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Redfish
Sebastes fasciatus

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Redfish is a slow-growing long-lived scorpaenid. In the Northwest Atlantic it is found from Davis Strait southward to the Gulf of Maine and Georges Bank at water depths up to 300 meters (Bigelow and Schroeder 1953). Growth rates attained to age 6 are the same for both sexes, but thereafter females grow faster than males. Both sexes mature sexually at age 8 or 9. Mating occurs during the fall, and gravid females can be found the following spring with larvae appearing in the water column from April to September (Kelly and Wolf 1959). A maximum age of 50 years has been documented and a size of 45-50 cm (18-20 inches) (Mayo et al. 1983).

Both scales and otoliths have been used to determine the age of redfish. Scales have been used by European investigators and are prepared by impregnating the scales with silver nitrate and viewing under polarized light (Kosswig 1971, 1980). In earliest investigations of redfish at the Woods Hole Laboratory, scales were cleaned in an acidic solution, impressed on a plastic slide, and observed using a microprojector. This method proved unsatisfactory because the annuli on older fish are very compact along the edge of the scale. Attempts were also made to stain otoliths; use of a silver-diammino solution provided a greater contrast between annuli (H. Foster and F. Nichy, unpubl. data, Woods Hole Lab.), but proved to be time-consuming.

Otoliths are preferred because they can be readily processed and annuli on older fish are more distinct than on scales. The otoliths are stored dry and prepared by the following method (Nichy 1977). An otolith is placed on a cardboard tag and covered with wax. A low-speed macrotome saw (fitted with two diamond blades, separated by a spacer) is then used to thin-section through the nucleus along the dorsoventral axis. The result is a transverse section approximately 0.178 mm thick. The section is viewed with a binocular microscope against a dark background using reflected light at a magnification of 25X or 50X. The section is moistened with clove oil, alcohol, or Kodak Photo-Flo 200 solution to enhance the contrast between opaque and hyaline zones.

Along the edge of the otolith, depending upon the time of the year, there may be either an opaque or hyaline zone. The hyaline zone predominates from November to May; the opaque zone is usually formed from March to November. Mayo et al. (1981) were able to validate that growth marks are annual events, based on seasonal formation of hyaline and opaque zones and comparisons of mean lengths-at-age with modes of length-frequencies.

The annual zones on a redfish section consist of a white opaque zone, representing fast summer growth, followed by a dark hyaline zone, representing slow winter growth. An opaque zone succeeded by a hyaline zone constitutes one year of growth. For age determination purposes, the annulus is defined as the hyaline zone marking the end of a year of growth. By convention, a 1 January birthdate is used.

Age determinations may be made by counting annuli from the nucleus to the dorsal edge, with corroborating counts usually made to the proximal and ventral edges (Figs. 1 and 2). The nucleus is centrally located and surrounded by the first annulus, which is a normally distinct, oval-shaped hyaline zone (Figs. 1-5). Figure 1 shows a fairly wide gray zone immediately surrounding the nucleus, inside the first annulus. This zone may be the result of a settling check, but is less apparent on otoliths from older fish (Figs. 2-5). The first annulus may be distinguished from this settling zone because it is separated from the gray zone and extends further out to the edges of the otolith (Fig. 1). If the first annulus appears irregularly shaped, the otolith should be resectioned closer to the nucleus (Fig. 4).

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Annuli from the second to about the tenth year are broad and relatively easy to read. The opaque zone between the first and second annuli is usually a clear white band. After ten years of age, annuli become more compact and less distinct (Figs. 3-5). An age reader can more readily discern split annuli and checks in younger (<12 years) rather than in older fish. Split annuli are recognized because the closely spaced hyaline zones are repeatedly interrupted by narrow opaque bands (Figs. 1-4). Checks are recognized because they are usually quite close to the preceding annulus and become diffuse along the proximal edge (Figs. 1-3).

Difficulties caused by checks can be overcome by following the annuli from the dorsal side of the otolith (where the hyaline zones are relatively broad) to the proximal side (where the hyaline zones narrow) back towards the nucleus. Along the proximal edge, split annuli converge to form a single narrow hyaline zone. Also, the checks become more diffuse and fade away. In specimens >15 years of age, annuli are quite compacted on the dorsal edge. For such specimens, age can be better determined by counting the annuli from the nucleus towards the proximal edge (Fig. 5). Increased thickness relative to width may result in serious underestimation of age if only the dorsal axis is used to interpret age. Age determinations for younger fish (<12) can usually be corroborated by counting the annuli along both the proximal and ventral edges of the otolith (Figs. 1 and 2). Thus, there are three ways of verifying annuli counts on a sectioned redfish otolith. One can begin at the nucleus and count out to the dorsal edge, or to the proximal edge, or count the annuli along the ventral edge.

Citations

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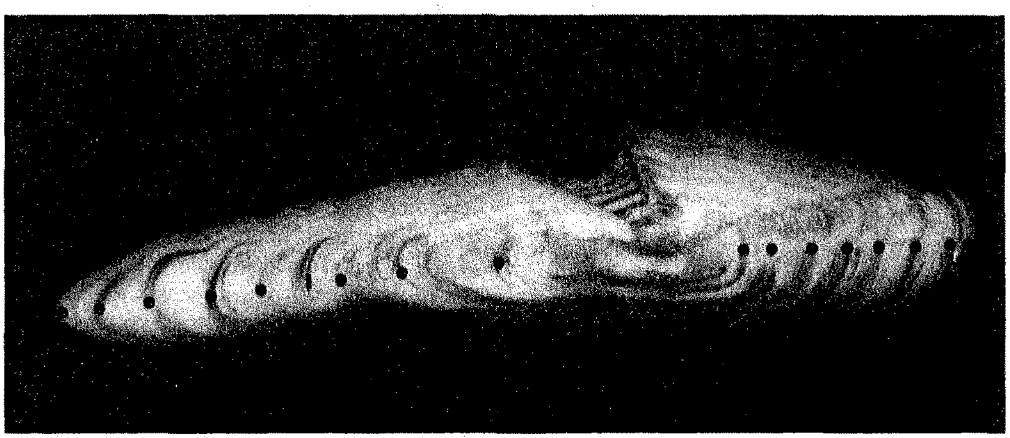

Figure 1

Otolith from a a 27-cm age-8 male redfish. As indicated by the markers, the first annulus separates from the gray settling zone and extends further out to the edges of the otolith. The second and third annuli are split zones which converge to form single annuli along the proximal edge. Note the strong check between the third and fourth annuli. The fourth annulus is fairly weak but discernible, especially along the proximal and ventral edges. The fifth to the eighth annuli are quite distinct and clear.

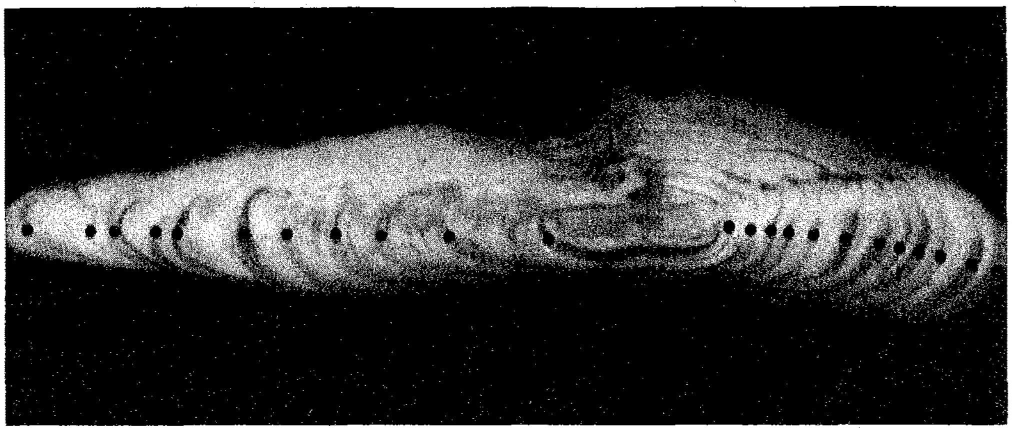

Figure 2

Otolith section from a 28-cm age-12 male redfish. Annuli along the ventral edge are more distinct and corroborate the age found along the dorsal edge. The second to fourth annuli are composed of numerous checks and splits but form clear annuli along the proximal edge. Also, the section shows an irregular growth pattern especially in later years where there are pairs of close annuli (7 and 8, 9 and 10, and 11 and 12) with a large opaque zone evident between the tenth and eleventh annuli.

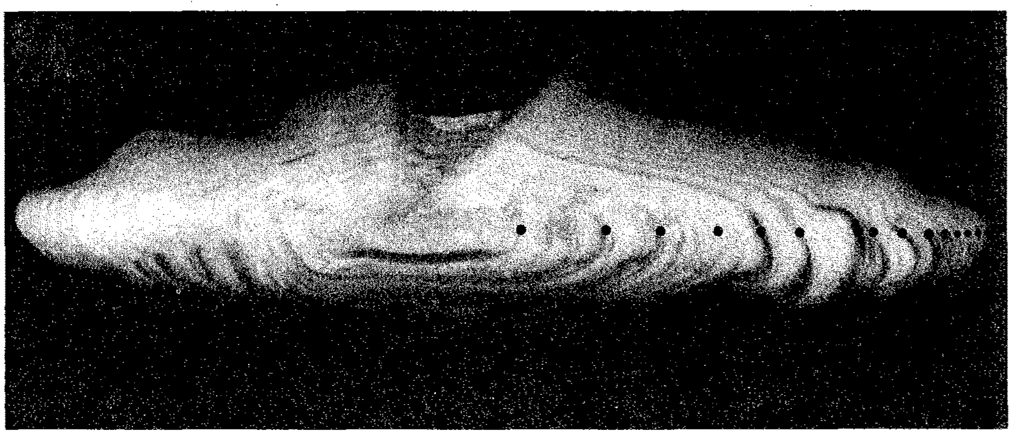

Figure 3

Otolith section from a 34-cm age-15 male redfish. This demonstrates how, with older otoliths, the ages along the dorsal edge are impossible to verify along the ventral edge. Additionally, the annuli are quite compact along the dorsal edge, making the age determination difficult.

Figure 4

Otolith section from a 29-cm age-17 male redfish. This otolith has been sectioned slightly off the nucleus resulting in an irregularly shaped first annulus. Because annuli along the dorsal edge are compact and not very distinct, counting annuli outward towards the proximal edge is the most accurate and precise way of determining age in older fish (>15).

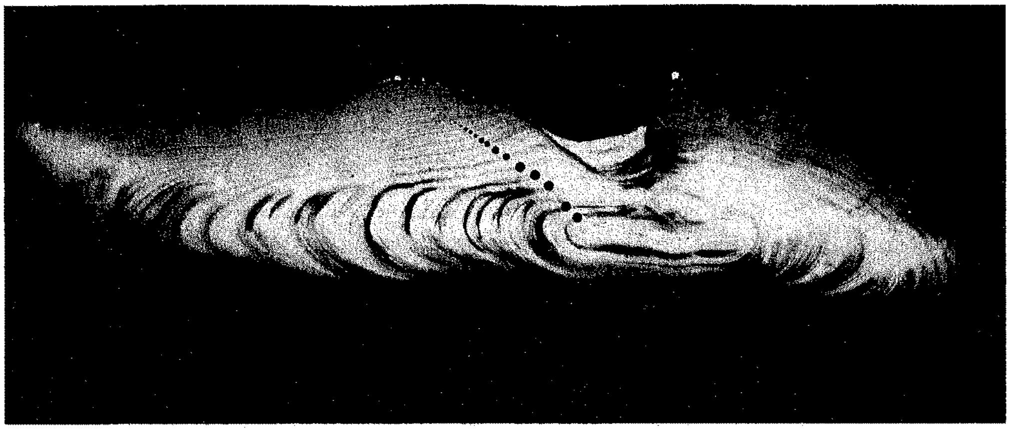

Figure 5
Otolith section from a 33-cm age-31 male redfish. Annuli are clearest on the proximal edge.