Aging of Three Species of Florida Catfish Utilizing Three Pectoral Spine Sites and Otoliths

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Abstract: Twenty-one brown bullhead (*Ictalurus nebulosus*), 25 channel catfish (*I. punctatus*) and 25 white catfish (*I. catus*) collected by fish trap were aged by counting annuli from the articulating process (AP), basal recess (BR) and mid-spine (MS) sections of pectoral spines. Five large channel catfish collected from hoop nets were also aged using spine techniques. Attempts were also made to age catfish by counting opaque bands or checks from whole sagittal otoliths and otolith longitudinal and cross sections. Annuli were visible in all pectoral spine sections. Fish older than 3 years showed some erosion of the spine's central lumen, but no annuli were absorbed in any of the fish examined. Ages using BR and MS spine sections were identical to ages using AP sections in all fish examined. When compared to spine ages, aging error for whole otoliths ranged from 29% to 68%. Aging errors in longitudinal sections ranged from 38% to 52%, and in cross sections ranged from 64% to 76%. Data indicated that in Florida it is no longer necessary to remove spines or sacrifice fish in order to age catfish since any spine section provides an accurate age determination.

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Accurate age determination in fish is essential to the fishery manager in developing and carrying out plans for successful resource management. Aging techniques that have been validated through the years include use of otoliths (Beamish 1979, Burger 1974, Coleman et al. 1982, Gregory and Jow 1976,

Gulland 1958, Joy and Tranquilli 1979, Taubert and Tranquilli 1982, and Rollefsen 1933), scales (Beamish and Harvey 1969, Coble 1970, Lee 1920, and Olson 1980) and spines (Mayhew 1969, Marzolf 1955, Prentice and Whiteside 1974, Sneed 1950, and Turner 1980).

Pectoral spines were most preferred when aging catfish by the spine technique (Mayhew 1969, Marzolf 1955, Sneed 1950, and Turner 1980). The spine section removal point was also critical for accurately aging catfish (Bruce Taubert, pers. commun.). Spine sections taken from the articulating process (AP) accurately depicted the ages of his known age fish. Ages from sections in the basal recess (BR) area were under estimated by 1 year. Turner (1980) found 5 annuli in AP spine sections from known age 5-year-old flathead catfish (*Pylodictus olivaris*). Ages determined from BR sections of the flathead catfish were underestimated by at least 1 year. Prentice and Whiteside (1974) also illustrated the accuracy of aging catfish using AP sections of known age fish. Jenkins (1952), Mayhew (1969), and Wahlquist (date unknown) verified that ages determined from BR sections were underestimated. Studies indicated as catfish grew, the central lumen of the spine eroded away the first year's growth zone erasing the annulus closest to the edge of the lumen. Erosion of the lumen occurred in the BR area and distally toward the end of the spine. Erosion did not occur in the AP area since this area is not affected by the lumen.

Removal of whole spines and otoliths requires that every fish utilized be sacrificed. This makes large scale population studies difficult. For this reason, an accurate aging technique that does not require that fish be sacrificed is needed. The authors contend that extended growth seasons and rapid growth rates in Florida catfish species minimizes erosion of the central lumen area and that annuli are not erased. As a result, any section cut from pectoral spines would accurately reflect a fish's age. This would allow clipping or partial removal of pectoral spines with little or no harm to the fish. This study compares aging of 3 species of catfish in Florida utilizing 3 separate spine sections and otoliths.

Methods

Twenty-one brown bullhead catfish (*Ictalurus nebulosus*) ranging from 255 to 350 mm total length, 25 channel catfish (*I. punctatus*) ranging from 289 to 592 mm, and 25 white catfish (*I. catus*) ranging from 256 to 468 mm were collected by fish trap from lakes Dora and Eustis, Lake County, Florida. Five additional channel catfish ranging from 787 to 940 mm were collected in commercial hoop nets from Crescent Lake, Putnam County, Florida.

Both pectoral spines and sagittal otoliths were removed from fish collected by trap. Pectoral spines only were removed from fish collected by hoop net. The entire right pectoral spine was removed utilizing a technique described

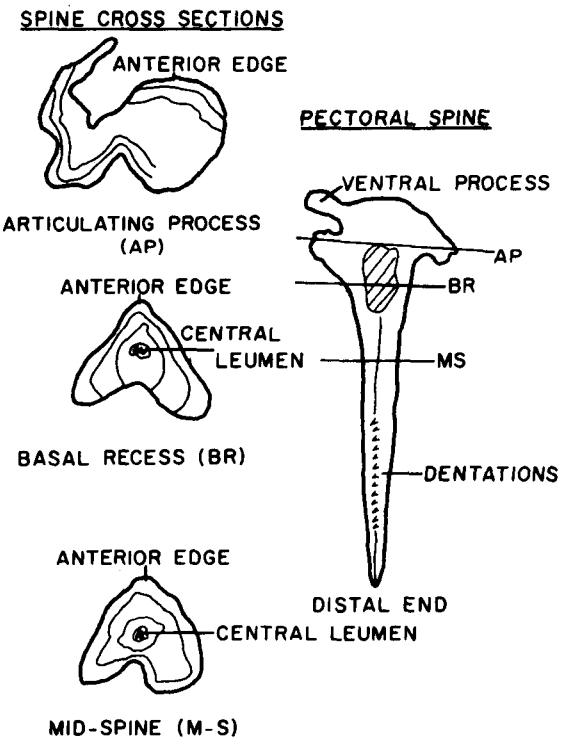

Figure 1. View of pectoral spine showing points of sectioning and corresponding cross sections used for age determination.

by Sneed (1950). The left pectoral spine was clipped adjacent to the body using surgical bone cutters. Otoliths were removed using techniques similar to those described by Coleman et al. (1982).

Age determinations were made from pectoral spines of each catfish. Spines were mounted in a C-clamp frame and spine sections were cut from 0.5 to 1.0 mm thick with a hand-held jeweler's saw. The whole spine was sectioned across the articulating process (AP), the basal recess (BR) and the mid-spine (MS), between the distal end of the BR and the spine dentations (Fig. 1). The clipped spine was sectioned only at the MS site, between the BR and the dentations. Numbers of annuli were determined by placing cut sections covered with water on a glass slide and observing them through a microscope.

Numbers of bands on otoliths were determined by covering whole otoliths with water on a glass slide and observing them through a microscope. One otolith was then ground longitudinally and the other ground in cross section using a variable speed electric grinding disc. Otolith sections were mounted in thermoplastic cement using procedures described by Coleman et al. (1982). Numbers of bands were determined by covering ground sections with emersion

oil and observing them through a microscope. The ground otolith sections were then etched with a 1% hydrochloric acid solution for approximately 5 minutes, similar to a technique used in aging American eels (*Anguilla rostrata*) (Bruce Taubert, pers. commun.). Numbers of bands were counted a second time by microscope.

A polarizing filter, attached to the microscope's light source, was used to aid in making annuli counts on spine sections and band counts on otolith sections.

Results

Pectoral Spines

Annuli were visible in 2 quadrants of the AP spine sections from brown bullhead, channel and white catfish examined (Fig. 1). Annuli were visible in 3 quadrants of BR sections and visible in all quadrants of MS sections for all 3 species. Annuli were readily visible on most AP spine sections without the need to manipulate the polarizing filter. Manipulation of the filter was sometimes necessary to view the annulus closest to the spine's central lumen in both BR and MS spine sections, but was necessary most often in MS sections.

The first and second annuli in AP, BR, and MS sections were further apart than annuli more distally located from the central lumen. Annuli in the distal portions of spine sections were more visible because annulus bands were narrow. The first annulus in BR and MS sections in fish $\geqslant$3 years (determined by spine aging) was closer to the outside edge of the central lumen than in 1- and 2-year-old fish, but in every case was easily discernible.

Brown bullhead ages, determined from spine sections, ranged from 1 to 3 years. Channel catfish ages ranged from 2 to 7 years, and white catfish ranged from 1 to 4 years. The comparative age values determined from AP, BR, and MS spine sections were identical in every fish examined for all 3 species.

Otoliths

Pairs of otoliths were found in all catfish collected in traps and all had recognizable opaque bands. When viewing whole otoliths, bands were more visible in ventral quadrants of the otolith than in dorsal, distal, or proximal quadrants (Fig. 2). No complete bands were discernible in any quadrant of otolith cross sections. Partial bands were found in all quadrants, but ages were determined more often by counting bands from distal and proximal quadrants. In most cases, bands more closely resembled checks, or reminant bands.

Fish were aged from longitudinal otolith sections by counting bands from dorsal quadrants. Bands commonly found in distal and ventral quadrants were also used for aging or to corroborate band counts from dorsal quadrants.

While bands were observed in dorsal, distal, and proximal quadrants of

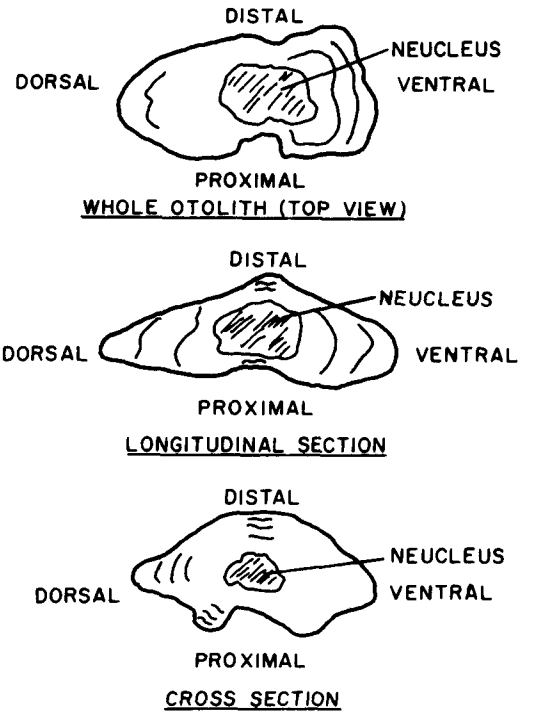

Figure 2. Views of whole otolith, longitudinal section and cross section showing locations of annuli used for aging.

otolith cross sections, ages were determined utilizing bands from distal and proximal quadrants. Ootolith cross sections were the most difficult to read.

When otolith-aged catfish were compared to spine-aged fish, aging error in the otolith techniques made otolith aging less than desirable. The whole otolith technique was the most successful for aging brown bullheads. The aging error in bullheads was 29% (6 of 21 fish). Aging error for channel catfish was 68% (17 of 25 fish), while aging error for white catfish was 48% (12 of 25 fish).

Error rates also ran high when ages were determined using longitudinal otolith sections. Error was lowest in brown bullhead and ran 48% (10 of 21 fish) prior to etching sections with acid and 38% (8 of 21 fish) following the use of acid. Aging error in white catfish was 48% (12 of 25 fish) prior to and following acid etching, and was highest in channel catfish, 52% (13 of 25 fish) prior to and following etching.

Overall, error was highest among fish aged utilizing otolith cross sections. Aging error was again lowest in brown bullheads. Error was 71% (15 of 21 fish) prior to and following acid etching. Error for channel catfish was 76% (19 of 25 fish) prior to etching and 64% (16 of 25 fish) after etching, while white catfish error was 76% (19 of 25 fish) prior to and following etching.

Discussion

Ages determined from pectoral spine sections were considered accurate based on results of Prentice and Whiteside (1974), Taubert (pers. commun.) and Turner (1980) which validated the AP aging technique with known aged fish. In this study, ages of catfish from BR and MS spine sections were the same as ages from AP sections in all 76 fish examined.

Annuli were visible in AP, BR and MS spine sections from all age fish (1 to 7 years) collected. Limited erosion of the central lumen was observed in BR and MS spine sections of fish ⩾3 years, but no annuli were absorbed in any fish aged.

Otoliths were present in all catfish collected by fish trap and all had growth zones recognizable as opaque bands or checks. No complete bands were observed in whole otoliths or in longitudinal and cross sections. Bands more closely resembled checks rather than annuli.

Use of otoliths to age catfish or to corroborate ages determined from spines is unacceptable. Aging error utilizing whole otoliths ranged from 29% to 68%. Error utilizing longitudinal sections ranged from 38% to 52%. Error was highest among ages determined from otolith cross sections. Cross section error ranged from 64% to 76%. Acid etching of otolith sections decreased aging error of brown bullheads aged using longitudinal sections by 10% (48% to 38%), and aging error of channel catfish using cross sections 12% (76% to 64%).

Data from this study indicated that pectoral spines were the best available method for aging catfish. In Florida, it appears that it is not necessary to completely remove spines or sacrifice fish since BR and MS spine sections provided accurate age determinations.

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