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Evaluation of Striped Bass (Morone saxatillis) Age from Body Scales, Opercles, and Dorsal Spines

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REDISCOVERY OF THE SUCKERMOUTH MINNOW, *PHENACOBIUS MIRABILIS* (GIRARD), IN ARKANSAS

The suckermouth minnow, *Phenacobius mirabilis* (Girard), is primarily a northern and western prairie stream species and is quite common in sand and gravel-bottomed riffles of permanent streams throughout much of Indiana, Illinois, Iowa, Missouri, Kansas, and Oklahoma. It is known to occur today in every state bordering Arkansas. Although *P. mirabilis* was originaly described from the Arkansas River at Fort Smith (Girad, Proc. Acad. Nat. Sci. Phila., 8:165-213, 1856) is has always been rare in this state, and the lack of any recent records, despite numerous collecting attempts, suggested the possibility of its extirpation from Arkansas waters.

Until now, the only verified records of *P. mirabilis* from Arkansas were five pre-1940 collections, all from western Arkansas (Black, Ph.D. Dissertation, Univ. Michigan, Ann Arbor, 500 pp., 1940). However, on 16 July 1986, a single adult specimen of *P. mirabilis* was collected from Little Bay Ditch (St. Francis River drainage), 3 miles southeast of Jonesboro, Craighead County, Arkansas (R5E, T13N, Sec 18) by William E. Keith, Roland McDaniel, Bob Singleton, Mark Brady, and Bo Smith of the ADPC&E. The specimen, 73 mm in standard length, which will be deposited in the Arkansas State University Museum of Zoology in Jonesboro, possessed the following meristics: 46 lateral line scales, 8 dorsal rays, 7 anal rays, and 14 pectoral rays.

Little Bay Ditch is a channelized stream with a drainage area of approximately 45 square miles. Land use within this watershed is about 60% agricultural and 40% suburban. Habitat at the collecting site consisted of 70% shallow, slow-flowing pools and 30% shallow, fast-flowing riffles. The substrate consisted of 78.3% sand and 21.7% mud and silt. Brush, logs, and debris comprised the instream cover (17.5% of mean stream width). Other physical habitat features were: a stream gradient of 0.9 ft/mi, a mean stream width of 41.4 ft, a mean stream velocity of 1.01 ft/sec, an observed flow of 27.4 cfs, a mean depth of 0.9 ft, and a maximum depth of 2.5 ft. The following water quality data were recorded: water temperature 27 °C, dissolved oxygen 5.1 mg/1, pH 7.99, turbidity 90 NTU, Total suspended solids 142 mg/1, Total dissolved solids 302 mg/1, BOD_5 3.8 mg/1, BOD_{20} 12.4 mg/1, Total phosphate 0.3 mg/1, NO_3 + NO_2-nitrogen 0.29 mg/1, NH_3-nitrogen 0.38 mg/1, chloride 9.0 mg/1, sulfate 18.0 mg/1, conductivity 426 µmho, Total hardness 166 mg/1, alkalinity 174 mg/1, chlorophyll-a 13.4 µg/1, fecal coliform 700 counts/100ml. A substantial summer rain had occurred 2-3 days previously resulting in above normal stream flow.

The single *P. mirabilis* specimen was collected in a shallow sandy-bottomed riffle in swift current with a 110 volt AC backpack electric shocker. The most abundant fishes by number at the collecting site were: *Gambusia affinis* (83), *Ictalurus punctatus* (76), *Lepomis cyanellus* (70), *Lepomis megalotis* (22), and *Notropis venustus* (22). Other fishes collected at this site were: *Amia calva* (1), *Lepisosteus oculatus* (6), *Dorosoma cepedianum* (11), *Cyprinus carpio* (10), *Notropis atherinoides* (2), *Fundulus notatus* (1), *Ictalurus natalis* (5), *Lepomis macrochirus* (1), and *Aplodinotus grunniens* (10).

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EVALUATION OF STRIPED BASS *(MORONE SAXATILIS)* AGE FROM BODY SCALES, OPERCULAR SCALES, OPERCLES AND DORSAL SPINES

Scales have been used in aging fish for almost a century (Carlander, 1987). Age estimates from scales often lead to systematic errors if the fish are very slow growing, or are old (Casselman, 1983). It is further complicated by resorption of scales to provide calcium to fish during periods of deficiency associated with ovary development and cessation of feeding during spawning migrations (Simkiss, 1974). Ever since Scofield (1931) demonstrated the validity of using striped bass *(Morone saxatilis)* scales to determine age, aging of striped bass was done mainly by the scales (Horn, *et al.*, 1984). Collins (1982) stated that incidence of age disagreements between readers increased over 50% in older striped bass due to compacted nature of annuli at the scale margin. Heidinger and Clodfelter (1987), using known age fish, found that otoliths correctly aged striped bass while scales mis-aged 20% of fish. It is apparent that there is a need to search for a suitable hard part other than the body scale for easy and accurate assessment of fish age. The objective of our study was to compare and evaluate four calcified structures — dorsal spine, opercle, opercular, and body scales — in assessing the age of Beaver Reservoir striped bass.

A total of 28 striped bass (total length 635-979 mm) was obtained in August 1986 from the Beaver Lake National Striped Bass Tournament at Rocky Branch. Body scales from below the lateral line at the tip of the left pectoral fin, the left opercle, and the second spine from the dorsal fin were collected from each fish. The opercular scales were of two types — oval and circular. The ovoid scales were located at the antero-dorsal region of the opercles. The ovoid opercular scales were used in this study due to the clarity of annular rings compared to the circular scales. Opercular and body scales were cleaned, mounted on glass slides, and photographed by microfiche reader-printer. Opercles were cleaned of tissue by boiling them in water. Spine sections of 0.45-0.50 mm thickness were mounted on glass slides in Permount and examined under phase-contrast microscope and photographed. Fish were aged by counting the number of annuli on the scales and the translucent zones on the opercles and spine sections.

The spine annuli (translucent zones), even of the older striped bass, were very distinct and denumerable under the phase-contrast microscope. Hence, the spine ages were used as the basis of comparison with ages estimated from the other three calcified structures. Graphical comparison (Fig. 1) showed that the opercular scale and body scale ages were lower than the spine ages. The percentage agreements of opercle, body scale, and opercular scale ages with spine ages were 82.1, 17.9, and 7.1, respectively. The opercle, opercular, and body scale ages were regressed respectively on the spine ages (Fig. 1), and the deviations of the predicted ages from the spine ages were calculated. The opercular and body scales underestimated the striped bass age by an average of 1.81 (range, 1.3-2.4) and 1.89 (range, 1.2-2.6) years respectively. This trend increased with spine age. The average underestimation of age by the opercle was 0.27 (range, 0.1-0.4).

Several investigators evaluated the reliability of scale method in age assessment and found the method wanting. Beamish and Chilton (1977) reported that the scales of older lingcod *(Ophiodon elongatus)* underestimate the fish age compared to fin-ray ages. Harrison and Hadley (1979) suggested the cleithral technique to be superior to the scale method for the older muskellunge *(Esox masquinongy)* due to resolution of cleithral annuli. Mills and Beamish (1980) found the scale ages to be consistently lower than the fin-ray ages in a mark-recapture age analysis of lake whitefish *(Coregonus clupeaformis)*. Based on percent errors in aging and coefficient of variation, Boxrucker (1986) reported on greater precision in aging white crappie *(Pomoxis annularis)* by otoliths than by scales. Heidinger and Clodfelter (1987) correctly aged the known-age (0-4 yr.) walleye *(Stizostedion vitreum)*, striped bass, and smallmouth bass *(Micropterus dolomieui)* by otoliths, while many of these fish were underaged by the scale method. Without validation through mark-recapture or by known-age fish study, it was not possible to confirm which of the four hard parts examined in our study truly depicted the correct ages of striped bass. However, it is reasonable to assume that the spines provide a better source for aging striped bass, in view of the fact that the marginal annuli are more distinct and countable in spine sections than in other hard parts used in this study.

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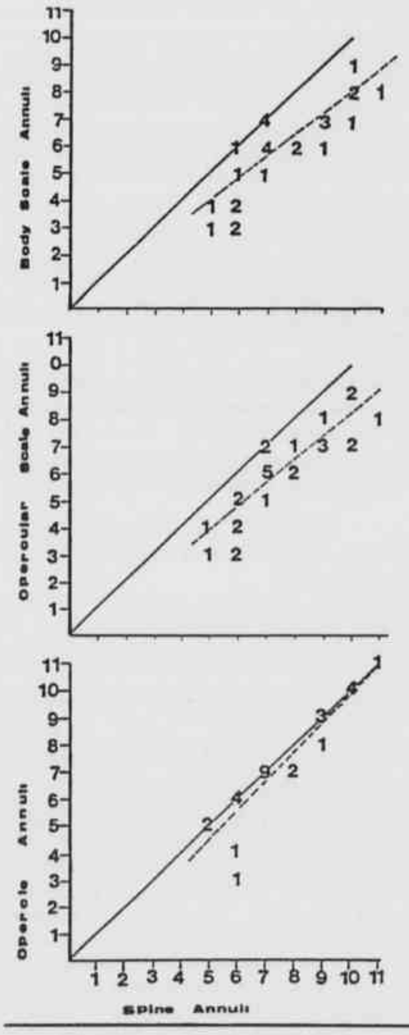

Figure 1. Comparison of body scale, opercular scale, and opercle ages with dorsal spine ages of striped bass. 45° diagonal line (—). Fitted regression line (---)

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