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Empty Mussel Shells on Mariculture Ropes as Potential Nest Places for the Blenny *Hypleurochilus Fissicornis* (Perciformes: Blenniidae)

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ABSTRACT

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We report on the use of empty shells from mariculture of Perna perna mussels as nesting places for males of *Hypleurochilus fissicornis* (Blenniidae). Although its habitat preferences remain still unnoticed, this species was found to be surprisingly abundant in mariculture structures. Ten (ready to harvest) mussel ropes were collected in a mariculture near Porto Belo island, Santa Catarina, Brazil. Seven species were found: *Hypleurochilus fissicornis* (n=327; 93.7%; min TL=15.82mm; max TL=66.18mm); *Abudefduf saxatilis; Parablennius pilicornis* and *Stephanolepis hispidus.* Manual collections rendered 3 additional species: *Malacoctenus cf. delalandei; Gobiesox barbatulus* and *Gobiosoma sp.* Nest samples (n=29) were taken from submersed ropes by snorkeling. From these nests, 13 were captured together with its parental fish owner, all of them males of *H. fissicornis*. Parental male size was found to be positively correlated with nest size (NS = 2.45 * MS 63.77; R2= 0.87). The availability of empty shells due to mussel mortality offered good opportunity for *H. fissicornis* males to build its nests. The "novel" habitat provided by mariculture may offer particular situations for males of this species. Since a temporal controlled mortality effect periodically kills part of the population (mariculture harvesting), older/larger males have a higher probability of being excluded of the reproductive active pool, which can potentially benefit young/smaller males. We also advanced with the hypothesis that the high availability of structures favorable to blenny reproduction may be working as a source area of larvae, thus possibly increasing fish recruitment in other adjacent areas.

ADDITIONAL INDEX WORDS: *Shells, nests, Blenniidae.*

INTRODUCTION

Blenniidae are small bottom dwelling fishes inhabiting restricted places with high complexity such as coral and rocky reefs usually in the intertidal, subtidal zone and coralline algae beds. Most of them are tropical to temperate marine fishes, but rare exceptions are found in fresh and brackish water.

Blenniid fishes are very conservative in having just male parental care, which typically guards eggs in crevices or holes where females come to spawn. The males defend their nests and surrounding areas from conspecifics and other intruders (GONÇALVES and ALMADA, 1998). GONÇALVES (1997) on a literature review, found that among the blennioid families (sub-order Blennioidei), nest site characteristics adopted by the males are not the same. Thus, Tripterygiidae, Labrisomidae and Clinidae preferred exposed surfaces, concavities and grottos, while Blenniidae and Chaenopsidae specialized on the utilization of shelters which provided further protection (visual and physically protected places). In contrast to the rich literature on the habitat use of Eastern Atlantic blenniids (KOTRSCHAL, 1988; ILLICH and KOTRSCHAL, 1991; PATZNER, 1999), most of the Southwestern Blenniidae are not well known in terms of distribution and habitat utilization. Examples are found in species such as *Hypsoblennius invemar*, which uses empty barnacles (Megabalanus tintinabulum) (C. RANGEL pers. obs.), and *Lupinoblennius paivai*, which uses empty shipworm holes as nesting places (SAZIMA and CARVALHO-FILHO, 2003). However, in recent years, knowledge on Brazilian cryptic species has substantially progressed. Species were described, revalidated, distribution range revised and natural history elucidated (GUIMARÃES, 1996; GASPARINI, 2001; GUIMARÃES, 2002; ROBSON, 2003; SAZIMA and CARVALHO-FILHO, 2003).

Habitat preferences of *Hypleurochilus fissicornis* remain still unnoticed mainly because of its secretiveness and probably lack of previous attention. Although its occurrence in natural habitat must be further investigated, *H. fissicornis* was found to occur abundantly in several mariculture locations in Santa Catarina state (L.C.G, pers. obs.) and Rio de Janeiro state (FERREIRA, pers. obs.). The mariculture of Perna perna (Bivalvia) in Southern Brazilian waters is an important economic activity that is raising production every year. This artificial substrate is imposing new human dependent dynamic constraints on the life cycle of this species. In this paper, the association of these fishes in mariculture ropes is investigated trough the occurrence and preliminary analysis of nest sites. We also present some hypothesis and discussion regarding the whole this "novel" habitat might play with natural environment and the population biology of *Hypleurochilus fissicornis*.

METHODS

From November/2001 to August/2002, a total of ten (ready to harvest) ropes of *Perna perna* mussels were collected in a mariculture, near Porto Belo island, Santa Catarina, Brazil (Figure 1). These ropes are vertical structures placed from the surface down to a few meters deep on which mussels are attached, creating a highly complex substrate. Ready to harvest mussel ropes were intended as a standard in terms of complexity (larger mussels means increased complexity), however some variation on the sampled ropes were observed. Provided the possibility that fishes could swim off the ropes as the harvesting procedure takes place, a cylindrical net with 3mm mesh size (FIGNA, unpublished) was used to circle the rope before it was brought up. All fishes were collected, identified and had their total length (TL) measured. Sex of *H. fissicornis* was determined by macroscopic examination of the gonads. The denomination "juvenile" was assigned to specimens whose sex was not recognizable by visual inspection of the gonads.

Nest samples (empty shells containing eggs) were taken manually from submersed ropes by snorkeling. Additional nest collections were made from August/2002 to November/ 2002. Parental males (PM) (males found guarding eggs) were measured for total length and nest size (total longitudinal length of the conch) (NS) estimated for all Perna perna mussels containing eggs. Lengths were measured to 0.1mm.

RESULTS

A total of 349 fishes were collected within the 10 ropes sampled (mean rope total length +/- 1 s.d = 2.39 +/- 0.28m; mean fish density per meter +/- 1 s.d.= 15.84 +/- 5.94 fishes/m), represented by the following species: *Hypleurochilus fissicornis* (n=327; 93.7%; min L=15.82mm; max L=66.18mm); *Abudefduf saxatilis* (n=12; 3.4%; min L=8.45mm; max L=46.14mm); *Parablennius pilicornis* (n=9; 2.6%; min L=38.06mm; max L=93.85mm) and *Stephanolepis hispidus* (n=1; 0.3%; L=65.05mm).

Manual collections of fishes associated to the mariculture ropes rendered an additional 3 species: *Malacoctenus cf. delalandei* (L=22.23mm); *Gobiesox barbatulus* (L=38.71mm) and *Gobiosoma sp* (L=22.76mm).

Juveniles of H. fissicornis measured 15.8237.92mm (n=89; mean L +/- 1 d.p.= 26.17 +/- 5.41mm); females measured 30.26 54.32mm (n=127; mean L +/- 1 s.d.= 40.02 +/- 5.94mm) and males measured 26.05 66.18mm (n=111; mean L +/- 1 s.d.= 48.29 +/- 9.46mm).

A total of 29 bivalves containing eggs were collected (mean NS +/- 1 s.d. = 73.75 +/- 13.48mm). From 13 nests it was possible to assess information of parental fishes, being all males of H. fissicornis. Parental males measured 43.74 64.09 mm (n=13; mean +/- 1 s.d. = 54.78 +/- 5.89). Parental nest size varied 47.38 111.30 mm (n=13; mean NS +/- 1 s.d. = 70.80 +/- 16.77mm) and was positively correlated with their body length (NS = 2.45 * MS 63.77; R2= 0.87) (Figure 2).

The egg batches were placed circularly on the inner faces of usually both valves and contained up to three different development phase oocites. Eggs located in central batches were usually more developed then outer batches. An examination on the inner face of the shells revealed that 9 in 13 shells (66.67%) had gastropod feeding holes, indicating that this was their major source of mortality.

DISCUSSIONS

On the studied mariculture area, the availability of empty shells due to mussel mortality offered a good opportunity for nest building by males of *H. fissicornis*. MARENZI (1992) obtained, in one of the most productive shellfish mariculture areas in Brazil, 21% of mortality in 8 months of immersion of Perna perna ropes (period usually lasting until the harvest).

Therefore, the "health" condition of the shell culture might be related with the availability of potential nest sites for this blenniid. High mass mortality on mussel ropes associated fauna occurs periodically during handling procedures and mariculture harvesting (L.C.G. pers. obs.). Although the mortality takes place periodically and adult blenniid males and its nests are removed from the mariculture, ichthyoplanktonic samples from the mariculture area cited above (MARENZI, op cit) showed that Blenniidae larvae occurs year-round (RUTKOWSKI, unpub. data) and probably maintain the population. On our study area, nests were collected year-round and although no seasonal quantification of nesting was done, it was noted that *H. fissicornis* reproductive activity encompassed all seasons. A. *saxatilis* and *S. hispidus* were found as juveniles and were using mariculture structures as hiding places.

Juveniles of these species are known to be associated to floating objects. *Malacoctenus cf. delalandei* (Labrisomidae), *Gobiesox barbatulus* (Gobiesocidae), *Parablennius pilicornis* and *Gobiosoma sp.* (Gobiidae) are all cryptic inhabitants of adjacent rocky shores.

Their presence on mariculture structures could not be further investigated due to their lower occurrence.

OLIVEIRA *et al.* (2000) found that larger males of *Parablennius sanguinolentus parvicornis* defended larger nests but suggested that male characteristics are more important factors determining male mating success than are nest-site characteristics. Further information is needed to see if this also occurs for *H. fissicornis* on the studied population. However, it is important to note that the "novel" habitat provided by

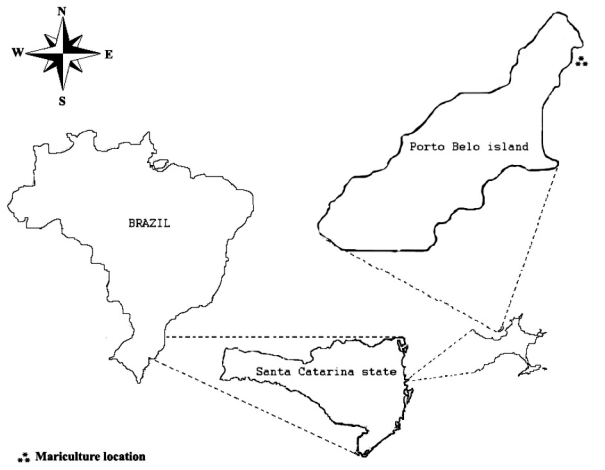

Figure 1. Map showing sampled. Mariculture location.

mariculture may offer particular situations for males of this species. Since a temporal controlled mortality effect periodically kills part of the population, older/larger males have a higher probability of being excluded of the reproductive active pool, which would benefit young/smaller males.

CARVALHO-FILHO (1999) reported a maximum TL for *Hypleurochilus fissicornis* of 10mm and MENEZES (1985) refers to individuals of up to 93mm. However, the largest individuals found in our samples measured 65.03, 65.40 and 66.18mm. If adults larger than these do really occur in natural environments, then two possibilities arise: (i) the mortality effect of the mariculture-associated fauna is likely selecting larger sized individuals to death; (ii) the ropes complexity does not fit to larger fishes. Both hypotheses must be further investigated.

Males are able to couple successive times, proved by the fact that in almost all nests eggs in different development stages were observed. The same pattern of sequential spawning was observed for other Blenniidae [e.g. *Parablennius sanguinolentus*, (SANTOS, 1989)]. This can be a manner of increasing reproductive efficiency.

It was not possible to assess the parental species of the remnant nests (16 nests out of the 29 sampled). However, the elevated overall predominance of *H. fissicornis* makes reasonable to admit that the majority of the nests encountered were owned by this species. *G. barbatulus* was also found nesting in Perna perna empty shells in another mariculture in Santa Catarina (L.C.G. pers. obs.); however the color of the eggs differed significantly from those observed for the blenny. G. barbatulus eggs are brilliant gold while *Hypleurochilus fissicornis* eggs have an orange color. *Parablennius pilicornis* specimens were not observed nesting on empty shells in the mariculture studied despite the fact that this blenniid also lays demersal eggs and provide male parental care on its life history, making them potential nest owners.

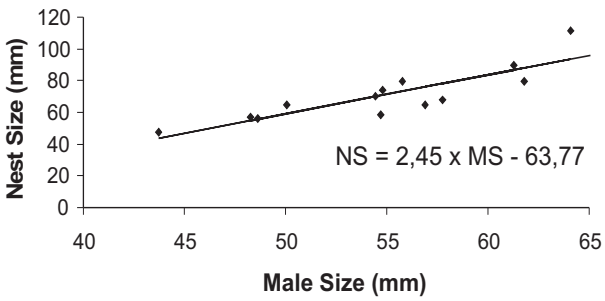

Figure 2. Correlation between *Hypleurochilus fissicornis* parental Male Size (MS) and its respective Nest Size (NS) (NS = 2.45 * MS 63.77; R2= 0.87; n=13).

Some nests, when collected, showed massive hatching of the eggs. This raises the hypothesis that this event could be attributed to environmental key factors related to egg hatching in natural conditions. Diminution of the hydrostatic pressure over the eggs (moving the nest rapidly upwards the water column) could be related to tide variation, so ebb tide was to take larvae away from the shore. However, further investigation of use and spawning in natural habitat must be addressed, and these hypotheses are to be considered preliminary.

Thinking on sources and sinks populations (PULLIAM, 1988), we may advance with the hypothesis that the high availability of structures favorable to blenny reproduction may be working as a source area of larvae, thus possibly increasing fish recruitment in other adjacent areas.

On the other hand we found a notable diminution of natural *Perna perna* mussel stocks on adjacent rocky shores due to seed exploitation for shell culture (IBAMA, 2002).

Together with this over exploitation, shrinkage of natural habitat for species that regularly associate with Perna perna mussel beds on its life cycle is observable. Manipulation of the mariculture structures, such as ropes, has a potential to test the hypothesis here raised about the reproductive and population ecology of *H. fissicornis.*

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