Fish Age Estimation Workshop, Oshkosh, June 28-29, 2006
WDNR Fisheries Management

Age interpretation of yellow perch using anal spine sections

Interpretation of annual marks to determine age of fish is a commonly accepted practice in fishery science (Nielsen and Johnson. 1983). Growth marks on various hard parts are used to interpret age in bony fish (Hirethota and Ringler 1993). Spiny rayed species such as yellow perch in Lake Michigan are aged using scale, otolith, spine, and opercle. The Southern Lake Michigan Fisheries Unit of Wisconsin Department of Natural Resources (WDNR) has been conducting various annual assessments of the yellow perch population since 1985. Reliable and easily applicable technique for accurate age determination is critical for effective management of natural fish populations, especially species of such high economic value.

WDNR used scales for determining age of perch until 2000. However, age interpretation based on annual marks on scales has its own limitations. In January 2000, we evaluated three different structures – scale, otolith and anal spine to compare aging of yellow perch. Samples of scales, otoliths and anal spines from each of 242 yellow perch were collected during our annual winter graded mesh gill net assessment. Ages were assigned independently by 3 enumerators. Of the 242 perch, 228 perch were aged using all three structures. The readers were unaware of the size of the perch or the result of other readers or the reading from another structure. The result of this study indicated that the percentage agreement among readers was greatest with the age data using the anal spine (Figures 1 and 2). Secondly, the average deviation of ages from 228 perch was much higher between scale age and spine age, and scale age and otolith age, than spine age and otolith age (Figure 2). For the most part, age assignments were very similar using spine and otolith. The clarity and readability of annual marks in the spine section was remarkable (Figure 1), yielding greater accuracy of data. Based on these observations, we have switched to using only anal spines for yellow perch age determination in Lake Michigan waters. Currently, we are consistent with the biologists at the WDNR Green Bay/Peshtigo office who have been using anal spines to age yellow perch from Green Bay for a long time.

Advantages of using spines:

- easy to collect and prepare
- it is a non-lethal technique as opposed to otolith removal
- new people can be easily trained
- relatively faster technique, except the duration for fixing
- multiple sections can be compared from the same spine
- multiple spines can be used
- spine sample can be collected with out damaging the fish, especially when it is collected from anglers

Limitations:

- cost of the sectioning tool
- time lag for preparation

Procedure and interpretation of spine section

STEP 1.

Collection:

Spine samples can be collected from yellow perch caught in assessment gear or from anglers. Although the dorsal fins have spines, anal spines are preferred for age determination of perch. Tools needed for collection include a sharp diagonal cutting pliers (side cutter) and a tweezers. There are two anal spines followed by soft rays. Using a sharp side cutter, clip off the two spines including the base along with some muscle tissue. (Caution: spine samples clipped too far from the base may crack and also lose an annulus.) Using a tweezers clean off the excess soft tissue attached to the base of the spine, and transfer the spines into the pre-labeled envelope. Lay spines flat in between the folded white paper inside the scale envelope. Spread the envelopes in an open space on a table in a safe place so that the spines samples are allowed to air dry (at least 24 hours before further preparation).

STEP 2.

Preparation of spine for sectioning:

Air dried spines should be removed from the envelopes carefully to avoid any break or fracture of the spine. There are two anal spines of which the second spine is preferred for analysis. Separate the second spine using a scalpel or a knife and clean any attached tissues without damaging the spine. Store the first spine in the envelope as this may be used as a back up in case the other spine sections prove not useful. Often, you will be handling a large number of spine samples during population assessments. When preparing multiple samples care should be taken to appropriately label the samples for accuracy.

In order to make multiple cross sections of a spine, the spine should be mounted in suitable epoxy. This will facilitate sectioning of the spine without cracking. From our experience, we have found a clear high strength 2 ton epoxy (by DEVCON), non-fast curing, most suitable for mounting. Mix amount of epoxy in a small disposable Dixie cup thoroughly. (Caution: Don't pour large quantities at a time as the epoxy begins to set in the cup with time and becomes unsuitable for mounting spines). Air bubbles in the epoxy, if any, will interfere with the sectioning process. Once the epoxy is prepared in the Dixie cup, the cleaned spine can be dipped using a tweezers, and laid on labeled white paper for air drying, at least 24 hours.

STEP 3.

Spine sectioning:

Multiple cross sections of the anal spine can be taken using ISOMET^{TM} Low Speed Saw (by BUEHLER Ltd., 41 Waukegan Rd., Lake Bluff, IL 60044). In order to prepare the saw for cutting, first fill up the lubricant pan with tap water making sure the saw blade is submerged. Clean the blade using a stone provided by the manufacturer (repeat this after

cutting approximately 25-30 spines). Use appropriate weights (25g or 50g) based on the size of the spine. (Caution: Do not over weight.) Adjust the cut off switch screw such that it stops the cutting blade once the spine has been sectioned. Set speed control of the cutting blade to between 4 and 5 (4.5 is optimal).

The spine, which is mounted and dried, needs to be prepared for cutting. First, trim off excess epoxy around the edges of the spine using scissors, leaving approximately 3 mm on either side to reinforce the spine. Insert the distal end of the spine into the chuck perpendicular to the blade, exposing the base of the spine only enough for cutting. (Caution: exposing too much spine beyond the chuck can cause vibration, and damage to the saw blade.) Secure the spine in the chuck tightly by tightening the chuck screws. (You may reverse the bottom half of the chuck which gives a flat surface to hold it firmly.) Gently lower cutting arm down onto the spine. The first cut is made at the distal end of the basal grove (discard this section), and continue making sections toward distal end of the spine. In order to determine optimal thickness of the spine cross section, adjust the micrometer. After making the first cut, adjust the micrometer TWO full turns. This sets for about 1 mm thick section, best suited to view under transmitted light. Continue making at least 2-3 cross sections for comparison purposes. As each section is cut, place each section on a pre-labeled microscope slide in the same order that they are made. This will be helpful while determining age, especially the first annulus. The samples can be saved by applying a small drop of superglue to the slide and fixing the sections. The slides can be inserted into the scale envelope and preserved after viewing.

STEP 4.

Age determination:

The spine sections, arranged in a sequence on a microscope slide, can be viewed using transmitted light under a binocular microscope. We use Olympus SZ-40 Stereo Microscope with Transmitted Light Base, with 0.67 to 4X Magnification Range, and 10X Eyepiece. First, view the section closest to the base of the spine. Sometimes, if the section is too thin or too close to the basal groove, there is a chance that you may miss the first few annuli. The same situation may happen if the sections are made too close to the distal end of the spine. Therefore, it is important to identify the portion of the spine that gives the best result. If the section is too thick, chances are that the light may not transmit and annuli may not be visible. From our experience, 1 mm thick sections are optimal. Having multiple sections of the same spine arranged in sequence has many advantages. You will have an option to compare and choose the best section that provides the clearest interpretation.

In the Northern Hemisphere, by convention the date of birth for fish is standardized to be January 1. We conduct various assessments of the yellow perch population throughout the year. From studies it is known that the annulus formation in Lake Michigan yellow perch occurs during late June or early July. The annulus is the result of a slowing of the growth rate in response to such factors as cold winter temperatures (Nielsen and Johnson 1983). In yellow perch, annuli appear as a transparent zone under transmitted light. Therefore, the yellow perch captured after December 31 and before the annulus is laid down is considered to have January birth date. For example, yellow perch spawn in late spring and are considered as age 1 when captured in the following January although they do not show any annulus. WDNR conducts graded mesh gill net assessments in winter

months. Accordingly, a four-year-old perch in our January sample will show 3 complete annuli and an outer edge, and will be designated as age 4 perch. In the same calendar year, an angler caught four-year-old yellow perch in our creel assessment during August-December will have 4 complete annuli, and will be designated as age 4 plus perch (age 4+). They both are four-year-old perch belonging to the same year-class.

The number of annuli is counted starting from the center of the spine towards the outer edge. A complete ring qualifies as an annulus. Often, fish show checks on the hard parts which may be caused due to other reasons, such as spawning checks, or food switch, disease, and so on. The annuli tend to get closer and closer as fish get older due to decreased growth rate. Therefore, care should be taken when dealing with older fish. Yellow perch are known to live as long as fifteen plus years in Lake Michigan, but most live up to ten years.

Back-calculation:

It is possible to use spine sections to measure the distance from the center of the section to different annuli and extrapolate the size at earlier ages (back-calculations). If back-calculation is one of the objectives it is important to keep the magnification and axis of taking measurements constant.

References:

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Nielsen, L. A. and D. L. Johnson. 1983. Fisheries Techniques. The American Fisheries Society, Bethesda, Maryland.

Prepared by:
Pradeep Hirethota and David Schindelholz
Southern Lake Michigan Fisheries Unit, WDNR
600 E. Greenfield Avenue
Milwaukee, WI 53204
Tel: (414) 382-7928/7925

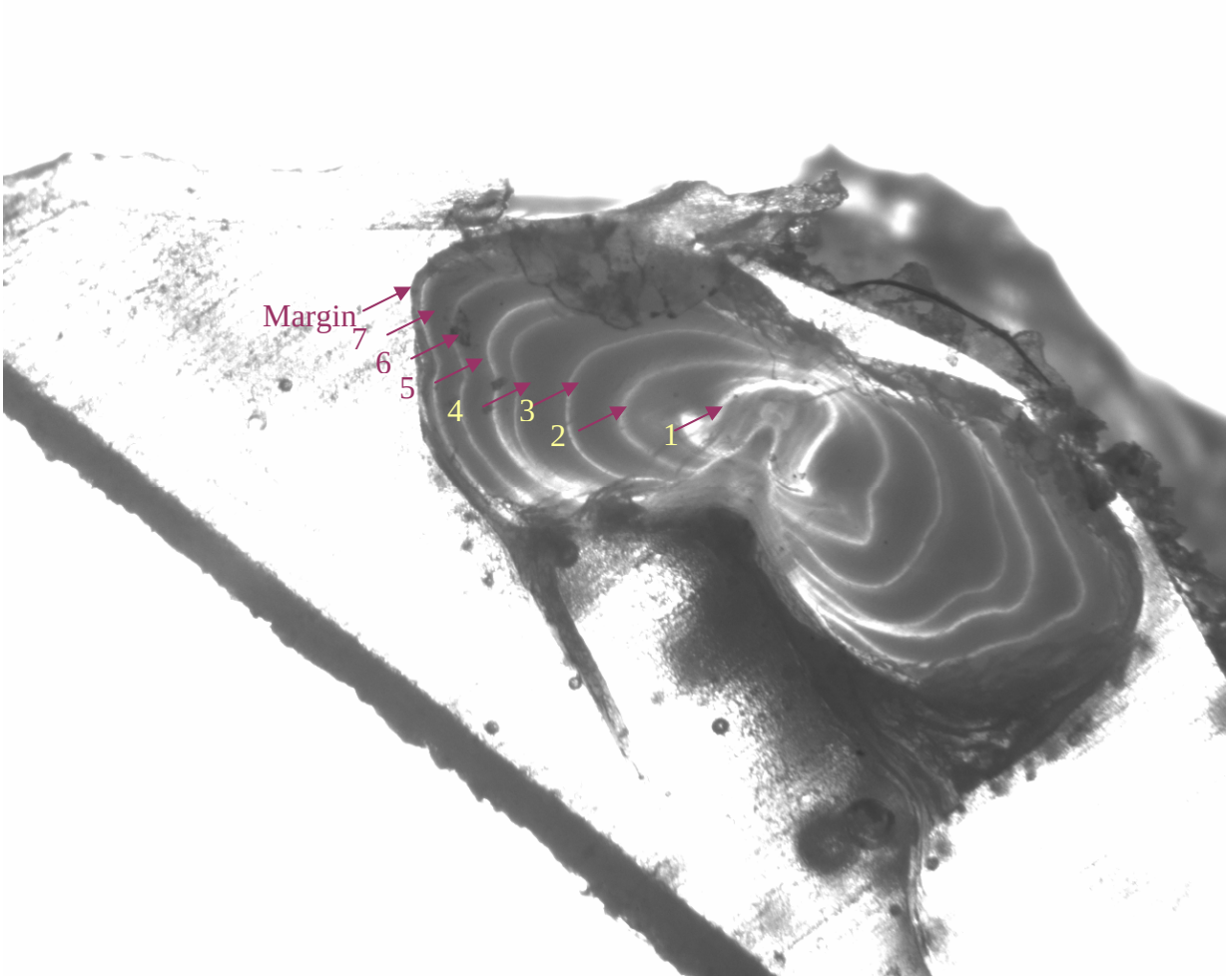
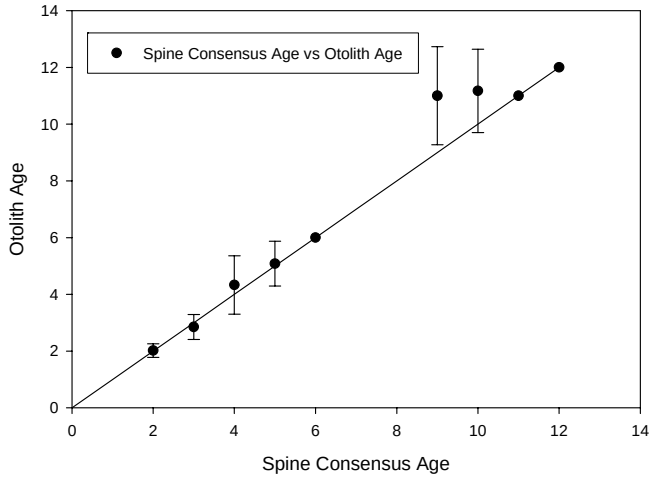
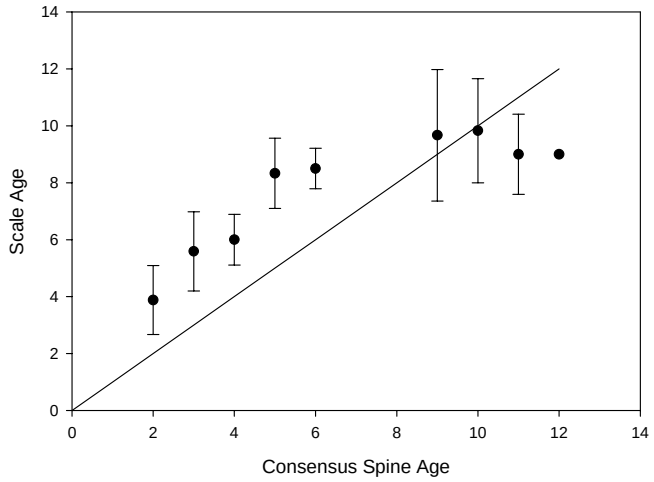


Figure 1. Yellow perch anal spine section showing 7 annuli marks.



A.



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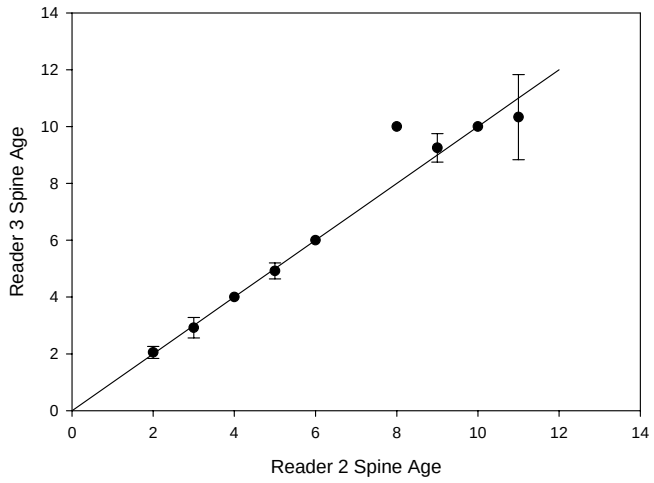
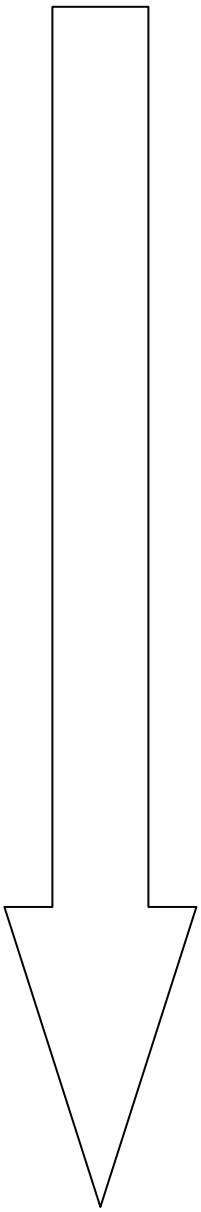


C.

Figure 2. **A**. Age comparison using otolith method and spine method for 242 yellow perch. **B**. Age comparison using scale method and spine method for 242 perch. **C**. Comparison between two readers (Reader 2 and Reader 3) using spine method for 242 perch. (Consenus spine age is the agreed upon age by both Reader 2 and Reader 3.)

Procedure for yellow perch age determination using anal spine



Yellow perch

Clip anal fin using a side cutter

Place in a labeled scale envelope, air dry for 24 hrs

Clean and fix in epoxy, air dry for 24 hrs

Take multiple cross sections, place on a labeled slide

View under microscope with transmitted light

Count the transparent rings