



Fishbyte is the Newsletter
of the Network of Tropical Fisheries Scientists

EDITORIAL

This issue of *Fishbyte* includes five papers. The contribution by Hardman-Mountford et al. presents estimates of growth parameters for *Pristipomoides filamentosus* based on sagittal otolith readings – showing that otoliths can be used for aging this deep slope lutjanid at a low latitude site (Seychelles). The paper by King gives growth parameters for 42 Nigerian fish stocks. It is the last of the three data-rich contributions (see *Fishbyte* October 1996 and January 1997 issues) from him which summarize assessment results which otherwise are quite difficult to access. The paper by Palomares et al. gives diet composition and daily ration estimates for four trawl-caught fish species in San Miguel Bay (Philippines), while the paper by Jayasankar provides population parameters for two sciaenids from the Palk Bay/Gulf of Mannar area (India). The contribution by Pauly et al. is the first in a four-part series which will be appearing in *Fishbyte* dealing with B:RUN – a low-level geographic information system for elaborating selected coastal zone management issues, as applied to Brunei Darussalam (South China Sea). The issue ends with the usual news items and announcements from NTFS members.

We are greatly encouraged by the increasing number of contributions we have been receiving lately. Every effort will be made so these 'go to print' soonest – but contributors should expect some 'lag time' given our publications backlog. We urge you to read on and to keep the contributions coming!

Geronimo T. Silvestre and Villy Christensen

Can the Age of Tropical Species Be Determined by Otolith Measurement? A Study Using *Pristipomoides filamentosus* (Pisces: Lutjanidae) from the Mahé Plateau, Seychelles

N.J. HARDMAN-MOUNTFORD, N.V.C. POLUNIN and D. BOULLÉ

Abstract

The sagittal otoliths of *Pristipomoides filamentosus* from the Mahé Plateau, Seychelles, were examined for growth rings using light microscopy. Banding with putative annual and monthly frequency were observed. Consistent age estimates were derived from each of the two patterns. The resulting length-at-age data were used to estimate the parameters K and t_0 , viz: $K = 0.33$, $t_0 = 0.16$ for males and $K = 0.36$, $t_0 = 0.06$ for females (using von Bertalanffy plots). Possible causes of the banding are discussed.

Introduction

The bluespot jobfish (*Pristipomoides filamentosus*) occurs throughout the Pacific and Indian Oceans, from the

Red Sea in the west to Hawaii in the east. Its latitudinal distribution in the western Pacific spans southern Japan to New Caledonia. It is a deep water species, occurring at depths of up to

360 m, and is found in rocky bottom habitats (McAllister et al. 1992). Like other deepwater lutjanids, little is known of its ecology and trophic relationships. It has been reported to feed

on invertebrates and fishes in the Maldives (McAllister et al. 1992). However, a recent study by Haight et al. (1993) suggested that zooplankton feeding dominates its trophic behavior in Hawaii.

On the Mahé Plateau, Seychelles, *P. filamentosus* occurs along drop-offs, mainly in the 75-100 m depth range, where water temperature is 20-24.5°C and primary productivity is relatively high (Mees 1993). It is the dominant snapper in the region, with a stock density up to 10 times greater than that of other lutjanids. It is also a highly marketable and valuable species, comprising about 50% of the catch of the local demersal handline fishery targeting Lutjanidae, Lethrinidae and Serranidae. Trials with deep set gill nets, which have recently been introduced to the fishery, show that *P. filamentosus* make up 90% of the catch (Mees 1993). As the stock is concentrated in a narrow depth zone, overfishing can be expected. The 1990 catch was close to the estimated maximum sustainable yield and more than half the catch was of a shorter length than that at which 50% of females have reached maturity, suggesting a danger of recruitment overfishing (Mees 1993).

An accurate method of determining the age of the population is important for fishery assessments. Annual growth rings have often been used for this purpose in studies of temperate

and subtropical species. The use of the technique for tropical species has been less common, owing to the supposition that marked seasonality does not occur in the tropics. This is now known not to be true (Longhurst and Pauly 1987). The number of tropical otolith studies has increased over the last twenty years. Pannella (1974) showed that otolith growth patterns occurred in 25 species from around the shores of Puerto Rico. There have been fewer reports of such patterns in lower latitude species. Studies along the Nigerian coast showed no banding patterns in the otoliths of some species, although growth lines were seen in the skeletal structures of others (Fagade 1974).

This study examined the otoliths of *P. filamentosus* to determine whether they could be used to determine the age of this deep slope species at a low latitude site.

Materials and Methods

Sagittal otoliths of *Pristipomoides filamentosus* were taken from fish obtained from commercial catches on the Mahé plateau between November 1989 and December 1990 inclusive. All fish were caught with baited hooks and lines (Mees 1993).

Initially, whole sagittae were examined under a compound microscope. The best images were obtained under transmitted light of low intensity with

the sagittae on a transparent background and using no color filters (Fig. 1). Clearing the sagittae with clove oil improved the image further.

Sagittae were sectioned after being set in clear-casting resin, using a Buehler Isomet low-speed circular saw. Two parallel cuts were made 2 mm apart, with one cut through the focus. The completed sections were mounted on glass slides and ground down to a thickness of 0.5-1 mm initially using 900 grit wet and dry paper, and then with aluminium oxide powder of 3 mm diameter on a Logitech CL30 lapping machine. After the excess powder was washed off the slides with distilled water, the sections were examined under a compound light microscope. Three different section orientations were examined: antero-posterior, dorso-ventral and diagonal (see Fig. 2). All three section orientations showed that banding was present, but it was seen most clearly in the dorso-ventral section so this orientation was used for the remaining samples.

The sections were viewed directly under a compound light microscope at 50x magnification with transmitted light at low intensity. All bands were counted from the edge of the focus to the outer edge along the dorsal and ventral axes. Agreement had to be achieved on three readings of each section. If agreement was not found between readings of the dorsal and ventral axes then bands along the proximal lateral axis were counted. If readings of two of the axes agreed then this modal value was taken. If not, then the mean was taken, as long as readings of all three axis readings were in agreement. If this did not occur, the section was discarded from the results. A precision of $\pm 10\%$ was used as the criteria for agreement between counts. Each sagittal section was counted three to five times. If after five readings, this criterion was not met, the section was discarded. If a modal value was available then this was taken, if not then the mean of the three was calculated.

The number of bands counted in each section was used to estimate the age of each fish. Using the von

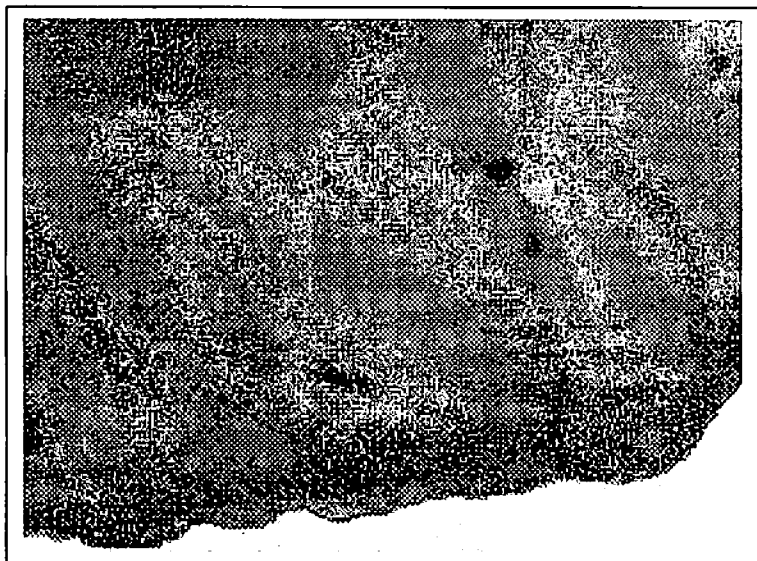


Fig. 1. Compound light microscope of a sagittal otolith.

Bertalanffy plots (Sparre et al. 1989), these were used to estimate the growth coefficient, K , and theoretical age at zero length, t_0 , of the von Bertalanffy growth equation. The parameters were estimated separately for males and females using asymptotic length (L_∞) values given by Mees (1993).

Two different terms are used for the patterns of banding which were seen in the sagittae. Those putative of annual banding are termed annuli and those putative of monthly banding are termed rings.

Results

Very faint hyaline and opaque regions were visible outside the central region when the convex proximal face was viewed. These were seen slightly more clearly from the concave distal face. Very fine banding could be resolved on parts of the dorsal edge and what appeared to be layered increments could be seen on the ventral edge. Very fine striae were observed on the proximal face running perpendicular to the banding. Such striae have also been recorded by Loubens (1978) and McPherson (1992).

Each sagitta showed regularly spaced rings from the edge of the focus to the external periphery. Less distinct annuli, each made up of one hyaline and one opaque region, were also present. Only complete annuli (i.e., where the full opaque and hyaline regions were visible) were counted. Approximately 12 times as many rings were counted as there were zones in each sagitta, leading to the hypothesis that the rings were laid down with a monthly periodicity whereas the annuli were annual. The predicted number of zones was computed by dividing the number of rings counted by

12.4 (the number of lunar months in a year). The observed number of zones (or annuli) plotted against the predicted number is illustrated in Fig. 3. Linear regression showed that the slopes between the two lines were not significantly different (student's $t = -1.00, v = 20, p > 0.05$). Comparisons of the 95% confidence limits for the intercepts of the two lines also showed no significant difference.

Plots of $-L_t/L_\infty$ against t (see Fig. 4.) showed the relationship between fork length and age to be significant for both males ($r^2=0.991$) and females ($r^2=0.971$), using the values for L_∞ (male = 85.8 cm, female = 77.6 cm) calculated by Mees (1993). Values of K and t_0 were then derived. These were found to be $K = 0.33, t_0 = -0.16$ for males and $K = 0.36, t_0 = 0.06$ for females.

Discussion

Banding is present in the sagittae of *P. filamentosus* and rings seemed to be laid down on a monthly basis while annuli appeared to be formed annually. Pannella (1974) said that monthly rings do provide a basis for age determination, but advised that in some tropical species, annuli are less obvious and can be misleading if used for growth studies. In this study both types of banding were consistent throughout each sagitta allowing age estimates to be made. Independent readings of the two types of banding gave similar ages. Using Mees' (1993) values for L_∞ gave a very strong correlation between the fork lengths and the ages determined from sagittal rings. Hence, the age estimates were found to be consistent with length-frequency data for the population.

Until recently, annuli were thought to be absent from fish species from tropical waters because seasonal environmental changes in these regions were less marked. However, the tropics are now regarded as exhibiting substantial seasonality (Longhurst and Pauly 1987) and some tropical fish species are showing evidence of high ambient temperature sensitivity in growth (Polunin and Brothers 1989). A number of instances of annual banding in warm water species have now been reported (Bullock et al. 1992; Ferreira and Russ 1992; Sadovy et al. 1992; Bullock and Murphy 1994), although most of the examples are from subtropical regions.

Reports of monthly banding are less common, even among species from subtropical areas. However, Pannella (1974) states that a basic bimonthly and monthly pattern may be common to all otoliths, from both temperate and tropical species. Monthly patterns seem to be more detectable when bimonthly patterns are not strongly developed. Microstructure studies, using electron microscopy have confirmed that these patterns exist by showing rhythmic growth patterns of 7, 14 and 28 daily increments in tropical otoliths (Morales-Nin 1995). The Caribbean wrasse *Lachnolaimus maximus* and surgeonfish *Acanthurus chirurgus* are two examples of species known to show monthly banding (Pannella 1980).

Annual and monthly banding can be caused by a variety of factors such as temperature variations. Chevy (1933 in Pannella 1980) concluded that a seasonal temperature change of about 4-5°C is enough to slow growth and leave a mark on scales. Such temperature changes are seen in the Seychelles at the depth range occupied by *P. filamentosus* (Mees 1993). Changes in feeding patterns may also be responsible. Haight et al. (1993) have noted that major daily and seasonal shifts occur in the diet of *P. filamentosus*.

Most explanations of monthly banding involve a lunar component. For instance, variations in the tide,

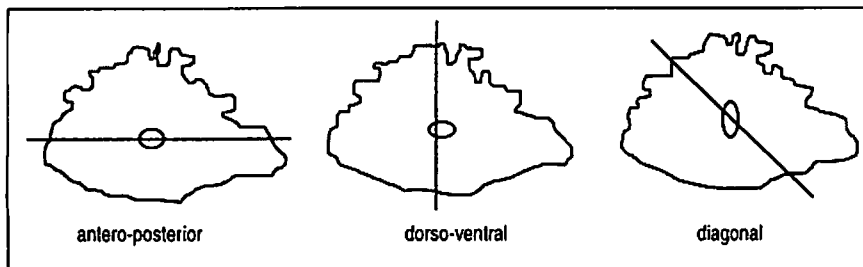


Fig. 2. The different section orientations tested.

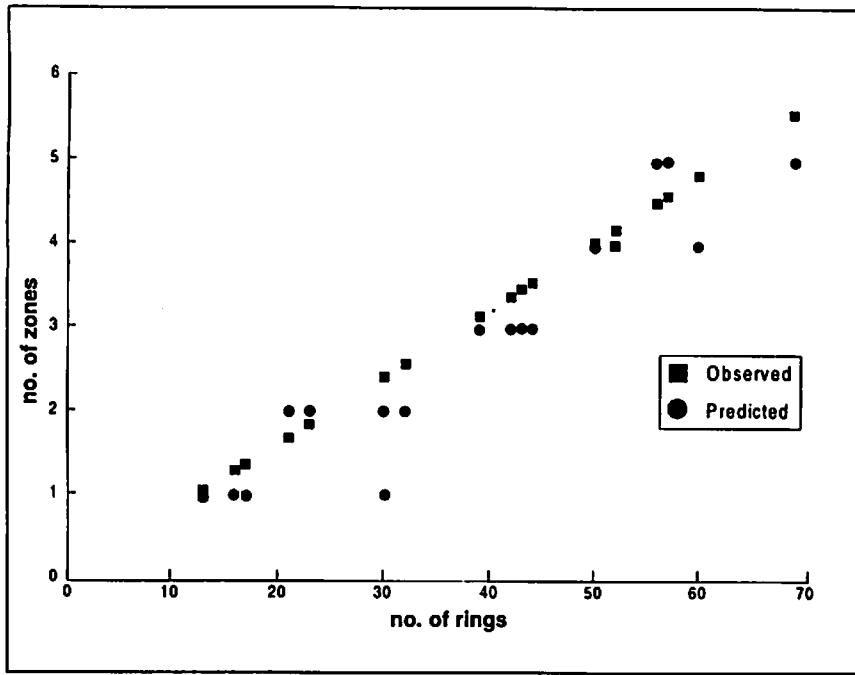


Fig. 3. Comparison of the number of zones observed with the number of zones predicted from the number of rings in sagittal *P. filamentosus*.

under lunar control, could perhaps lead to changes in the rate of calcium carbonate deposition in the sagittae. *Tilapia* spp. from tidal lagoons have been seen to show such banding whereas those from nontidal pools have not (Pannella 1980). The absence of such periodic banding has also been noted in species held in stable, controlled experimental environments (Gutiérrez and Morales-Nin 1986). Tides would not be expected to directly influence deepwater species in this way, although

the bands may be due to increased feeding activity during full moon periods, a phenomenon well recognized by fishers.

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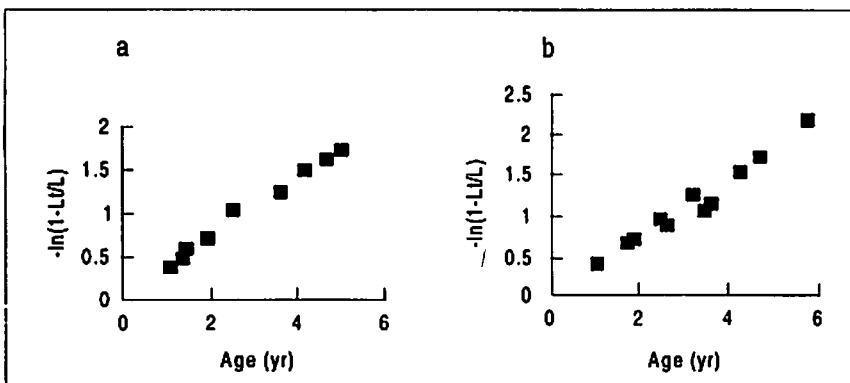


Fig. 4. Von Bertalanffy plots for (a) male and (b) female *P. filamentosus*.

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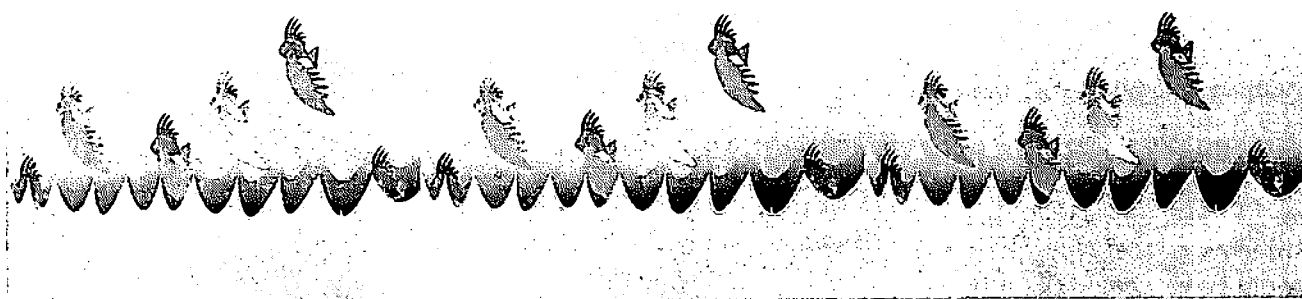
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Growth Performance of Nigerian Fish Stocks

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Abstract

Parameters of the von Bertalanffy growth function are presented for 42 fish stocks belonging to 16 families, 22 genera and 27 species. The growth performance index, ϕ' ($= \log K + 2\log L_{\infty}$), was computed for each stock and was found to be highest in male *Gymnarchus niloticus* (Gymnarchidae) from Lake Chad and lowest in *Chrysichthys auratus* (Bagridae) from the Cross River. Mean ϕ' for major fish genera and families are also presented and was highest in brackishwater fishes, closely followed by freshwater and inshore marine water fishes.

Introduction

Interest in studies on growth in tropical fishes has recently grown in view of their relevance to the resultant parameters in pragmatic fisheries management. Growth parameters are important in the selection of fishes for aquaculture (Moreau et al. 1986; Mathews and Samuel 1992) and in

estimating food consumption of fish populations (Palomares and Pauly 1989; Pauly 1989).

Numerous studies on the growth of tropical African fish stocks have been carried out as a result of this increased interest (e.g. Merona 1983; Hustler and Marshall 1990; Torres and Pauly 1991; Kolding et al. 1992; Makwaia and Nhwani 1992). However, up to now,

no data have been gathered on the growth performance of fishes in Nigeria, where there is an important commercial fishing industry as well as active aquaculture. This paper summarizes the available growth parameters of Nigerian fish stocks from inshore marine water, brackishwater and freshwater ecosystems. The results may be entered into FishBase