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The feasibility of using eye lens diameter and eye weight as an indicator of the age of *Pentaprion longimanus* (Pisces: Gerreidae) collected along the coast close to Muscat on the Sea of Oman

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Abstract. Classical methods of aging fish, such as scales and otoliths, are not reliable. The weight and diameter of the eye lenses of 295 specimens of *Pentaprion longimanus* (Cantor, 1849) (Gerreidae) were used to determine whether it is possible to use these parameters as an indicator of age. The results indicate that the diameter and the weight of the eye lenses can be used to determine the age of this species when it is between one and two years old. This method is especially useful for age determination when otolith or scale rings are not visible or when false rings may give erroneous readings.

Key words. Ichthyology, eye lens, diameter, weight, aging, *Pentaprion*, Sea of Oman.

INTRODUCTION

The longfin mojarra, *Pentaprion longimanus* (Cantor 1849) (Gerreidae) is a marine, tropical and demersal species, which occurs at depths ranging between 15–220 m and occasionally in brackish water (Pauly et al. 1996). It occurs in the Indo-West Pacific region along the western and southern coasts of India and Sri Lanka to Indonesia. It is recorded from the Philippines and Ryukyu Islands, and as far south as the northern part of Australia (Sainsbury et al. 1985). Maximum total length is 180 mm but more usually 110 mm (Bianchi 1985). It inhabits coastal waters, forms large schools and feeds on small benthic animals (Froese & Pauly 2012).

Age determination is important when studying the growth of fish. This is usually done by counting the annuli on scales or otoliths of a large number of specimens (Fletcher 1991). In spite of the time and effort put into counting the annuli on the otoliths and scales the readings are subject to both systematic and random errors in interpretation and require independent validation (Beamish 1979). Thus, a considerable amount of time is needed to acquire the skill necessary for consistent interpretation of the material. In addition, extra readings are usually needed in order to verify the age assigned to a specimen (Sandeman 1969).

The size of the lens in an eye is commonly used to estimate the age of mammals and birds (Lord 1959, Friend 1967). Various authors have used the diameter of a lens to estimate the age of fish (Carlton & Jackson 1968, Burkett & Jackson 1971, Crivilli 1980, Saleem et al. 1990, Douglas 1987, Al-Hassan et al. 1991, 1992, Al-Hassan & Al-Sayab 1994, Conides & Al-Hassan 2000, Jawad 2001, 2003, 2004, Jawad et al. 2001).

The aim of this study is to determine whether it is possible to use the diameter of an eye lens and weight of the eye as indicators of age in the Oman Sea fish, *Pentaprion longimanus*, and

establish a faster method for ageing fish than the conventional methods based on measurements of scales and otoliths.

MATERIAL AND METHODS

The results presented in this paper are the measurements of the diameter and weight of lenses, and age based on measurements of the size of the operculum and preoperculum of 295 specimens of *Pentaprion longimanus*. The fish were collected from the coastal waters around Muscat City on the Oman Sea over the period March–May 2010. The eye lenses were extracted, dried at room temperature and individually measured and weighed to the nearest micrometer and milligram (Jawad et al. 2001). Both lenses from each specimen were measured and weighed. The large bony operculum and preoperculum were used to determine the age following the method of Al-Hassan & Al-Sayab (1994). The bones on both the left and right sides were measured twice independently, using an ordinary dissecting microscope. One way analysis of variance followed by Duncan's multiple range test (Harraway 1997) were used to test the differences between the total length of a fish and its age. The age of the specimens of *Pentaprion longimanus* collected ranged from zero to two years. It was not possible to obtain specimens over two years old.

RESULTS AND DISCUSSION

The total lengths recorded for the different age classes of this species revealed that body size is variable within an age class and that there is considerable overlap in body sizes of individuals in the different age classes ($P>0.05$). This is one of the reasons for using the diameter of the eye lens as an indicator of age (Fig. 1).

The results indicate that there is a marked increase in the average diameter of a lens with age (Fig. 2). This is obvious for fish belonging to age class I and II ($P>0.05$). However, there is a significant overlap between the average diameter of the lens of individuals of age groups 0^+, I and I^+. This is also true for the weight of the eye lens. On the other hand, fish in their second year of life can be differentiated from those of age group 0^+ (Fig. 3). Therefore, this method cannot be used to differentiate *Pentaprion longimanus* specimens in the age groups mentioned above.

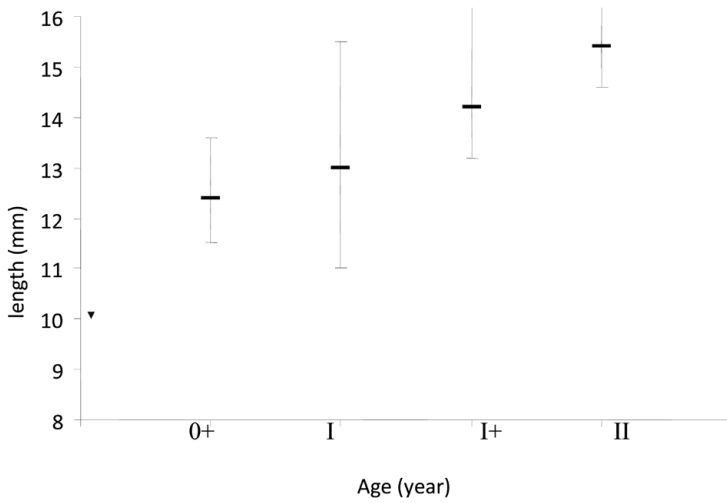

Fig. 1. Lengths recorded for *Pentaprion longimanus* of different ages calculated on the basis of the size of their opercular bones. Vertical bars represent range in length of the fish and horizontal lines their mean length.

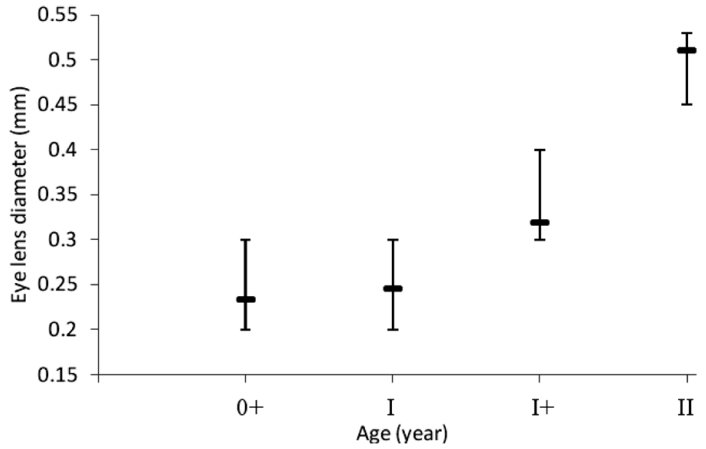

Fig. 2. The diameter of the lenses of *Pentaprion longimanus* of different ages calculated on the basis of the size of their opercular bones. Vertical bars represent range in the diameter of lenses and horizontal lines their mean diameter.

On the basis of the diameter of the eye lens, the results indicate that fish in their second year of life can be separated from those in the other three age groups studied. However, the weight of the eye lens can only be used to separate fish in age group II from those in 0^{+}. Thus, the diameter and weight of the eye lens can be used to determine the age of this fish in addition to the number of rings on the scales and otoliths.

Carlton & Jackson (1968) and Jawad (2001) reach the same conclusion working with small samples of carp and tilapia that were not older than five years.

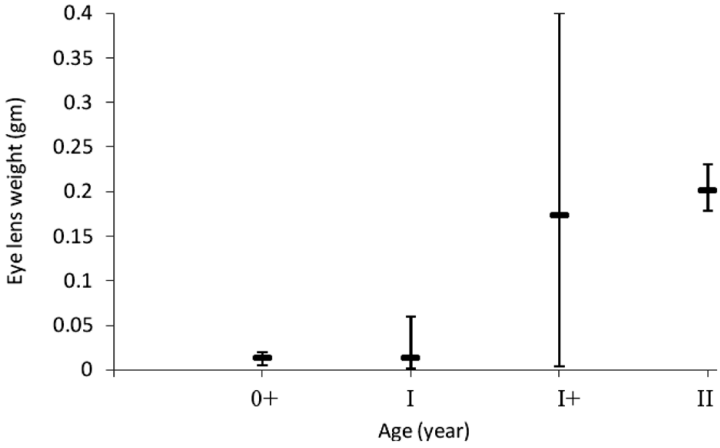

Fig. 3. The weights of the lenses of *Pentaprion longimanus* of different ages calculated on the basis of the size of their opercular bones. Vertical bars represent range in weight of the lenses and horizontal lines their mean weight.

Gerking (1966) reports that different environmental factors can result in different growth rates in the bluegill; *Lepomis macrochirus* Rafinesque, 1819 and Swedberg (1965) summarizes the different growth rates recorded for drum, *Aplodinotus grunniens* Rafinesque, 1820 in different areas of the United States. Environmental conditions are also likely affect the growth of the lens of fish (Burkett & Jackson 1971). Crivilli (1980) states that in carp during the reproductive period more energy is invested in somatic than gonadal growth. Since the increase in the diameter and weight of the lens is closely correlated with somatic growth, the variation in individual reproductive development could result in an increased variation in lens weight within an annual group. In other words, the growth rate during the reproductive period decreases due to the fish switching the allocation of resources mainly to reproduction. This decrease in the somatic growth rate will affect other parts of a fish including the lenses in its eyes. This could account for the results that do not conform with those recorded for the general growth rate of an individual.

CONCLUSIONS

The possibility of using the diameter and weight of the eye lens as an indicator of age in *Pentaprion longimanus* was tested. This technique can be used to age individuals of this species that are up to two years old. The method is especially useful for determining age when otolith or scale rings are not visible or when false rings may give erroneous readings.

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