

# Cleaning by the occasional cleaner *Diplodus argenteus* (Perciformes: Sparidae) in south Brazil: why so few client species?

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Here I record the cleaning activity of the occasional cleaner *Diplodus argenteus* at rocky reefs off southern Brazil. *Diplodus argenteus* juveniles are referred to as occasional cleaners, but there is no further description of their cleaning activity in the literature. Only two fish species were here recorded as clients, which I hypothesize to be related to a lack of visual attractiveness of *D. argenteus* cleaning services.

## INTRODUCTION

Cleaner fish feed on ectoparasites, mucus and dead skin from the surface of client fish. In this interaction, known as ‘cleaning symbiosis’, cleaner organisms obtain food and clients get rid of parasites (Grutter, 1999; Côté, 2000). Visual signs are often regarded as an important feature of cleaning organisms, which helps them attract clients (Stummer et al., 2004; Becker et al., 2005; Arnal et al., 2006). Many specialized cleaner fish have contrasting colour patterns that appear to play an important role in helping them attract their clients, and consequently increase the frequency of cleaning associations (Stummer et al., 2004; Arnal et al., 2006). Some types of colour patterns are also considered to play an important role in the evolution of cleaning behaviour in some reef fish families, the striped contrasting colour pattern being considered a prerequisite for cleaning (Arnal et al., 2006).

Although many reef fish species are considered occasional cleaners, which clean less frequently than specialized cleaners and usually only as juveniles (see examples in Randall et al., 1997; Deloach, 1999), they are usually ignored in studies of cleaning symbiosis. The proximate causes of the lower cleaning rate of occasional cleaners are yet to be investigated, but one plausible reason is that some occasional cleaner species are visually less attractive to potential clients than specialized cleaner fish.

The silver porgy, *Diplodus argenteus* (Valenciennes), is a common, diurnally active reef fish species on the Brazilian coast, and usually swims and feeds on groups, both as juveniles and adults (Carvalho-Filho, 1999). Juveniles are referred to as occasional cleaners (Carvalho-Filho, 1999), but there is no further description of their cleaning activity in the literature. Moreover, despite a dark spot on the caudal peduncle, juvenile silver porgy typically have a silvery uniform colour pattern and do not have a contrasting colour pattern as is typical of specialized cleaners (Carvalho-Filho, 1999; Stummer et al., 2004).

The cleaning activity of juvenile *D. argenteus* (up to about 8 cm TL) was recorded at the Ilha do Arvoredo (27° 17'S

48° 18'W), in the Marine Biological Reserve of Arvoredo, 15 km off the coast of Santa Catarina, southern Brazil. The main questions addressed in this study were: (1) how often does *D. argenteus* clean other fish at the Ilha do Arvoredo? (2) What fish species are cleaned by *D. argenteus* at the Ilha do Arvoredo? (3) Are there other potential cleaner fish at the Ilha do Arvoredo? The data on cleaner activity of *D. argenteus* were also complemented with cleaning activity and behaviour records from rocky reefs of Praia da Vigia, about 80 km south of the Ilha do Arvoredo.

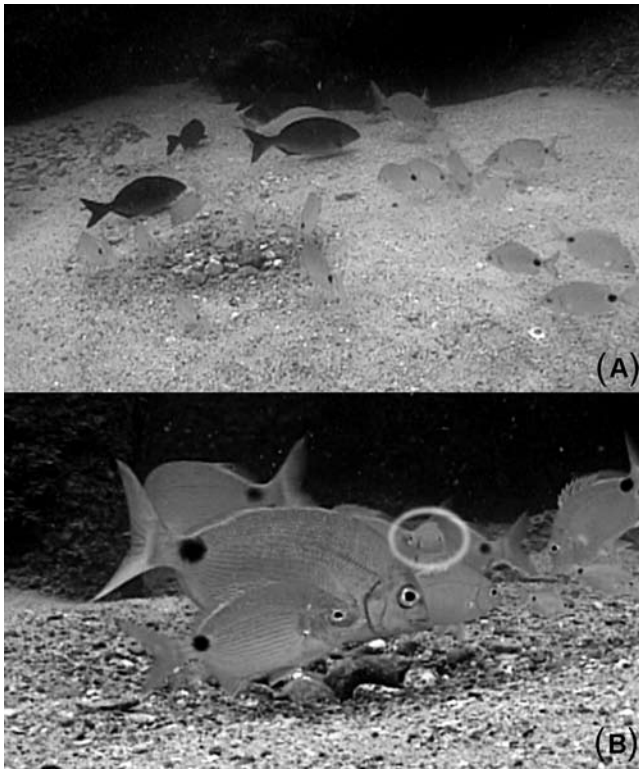
## MATERIALS AND METHODS

Twenty-eight SCUBA dives were conducted at the Ilha do Arvoredo in summer from 1999 to 2005, amounting to about 23 h of direct observation. About 70% of the dives were conducted on the southern shore of the island. Depth ranged from 3 to 15 m, water temperature was 20–28°C, and visibility ranged from 4 to 15 m. During each dive the rocky shore was haphazardly surveyed and the cleaning activity of juvenile *Diplodus argenteus* was registered. Once a cleaning interaction was found it was video-recorded for up to five minutes. Special attention was paid to the overall cleaning behaviour of focal individuals and the client species were identified. Cleaning interactions between other cleaner fish and their clients were opportunistically recorded during the study, and all client species found were also recorded.

At the Praia da Vigia, the cleaning activity of *Diplodus argenteus* was opportunistically recorded during 3 h of snorkelling sessions on two consecutive days. The behaviour of the cleaner fish and client species were recorded on plastic slates and photographed.

## RESULTS

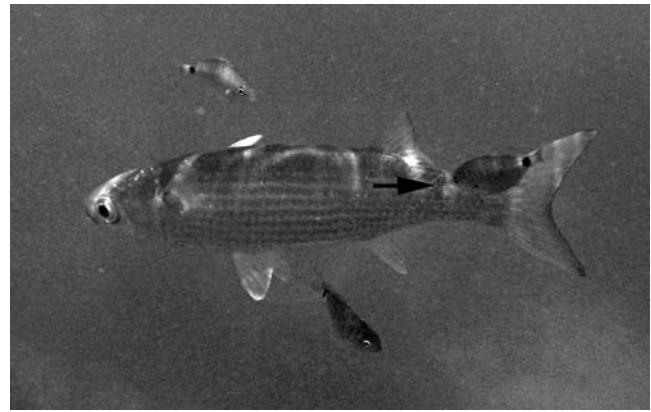
*Diplodus argenteus* is a very common species at the Ilha do Arvoredo (Hostim-Silva et al., 2006; personal observation). Both juveniles and adults were observed in all dives, but only three instances of cleaning activity by juveniles were recorded, which were on the south coast. One record was



**Figure 1.** (A) The client fish *Diplodus argenteus* (silvery) and *Kyphosus sectator* (dark) seeking cleaning at a transitory cleaning station of juvenile *D. argenteus*, on the south coast of the Ilha do Arvoredo, South Brazil; (B) details of an adult *D. argenteus* being cleaned by a juvenile conspecific (circle) at the same cleaning station as in (A). (Both pictures taken from a video by Roberta M. Bonaldo).

in December 1999 at a dive site called ‘Saco do Vidal’, and two were in January 2002 at a dive site called ‘Saco do Batismo’. The depth was 8 m, visibility was 8 m, and the water temperature ranged from 25 to 28°C. A total of approximately 6 min of the cleaning activity of *D. argenteus* was video-recorded. A copy of the record is deposited as a voucher in the Museu de História Natural da Universidade Estadual de Campinas (ZUEC tape no. 27).

During the cleaning activity, juvenile *D. argenteus* (2.5–6 cm total length) were grouped in 4–12 individuals 5–10 cm above the sandy bottom, and 50 cm from the rocky coast (Figure 1A). The juvenile *D. argenteus* cleaned client fish that swam towards the cleaner fish group, and posed in an oblique head-down position (Figure 1B). Although there are about 270 reef fish species at Ilha do Arvoredo (A. Carvalho-Filho; personal communication), the only species recorded as clients were adult *D. argenteus* (about 60 individuals) and the chub *Kyphosus sectator* (Linnaeus) (Perciformes: Kyphosidae) (12 individuals). While posing for the cleaner fish, ten out of the 12 *K. sectator* individuals that were recorded changed their usual silvery colour pattern to a darker uniform colour with or without light spots (Figure 1A). The cleaning interactions between a single cleaner and client fish lasted about 1–4 s and the cleaner fish took usually only one bite over the client’s body during each interaction. The cleaner fish groups left the place where they were cleaning about 10–40 min after the beginning of the records. During dives on consecutive days (21 and 22 January 2002) the cleaner



**Figure 2.** A *Mugil* sp. individual being cleaned by three juvenile *Diplodus argenteus* near a reef promontory at Praia da Vigia, South Brazil. The arrow indicates an ulceration being inspected by a *D. argenteus* individual.

fish were not found cleaning in the same place where they were the day before, suggesting that *D. argenteus* have some flexibility in cleaning locations.

Other cleaning interactions observed at Ilha do Arvoredo involved the juvenile angelfish *Pomacanthus paru* (Bloch) as the cleaner and the grunts *Anisotremus virginicus* (Linnaeus) and *Haemulon aurolineatum* Cuvier, the butterflyfish *Chaetodon striatus* Linnaeus, the goatfish *Pseudupeneus maculatus* (Bloch), and *D. argenteus* as its clients. At all times *P. paru* was seen (N=7) it was cleaning other fish species. Juvenile *P. paru* were found on cleaning stations where usually 2–15 reef fish individuals were seeking its cleaning services. Moreover, other reef fish which were not recorded in cleaning interactions during this study are known to act as cleaners at Ilha do Arvoredo. The damselfish *Abudefduf saxatilis* (Linnaeus) is a common species at Ilha do Arvoredo (personal observation) and its juveniles are known to occasionally clean other reef fish (Sazima, 1986).

As the parasitic load of clients is usually regarded as the main proximate cause of cleaning symbiosis (Grutter, 2001; Bansemmer et al., 2002), it is worth noting that many reef fish individuals that may be considered as potential clients for cleaner fish showed ulcerations at Ilha do Arvoredo. Such ulcerations are plausibly caused by parasitic infection (see Limbaugh, 1961; Hostim-Silva et al., 2006). Although not counted, these ulcerations appeared to be especially common on mullet (*Mugil* spp.), the planehead filefish *Stephanolepis hispidus* (Linnaeus) (Hostim-Silva et al., 2006), and occasionally on the comb grouper *Mycteroperca acutirostris* (Valenciennes).

Additionally, the cleaning activity of juvenile *D. argenteus* was recorded on two consecutive days (4–5 January 2006) at Praia da Vigia. A large group (approximately 400 individuals) of juveniles and adults were documented in an aggregation over a reef pinnacle, about 20 m from the rocky shore. Depth was 5 m and water visibility was 10 m. On the first day, juvenile *D. argenteus* among the group were cleaning conspecifics and 11 individuals of *Mugil* sp., which swam towards the *D. argenteus* group. At least three of the *Mugil* sp. individuals showed large ulcerations near the dorsal fin base and on the caudal peduncle (Figure 2). Juvenile

*D. argenteus* promptly cleaned the *Mugil* sp. individuals, and especially those with large ulcerations (Figure 2). On the second day, juvenile *D. argenteus* were only seen cleaning their conspecifics, where their behaviour was similar to that recorded at Ilha do Arvoredo. Juvenile *A. saxatilis* individuals were also observed among the *D. argenteus* group, but they rarely cleaned despite a few instances where they were recorded to briefly clean adult *D. argenteus* individuals that posed with their heads down.

## DISCUSSION

Compared to some specialized cleaner fish species (e.g. the gobies *Elacatinus figaro* Sazima et al. (2000) and *Elacatinus* cf. *randalli* Böhlke & Robins; and juvenile *Pomacanthus paru*) and even other occasional cleaner fish (e.g. *Abudefduf saxatilis* and *Chaetodon striatus*) from the Brazilian coast, *Diplodus argenteus* is less active as a cleaner and attends to fewer client species (see Sazima et al., 1999, 2000, 2004; Sazima & Sazima, 2001).

The cleaning activity (e.g. feeding frequency and frequency of interactions) of a cleaner fish has often been related to the parasitic load of its clients (Grutter, 2001; Bansemmer et al., 2002). Thus, the differences between the cleaning activity of *D. argenteus* and other cleaner fish could plausibly be related to differences of parasitic load of their clients. However, this hypothesis does not explain the apparently lower frequency of *D. argenteus* cleaning interactions when compared with other cleaner fish from the Brazilian coast. *Diplodus argenteus* is widely distributed on the Brazilian coast (Carvalho-Filho, 1999) and has a much lower frequency of interactions than other sympatric cleaners (personal observation). Moreover, many reef fish at Ilha do Arvoredo and Praia da Vigia showed large ulcerations, implying a high parasitic load (Hostim-Silva et al., 2006). Thus, a more plausible hypothesis is that the lower cleaning activity of *D. argenteus* compared with other cleaner fish is due to a lower attractiveness of its cleaning services. Since *D. argenteus* does not have the typical striped or contrasting colour pattern of a specialized cleaner fish it probably lacks a recognizable cleaner guild signal (Stummer et al., 2004; Arnal et al., 2006), and thus would be non visually attractive to potential clients. This hypothesis is strengthened by the higher cleaning frequency and larger number of client species of *P. paru* at Ilha do Arvoredo. *Pomacanthus paru* is a ubiquitous cleaner as a juvenile and has a contrasting striped colour pattern (DeLoach, 1999; Sazima et al., 1999) and, although it shares the same potential clients with *D. argenteus*, it is clearly more sought after as a cleaner. In Abrolhos Archipelago, eastern Brazil, *P. paru* is regarded as a specialized cleaner due to its wide and species-rich client assemblage (Sazima et al., 1999).

The bulk of clients for a non-attractive cleaner fish may be potential client fish that haphazardly pass nearby, rather than clients that are attracted by the visual signs of the cleaner fish. Thus, non-attractive cleaner fish species that usually travel in groups of both adults and juveniles probably associate in much higher frequencies with their conspecifics. This latter suggestion may explain why the bulk of the clients of *D. argenteus* are members of its own species.

The differences in the cleaning behaviour and cleaning activity between specialized and occasional cleaner fish are hypothesized to be related to their attractiveness (this study),

but may also be plausibly related to the parasitic load of clients (Grutter, 2001; Bansemmer et al., 2002). These hypotheses are not easy to adequately test in the field. However, comparative field studies could be instrumental to elucidate the problem. Such studies might include: (1) the activity and behaviour of occasional and specialized cleaners in different areas (see Sazima et al., 1999); (2) the list of client species attended by the cleaner fish in these different areas (see Johnson & Ruben, 1988); and (3) the parasitic load of potential clients in the different areas where occasional cleaner are known to be more and less active. On the south-eastern and southern Brazilian coast, these data are especially hard to obtain due to the generally poor water visibility and variable weather conditions, which prevent underwater observation for successive days. Thus, hypotheses about differences in cleaning behaviour and activity between specialized and occasional cleaner fish in southern Brazil would mostly be developed by opportunistic studies such as this one.

Several common reef fish species are considered occasional cleaners elsewhere (see Randall et al., 1997; DeLoach, 1999; Shepherd et al., 2005), but are usually ignored in behavioural studies (but see Shepherd et al., 2005). Studying the activity and behaviour of occasional fish cleaner species in places with better water visibility and more stable weather conditions would be of great value for understanding their ecological role and why their cleaning rates are lower than those of specialized cleaners.

I thank R.M. Bonaldo for help in the field, video-recording the cleaning activity of *Diplodus argenteus* and reading the manuscript; C. Mantyka for reading and correcting the English; A. Carvalho-Filho and I. Sazima for access to their unpublished data; I. Sazima for suggestions in the manuscript; S.A. Shepherd for providing literature; M.S. Maule for help in the field; and FAPESP for financial support. I dedicate this paper to I. Sazima, whose skilful and open mind showed me the windows for the study of natural history of reef fish.

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Submitted 27 September 2006. Accepted 18 May 2007.