

Can scales be used to sex winter flounder, *Pleuronectes americanus*?

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We tested the accuracy of a technique to rapidly determine the sex of mature winter flounder, *Pleuronectes americanus*, in the field without sacrificing individuals. Although a number of techniques have been developed for sexing fish by examining reproductive anatomy (Moen, 1959; Driscoll, 1969; Martin et al., 1983; Ross, 1984), they are not well suited for easy and rapid determinations in the field. External characteristics, such as features of the urogenital region (Sigler, 1948; McComish, 1968; Flickinger, 1969; Lebeau and Pageau, 1989) or body shape (Snow, 1963), have been successfully applied in the field for other species but are not applicable to winter flounder which exhibit no obvious sexual dimorphism. Some studies have suggested that male and female winter flounder can be differentiated by the texture of the scales on the blind side; males allegedly have ctenoid scales which feel rough, whereas females allegedly have cycloid scales which feel smooth (Perlmutter, 1947; Lux and Porter, 1963). Unfortunately, the literature is inconclusive and none of the studies have carefully tested the relationship of texture as related to scale type and sex. MacPhee (1978) citing Norman (1934) claimed that scales on the blind side of males are ctenoid rather than cycloid when, in fact, Norman stated that for the

species in general the scales are ctenoid on the ocular side and cycloid on the blind side.

Methods

From March through September, 1989, winter flounder were collected with an otter trawl in New Jersey waters. Fish were collected at 14 inshore sites in Raritan and Sandy Hook Bays (Phelan, 1992) and 22 offshore sites 22.2 km east of Sandy Hook (Studholme et al., 1995). Fish were measured to the

nearest millimeter total length. Using the method described by Lux and Porter (1963), we palpated the blind side of the caudal peduncle noting either roughness (males) or smoothness (females). The fish were then dissected to determine (visually) maturity and sex. All immature fish were eliminated from the study. When possible, a sample of ten or more scales was taken from the palpated area. In the laboratory, the scales were examined with a dissecting microscope to determine their type and relation to texture.

Results and discussion

A total of 730 mature fish, ranging from 12.9 to 39.7 cm, were examined. External palpation resulted in a significantly higher ($\chi^2=51.528$, $P<0.001$) sex ratio (females to males) of 2.7:1 than the actual ratio of 1.2:1 (Fig. 1). The difference in the ratios was due primarily to males being identified as females. Forty six percent (155 of 332) of the

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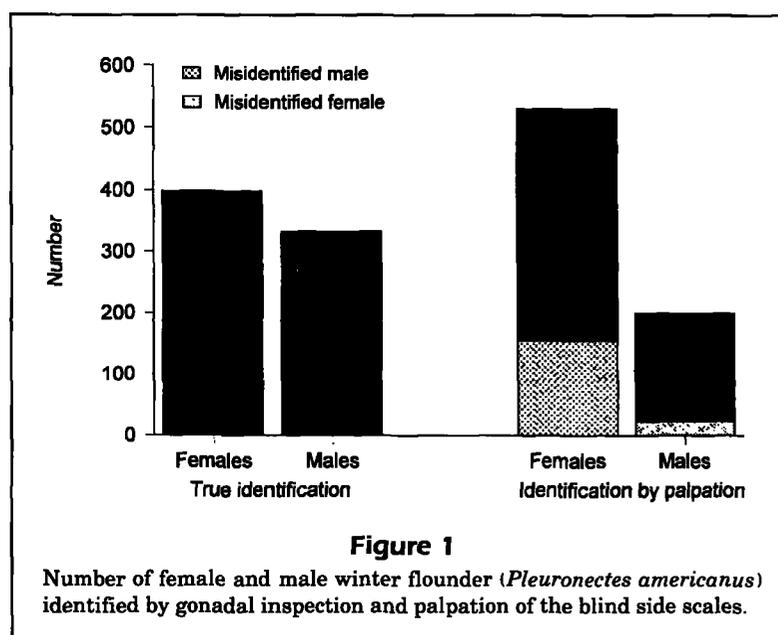


Table 1
Sex ratio of winter flounder as determined by external palpation and gonad inspection.

| Sex ratio (female:male) | Method | Number of fish | Location | Source |
|-------------------------|----------|----------------|--------------------------|---------------------------------|
| 2.5:1 | External | 3711 | New England and New York | Perlmutter, 1947 |
| 2.3:1 | External | 601 | Rhode Island | Saila, 1961 |
| 2.6:1 | External | 1431 | New England | Lux and Porter, 1963; Lux, 1969 |
| 2.3:1 | External | 12,151 | Massachusetts | Howe and Coates, 1975 |
| 1.5:1 | Internal | 940 | Rhode Island | Saila, 1962 |
| 1.2:1 | Internal | 1569 | Rhode Island | Berry et al., 1965 |
| 1:1 | Internal | 227 | Newfoundland | Kennedy and Steele, 1971 |
| 1:1 | Internal | 1465 | Massachusetts | Haedrich and Haedrich, 1974 |

males were misidentified, and six percent (23 of 398) of the females were identified as males. Similar differences between sex ratios derived from palpation of the scales and from gonadal inspection have been reported in the literature (Table 1). In the four studies that used palpation to determine sex, ratios ranged from 2.3 to 2.6:1 compared with ratios of 1:1 to 1.5:1 when gonads were used.

Scales were collected and examined from 672 of the 730 fish. Sex ratios for this subset also differed significantly ($\chi^2=44.203$, $P<0.001$) between the two sexing methods: 2.5:1 for palpation and 1.2:1 for gonadal inspection (Fig. 2). Individual fish exhibited either cycloid (479 fish) or ctenoid (199) scales, a finding that differs from Norman's (1934) observation that scales on the blind side were cycloid. Female fish exhibited primarily cycloid scales (Fig. 2) which were present on 352 (98%) of the 361 females examined. Scale type for male fish, however, was variable; 120 (39%) fish exhibited cycloid scales and 191 (61%) ctenoid (Fig. 2). Discrepancies between texture determinations and scale type (observer error) occurred in 33 (5%) of the fish examined (Fig. 2).

It is therefore apparent that the use of texture according to scale type for sexing winter flounder (Perlmutter, 1947; Lux and Porter, 1963; MacPhee, 1978) is not accurate, resulting in a significantly female-biased sex ratio.

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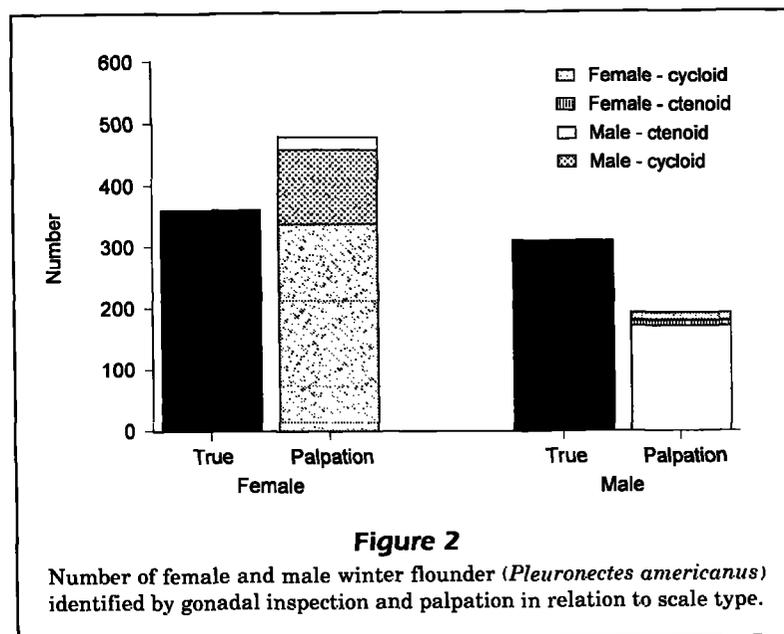


Figure 2
Number of female and male winter flounder (*Pleuronectes americanus*) identified by gonadal inspection and palpation in relation to scale type.

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