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Field Studies of a Brazilian Seahorse Population, *Hippocampus reidi* Ginsburg, 1933

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ABSTRACT

This study was carried out to fill the gaps that remain under Hippocampus reidi *biology. Analysis of variations of sex ratio, density, breeding season, distribution and home range of a population of the endangered Brazilian seahorse H. reidi from a rocky shore on Araçatiba beach, Ilha Grande, Brazil were carried out. Araçatiba beach is a tourist Environmental Protected Area, suffering antropic pressure. A fixed population of* H. reidi *was studied, where al lthe individuals were visually tagged and sex, reproductive state and location on site were identified from December 2002 to November 2004. A total of 20 individuals were visually tagged with a mean density of 0.18 m^{-2}. Sex ratios were skewed, with more females than males. All the males brooded during 13 months and presented smaller home range than the females during the breeding season. The highest densities were found on shallowest areas.*

Key words: Seahorse, *Hippocampus reidi*, Brazil, natural biology

INTRODUCTION

Seahorses belong to the family Syngnathidae with only one genus *Hippocampus* Rafinesque, 1810 (Nelson, 1994; Lourie et al., 1999; Silveira, 2000a). The taxonomy of this group is still under discussion, but 44 species have been till-date recongnized (Lourie et al., 1999; Kuiter, 2000; Horne, 2001; Kuiter, 2001; Kuiter, 2003; Lourie and Randall, 2003; Lourie et al., 2004).

In Brazil there are only two species of seahorse: *H. reidi* Ginsburg, 1933 and *H. erectus* Perry 1810 and the former is more abundant (Figueiredo and Menezes, 1980; Rosa et al., 2002; Dias et al., 2002). *H. reidi* is commonly known as the Brazilian seahorse or longsnout seahorse and occurs from Cape Hatteras, in the United States, Caribbean, to Santa Catarina, Brazil (Lourie et al., 1999; Rosa et al., 2002). They occur at Rio de Janeiro coastal areas and are characterised by a long snout, which is larger than the posterior orbital margin to the gill opening (Figueiredo and Menezes, 1980). Their colour varies from black to yellow, red, orange and brown (personal observation) with numerous white dots, mainly on the tail and may present paler saddles across dorso-lateral surface (Lourie et al., 1999). An adult may reach up to 17,5cm in size. The males present a brood pouch, which allows them to incubate developing embryos (Gill, 1905; Vincent and

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Sadler, 1995; Vincent, 1996; Jones et al., 1998; Lourie et al., 1999; Kvarnemo et al., 2000; Masonjones and Lewis, 2000; Jones and Avise, 2001; Wilson et al., 2001; Perante et al., 2002; Jones et al., 2003; Wilson et al., 2003; Vincent and Giles, 2003; Casey et al., 2004; Lourie et al., 2004).

H. reidi is considered a vulnerable species by the IUCN Red List of Threatened Species (IUCN, 2002), as well as by the list of Threatened Animals of Rio de Janeiro State (Mazzoni et al., 2000). An intense decrease in *H. reidi* population occurred during the last 20 years due to its demand for live ornamental display, souvenier commerce, traditional medicines as well as degradation and loss of habitats. (Vincent, 1996; Vincent and Pajaro, 1997; Costa – Neto, 2000, Lourie et al., 1999; Rosa et al., 2002;).

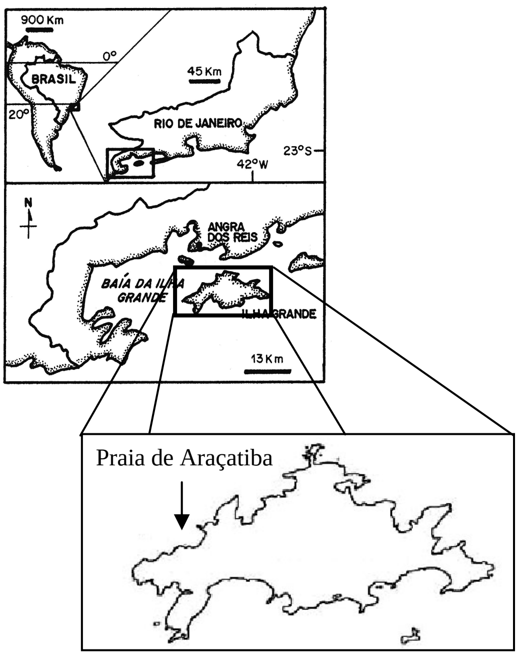
Seahorses are relatively sedentary (Vincent, 1996) presenting evidence of a stable populations. Sex ratio may be equal, because of monogamic characteristics of the study species (Dauwe, 1993). Males possibly have smaller home ranges during the breeding season due to brood pouch (Vincent, 1996). There are few studies about its reproduction in captivity (Silveira, 2000a, b); however there are still many gaps on its natural biology (Rosa et al., 2002). Studies related to natural biology of threatened species are crucial to understand species population structure, providing data for conservation projects.

The present work aimed to study the variation of sex ratio and density, breeding season, distribution and home range of a population of *H. reidi* from a rocky shore on Araçatiba beach (Ilha Grande, Rio de Janeiro, Brazil).

MATERIALS AND METHODS

Study Site

This work was done at Araçatiba beach (Fig. 1), which is na environmental Protection Área (EPA) at Ilha Grande, located between 23º 09' S and 044º 20' W (Rio de Janeiro, Brazil). The beach presents an extension of 120 m, surrounded by Atlantic Rainforest vegetation. It is a cove with calm and clear waters, where two small seasonal rivers discharge. Even being an EPA, it is subject of pressure, especially during the holiday season.



The rocky shore studied is located on the west side of the beach. Depth in lowest spring tide reached from 0.20m to 2.80m at the end of study area. Temperature ranged from 22 to 34.5ºC (mean = 28 ±3ºC) and salinity varied between 31 and 35 ups (mean = 33 ± 1 ups) during the study. Direct solar incidence occurred only during the morning. The rocky shore was divided in five sub-areas according to initial substrate. Sub-area 1 was characterised by sparse rocks and sub-area 2 by a small re-entrance on rocky shore; both were Sargassum sp. beds. Sub-areas 3, 4 and 5 were composed by overlapped rocks covered by different initial vegetation, which differed the sub-areas. Sub-area 3 was covered by Caulerpa sp., sub-area 4 by *Dictyota* sp. and *Sargassum* sp. and sub-area 5 presented a great quantity of Cnidaria, Equinodermata and Porifera.

Population parameters

The study was carried out in every second months from December 2002 to November 2004. Forty observations were made on a permanent focal study site (Vincent et al., 2005) by snorkelling method, which was recommended for shallow and clear water (Appeldoorn et al., 2003; Christensen et al., 2003; Layman et al., 2004). The observations were made during the morning of at least two days of each month. The study area was determined by a 35m by 5m fix grid and recorded seahorse locations were within 1m by 1m sections of this grid square.

Seahorses present a structure on the top of its head called coronet, which functions as a finger-print to identify every individual. All the individuals of *H. reidi* species along the focal study were visually tagged by schematising and photographing their coronet and describing the morphological characters. This methodology was tested by tagging the seahorses with an uniquely numbered white PCV disc (5.5mm x 3 mm) hung around their neck by a cotton thread (Vincent and Sadler, 1995) to confirm their identity. Since all tagged individuals were recognized by the Coronet Methodology and confirmed by the disc tag, the former was used, because it was more appropriate for long lasting studies. Sex was determined by the presence (male) or absence (female) of a brood pouch (Gill, 1905; Vincent and Sadler, 1995; Vincent, 1996; Lourie et al., 2004). They were catalogued by codes, where M = Male and F = Female + number of occurrence (*e.g.* M1, M2, F1, F2). Total length was measured according to Lourie et al. (1999). Reproductive state of males were noted according to Lourie (2003), where 0 = just given birth, pouch flabby, 1 = pouch empty, pouch flat, 2 = pregnant, pouch rounded, 3 = about to give birth, pouch extremely rounded and shiny. Site was divided on 5 sub-areas to verify aggregation. Distribution of all individuals on each sub-area was noted. Resident individuals were established by Constancy of Occurrence (adapted from Dajoz, 1979), where C > 50% were considered resident, 25% < C < 50% were visitors and C < 25% were rare. Home range of the resident individuals was established by the grid cell method, which overlayed a grid of squares on the animal's range and counted the number of squares in which at least one fix was obtained. This method provided an easily interpretable representation of habitat usage (Vincent et al., 2005; Harris et al., 1990).

Data Analyses

Density and sex ratio variation of *H. reidi* during the two years were compared by *t*-test for dependent samples, using months as replicates for the years. Distribution of individuals on each sub-area was determined by frequency and sub-area preference was compared using Friedman ANOVA (α = 5%), once data did not present a normal distribution and homogeneity (Zar, 1999). Data of density and sex ratio variation were divided in the first year of study, which was represented from December 2002 to November 2003 and the second year of study, represented from December 2003 to November 2004.

All values were reported as mean ± S.D. except where otherwise stated.

RESULTS

Population Parameters

A total of 20 individuals of *H. reidi* were visually tagged within 175 m^2, of which 15 were females and 5 males, accomplishing 113 resights. The density ranged from zero m^{-2} to 0.40m^{-2}, with a mean overall density of 0.18 ± 0.089 m^{-2}.

Population density presented an extremely significant decrease during the two years of the study (p = 0.0011, t=4.1633, d.f. = 13). (Fig. 1). Sex ratio presented no seasonal pattern (Fig. 2). The total ratio of males to females was 1:3 with a monthly ratio of 1:1. Mean number of males and females during the study did not differ significantly (χ^2 = 0.24, p = 0.6272, g.l. = 13).

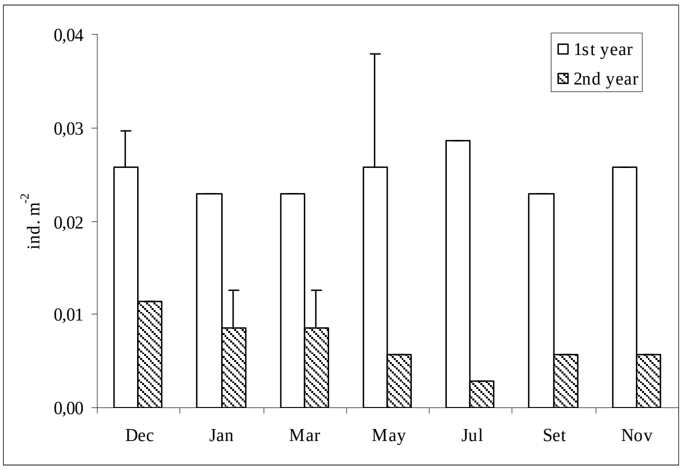


Figure 1 - Mean density of *Hippocampus reidi* during December 2002 and November 2004 at study site.

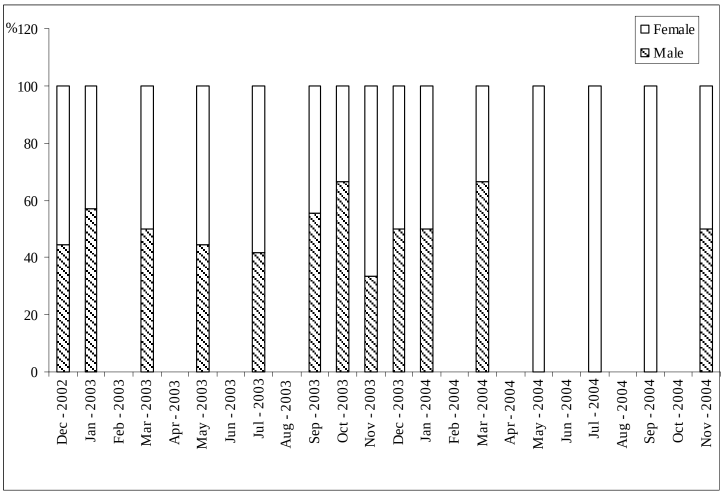


Figure 2 - Percentage of males and females *Hippocampus reidi* during December 2002 and November 2004 at study site.

The male seahorses brooded young along 13 months with 100% of males reproductively active. A resting period of seven months was identified, followed by the restart of reproduction (Fig. 3). Constancy of occurrence detected no resident females with 82.4% rare and 17.6% visitors, while 40% males were considered resident and 60% rare (Fig. 4). Resident males were represented by two individuals presenting a home range of $56m^2$ and $54m^2$.

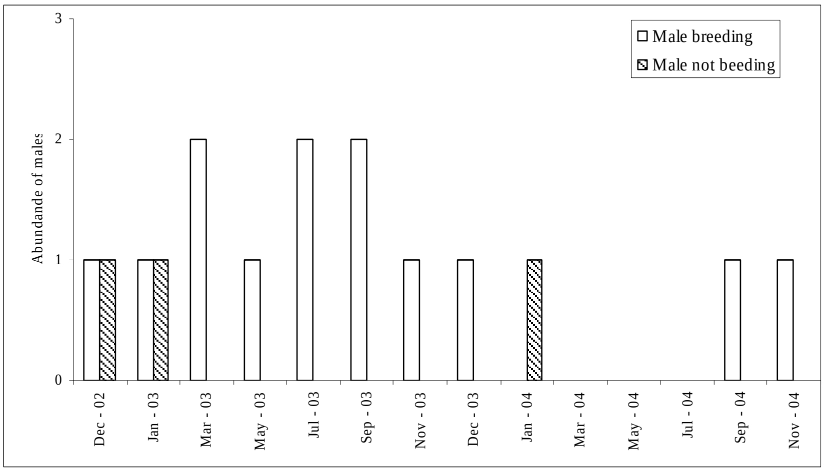


Figure 3 - Abundance of breeding and not breeding males *Hippocampus reidi* during December 2002 and November 2004 at study site.

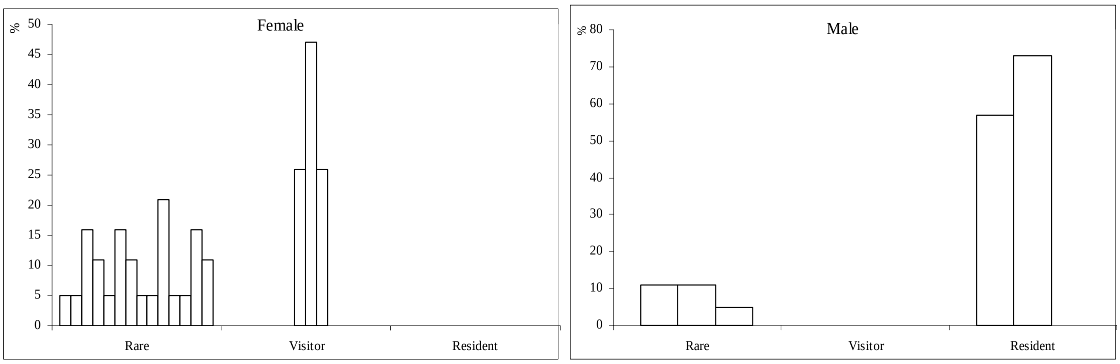


Figure 4 - Constancy of occurrence of rare, visitor and resident females and males Hippocampus reidi during December 2002 and November 2004 at study site.

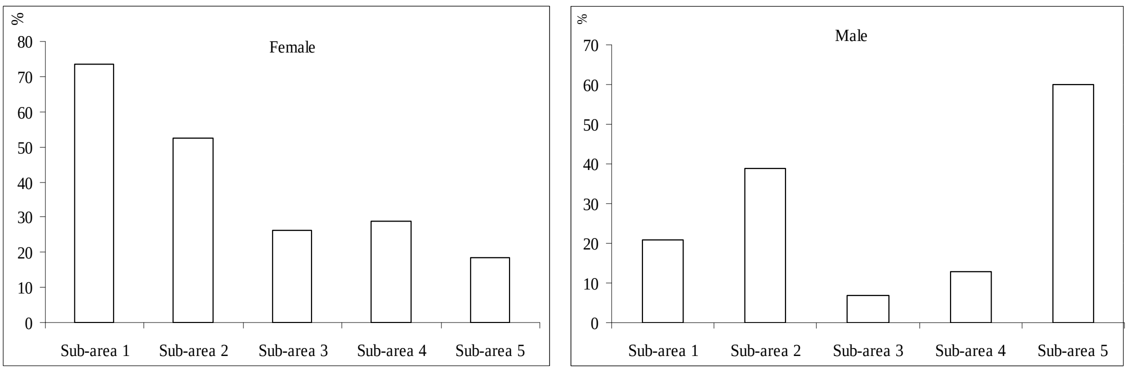


Figure 5 - Frequency of females and males *Hippocampus reidi* during December 2002 and November '2004 at study site.

Females preferred shallowest areas having frequency of 37 and 26% in sub-areas 1 and 2, respectively (Fig. 5). The Friedman ANOVA test has detected a significant difference between female density in the sub-areas ($p < 0.05$, Fr =9.066, d.f. = 4). Male seahorses presented a higher frequency in sub-areas 2 and 5 with 39 and 61%, respectively. Significant difference between sub-areas was not observed ($p = 0.719$, Fr = 2.087, d.f. = 4) (Fig. 5).

DISCUSSION

Seahorses usually present low densities (Foster and Vincent 2004). Bell et al.(2003) found similar mean density (0.22 m^{-2}) for *H. capensis* Boulenger, 1900 on an African estuary using the same transect methodology. Perante et al. (2002) detected a mean density of 0.02m^{-2} for *H. comes* on a grid focal study in the coral reef of Bohol, Philippines. Studies accomplished with *H. abdominalis* Lesson, 1827 in Australia (Martin-Smith *in* Foster and Vincent, 2004) and *H. hippocampus* in Portugal (Curtis *in* Foster and Vincent, 2004) presented the same mean density of 0.007 m^{-2}. Vincent et al. (2005) observed a mean density of 0.215 m^{-2} for *H. whitei* Bleeker 1855 on a grid focal study in a seagrass bed of Australia. Dias and Rosa (2003) reported for *H. reidi* mean densities varying from 0.51 m^{-2} to 0.006 m^{-2} on Rio Grande do Norte, Brazil. Most seahorse species have small home ranges during reproductive periods (Vincent, 1996), but later, males increase their home ranges and patches may change place, explaining density decreases during this study. Months with lowest mean density and relative abundance were from January to July 2004, when males were absent or not brooding.

This study found a 13 months breeding season for the population. Rosa et al. (2002) observed an eight month breeding season in captivity for the same species. Seahorse species tend to have long breeding seasons (Foster and Vincent, 2004), but it is apparently related to the light and water temperature. Species from tropical regions have longer breeding seasons (Lourie et al., 2004).

No significant difference was found in sex ratio along the study, which corroborated Perante et al. (2002), who found a proportion of 15 males to 13 females; Moreau and Vincent (2004) detected sex ratio of 1:1. That indicated a pair social structure and might possibly suggest monogamy. That kind of social organization is common in many seahorse species such as *H. bargibanti* Whitley, 1970 (Tacket and Tacket, 1997), as well as *H. fuscus* Rüppel, 1838 (Vincent 1990) and *H. histrix* Kaup, 1856 (Kuiter and Debelius, 1994).

Seahorse males presented site fidelity and a smaller home range. Vincent (1996) reports males having smaller home ranges during breeding season because of deficient mobility due to brood pouch. Vincent and Sadler (1995) observed a significantly larger home range for females than males with 1m^2 and 100m^2, respectively, although Vincent et al. (2005) reported for the same species from 4 to 21 m^2. Vincent (1990) reported no site fidelity for *H. abdominalis*. Field studies showed small home range for *H. reidi* between 6 and 20 m^2 (Rosa et al., 2002) and between 3.5 and 13.3 m^2 (Dauwe, 1993).

Sex difference in distribution was observed. Females presented preference sub-areas 1 and 2, showing a relative aggregation. Males occurred along the rocky shore, but the two resident seahorse males did not overlap in their distribution. In January 2003 an interaction between both males was observed, which was characterized by grasping each other by their tails. Afterwards both occupied different areas along the study area. This might suggest a territorial defense during breeding season, although it has not yet been reported. Territorial defense is a common behavior of patchy distribution and sedentary organisms (Grant, 1997; Roberts and Ormond, 1992). As it was an unique event more studies are needed.

This study showed that density and sex ratio were directly related to breeding season. Seahorse males presented smaller home range than female during breeding season. Highest densities were found in the shallowest areas. Females occurred simultaneously on same sub-areas, while males were distributed along the study site.

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RESUMO

Este estudo foi realizado com o objetivo de preencher algumas lacunas sobre a biologia natural de *Hippocampus reidi*. Foram analisadas as variações na proporção sexual e densidade, período reprodutivo, distribuição e área de deslocamento de uma população do cavalo marinho brasileiro ameaçado de extinção *Hippocampus reidi* de um costão rochoso da praia de Araçatiba, Ilha Grande, Brasil. A praia de Araçatiba é uma Área de Proteção Ambiental turística, a qual sofre com a pressão antropogênica. Foi estudada uma população fixa de *H. reidi*, sendo que todos os indivíduos foram marcados visualmente e foram determinados o sexo, o período reprodutivo e a localização na área de novembro de 2002 a novembro de 2004. Um total de 20 indivíduos foram marcados com uma densidade média na área de 0,18 m^{-2}.A proporção sexual variou de forma alternada com maior número de fêmeas que de machos. Durante 13 meses todos os machos encontrados estavam incubando. Os cavalos marinhos apresentaram área de deslocamento menor que as fêmeas durante o período reprodutivo. As maiores densidades foram encontradas em áreas mais rasas da área de estudo.

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