

## Weakfish

### *Cynoscion regalis*

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Weakfish, or gray seatrout, is a sciaenid species indigenous to eastern United States coastal waters, where it ranges from Cape Cod to Florida. Seasonal migrations consist of northward movement along the coast during the spring followed by a return migration in autumn to overwinter in warmer, southern waters (Wilk 1979). Spawning takes place primarily from April to July (Mercer 1983). Ages of up to 12 years and maximum sizes up to 95 cm have been reported (Shepherd and Grimes 1983), with females generally larger at age than males.

Weakfish growth is variable, depending in part on the location sampled and the growth peculiar to a particular year-class. Pronounced variation in growth over the last 60 years has been observed. Size at age 3 from the same general locality has varied between studies by 15 cm (Mercer 1983). Differences may be due to density-dependent growth, mixing of different groups of fish, or differences in ageing techniques. It is important to keep such differences in mind to avoid the pitfalls of bias due to previously determined expectations of age-at-length.

Age studies of weakfish were initiated in 1901 when Eigenmann (1901) examined the natural history of young weakfish in southern New England. Since then, investigations have been conducted for weakfish throughout the geographic range and during different levels of population abundance (Welsh and Breder 1923, Perlmutter et al. 1956, Thomas 1971, Merriner 1973, Seagraves 1981, Shepherd and Grimes 1983). In each case, the primary ageing structure has been scales. Otoliths and vertebrae have also been used (Merriner 1973) but provided no increased information or clarity. Scales are usually more accessible from commercial and recreational landings and therefore are the age structure traditionally used for weakfish.

Age information generated from scales has been validated through comparison with modal progressions in length-frequencies (Taylor 1916, Perlmutter et al. 1956) and examination of seasonal changes in the marginal increments (Taylor 1916, Massmann 1963, Shepherd and Grimes 1983). Marginal increment analyses have shown that annulus formation occurs once a year from April to September, with the principle period between May and June (Fig. 1). Time of annulus formation coincides with migration and spawning activity, but a cause-and-effect relationship has never been verified. Information from tagging experiments has not been adequate to validate annulus formation.

Scales are traditionally removed from one of two places on weakfish. The primary location is an area between the middle of the second dorsal fin and the lateral line (Fig. 2). Perlmutter et al. (1956) chose these scales because they contain the greatest number of circuli. An alternative area for scale samples is posterior to the pectoral fin. Merriner (1973) used these scales because they are the first formed during weakfish ontogeny. Weakfish have a high number of regenerated scales and lose scales easily during the sampling process. Therefore, it may not always be possible to collect scales from the preferred location and the alternate area must be used. Both areas provide valid ages, although scales from the primary location may be easier to read. After removing scales, they are best stored dry prior to use.

Preparation of scales for age reading involves impressing the scales on laminated plastic slides. Clean, nonregenerated scales should be chosen. The thickness of the laminate should be enough to accommodate the relatively thick scales of large weakfish. If too thin a plastic is used, information on the thinner anterior edge may be lost. Scale impressions are generally examined on a standard microprojector at a magnification of 32 $\times$ , although this can be modified depending on the scale size.

Weakfish scales are of the ctenoid type, and have a rather short and wide configuration (Fig. 3). Scales are characterized by distinct radii emanating from the focus to the anterior edge, and prominent circuli in the lateral fields. Annual marks appear as thin, opaque, broken lines and are most distinct in the radii zone. These annuli are sometimes referred to as "cutting-over" zones. One distinctive feature of the annuli is the shape or lack of circuli in the thin band. Unlike some fish scales, such as haddock, the annuli appear as an abrupt stoppage or change in growth. This is followed by immediate resumption of regular growth, as opposed to a gradual change. Consequently, identifying an annulus becomes more of a "yes or no" decision rather than a "possibly."

In assigning an age to an individual fish, the researcher should be aware of advantages in using a standardized 1 January birthdate. Weakfish are somewhat unusual since the annulus is formed in late spring, at the same time that spawning occurs. If the age reader uses the mean spawning date for a birthdate, the same year-class may be assigned to 0 and 1-year-old fish. A 1 January birthdate eliminates this problem, especially if the reader assigns the correct age for samples between January and the time of annulus formation.

Checks may create some confusion for an age reader. Checks are distinguished from annuli by their appearance in the lateral field and by the relative spacing since the last annulus (Fig. 4). An incomplete annulus in the lateral field is probably a check. Also, circuli in the lateral field intersect the annulus at oblique angles, whereas the circuli are parallel to checks. A check may also create a false annulus near the focus (Fig. 5). In older fish greater than age 6 or 7, annuli may be difficult or impossible to follow into the lateral fields because of crowding. In such specimens, the appearance of a check in the anterior field will be the sole source for a decision (Fig. 6).

The focus of a weakfish scale is usually a large area lacking any clearly defined circuli. Often there is a small degree of regeneration that occurs near the focus which can be ignored. If the scales are collected too close to the lateral line, the scale may have a hole in the area of the focus. The first year of weakfish growth is generally quite rapid and total length reaches 15-25 cm. Consequently, the first annulus on the scale is relatively far from the center and usually quite distinct (Fig. 7). Scale growth during the first year is fairly constant for fish throughout the geographic range.

The second annulus may be quite close to the first, indicating a growth-rate decrease of 10-15 cm per year, but may vary somewhat depending on the origin of the sample. Fish in the northern end of the range tend to have slower annual growth than fish from southern waters and may have closely spaced first and second annuli (Fig. 8). This phenomena, which has also been noted by other researchers (R. Seagraves, Del. Div. Fish Wildl., P.O. Box 1401, Dover, DE 19903, pers. commun. April 1980) may not be consistent for each year. Nevertheless, close annuli are possible and age readers should be aware of this possible source of error. Growth between the second and third annuli varies, with the third annulus often relatively close to the second (Fig. 9). The growth to the fourth annulus may be as great, or greater, than the second to third increment (Fig. 10). At ages of 6, 7, and older, annuli are harder to identify and may only be visible as a line of distorted circuli in the anterior field (Fig. 6). The frequency of older fish tends to be greatest at the northern end of the weakfish range.

With adequate preparation techniques, weakfish scales can be relatively easy to age. Annulus interpretation problems can be minimized if the sampling time and location are considered.

## Citations

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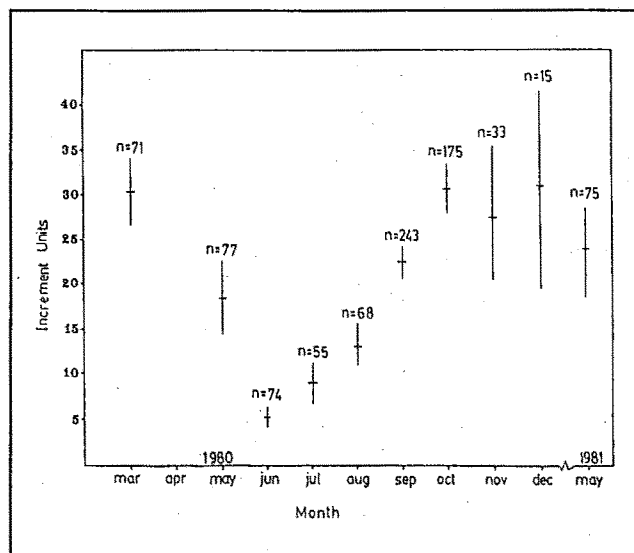
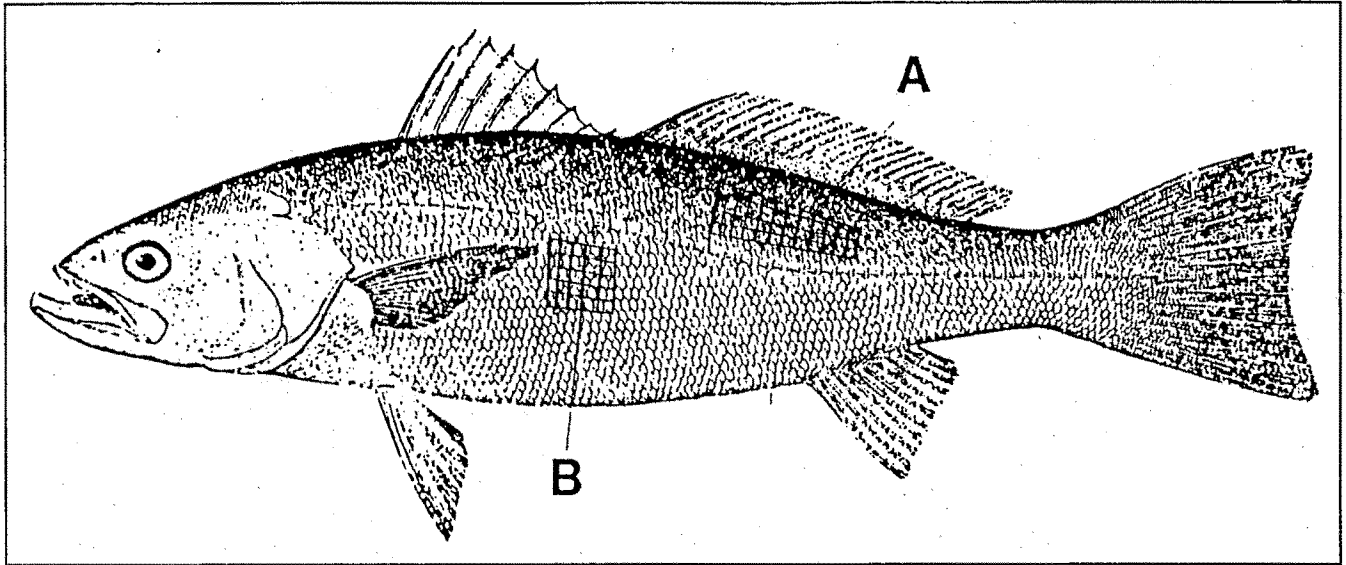
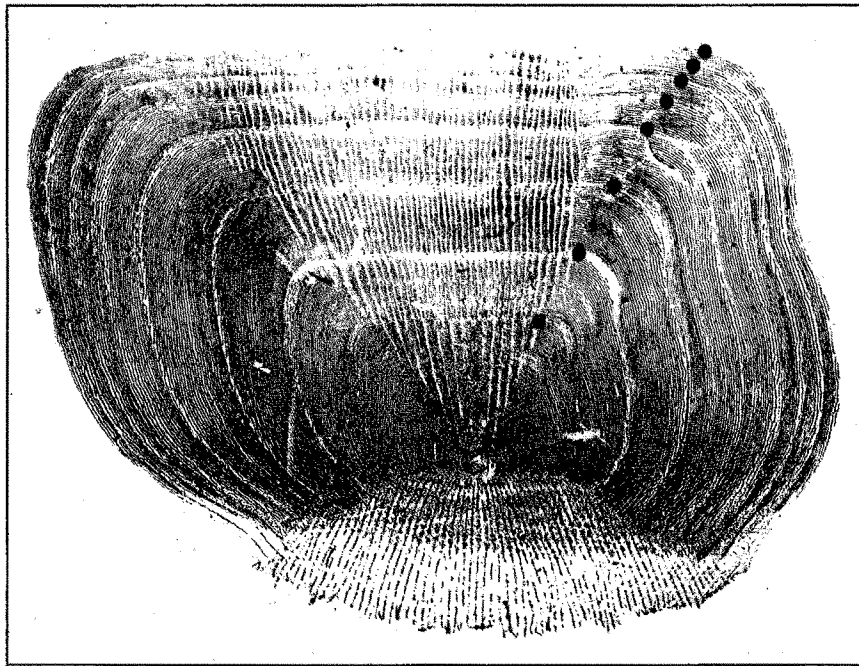


Figure 1

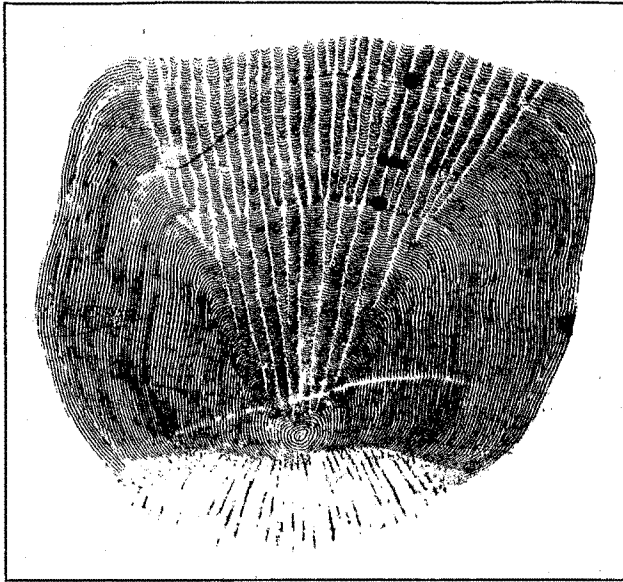
Mean marginal scale increments with 95% confidence intervals of weakfish for all ages combined. Sample size given for each month.



**Figure 2**  
Weakfish, *Cynoscion regalis*, showing primary (A) and secondary (B) locations for collecting scales.

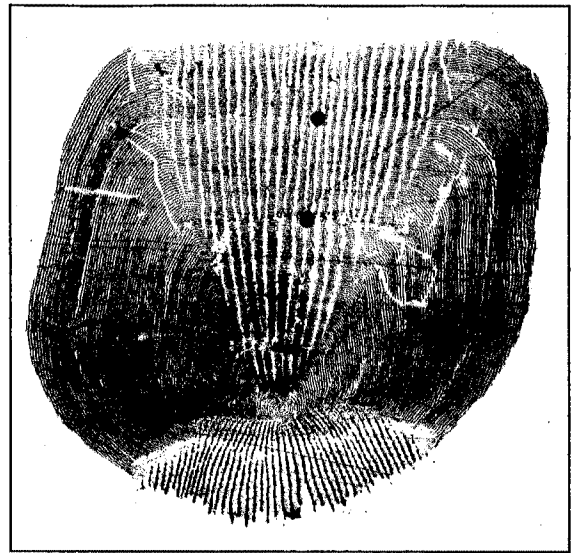


**Figure 3**  
Scale impression from a 75-cm age-8 female weakfish showing common configuration of annuli with cutting edge.



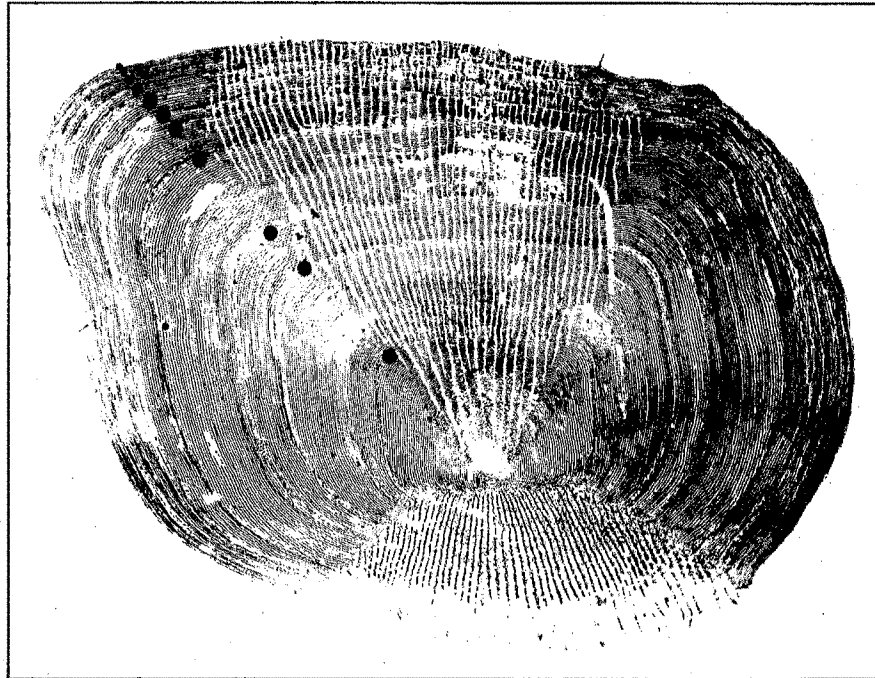
**Figure 4**

Scale impression from a 35-cm age-2 female weakfish showing 2 annuli and a check after first annulus.



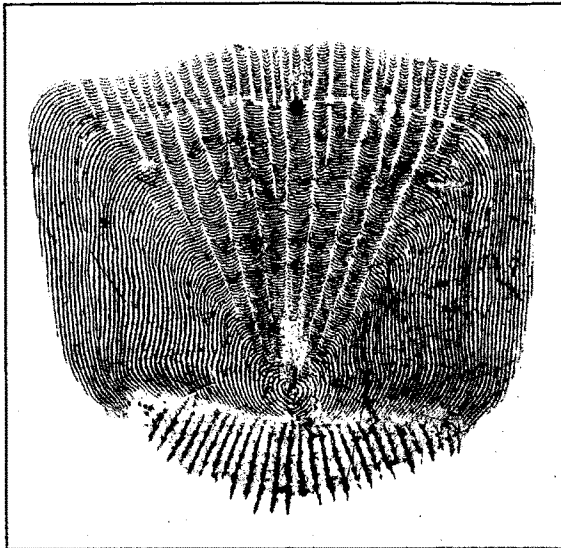
**Figure 5**

Scale impression from a 47-cm age-2 male weakfish showing a false annulus near the focus.

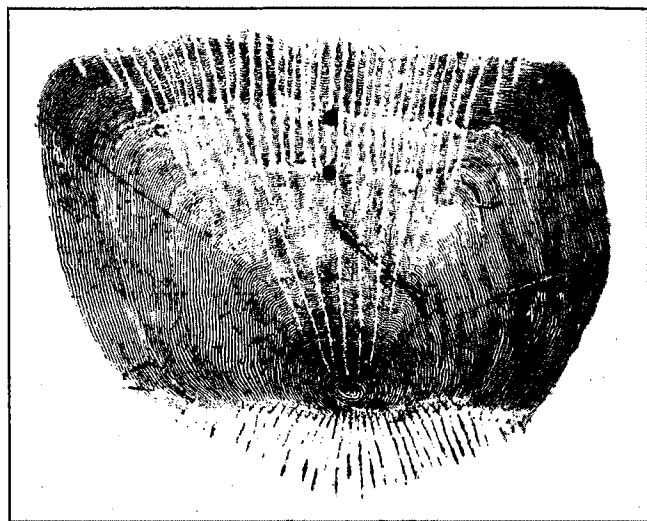


**Figure 6**

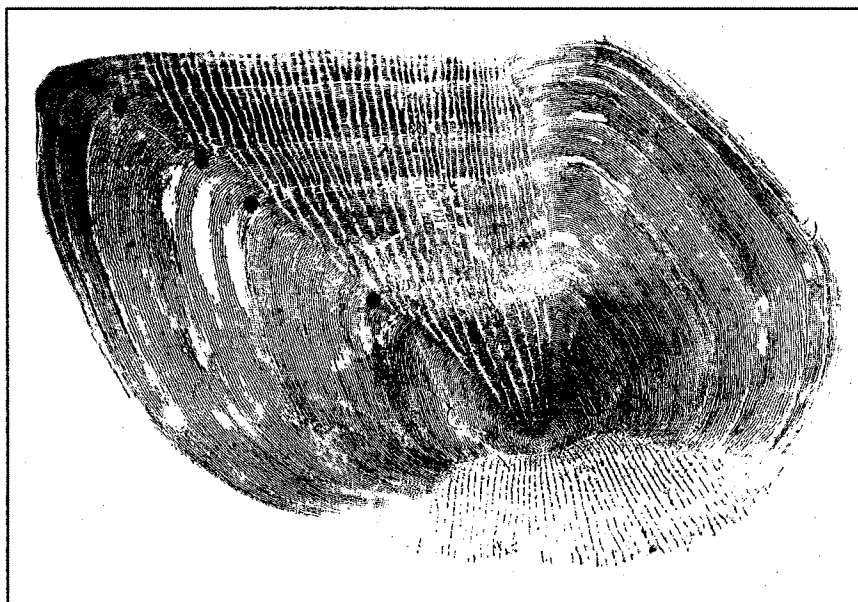
Scale impression from a 79-cm age-11 female weakfish showing crowding of recent annuli near the anterior edge of the scale. Last annulus on edge not yet formed.



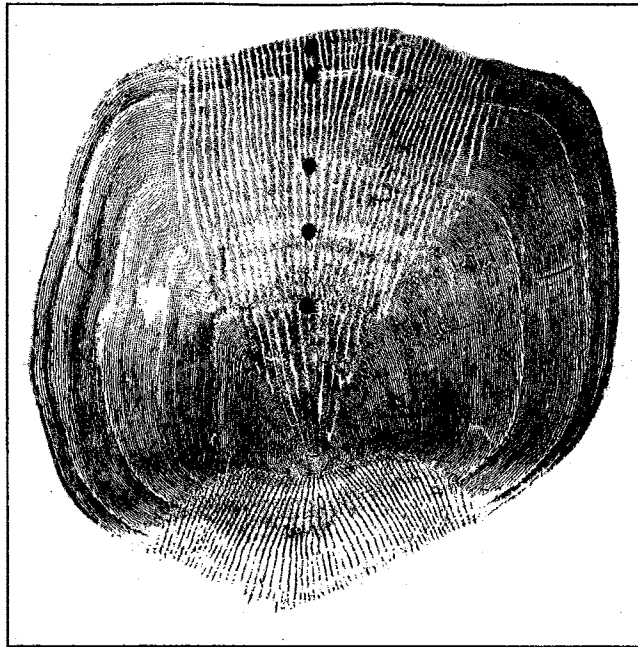
**Figure 7**  
Scale impression from a 24-cm age-1 male weakfish showing typical configuration of the first annulus.



**Figure 8**  
Scale impression from a 34-cm age-2 female weakfish showing close first and second annuli.



**Figure 9**  
Scale impression from a 73-cm age-6 female weakfish showing close second and third annuli.



**Figure 10**

Scale impression from a 68-cm age-5 female weakfish showing amount of growth between the third and fourth annuli relative to growth between the second and third.