

**PLANKTON-FEEDING AGGREGATION AND OCCASIONAL
CLEANING BY ADULT BUTTERFLYFISH,
CHAETODON STRIATUS (CHAETODONTIDAE),
IN SOUTHWESTERN ATLANTIC**

by

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ABSTRACT. Butterflyfishes of the genus *Chaetodon* (Chaetodontidae) are mostly bottom-feeders, and juveniles of some Pacific species are known to clean other fish. Herein we report on occasional cleaning by adult individuals of the Western Atlantic butterflyfish *Chaetodon striatus*, during their plankton-feeding aggregation. Four species of reef fish solicited cleaning to the butterflyfish amidst the aggregation.

RÉSUMÉ. Rassemblement alimentaire pour la capture de plancton et nettoyage occasionnel par des *Chaetodon striatus* (Chaetodontidae) adultes, dans l'Atlantique occidentale.

La plupart des poissons-papillons du genre *Chaetodon* (Chaetodontidae) recherchent leur nourriture sur le fond et les jeunes de quelques espèces du Pacifique sont connus comme nettoyeurs d'autres poissons. Nous avons observé un comportement de nettoyage occasionnel pratiqué par des *Chaetodon striatus* adultes, dans l'Atlantique occidentale, quand ils se regroupent pour capturer des organismes planctoniques. Quatre espèces de poissons récifaux sont venus se faire nettoyer par le groupe de chaetodons.

Key words. Chaetodontidae - *Chaetodon striatus* - ASW - Brazil - Planktivory - Group feeding - Cleaning behaviour.

On the coral reefs over the world, butterflyfishes (Chaetodontidae) are conspicuous components of the reef community, usually seen in pairs or solitary, sometimes in aggregations a few meters above the sea floor (e.g., Itzkowitz, 1974; Allen *et al.*, 1998). Species of the genus *Chaetodon* are mostly bottom-foragers, although some species forage for plankton in the water column (Hobson, 1974, 1991; Motta, 1988; Allen *et al.*, 1998). The diet of the bottom-foraging butterflyfishes consists primarily of anthozoans, polychaetes and algae. The plankton-feeders forage mainly on copepods (Hiatt and Strasburg, 1960; Randall, 1967; Hobson, 1974; Motta, 1988; Pitts, 1991). Except for *Chaetodon aya* from deep reefs and *Chaetodon obliquus* from oceanic islands, whose habits are largely unrecorded, the remaining five butterflyfish species of the West Atlantic are bottom-feeders known to feed mostly on anthozoans and polychaetes (Randall, 1967; Birkeland and Neudecker, 1981; Pitts, 1991). Group foraging for plankton in the water column remains largely unreported for West Atlantic chae-

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todontids.

Cleaning symbiosis among reef fishes is an interaction by which a fish obtains food from the body of another fish, which, in turn, is rid of its ectoparasites (Losey, 1971, 1987). Among the chaetodontids, cleaning is recorded for a few Pacific species such as *Heniochus diphreutes*, *Chaetodon litus*, and *Chaetodon plebeius* (the two latter as juveniles), as well as the schooling adults of *Johnrandallia nigrirostris* (Hobson, 1968; Van Tassell *et al.*, 1994; Allen *et al.*, 1998; Côté, 2000). For the Western Atlantic, there is a cursory mention of cleaning activity by "*Chaetodon* sp. (young of several species)" in Ray and Ciampi (1958) and Feder (1966) without, however, any substantiated or further record. We report and comment herein on two unusual behaviours for adult individuals of the banded butterflyfish, *Chaetodon striatus*, namely plankton-feeding aggregation, and occasional cleaning of other fish that joined the group and posed there.

MATERIAL AND METHODS

Our records were made on the rocky reefs of Santa Barbara Island, Abrolhos National Marine Park, Abrolhos Archipelago (17°58'S 138°42'W), off eastern Brazil, in December 1999. The rocky ledges composing the reef are sparsely to thickly covered by brown foliose algae, red coralline algae, and stony corals (see Leão, 1994 for a description of the Abrolhos reef complex). Depth at the study site ranged from 3-6m, water temperature ranged between 24-27°C, and the water was slightly turbid at the time of our observations (4m horizontal visibility). There were numerous planktonic organisms (salps, copepods) patchily distributed over the reef.

The plankton-feeding aggregation and cleaning behaviour of *Chaetodon striatus* was observed over five days while scuba diving. During observational sessions of 15-20 min we used 'focal animal' sampling, in which all occurrences of specified actions were recorded (Altmann, 1974). Besides records pencilled on plastic slates, behavioural events were photographed and video-recorded, the tape being on file at the Museu de História Natural, Universidade Estadual de Campinas (ZUEC tape # 7).

RESULTS

A loose aggregation of adult banded butterflyfish, *Chaetodon striatus*, hovering about 0.5-1.5m above the sea floor, was recorded over five days. The fishes measured 10-12cm total length, and their numbers varied over the five days (about 10-20 individuals, see below). Most of the individuals lined up loosely (Fig. 1), heading the weak surge current, and occasionally picked organisms from the plankton. The feeding aggregation was recorded during the rising tide and throughout the morning. Later in the day the butterflyfish foraged singly or in pairs on the bottom. Over the five days, the number of aggregated individuals, as well as the aggregation time (estimated only), decreased. On the first day we counted 18-20 aggregated individuals, which decreased to 10-12 fish on the fifth day.

Within the aggregation, the butterflyfish maintained a slightly oblique, head-down posture and on occasions picked off plankters from the water column. On close observation we were able to record salps and drifting algae pieces picked up by the fish. Occasionally a few individuals or even the whole group lowered to the bottom, where they apparently picked at organisms among the attached algae, and after a while they rose up again to 0.5-1.5m



Fig. 1. A plankton-feeding aggregation of adult banded butterflyfish, *Chaetodon striatus*, at the Abrolhos National Marine Park, Brazil. A grey parrotfish, *Sparisoma axillare*, is soliciting cleaning while hovering in a head-up oblique posture (another parrotfish is leaving the group after posing there briefly).

above the sea floor. We recorded several instances of agonistic interactions within the aggregation. Most interactions consisted of short chases, but two individuals twice engaged in side-to-side swimming followed by head-to-tail rounds moving in a carousel-like fashion, and then turning to side-to-side swimming again. After a while they ceased this formation and one individual chased the other over a short distance, both of them returning to the aggregation thereafter.

We recorded four species of reef fishes joining the butterflyfish aggregation, posing there and being cleaned: the grey parrotfish *Sparisoma axillare* and Agassiz's parrotfish *Sparisoma frondosum* (Scaridae), the surgeonfish *Acanthurus chirurgus* (Acanthuridae), and the white grunt *Haemulon plumieri* (Haemulidae). The two latter also fed on drifting algae and plankton amidst the grouped butterflyfish, whereas the parrotfishes only solicited cleaning. Size of clients ranged 8–18 cm for the parrotfishes and surgeonfish and 22–25 cm for the white grunt. The clients approached the butterflyfish aggregation singly, in pairs, or in small groups (3–8 individuals) amidst the grouped fish or rarely at the periphery of the aggregation (Fig. 1). The client fish solicited cleaning services by hovering and posing for a few seconds amidst the butterflyfish. The parrotfishes hovered in an oblique head-up posture, whereas the white grunt adopted a head-down posture (see Losey, 1971 for classification of client poses).

Table 1. Decline in the number of soliciting poses of two client fish species and their cleaning by adult butterflyfish, *Chaetodon striatus*, along three of five consecutive days in the Abrolhos National Marine Park, Brazil. N refers to the number of recorded events during an observation session of 15 min per morning, at the same time each day.

Client fish species	First day	Third day	Fifth day
	Posed/cleaned (n)	Posed/cleaned (n)	Posed/cleaned (n)
<i>Sparisoma axillare</i>	14/4	7/0	1/0
<i>Acanthurus chirurgus</i>	7/2	4/1	0/0

Some of the butterflyfish individuals briefly inspected a posing client and delivered one to three fleeting nibbles at its body. The cleaner aimed mostly at the flanks of its client, a behaviour recorded for several species of less specialised cleaners (Hobson, 1976; Van Tassel *et al.*, 1994). After some of the nibbles the client shuddered a little, a behaviour indicative of parasite or tissue removal (Losey, 1971, 1993; Sazima *et al.*, 1998). Both the soliciting poses of the clients and the cleaning by the butterflyfish were more intense on the first day we recorded the aggregation, declined thereafter and almost vanished on the fifth day (Table 1). We recorded no posing or cleaning behaviour on the sixth day, when the aggregation was reduced to about 6-8 butterflyfish mostly foraging on the bottom. At that time plankton drift decreased notably.

DISCUSSION

Plankton-feeding aggregation among West Atlantic butterflyfishes remains largely unreported, although some Pacific *Chaetodon* species engage in such behaviour. The Hawaiian *Chaetodon kleinii* (mentioned as *C. corallicola* in Hobson, 1974) and *Chaetodon miliaris* forage on plankton while swimming in pairs or in loose aggregations a few meters above the sea floor, picking mostly copepods from the water column (Hobson, 1974, 1991; Motta, 1988). The feeding aggregation of *Chaetodon striatus* recorded herein is typical of the feeding behaviour recorded for several diurnal reef planktivores (Hobson, 1991) and is especially reminiscent of the plankton-feeding aggregation described for the pomacentrid *Abudefduf saxatilis* (Fishelson, 1970). Groups of *Chaetodon sedentarius*, as well as *C. striatus* were recently observed foraging on plankton in the cold water coastal up-welling zone at Cabo Frio, south-eastern Brazil (C.E.L. Ferreira, pers. com., August 2000), which raises to two the number of Atlantic chaetodontid species known to aggregate while feeding on plankton. Corallivorous and bottom-feeding butterflyfish species usually occur in pairs, whereas the planktivorous ones are generally found in aggregations, although several species have been recorded in more than one social category (Hourigan, 1989). However, a clear correlation occurs between planktivory and schooling, and between corallivory and pair-bonding (Hourigan, 1989). *Chaetodon striatus* is a relatively morphologically generalised butterflyfish species (Motta, 1988), and thus shifts from one diet/social system to another would be expected. *Chaetodon sanctaehelenae* is another species known to forage in pairs on the bottom and to aggregate while foraging on plankton in the water column (Hourigan, 1989).

Agonistic interactions occasionally occur within spawning and other aggregations, and intrasexual aggression is recorded in pair mating butterflyfishes (e.g., Hourigan, 1989; DeLoach, 1999). In the Western Atlantic, *Chaetodon capistratus* may spawn in pairs or in social groups, but *C. striatus* is known to spawn in pairs only (Colin, 1989; DeLoach, 1999). Although the reproductive season of the latter species occurs from August to January on the coast of Brazil (Carvalho-Filho, 1999), at the time of our observations the grouped individuals were engaged in plankton feeding with no spawning behaviour recorded. Thus, we believe that the intraspecific agonistic interactions of the plankton-feeding *C. striatus* are related to defence of temporary feeding spots, not to reproductive activities, even if Hourigan (1989) points out that defence of plankton resource is uneconomical for the planktivorous butterflyfishes. As *C. striatus* is essentially a bottom-feeder, usually solitary or paired while feeding, and has a small home range (Bardach, 1958; Randall, 1967; Pitts, 1991), the suggestion of Hourigan (1989) may not apply to this species and its aggregated feeding would create an opportunity for agonistic interactions (inasmuch as search for food increases the chance of

encounters and proximity between individuals; see Curio, 1976). Plankton drift is not often available at the study site (pers. obs.) and its unpredictable occurrence creates favourable conditions both for the occasional feeding aggregation and the associated agonistic interactions between the individuals of this usually non-schooling and non-aggressive species (Itzkowitz, 1974).

The only record of cleaning activity by chaetodontids in the Western Atlantic seems to be a brief and apparently unsubstantiated mention of *Chaetodon* spp. juveniles (Ray and Ciampi, 1958; Feder, 1966). However, cleaning behaviour is known for some Pacific species of *Chaetodon*, mostly solitary and which engage in this activity as juveniles (Van Tassel *et al.*, 1994; Allen *et al.*, 1998). Several reef fish species practise cleaning only as juveniles (Limbaugh, 1961; Van Tassel *et al.*, 1994; Sazima *et al.*, 1998), and this appear to be the case of the Pacific *Chaetodon* species as well (Feder, 1966; Allen *et al.*, 1998; Côté, 2000). Thus, our record of aggregated *Chaetodon striatus* adults engaged in cleaning seems a novelty for the genus, although both the feeding behaviour (slight forward lunges and lateral jerks) and the grabber-tearer dentition type of this species (teeth set in distinct rows, the labial ones more spatulate, see Motta, 1989) seem well suited for removal of ectoparasites and mucus from the body of other fish (Losey, 1987).

A Pacific scorpidid, *Atypichthys strigatus*, is a schooling planktivore which also feeds on benthic organisms and cleans other fish occasionally (Glasby and Kingsford, 1994). In this sense, the aggregated *Chaetodon striatus* may be compared to *A. strigatus* (albeit the banded butterflyfish is a benthic forager that may feed on plankton). The fish cleaned by *A. strigatus* responded to its cleaning activity by toleration or accommodation and there is no mention to previous soliciting behaviour, the interaction being initiated by the scorpidid swimming beside the fish and taking a bite from its flank (Glasby and Kingsford, 1994). These authors suggest that cleaning by *A. strigatus* may become more common when plankton supply is low, and thus cleaning would supplement the diet of this scorpidid (Glasby and Kingsford, 1994). However, we believe that the very occasional cleaning behaviour by *Chaetodon striatus* was mostly induced by the conspicuous posing behaviour of the soliciting fish rather than due to dietary causes. Plankton was not in low supply during our observations and, additionally, mucous material (an energy-rich source sought after by cleaners on the body of other fish; see Gorlick, 1980) may be obtained from anthozoans, a usual component of the banded butterfly diet (Randall, 1967; Pitts, 1991).

Plankton-feeding and cleaning activity by adult, schooling individuals were previously unrecorded for the genus *Chaetodon* and possibly are restricted to a particular set of conditions. During the period we recorded the banded butterflyfish aggregation, planktonic drift was unusually evident (during the same period we observed another two fish species plankton-foraging in groups, an uncommon event at the study site). Specialised cleaners are known to feed on mucus and include planktonic crustaceans in their diets when parasite loads of the clients are low (Grutter, 1997). At Marshall Islands, in the Pacific, the specialised cleaner labrid *Labroides dimidiatus* was recorded to clean less when plankton was unusually plentiful (G.S. Losey, Jr., pers. com., January 2001). However, for *Chaetodon striatus* cleaning is very occasional and we thus believe that the episodic abundance of drifting plankton possibly led the butterflyfish to aggregate and feed on this occasional and plentiful source and, in turn, their boldly patterned assembly elicited posing behaviour in some reef fish amidst the conspicuous aggregation. At our study site, the same species of fish recorded posing for the butterflyfish habitually solicit cleaning from yellow and black patterned cleaners such as the porkfish *Anisotremus virginicus* and the French angelfish *Pomacanthus paru*, at whose cleaning stations large fish aggregations may occur (Sazima *et al.*, 1999; pers. obs.). Thus it seems that

the plankton-feeding aggregation and the cleaning activity by the banded butterflyfish are related (the latter most probably would not occur in the absence of the former). We recorded a similar sequence of events (plankton drift - feeding aggregation - posing behaviour - cleaning interaction) for another boldly patterned fish, the pomacentrid *Abudefduf saxatilis*, in south-eastern Brazil. We propose that the combination of a plankton-feeding aggregation and occasional cleaning may occur in other fish species as well, and that our *Chaetodon* record possibly follows a more general pattern. However, the possibility remains that our record relates to an event very localised in space and time, and/or to a rare behaviour restricted to a few populations of butterflyfishes.

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