

ASPECTS OF THE FEEDING BIOLOGY OF *POROGOBIUS SCHLEGELII* (GUNTHER) (PISCES: GOBIIDAE) IN THE FOSU LAGOON, GHANA

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Summary

As part of a general survey of the fisheries, biology and ecology of the Fosu Lagoon (Ghana), the feeding structures, diet and feeding activities of *Porogobius schlegelii* in the lagoon was studied during a period of 9 months. Feeding structures of the fish viz: prominent unicuspid caniniform teeth, widely-spaced gill rakers and a short gut ($0.63 \times SL$) suggested that the species was a carnivore. However, stomach content analysis of the population studied revealed an omnivorous diet. Stomach contents consisted of pieces of macrophytes, algae, rotifers, copepods, ostracods, insect larvae, detritus, gastropods, fish eggs and fry. Investigations on the diet and feeding activities of the fish showed that *P. schlegelii* in the Fosu Lagoon fed throughout the day. Both diurnal and nocturnal feeding were suggested by observations made on two 24-hour occasions.

Introduction

Fishes of the Gobiidae family are common in the marine coastal waters and brackishwaters of West Africa (Irvine, 1947): Some species are known to enter tidal lagoons and estuaries, migrating as far as the freshwater reaches of the latter (Irvine, 1947; Wright, 1986). In Ghana, *Porogobius schlegelii*, in addition to the marine intertidal zones also occurs in the 'closed' Fosu Lagoon where it constitutes about 7 per cent of the fish catch which is dominated by the lagoon tilapia, *Sarotherodon melanotheron* (90% of the catch) (Blay & Asabere-Ameyaw, 1993). Because the lagoon is separated from the sea by a sand bar, the gobies apparently enter from the sea when the sand bar is breached by rain floods or sand winning activities. The lagoon and some of its prevailing environmental conditions have earlier been described (Blay & Asabere-Ameyaw, 1993; Blay & Dongdem, 1996).

There is a general paucity of information on gobies in West Africa, the only reports available being on the food of *Oxyurichthys* (= *Gobionellus*) *occidentalis* in the 'semi-closed' Sakumo Lagoon in Ghana (Pauly, 1975), and the spatial and seasonal occurrence of *P. schlegelii* in the

Niger Delta, Nigeria (Wright, 1985). As part of a general survey of the fisheries biology and ecology of the Fosu Lagoon (Eyeson, 1978; Blay & Asabere-Ameyaw, 1993; Blay, 1995; Blay & Dongdem, 1996) and to augment our knowledge of the biology of gobies in general, the present study describes the feeding structures, diet and feeding activity of *P. schlegelii* occurring in the Fosu Lagoon.

Experimental

The population of *P. schlegelii* in the Fosu Lagoon was sampled monthly from November 1992 to July 1993. Samples were obtained mainly by cast-netting (net with 25 mm mesh) and occasionally a few individuals sticking onto rocks in the littoral zone were caught by hand. The fish sampled were immediately preserved in 10 per cent formalin for later examination in the laboratory. In the laboratory, individual fish were measured for total length (TL) and standard length (SL) to the nearest 0.1 cm, and the weight determined to the nearest 0.1 g. The gut of each fish (from the esophagus to the rectum) was dissected out and measured to the nearest 0.1 cm.

Food items from the stomachs were identified

under compound dissecting microscopes. The stomach contents of 285 individuals were analyzed by the frequency of occurrence method (Hynes, 1950). To investigate the daily feeding pattern of the species, samples of fish were taken at 4-h intervals on 12-13 February and 11-12 June 1993, with samplings at 08.00, 12.00, 16.00, 20.00, 24.00 and 04.00 hours local time. For each sample, stomach contents of the fish were weighed and the different components identified for a study of the food item taken at different times of the day. The 24-h feeding activity of the fish was determined by changes in the percentage of fish with empty stomachs and the index of stomach fullness defined as: weight of stomach content/body weight $\times 100$ (Hureau, 1966).

Results

Dentition, pharyngeal bones and gill rakers

Three to four rows of unicuspid caniform teeth were observed in both the upper and lower jaws of *P. schlegelii* of which the frontal set are the largest, and the median teeth, the smallest (Fig. 1) Both the upper and lower pharyngeal bones have smooth glabrous surface without conspicuous teeth (Fig. 2). The first branchial arch has 15-16 gill rakers (Fig. 3) and the widely-spaced gill rakers

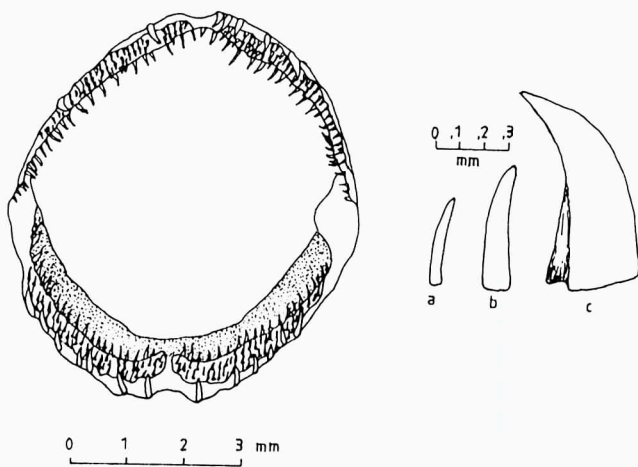


Fig. 1. Upper and lower jaws of *Porogobius schlegelii* showing arrangement and details of the unicuspid teeth (a, median; b, innermost; c, frontal)

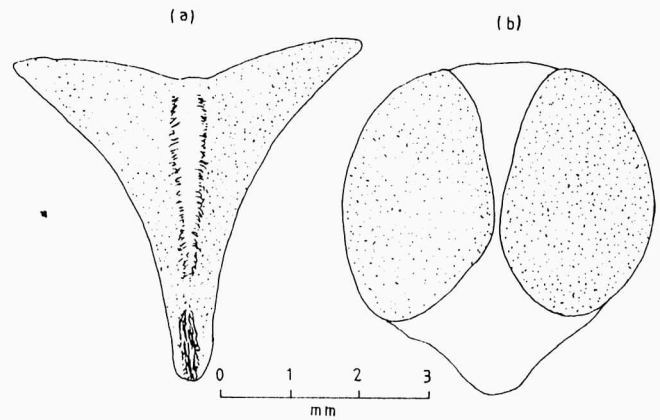


Fig. 2. (a) Lower and (b) upper pharyngeal bones of *Porogobius schlegelii*

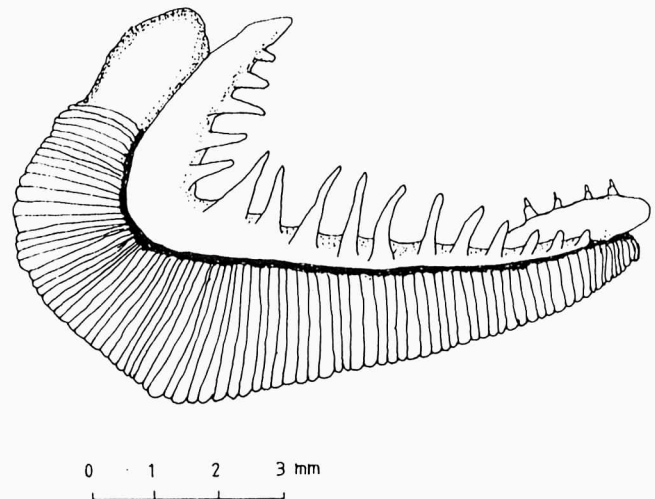


Fig. 3. First branchial arch of *Porogobius schlegelii*

lack any visible projections.

Gut length to standard length ratio

Specimens of the fish studied measured 1.8-8.6 cm SL; the ratio of the gut length to standard length ranged from 0.20 to 1.28 with an average of 0.63. No clear relationship was observed between this ratio and fish size.

Stomach content

A total of 285 stomachs were examined and

TABLE 1

Percentage frequency of occurrence of the food of 285 *Porogobius schlegelii* specimens

Food item	Frequency (per cent)
Algae	47.0
Strands of macrophytes	74.7
Rotifers	6.4
Copepods	45.3
Ostracods	49.5
Insect larvae	9.2
Gastropods	21.8
Fish fry/eggs	4.6
Fish scales	16.8
Detritus	40.4
Sand particles	48.8

The percentage occurrence of the food items is presented in Table 1. Benthic algae, pieces of microphytes, copepods, ostracods, detritus and sand particles occurred in more than 20 per cent of the stomachs. Rotifers, insect larvae, fish eggs and fry, and scales were less frequently eaten, being present in a lesser proportion of the stomachs.

Of the algae taken, diatoms (mainly *Amphiprora* sp. and *Pleurosigma* and *Gyrosigma* spp.), desmids *Netrium digitus*, filamentous blue-green algae *Spirulina* sp. and *Anabaena* sp.), and the colonial blue-green alga, *Merismopedia* sp. were the most predominant. Copepods in the diet were species of *Microsetella*, *Euterpina* and *Cyclops*, and ostracods consisted of unidentified forms. *Lymnaea natalensis* was the commonest gastropod eaten by the fish.

Daily feeding activity

Results of the diel feeding study are shown in Fig. 4. The fluctuations in the percentage of fish with empty stomachs and the average index of stomach fullness indicate that the fish fed throughout the day. On 12-13 February 1993, feeding increased steadily from morning becoming most intense at 16.00, 20.00 and 24.00 h, while on 11-12 June feeding peaked at 16.00 h and was at a

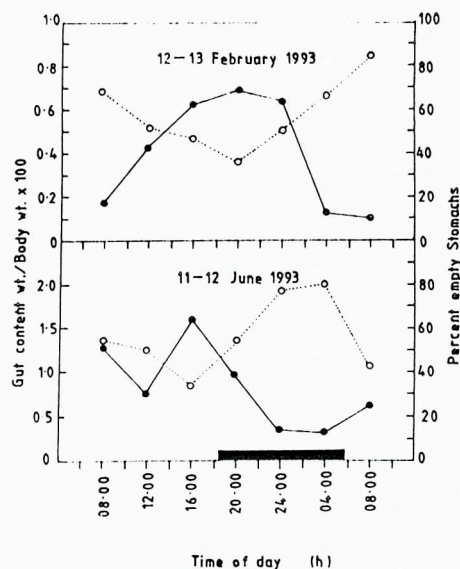


Fig. 4. Feeding periodicity of *Porogobius schlegelii* over two 24-h periods. Mean percent weight of food per body weight (●), percent of fish with empty stomachs (○). Bar indicates dark period.

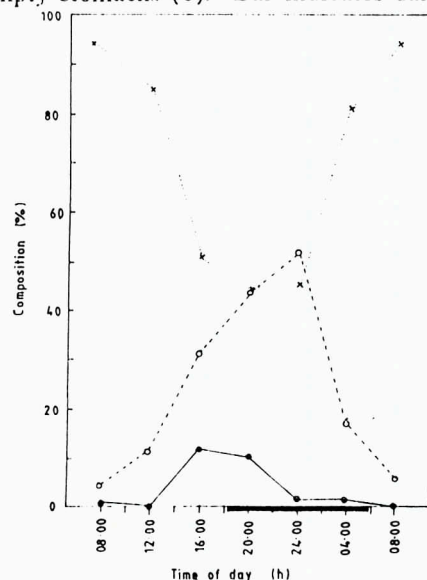


Fig. 5. Diet changes on the percentage numerical composition of gastropods (●), ostracods (○) and copepods (x) in the diet of *Porogobius schlegelii*.

minimum at 24.00-04.00 h.

The daily variations in the proportion of invertebrates commonly taken by fish on the two sampling days were combined and the results are presented in Fig. 5. The highest predation of copepods occurred from dawn till noon, and that of ostracods mainly around midnight. Gastropods were most intensely consumed in the late afternoon and at night.

Discussion

The anatomical features of *P. schlegelii*, such as the numerous caniform teeth and the widely-spaced gill rakers suggest canivory in the species; however, the pharyngeal bones with smooth glabrous surfaces are probably adapted for grinding smaller food particles. The short gut ($0.63 \times SL$) is also typical of canivores (Ilin, 1954, quoted in Hickling, 1970).

As indicated by the wide range of food items found in the stomachs, the *P. schlegelii* population in the Fosu Lagoon had an omnivorous diet consisting of both plant and animal matter. Although a short gut reduces the efficiency of digestion of large amounts of vegetable material in fish (Martinex-Palacios & Ross, 1988), a greater portion of the population fed on fronds of aquatic macrophytes and, to some extent, algae. Pauly (1975) found *Oxyurichthys* (= *Gobionellus*) *occidentalis* in the Sakumo Lagoon (Ghana) to feed entirely on phytoplankton. Wright (1988) also reported occasional consumption of algae by the gobiid fish, *Acentrogobius ornatus* in Kuwait although its food consisted chiefly of animals (e.g. harpacticoid copepods, amphipods, bivalves and polychaetes) and detritus).

Fish eggs and larvae found in the stomach of *P. schlegelii* were identified as those of the lagoon tilapia, *Sarotherodon melanotheron*. Predation of gobies on fish eggs fry has also been reported in Belgian coastal waters (Hamerlynck & Cattrijsse, 1994). Even though predation on these developmental stages of the lagoon tilapia appeared on a small scale (seen in 4.6 % of the stomachs), it could be of considerable ecological importance regarding control of their high recruitment rate (Blay & Asabere-Ameyaw, 1993)

Results of the present study show that *P. schlegelii* fed throughout the day. However, the diurnal and nocturnal rhythms observed in the feeding could be ascribed to differences in ecological conditions in the lagoon and/or the behaviour of the fish on the two sampling dates. Further studies involving simultaneous investigations of the feeding activity and prevailing

environmental factors over several 24-h samplings might throw more light on the feeding pattern most commonly exhibited by the *P. schlegelii* population in the Fosu Lagoon. Other workers (e.g. Gibson, 1993; Hamerlynck *et al.*, 1993) have nevertheless, reported that daily feeding rhythms are common in gobies.

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