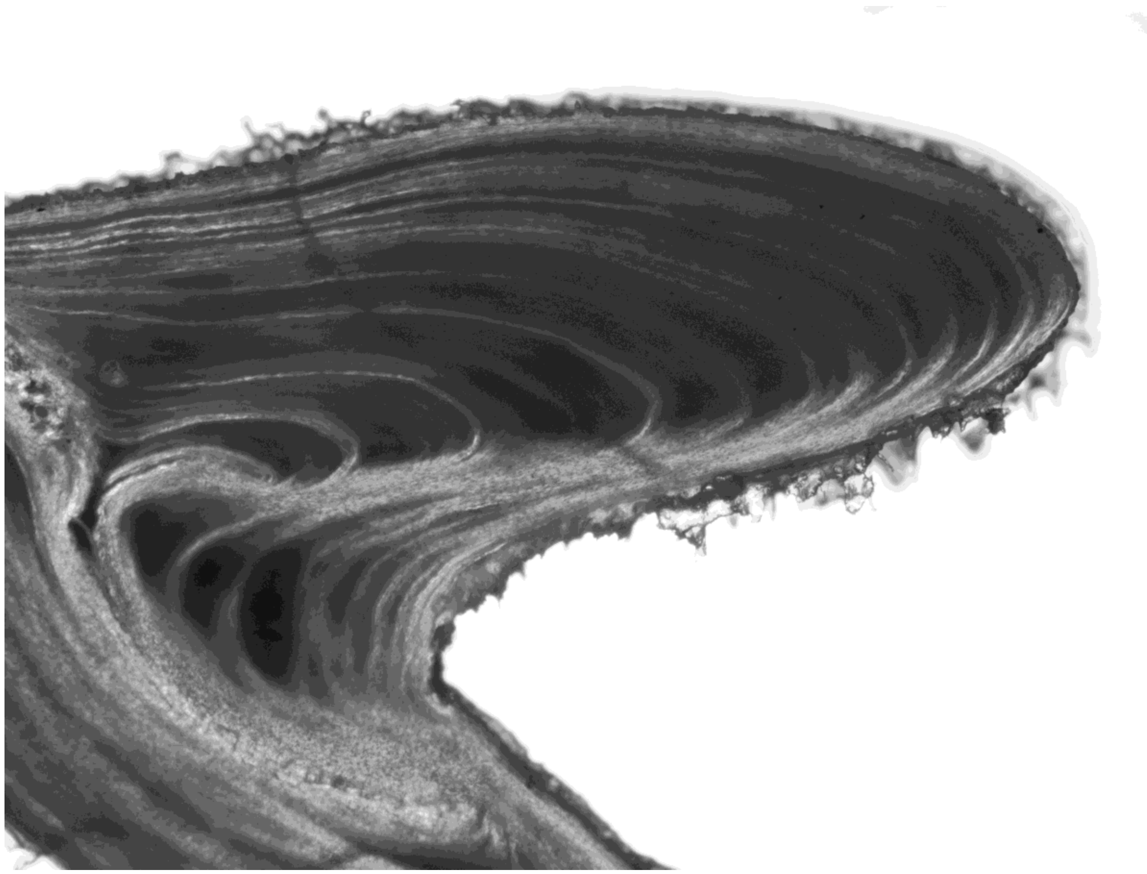
Arkansas:

Fish ID=A1244 (Year=2004, Location=OZARK, Age= 9, no lt-wt-sex info). In fish with numerous false annuli, it is preferable to have a range of fish sizes to see patterns more effectively. This fish's actual age could be aged younger with a more conservative approach. These issues can be resolved with more samples in different age and size groups.



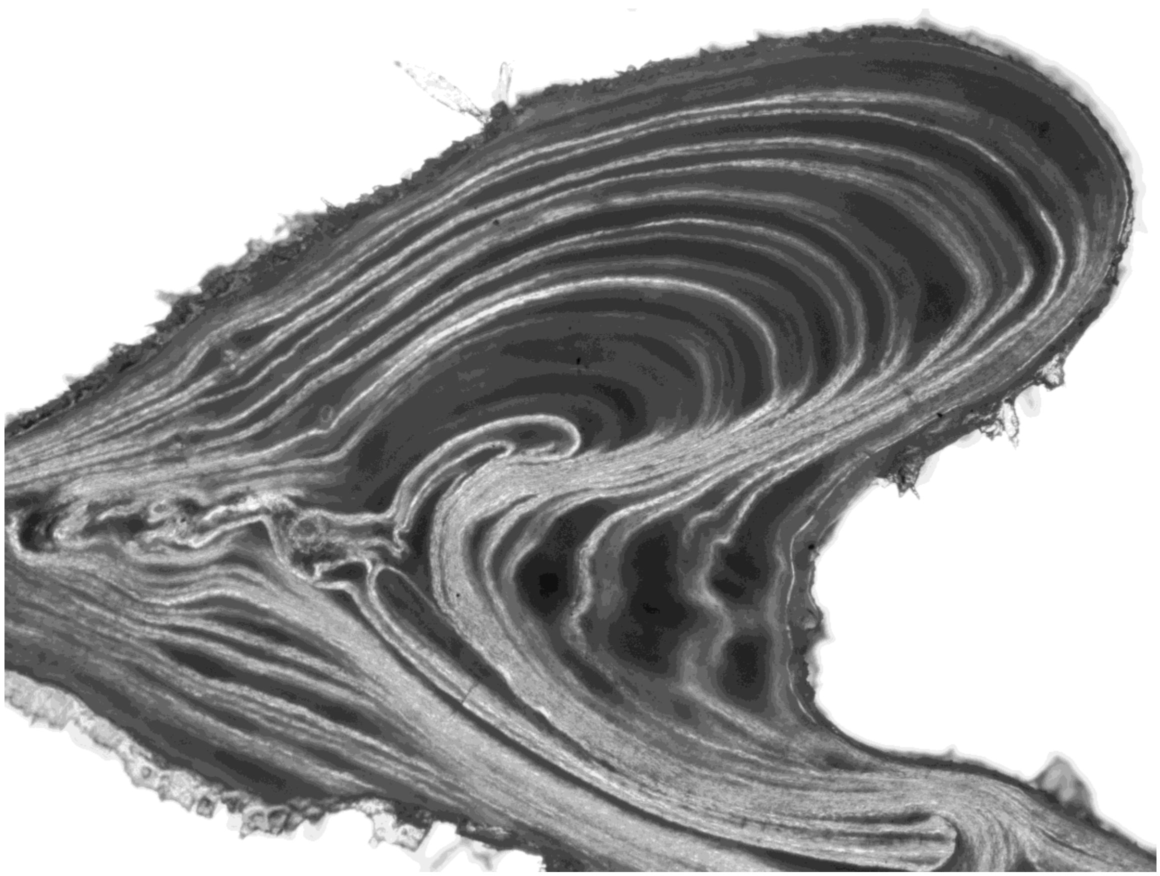
Indiana:

(03-27-2015, ID=8, Sex=M, Age=12, EFLflat=845mm, EFLcurve=858mm, Wt=7.6 kg). This fish is typical of a younger fish with steady, if decreasing, growth and no evidence of closely packed annuli near the edge. Compare with Alabama samples.



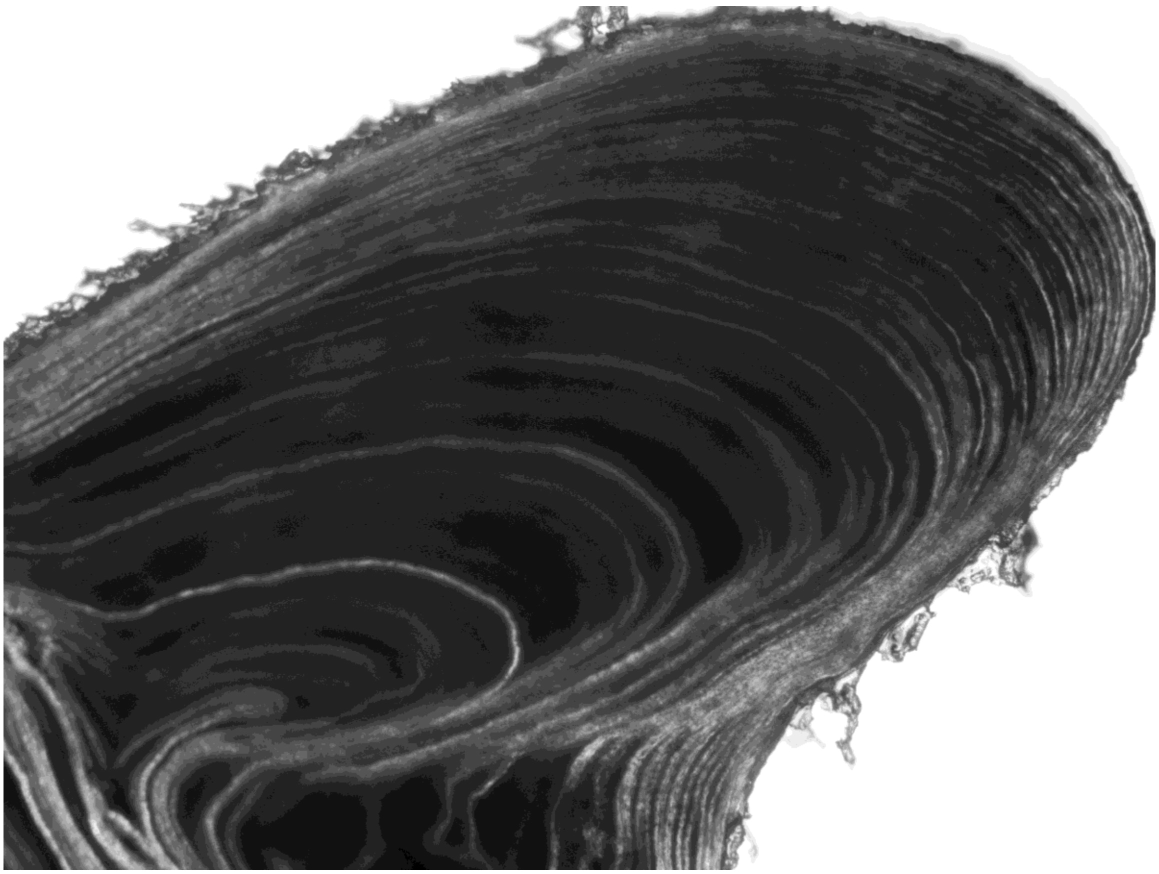
Kentucky:

(02-13-2015, ID=11, Sex=M, Age=8, EFLflat=824 mm, EFLcurve=848 mm, Wt=20.87 lbs). This fish is typical of a younger fish with steady, if decreasing, growth and no evidence of closely packed annuli near the edge. Compare with Alabama samples.



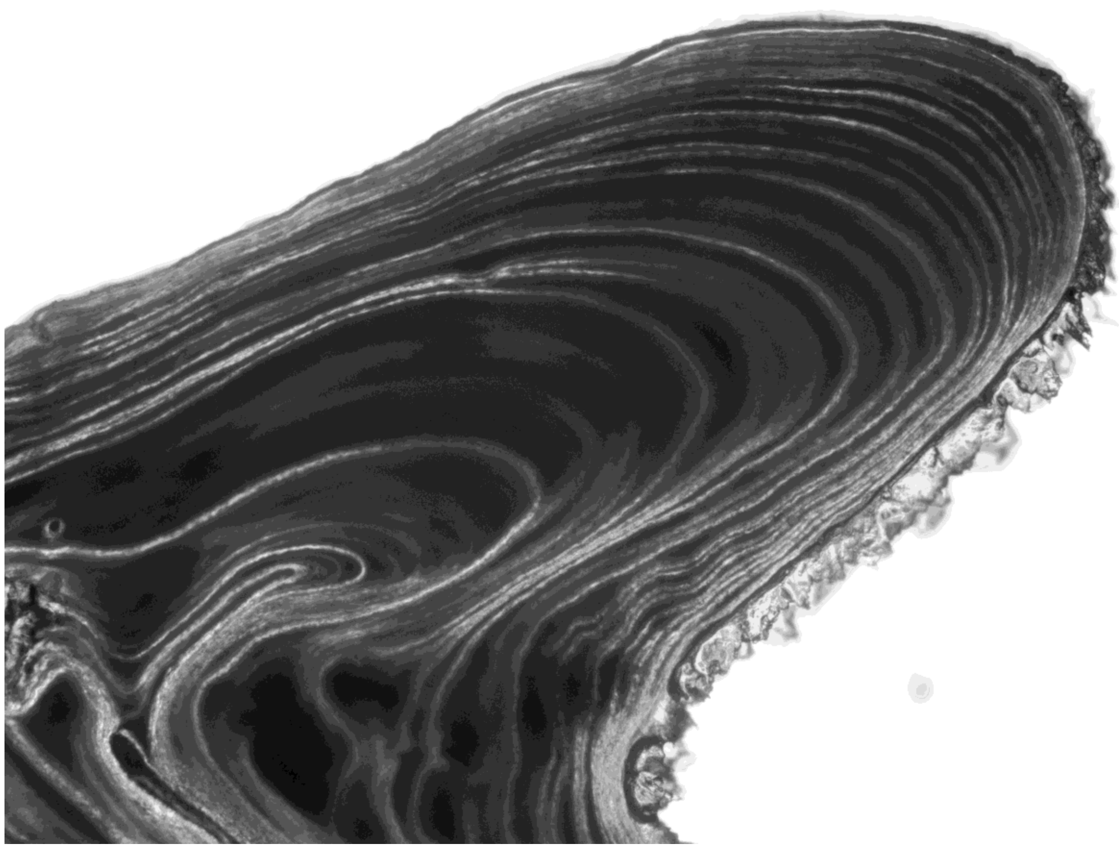
Mississippi:

(02-07-2011, ERDC#228, MDWFP#1461, Sex=M, Age=17, EFL= 1117.6 mm). This fish, as with many from Mississippi, indicated rapid early growth and often numerous closely packed annuli near the edge.



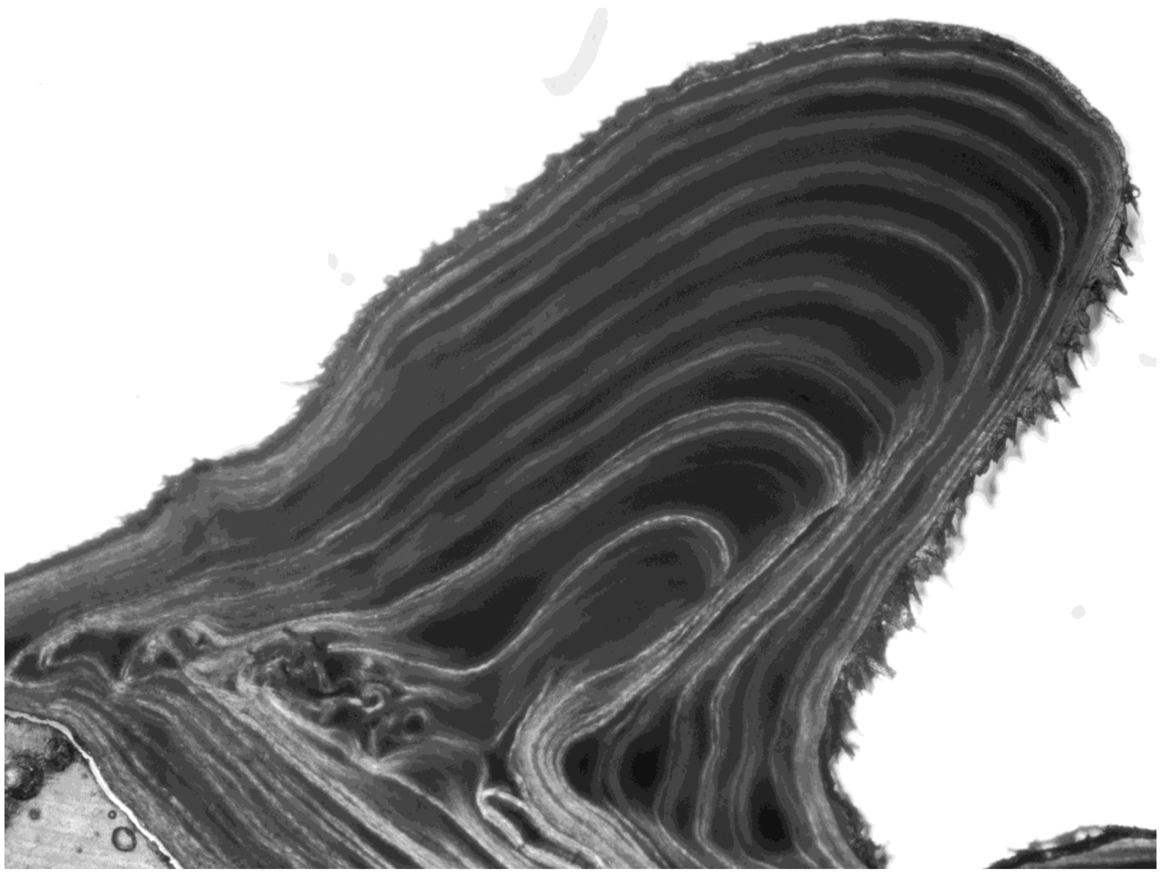
Mississippi:

(02-07-2011, ERDC#236, MDWFP#1996, Sex=M, Age=13, EFL= 1066.8 mm)



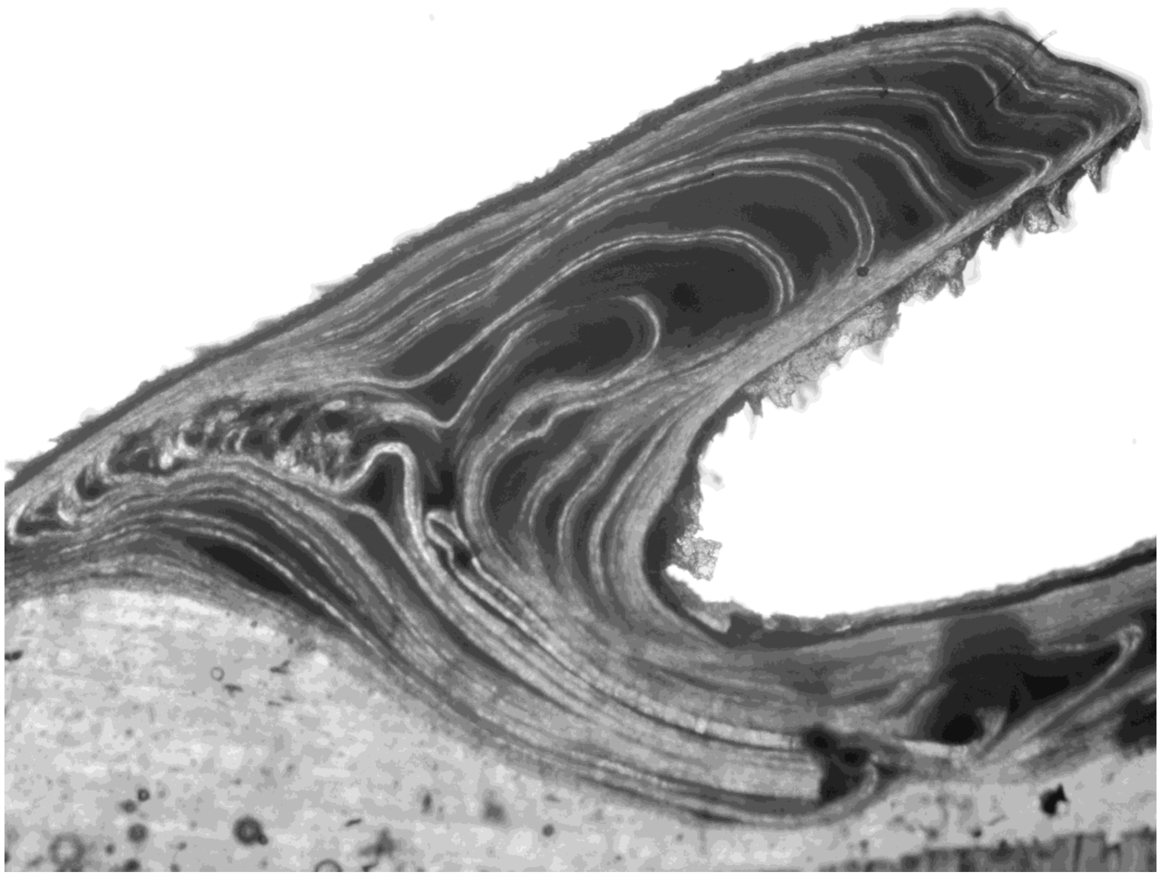
Missouri:

(Sample# MDC014, Age=11, no lt-wt-sex data). This section was above average in clarity, with no strong false annuli and little evidence of packed annuli near the edge other than the last annulus. One annulus at the center shows as a line.



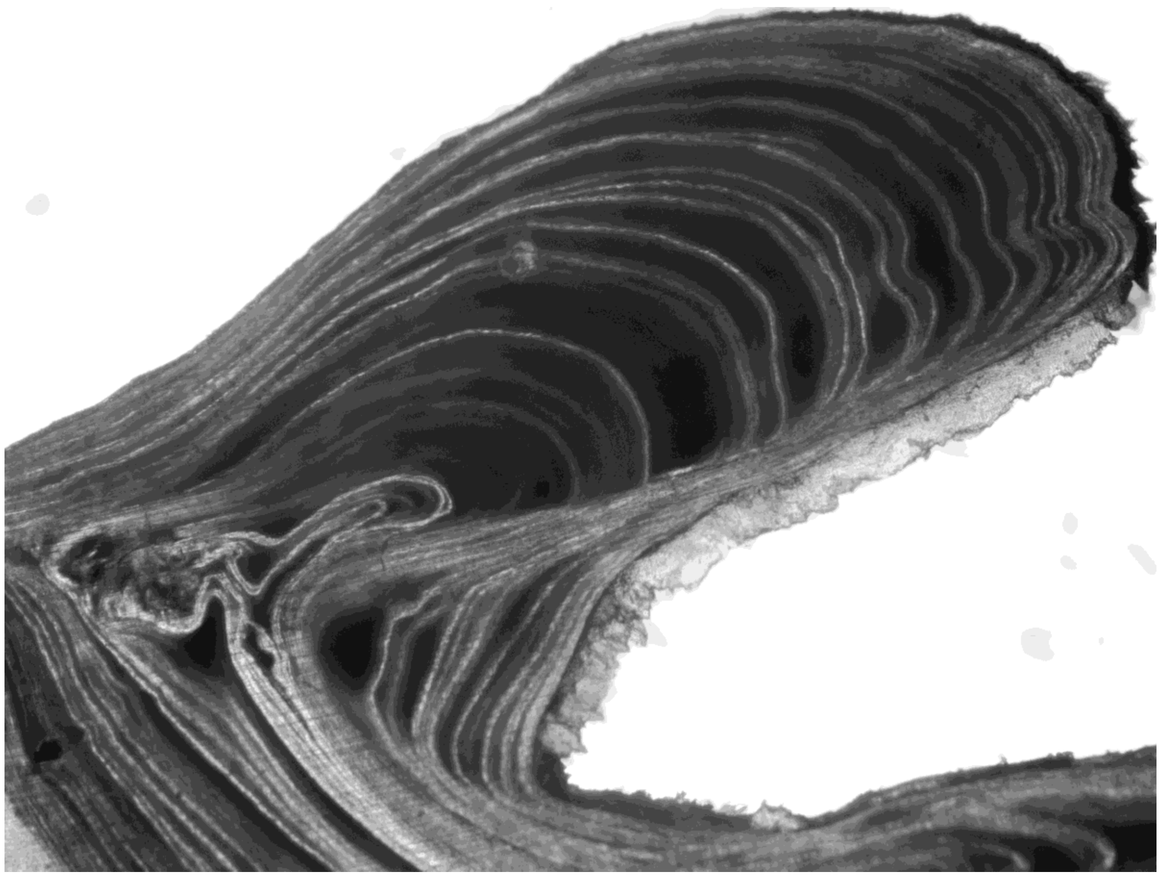
Missouri:

(Sample# MDC024, Age=9, no lt-wt-sex data). Easy doublets. One at center.



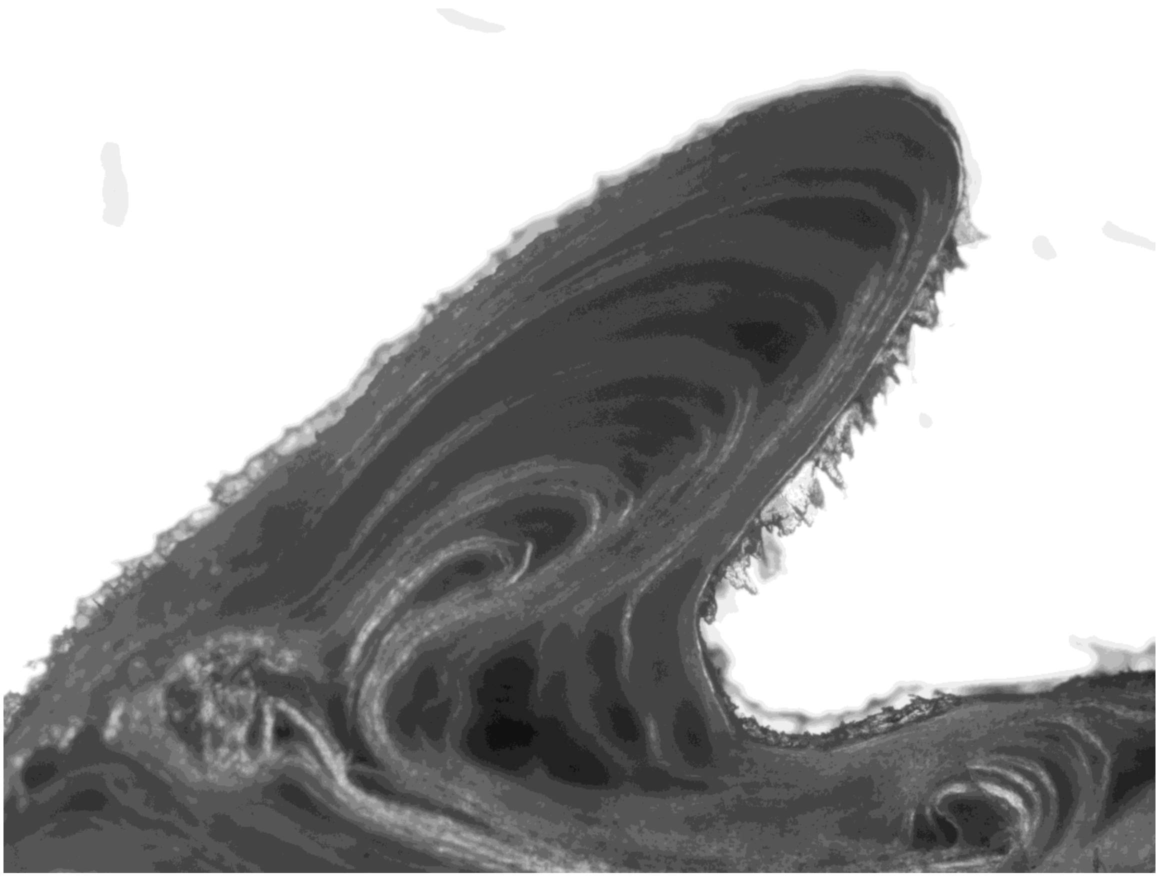
Missouri:

(Sample# MDC038, Age=13, no lt-wt-sex data). More difficult, irregular spacing and doublets. Doublets in later years can cause difficulties.



Tennessee:

(Sample# TN K53, Age = 8, no lt-wt-sex info). Typical younger Tennessee fish.



Tennessee:

(Sample# TN K77, Age = 9, no lt-wt-sex info). Typical younger Tennessee fish. One at center shows as line.

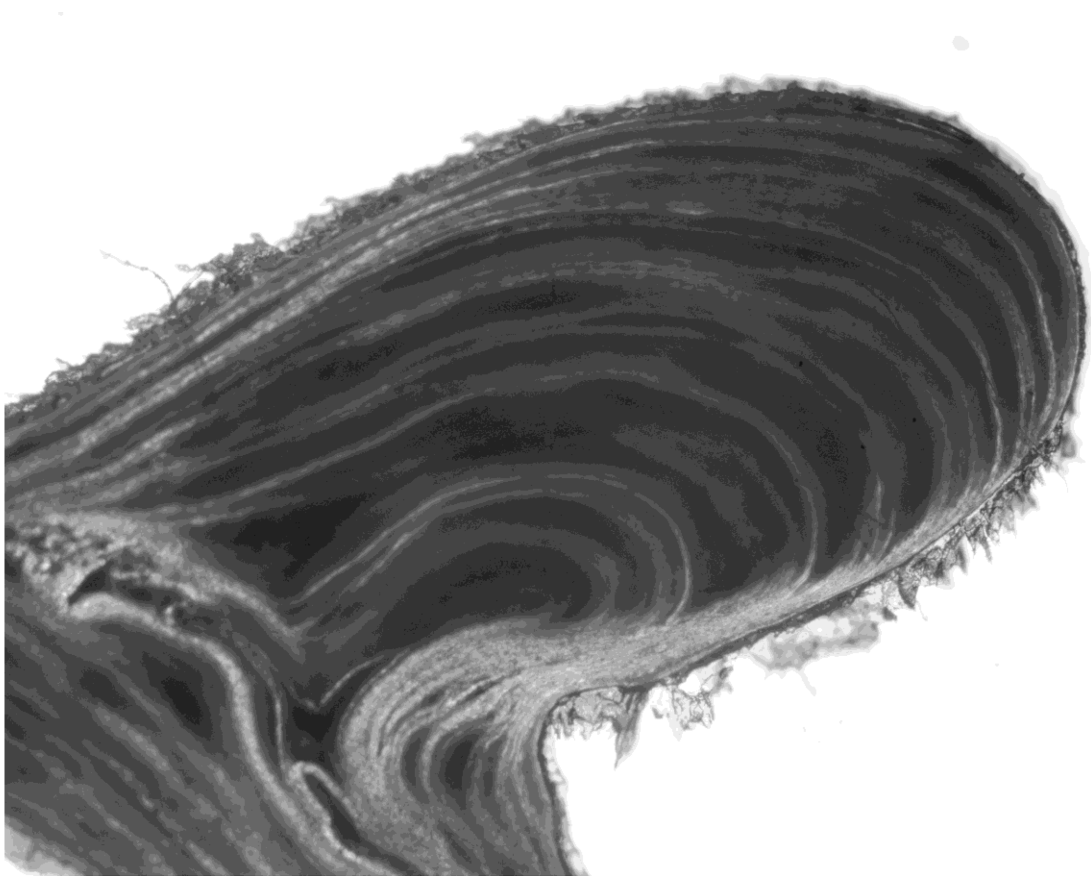


Table 1. Summary of paddlefish age samples for seven states.

State	**N of aged-samples***
1. Alabama	217
2. Arkansas	227
3. Indiana	65
4. Kentucky	543
5. Mississippi	365
6. Missouri	171
7. Tennessee	848
(Total:	2,436)

Note:
"**N of aged-samples**" only counts **age-measured samples**.