OBSERVATIONS ON THE MICROSTRUCTURE OF THE OTOLITHS OF THE BIG-EYE GRUNT, *BRACHYDEUTERUS AURITUS* (*PISCES HAEMULIDAE*)

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ABSTRACT
The microstructure of the otolith of the big-eye grunt, Brachydeuterus auritus has been studied using the scanning electron microscopy (SEM) technique to elucidate its utility for age determination and growth studies of the species. The otolith lacks a hatching check, hence the embryonic phase cannot be clearly defined. Patterns of increment deposition that can be described as weekly, appear as prospective for ageing larger specimens, but they tended to be obscure in parts of the otolith. In otoliths of juvenile fish, the increments were readable from the nucleus to the edge, at least in the region of the sulcus, suggesting that such fish could be aged from counts of the increments.

1. INTRODUCTION
Otolith microstructure has a wide application in fisheries studies, providing information on such aspects of the biology of fish as the early life history (Campana, 1984b; Lecomte-Finiger, 1994), age and growth (Pannella, 1971; Taubert and Coble, 1977; Karakiri and Hammer, 1989; Ekau and Blay, 2000), and recruitment and mortality of stocks (Crecco *et al.*, 1983; West 1983, quoted in Campana and Neilson, 1985). These characteristics are fundamental to understanding the population dynamics of a fish species. The microstructure of otoliths has also been used to distinguish spring-and autumn-spawned larvae of some species (Moksness and Fossum, 1991) as well as reared and wild fish stocks (Hendricks *et al.*, 1994). Information on the microstructure of fish otoliths therefore has considerable practical utility in studies on the dynamics of fish stocks.

The big-eye grunt also known as burrito (*Brachydeuterus auritus*) is a semi-pelagic fish of considerable importance in the marine fisheries of Ghana, constituting a cheaper source of fish during the off-season of the main fishery resource, *Sardinella aurita*. Understanding the dynamics of the species is therefore paramount for the proper management of the stock.

The present study was undertaken to investigate the microstructure of sagittal otoliths of *B. auritus*, to elucidate its possible utility for determining the age and growth of the stock in Ghana.

2. MATERIALS AND METHODS

Pairs of sagittae from burrito were embedded in Metset resin (95-130007, Beuhler Co.) and sectioned in the frontal and transverse planes. The cut surface was ground on wet silicone carbide abrasive paper (600, 800, 2400 and 400 grit) and polished with alumina slurry (0.3 μm) on a glass slide or with a metal polish (brasso) on a polishing cloth. The polished surface was etched with 1%, 2%, or 5% HCl aqueous solution depending on size. After etching, the blocks of etched otoliths were cleaned then mounted on a brass SEM stubs and sputter-coated with gold in a vacuum for 4 minutes before examination with the electron microscope.

3. RESULTS AND DISCUSSION

Photomicrographs of frontal and transverse sections of otoliths were examined to describe the microstructure of the sagittae of *B. auritus*. A peculiar feature of the microstructure of the sagittae of the species is the absence a hatching check delimiting a core or nuclear zone (Fig. 1), unlike what occurs in otoliths from other bony fish such as tilapia (Tanaka et al., 1981; Ekau and Blay, 2000), the herring *Clupea harengus* (Lough *et al.*, 1982), the American eel *Anguilla rostrata* (Wang and Tzeng, 2000) and the American shad *Alosa sapidissima* (Hendricks *et al.*, 1994). The absence of the hatching check in otoliths of *B. auritus* is similar to what has been reported for the Chinook salmon (Neilson and Geen, 1982), and is associated with species in which hatching may be a physiologically insignificant event (Balon, 1984).

Primary growth increments consisting of thick incremental zones and thin discontinuous zones are deposited concentrically around the core, and in the etched otolith, these appear as alternate crests and grooves due to the different response of the zones to the acid (Fig. 1). Incremental zones are rich in calcium carbonate deposits while discontinuous zones are rich in protein. The widths of the increments follow the typical growth pattern on the transverse axis, being narrow near the core, wider in the middle, and narrow towards the edge of the otolith (Fig. 2).

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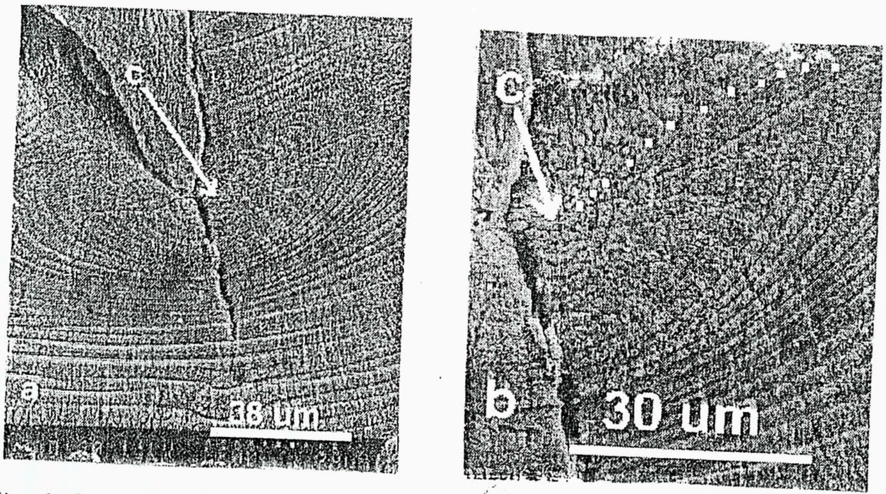

Fig. 1: Scanning electron micrographs of transverse etched otolith of B. auritus showing the central core (arrow) and growth increments on the transverse axis (dot to dot)

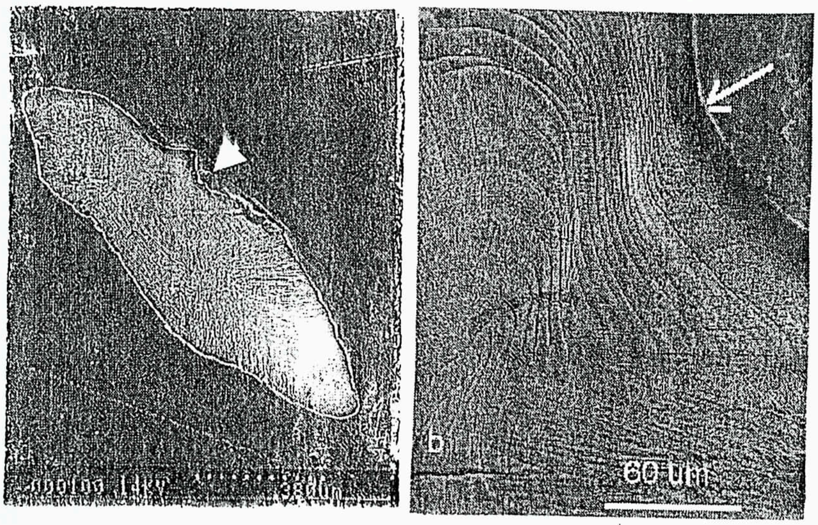

Fig. 2: Scanning electron micrographs of transverse etched otolith of Brachydeuterus auritus (3.0 cm TL) showing (a) the sulcus (arrow) and (b) approximately 35 increments from the core to the edge of the sulcar zone

Accessory growth centers or peripheral nuclei observed in other species, e.g. *Platichthys stellatus* (Campana, 1984b), *Sarotherodon melanotheron* and *Oreochromis mossambicus* (Blay, pers. obs.) were also present in otoliths of *B. auritus*, where they appeared to originate from the 28th increment. Further increment deposition from these centers results in accessory growth zones with increment continuous with those originating from the core (Fig. 3).

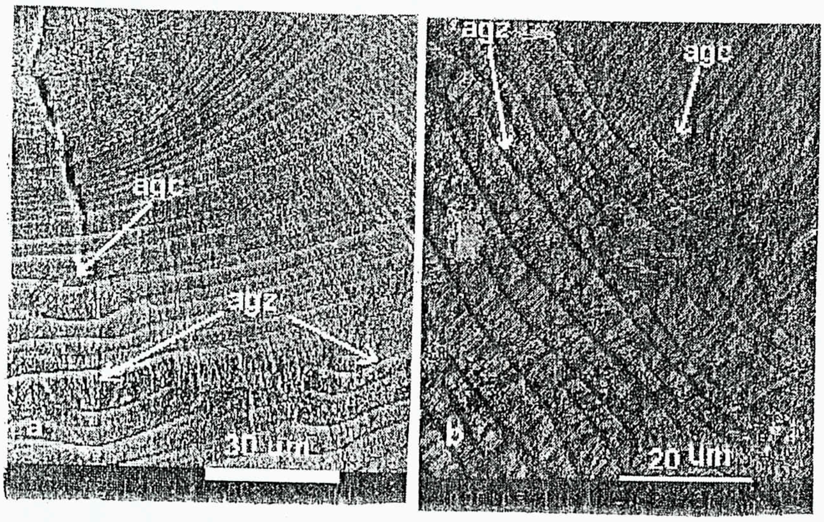

Fig. 3: Scanning electron micrographs of transverse etched otoliths of Brachydeuterus auritus showing accessory growth centres (agc) and accessory growth zones (agz)

Another feature of significance in the otoliths of the big-eye grunt is the occurrence of periodic interruptions (checks) at intervals of seven increments in larger specimens, similar to tidal (weekly or fortnightly) patterns reported in certain coastal species (e.g. Pannella, 1980) (Fig. 4). This phenomenon might suggest a possible daily formation of the increments in *B. auritus* otoliths. Geffen (1987) suggested the assumption of daily periodicity in otoliths of coastal species with cycles of 7-14-28 increments. However, this phenomenon was not manifest throughout the sections examined, being obscure in certain areas, and this could constitute a major drawback in its application for ageing the species.

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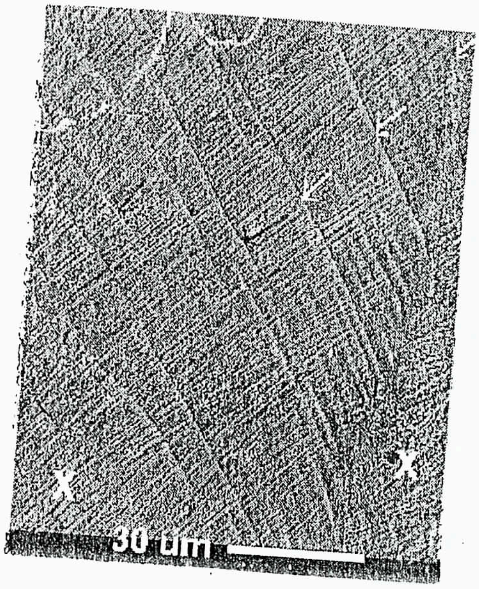

Fig. 4: Scanning electron micrograph of frontal etched otolith of Brachydeuterus auritus showing increments bounded by weekly checks (white arrows), and checks due to stress (black arrows). X indicates areas with obscure patterns

In addition to the weekly checks, some checks appeared to be non-periodic. Such checks are reported to be associated with periods of stress or sexual maturity (Pannella, 1980; Campana, 1984a). In otoliths from smaller and presumally younger fish, the increments are readable from the core to the edge of the otolith in the sulcar zone (Fig. 2b), and counts could possibly be used to estimate the age of such fish.

4. CONCLUSION

From the foregoing, it is apparent that there are some limitations in the use of the microstructure of *B. auritus* otoliths as a tool for its ageing, particularly in otoliths of older fish because of the problems associated with reading the increments from the core to the edge. Assuming daily increment deposition in the species, it seems possible that the age of smaller fish could be determined because of the possibility of counting all the increments in the otolith.

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