

Diplodus argenteus behaviour as eavesdroppers: an interaction with scuba diving

O comportamento de *Diplodus argenteus* como bisbilhoteiros: uma interação com mergulhadores

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Resumo Durante o mês de janeiro e outubro de 2006 a espécie de peixe *Diplodus argenteus* foi observada em um total de 32 horas na porção sul (abrigada) da Ilha Escalvada (20°41'S; 40°24'W), região sul do Espírito Santo, sudeste do Brasil, com o objetivo de descrever a interação entre a espécie e mergulhadores autônomos. Foi observado que a espécie *D. argenteus* segue os mergulhadores até ninhos de espécimes de outro peixe *Abudefduf saxatilis*, onde um indivíduo protege seus ovos contra predadores. Quando o defensor (*A. saxatilis*) foge em função da proximidade dos mergulhadores *D. argenteus* consome os ovos do ninho. O comportamento descrito serve como subsídio a tomada de medidas para conservação de áreas recifais na região na conscientização de mergulhadores quanto ao seu comportamento durante a atividade.

Palavras-chaves: *Abudefduf saxatilis*, ninho de presas, territorialismo, sudeste do Brasil, Atlântico ocidental.

Abstract During January and October 2006 the fish species *Diplodus argenteus* was observed achieving a total of 32 hours effort. This study was taken in the south portion (sheltered) of Escalvada Island (20°41'S; 40°24'W), south region of Espírito Santo State, southern Brazil. The goal of this study was to describe the interaction between this species and SCUBA divers. Was observed that *D. argenteus* follows SCUBA divers until they approach nests of other fish species (*Abudefduf saxatilis*), where an individual protect the eggs. When this guardian moves away, frightened by the approximation of the diver, *D. argenteus* take advantage of the absence of the guardian and forage over the unprotected eggs. The description of this behaviour provide information to SCUBA diver centers to alert their costumers to conduct their activities according to conservations protocols in order to preserve the reef areas in the south of Espírito Santo.

Keywords: *Abudefduf saxatilis*, nest prey, territorialism, southern Brazil, Western Atlantic.

Introduction

Many animals use information produced by other organisms to find food, mates or avoid predators. Such organisms are referred as “eavesdroppers” or “observers”. The transmitted information may be simply the demonstrating individuals behaviour toward a particular audience, developing a “social learning” via observation (McGregor 1993, Heyes and Galef 1996, Brown and Laland 2003). Social learning is usually associated to large-brained animals. However, over the last 50 years studies have demonstrated that social learning is a common feature in fishes regarding to ethology, behaviour, ecology and comparative psychology (Galef and Giraldeau 2001, Shettleworth 2001, Brown and Laland 2003). Despite its importance, eavesdropping has been ignored within the social learning literature.

The species involved in this kind of behaviour, eavesdropping, are the fishes *Abudefduf saxatilis* (Linnaeus, 1758 - Pomacentridae) and *Diplodus argenteus* (Valenciennes, 1830 - Sparidae). The first one is a cosmopolitan species, widely distributed over Brazilian rocky reefs occurring from one to 40 meters deep (Carvalho-Filho 1999, Barreiros *et al.* 2004; Floeter *et al.* 2006a; Floeter *et al.* 2006b). It's an opportunistic fish which forage over benthic organisms, plankton in the water column and also acting as cleaner (Hoelzer 1992, Fitzgerald 1992, Hoelzer 1995, DeLoach 1999, Sazima and Sazima 2001, Sazima *et al.* 2004). Despite Pomacentridae fish usually defend feeding territories, *A. saxatilis* presents this behaviour only in reproductive periods protecting the eggs until they hatch with larvae being released in the plankton. In this period individuals become bluish

colored (Fishelson 1970, Helfman 1997, DeLoach 1999, Araújo *et al.* 2004, Knouft and Page 2004). The other species (*D. argenteus*) are distributed along the Western Atlantic from southern Florida (USA) to South America (Argentina). This fish feeds on benthic invertebrates, algae and preys on *A. saxatilis* eggs, a feeding behaviour that is described in the present note (Sazima *et al.* 2000, Peña *et al.* 2004, Barreiros *et al.* 2004, Ferreira *et al.* 2004, Galván *et al.* 2005, Floeter *et al.* 2006a, Floeter *et al.* 2006b).

Many studies have demonstrated negative impacts of marine recreation over coral reefs, such as reef walking (Kay and Liddle 1989), boating (Rogers 1988), snorkeling and SCUBA diving (Ward 1990, Hawkins and Roberts 1992, Dixon *et al.* 1993, Prior *et al.* 1995, Roupheal and Inglis 1995, Allison 1996, Harriott *et al.* 1997). Unlike other interactions that cause damage on reef environments, SCUBA diving does not necessitate physical contact with organisms. Damage usually occurs when divers accidentally or intentionally bump, kick, stand, kneel, hold or touch substrate, therefore, the impact relies in the experience and behaviour of SCUBA divers (Tagle 1990, Davis *et al.* 1995).

Methods

In this study the observations of this interaction were made in the south (sheltered) portion of Escalvada Island (20°41'S; 40°24'W), south region of Espírito Santo State, Southeastern Brazil. The island is 10 kilometers away from the coast and presents vertical rocky foreheads with sandy bottom at 20 meters deep. During January and October 2006 several dives were made in the study region establishing a total of 32 hours of observation. *Abudefduf saxatilis* nest was observed through animal focal methodology in spots where the number of SCUBA divers was higher. *Diplodus argenteus* was observed following divers until they approach *A. saxatilis* nest, which was defended by one specimen, usually bluish colored. When this approach was closer enough the guardian specimen of *A. saxatilis* swam away from the nest given the opportunity to *D. argenteus* to forage on unprotected eggs.

Results and discussions

During this attack, other species were observed taking advantage over the interaction such as *Bodianus rufus* (Linnaeus, 1758) and *Holacanthus tricolor* (Bloch, 1795). When the diver moved away from the nest the guardian *A. saxatilis* specimen immediately returned to banish the egg predators (Figures 1 and 2). In all the observations performed *D. argenteus* school (approximately 100 individuals) followed the divers, and all the approaches observed from divers to the nest ($n = 23$), this fish take advantage from the

absence of *A. saxatilis* to forage over eggs. The attack to *A. saxatilis* nests never occur without following a diver during our observations. In this dive spot the number of divers can vary from six to 30 divers, especially during summer. This behaviour was also observed in other regions of Brazilian rocky reef, with different opportunistic fish species, *Haemulon aurolineatum* (Cuvier, 1830) and *Anisotremus virginicus* (Linnaeus, 1758), but the same prey species, *A. saxatilis* (O. Luiz-Junior; C.E.L. Ferreira, unpublished data).

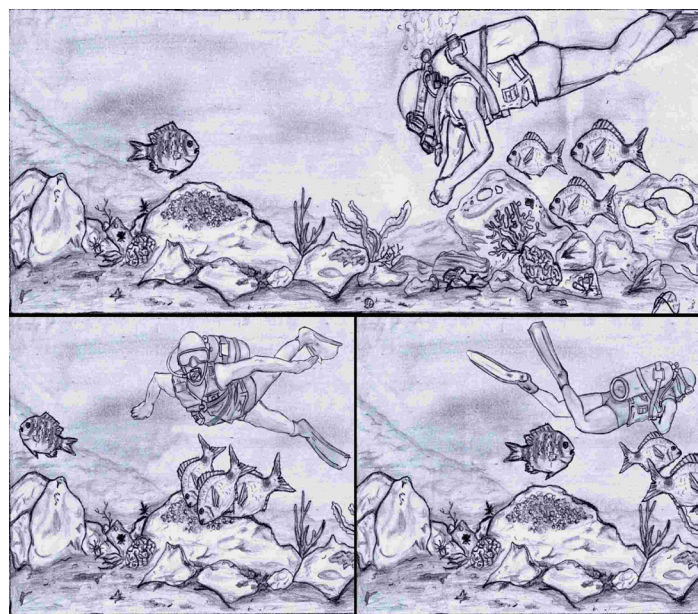


Figure 1 Illustration of the behaviour of *Diplodus argenteus* as eavesdroppers. In the first moment *D. argenteus* follow divers during their recreational activities. In the second moment the diver approaches the *Abudefduf saxatilis* nest, scaring the guardian away, allowing *D. argenteus* to forage over the eggs unprotected. In the third moment, the diver moved away from the nest and *A. saxatilis* return to defend it, scaring away this time *D. argenteus* (Illustration by Loureiro, G. C).



Figure 2 The moment of eavesdropping *in locus*, at Escalvada Island. When this guardian moves away, frightened by the approximation of the diver, *Diplodus argenteus* take advantage of the absence of the guardian and forage over the unprotected eggs. The presence of the photographer scared the guardian of the nest (Photo by Krohling, W).

This opportunistic feeding behaviour of *D. argenteus* can be classified as a 'local enhancement' or 'stimulus enhancement' in the Eavesdropper literature (Brown and Laland 2003), which is defined

as the behaviour (or simple presence) of one individual (in this case SCUBA diver as an animal). Humans (including divers, of course) are animals that attracts the attention of another individual (in this case *D. argenteus*) to a particular location or stimulus, about which the naïve individual – *D. argenteus* subsequently learns something. Therefore, the species in question learn from the observation of a SCUBA diver a way to forage over a food item, avoiding the agonistic interaction with *A. saxatilis*. According to Brown (1964), an animal will defend or attack a defended territory if the benefits surpass the costs of injuries from agonistic interactions. In this case, the egg predation may occur mainly due to with the presence of the SCUBA diver due to the aggressive behaviour of *A. saxatilis* (Araújo *et al.* 2004, Knouft and Page 2004).

The description of this interaction is important to alert dive centers for activities regarding to conservation of marine environments. In reefs characterized by a complex web of interaction between species, the chance on inducing negative impacts in cascade are enhanced. In this sense, this note reports a specific interaction between fishes, as eavesdroppers, with SCUBA divers causing impact over a reef fish species which can be avoided by changing diving behaviours.

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