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A Comparison of Calcified Structures for Aging of Pikeperch (*Sander lucioperca*) in Bafra Fish Lake, Turkey

ABSTRACT

Scales, otoliths, vertebrae, and opercular bones of pikeperch (*Sander lucioperca*) were evaluated to identify the best age determination structure. Neither vertebrae nor opercles provided material for consistent estimation of age. Marks on scales were typically clear and easy to read in younger fish, but the age determination from scales of older fish was difficult and subjective. Annuli of otoliths were very clear and easy to interpret. The precision of age estimation was derived by percentage of agreement of repetitive readings and the average percentage of error; these parameters were respectively highest (91.4%) and lowest (4.5%) for otoliths, indicating that they were the most reliable structures for age determination in pikeperch.

I evaluated the reliability of scales, otoliths, vertebrae, and opercular bones to age 238 pikeperch (*Sander lucioperca*) collected by net from Bafra Fish Lake in Turkey (41°36'N-36°04'E) between January 2000 and July 2002. Scales, otoliths, vertebrae, and opercular bones were removed from individuals and cleaned by appropriate procedures (Chugunova 1963). Scales were viewed under magnification (10X) with transmitted light; otoliths, vertebrae, and opercles were observed at 10X with reflected light in a black dish filled with alcohol. Age determinations were done with three independent readings. Accuracy of repetitive readings was evaluated by percentage agreement for assigned age among the first, second, and third readings by the one reader. In addition, the average percentage of error (APE) was used to assess consistency in repeated age determinations (Campana 2001).

The rings on the vertebrae were inconsistent and were often blurred and impossible to follow around most of the bony structures. Interpretation was difficult. Opercles were yellowed and spongy and contained no visible marks, especially in younger fish. Annuli on scales were distincly clearer and more regular than those on vertebrae and opercles, but they still required some subjective interpretation. Annuli on otoliths were very clear and consistently easy to interpret. Because of this, different structures from the same fish often did not give the same age estimates (Table 1). Exact agreement among the three readings was highest for otoliths (91.4%). Otoliths also had the lowest APE (4.5%). The highest agreement and lowest APE indicate that otoliths were the most reliable bony structures for age determination of pikeperch.

Scales of *S. lucioperca* were more difficult to interpret than otoliths, which indicates

Table 1. Precision of age estimation by the same interpreter using four different bony structures of *S. lucioperca*. SE = standard error of the mean of three readings.

Structure	n	% of full agreement	APE	
			(%)	SE
Scale	238	53.3	12.3	0.8
Vertebra	238	45.3	10.5	0.7
Otolith	238	91.4	4.5	0.6
Opercle	238	38.3	11.7	0.8

that scales may not be suitable for reliable age determination. The first two rings were generally clear and well spaced; later hyaline zones often were crowded on the scale edge. The first few annuli were broadly separated, which made them easy to discern compared to those produced later. The last few annuli were not well defined in some fish. Thus, age interpretation was difficult, especially in older fish. False annuli were identified as incomplete checks. When scale ages were compared with otolith ages, scale estimates clearly deviated considerably (Fig. 1). In 132 specimens (55%), the scale ages were the same as the otolith ages. However, the scale method overestimated otolith age in 56 specimens and underestimated otolith age in 36 specimens.

While scales, vertebrae, and otoliths have all been reported as reliable structures for aging other fishes in Bafra Fish Lake (e.g., *Mugil cephalus, Carassius auratus gibelio, Scardinius erythrophthalmus*; Yılmaz et al. 2007, Bostancı 2005, Gümüş et al. 2007), the otolith is the best aging material for *S. lucioperca* in this lake system.

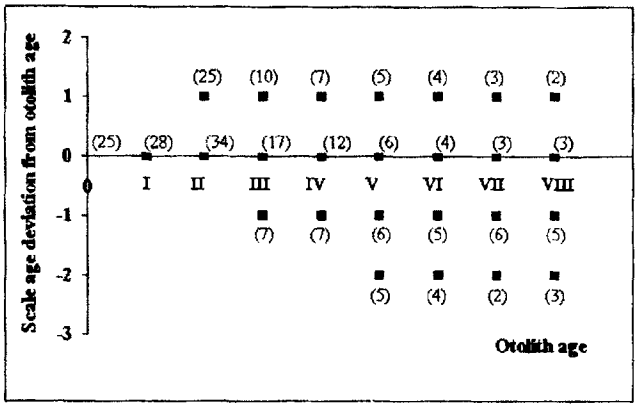

Figure 1. Deviation of age determined by interpretion of scales from that determined from otoliths in *S. lucioperca*. Numbers of fish are shown in parentheses.

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