Population dynamics of the endangered seahorse *Hippocampus reidi* Ginsburg, 1933 in a tropical rocky reef habitat

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Abstract
Population dynamics of the endangered seahorse Hippocampus reidi *Ginsburg, 1933 in a tropical rocky reef habitat.* This study was conducted in Armação de Búzios, Brazil, a municipality where ecosystem degradation has been observed following large increases in tourism and population growth. The goal of this study was to determine seasonal variations in three Búzios populations of the long snout seahorse *Hippocampus reidi*. Monthly dives were conducted from November 2011 to October 2013. All three subpopulations had low densities of seahorses and no seasonality. The sex ratio differed at each site. The most commonly used microhabitats were the sponge *Aplysina fulva* and the seaweed *Sargassum* sp. There was no significant difference in temperature and salinity. The environmental trends could not explain the variation in seahorse density at the three beaches. The population showed no seasonality and no further decline.

Key words: Monitoring, Seasonality, Fish, Syngnathidae, Brazil

Resumen
Dinámica de la población del hipocampo en peligro de extinción Hippocampus reidi *Ginsburg, 1933 en un arrecife rocoso tropical.* Este estudio se realizó en Armação de Búzios, en Brasil, un municipio en el que se ha observado la degradación de algunos ecosistemas tras el gran aumento del turismo y el crecimiento demográfico. El objetivo fue determinar las variaciones estacionales de tres poblaciones de Búzios del caballito de mar, *Hippocampus reidi*. Las inmersiones mensuales se realizaron entre noviembre de 2011 y octubre de 2013. Las tres subpoblaciones tenían baja densidad de caballitos de mar y carecían de estacionalidad. La razón de sexos fue diferente para cada sitio. Los microhábitats más utilizados fueron la esponja *Aplysina fulva* y el alga *Sargassum* sp. No hubo diferencias significativas ni en temperatura ni en salinidad. Las tendencias ambientales no pudieron explicar la variación de la densidad de caballitos de mar en las tres playas. La población no mostró estacionalidad y no disminuyó más.

Palabras clave: Seguimiento, Estacionalidad, Peces, Syngnathidae, Brasil

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Introduction

Seahorses are reef fishes belonging to the Syngnathidae family, with 42 species currently described (Lourie et al., 2016; Han et al., 2017). They are found all over the world in both tropical and sub–tropical waters (Lourie et al., 1999). Three seahorse species occur in Brazil, namely *Hippocampus reidi* Ginsburg, 1933, *Hippocampus erectus* Perry*,* 1810 and *Hippocampus patagonicus* Piacentino & Luzzatto 2004, and all can be found in several threatened species lists (Mazzoni et al., 2000; IUCN, 2010; MMA, 2010). *H. reidi* is commonly called the Long Snout Seahorse and is the most abundant species of the Rio de Janeiro state coast (Freret–Meurer, 2010), although it is classified as *vulnerable* by the List of Threatened Species of the Rio de Janeiro State (Mazzoni et al., 2000). Its population has been declining for the last 30 years (Costa–Neto, 2000) but little is known about its ecology, population structure, distribution, or behavior.

The Armação de Búzios area comprises many costal ecosystems such as beaches, rocky reefs, and bays usually inhabited by seahorses (Rosa et al., 2007; Freret–Meurer and Andreata, 2008). The area has increasingly attracted large numbers of tourists because of its natural beauty, resulting in high city development in recent years (Xavier, 2006). In addition, local fishermen traditionally capture marine animals, including seahorses, to sell as souvenirs or handcrafts. The pressure associated with their capture for the aquarium market has a detrimental impact in the local marine species (Freret–Meurer, pers. observ.).

Information regarding the seahorse population in Búzios over the last two decades is lacking but there are anecdotal reports that seahorses used to be frequently seen on beaches and were constantly captured in fishing nets. Currently, it is rare to find seahorses in the area. These animals have great potential as a flagship species for conservation due to their peculiar morphology and life history (Shokri et al., 2009)

The present study aimed to check for seasonal variations in population parameters of *H. reidi* in three populations, at Armação de Búzios, Rio de Janeiro, Southeastern Brazil, by recording population size, reproductive state, sex ratio, ratio between juveniles and adults, behavior, substrate and occurrence depth. Environmental trends, such as salinity, temperature and visibility were also characterized at each study area.

Material and methods

Study sites

The state of Rio de Janeiro, located in the southeastern region of Brazil, has a coastal area of 800 km and exhibits great ecosystem diversity, including a continuous rocky reef (Freret–Meurer, 2010). Surveys were conducted at three beaches in the southeast of the region, namely João Fernandes, Canto and Ossos. These beaches were selected due to the previous report by Freret–Meurer (2010) and the fact that they might be good indicators of the seahorse population conservation status in the state of Rio de Janeiro (fig. 1).

Field sampling

Dives were conducted monthly from November 2011 to October 2013 by snorkeling, between 8:00 a.m. and 5:30 p.m. Scuba diving was not necessary, since the rocky reef depth is less than 4 m. Water visibility ranged from 80–100 % from surface to the bottom of the study site and did not interfere with the research. *H. reidi* were searched for in eight fixed transects (20 x 5 m, comprising 800 m^2) by two divers at each site of the transect (2.5 m), parallel to the coast. The species was identified according to Lourie et al., (2004) and Figueiredo and Menezes (1980). Sex was recognized by the presence (male) or absence (female) of the brood pouch (Lourie et al., 1999) in individuals larger than 100 mm only (Silveira, 2005). Individual height was measured from the top of the coronet to the stretched tail (Lourie, 2003). Reproductive state was determined according to Lourie (2003), as follows: for males: 0, just given birth, pouch flabby; 1, ouch empty, pouch flat; 2, pregnant, pouch rounded; 3, about to give birth, pouch extremely rounded and shiny, and for females: 0, eggs recently entrusted to males, belly sunken; 1, no mature eggs, belly flat; 2, bearing mature eggs, belly slightly raised; 3, hydrated eggs, belly distended. Juveniles were identified by size, according to Rosa et al. (2007); specimens smaller than 100 mm were considered juveniles.

Data on behavior were obtained by the scan method (Altmann, 1974) which recorded the behavior of the individual at the time it was found. Depth and substrate where the animals were anchored were also recorded. Water temperature and salinity were measured at each site.

Statistical analyses

Descriptive statistics were reported as percentages and means ± standard deviation. Comparative analyses of population densities between sites were performed by the Kruskal–Wallis test, followed by Dunn's test because these parameters did not pass the normality assumption (Kolmogorov–Smirnov test; $\alpha < 0.05$) and homoscedasticity test (Bartlett's test; $\alpha < 0.05$). Comparisons between individual height, depth, temperature and salinity were conducted using the ANOVA one–way test, followed by Tukey's test. The correlation between height and depth was conducted using Spearman correlation. Multiple regression was used to assess the relationship between temperature/salinity and seahorse density.

Results

Canto beach showed a mean density of 0.029 ± 0.572 ind/m^2 throughout the study period. Higher densities were recorded from December

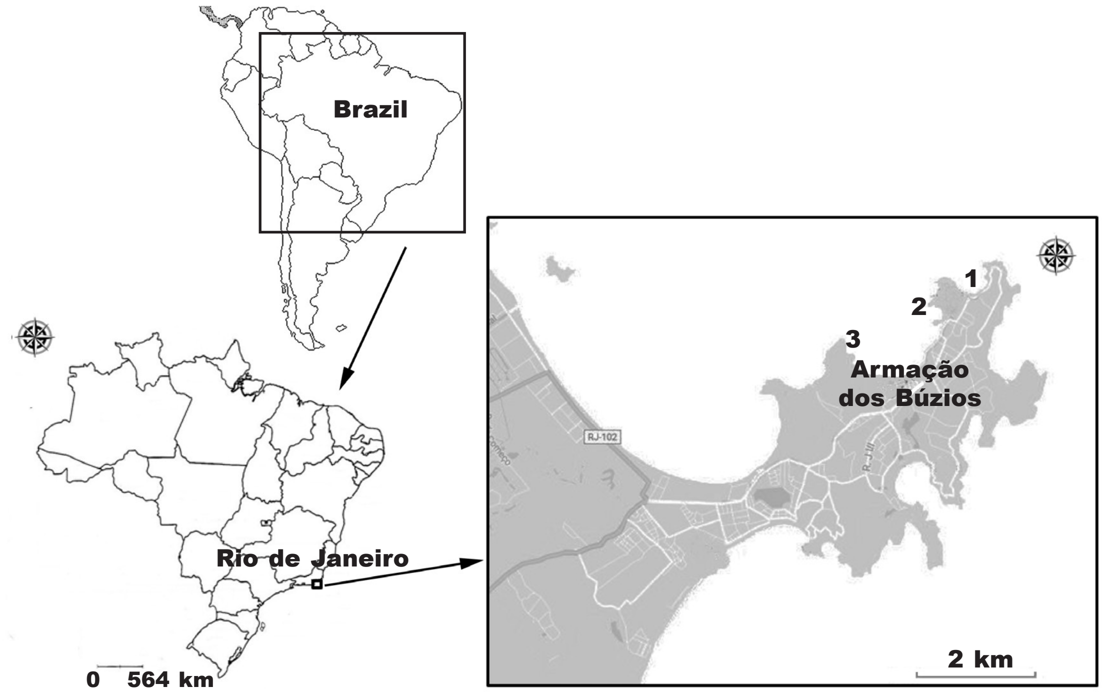

Fig. 1. Seahorse monitoring at three beaches in Armação dos Búzios, state of Rio de Janeiro, south–eastern Brazil: 1, João Fernandes; 2, Ossos; 3, Canto.

Fig. 1. Seguimiento de los caballitos de mar en tres playas ubicadas en Armação dos Búzios, en el estado de Río de Janeiro, en Brasil: 1, João Fernandes; 2, Ossos; 3, Canto.

2012 to April 2013. No seasonality between wet (November–April) and dry season (May–October) was detected (p = 0.30; t = 1.093; df = 11). João Fernandes showed considerable variation in population density due to changes in the locations of seahorse population patches. A patch was initially detected, but due to the absence of any animals during population monitoring (November 2011 to June 2012), a methodological readjustment was required, with an increase in the number of transects (n > 8) and, in parallel, an intensive search for the seahorses, to find the patch again. In July 2012 the patch was found, with high numbers of seahorses for this month (average density = 0.05 ± 0.07 ind/m^2), remaining constant throughout the rest of the study months, and peaking in August 2012, with an average density of 0.1 ± 0.25 ind/m^2. Once methodology was adjusted, we used only one year data, from November 2012 to October 2013, to compare wet (November 2012–April 2013) and dry (May 2013–October 2013) seasons. We found a statistical difference between the dry and wet seasons for the population in João Fernandes (p = 0.003; t = 5.198; df = 5), representing a higher population in the dry season (0.039 ± 0.002 ind/m^2). Density at Ossos beach remained relatively constant, with an average total of 0.04 ± 0.02 ind/m^2. Density peaks occurred in March 2012, of 0.07 ± 0.12 ind/m^2, followed by peaks in April 2012, August 2012 and October 2012, all of 0.06 ind/m^2 (standard deviations of 0.09; 0.09 and 0.07, respectively). The lowest densities were observed in November and September 2012, of 0.01 ± 0.04 ind/m^2. No significant difference was found between dry and wet seasons (p = 0.191; t = 1.393; df = 11). Densities between the three beaches were significantly different (p = 0.01; KW = 8.149), being higher at Ossos Beach, followed by Canto Beach and, finally, João Fernandes beach, with the latter two showing no significant difference between them (table 1). It is important to note that the established density of João Fernandes after adjustment was higher than that at the other beaches (fig. 2).

Sex and juvenile x adult ratios

The operational sex ratio at Canto Beach was of 1:2, skewed towards females. Contrary to what was found during most of the study months, only males were recorded in June (3:0). Despite the unequal sex ratio and the fact that females were absent from the study area for many months, all observed adults (100 %, n = 14) were reproductively active. Only adults were observed in the area, except in August, when a juvenile specimen was found. The overall sex ratio for the population of seahorses at João Fernandes was 1:1, but this varied over the study months, with

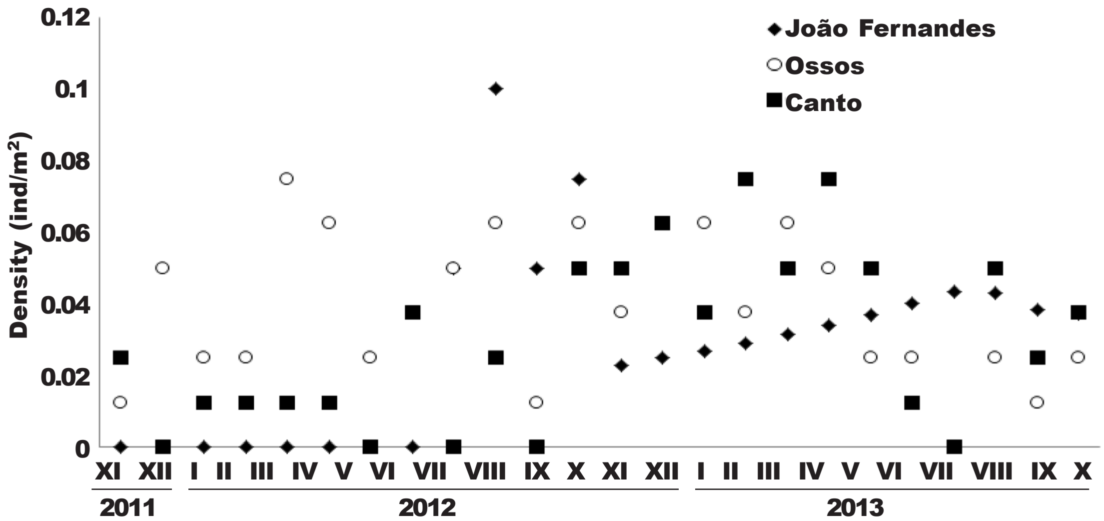

Fig. 2. Density (ind/m^2) of *H. reidi* seahorses during the study period at João Fernandes, Ossos and Canto beaches.

Fig. 2. Densidad (ind./m^2) de los caballitos de mar H. reidi *durante todo el período de estudio en las playas de João Fernandes, Ossos y Canto.*

a trend towards the presence of females in July and August 2012, and towards the presence of males in September and October 2012 (fig. 3). The number of juvenile individuals in the area remained constant over the study months (1 per month), but the number of adults was variable (fig. 3). All the recorded adults (100 %) were reproductively active. The total operational sex ratio found for this population was skewed towards males (2:1), dominant in March and April 2012 and from June to October 2012. The sole presence of males at Ossos Beach from June to September 2012 is noteworthy. In addition, only adults in this study area were observed, reproductively active at all times (100 %), including during the months when no females were found in the area.

Table 1. Matrix results of Dunn's post–test analysis, indicating the differences between seahorse population densities at the studied beaches (α = 0.05). * Statistically significant.

Tabla 1. Resultados de la matriz del análisis a posteriori *de Dunn, que indican las diferencias entre las densidades de población de caballitos de mar de las playas estudiadas (α = 0,05). * Estadísticamente significativo.*

Study sites	*p*–value
João Fernandes x Ossos	< 0.05*
João Fernandes x Canto	> 0.05
Ossos x Canto	< 0.05*

The sex ratio was different between the beaches, indicating distinctive characteristics. Canto Beach showed a total operational sex ratio skewed towards females (1:2), while a proportionate sex ratio (1:1) was observed at João Fernandes Beach. At Ossos Beach, the same parameter was skewed towards males (2:1) (fig. 3).

Regarding the juvenile x adult ratio, João Fernandes and Canto Beaches were observed as areas that receive and house juveniles, while Ossos Beach showed no juvenile individuals throughout the study period.

Size and depth

Seahorses at Canto Beach had a mean size of 155 ± 34 mm. The mean size of adults observed at João Fernandes Beach was 144 ± 15 mm, while juveniles had a mean size of 83.75 ± 8.9 mm. The mean size of adult seahorses at Ossos Beach was 162.2 ± 21 mm, remaining constant throughout the study months. Adult sizes differed significantly between beaches (p = 0.023, F = 3.990). The multiple comparison Tukey–Kramer test indicated that animals from João Fernandes Beach were significantly smaller (p < 0.05; q = 3.89) than those from Ossos Beach, but similar to Canto Beach (p > 0.05, q = 2.87). No significant difference was observed between seahorse size from Ossos and Canto Beach (p > 0.05; q = 0.26). Regarding height, a higher number of

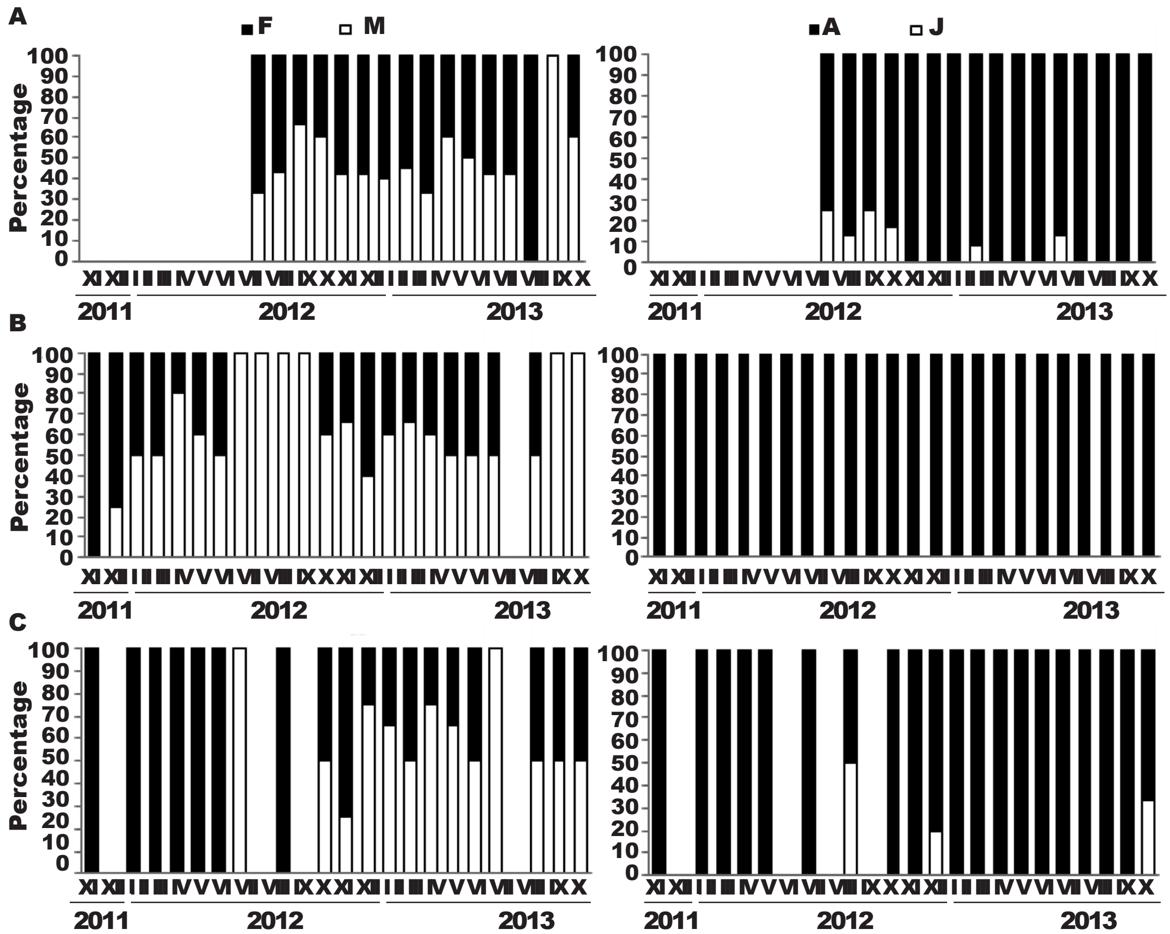

Fig. 3. Total operational sex ratio (%) (F, females; M, males) and juvenile (J) x adult (A) ratio at the three study areas João Fernandes (A), Ossos (B) and Canto beaches (C), Armação de Búzios (RJ).

Fig. 3. Razón de sexos total (%) (F, hembras; M, machos) y proporción entre juveniles (J) y adultos (A) en las tres zonas del estudio de playa João Fernandes, playa Ossos y playa Canto, en Armação de Búzios (RJ).

individuals from Ossos Beach were categorized in higher height classes than individuals from the two other beaches (fig. 4).

The mean occurrence depth of seahorses was of 141 ± 36 cm, constant throughout the study year. No correlation was found between the individual size and occurrence depth ($p = 0.375$, $r = 0.256$). The occurrence depth of the seahorses was significantly different between beaches ($p < 0.001$; $F = 55.605$), with João Fernandes showing the highest occurrence depths (fig. 5). The multiple comparison Tukey–Kramer analysis showed that seahorses found in significantly deeper locations at João Fernandes beach than at Ossos ($p < 0.05$; $q = 14.185$) and Canto ($p < 0.05$, $q = 10.916$) beaches. No significant difference was observed between occurrence depths between Canto and Ossos beaches ($p > 0.05$; $q = 0.470$). Spearman correlation showed no significant relation between depth and size ($p = 0.168$, $r^2 = 0.008$).

Substrate and behavior

Although we did not quantify this, we observed dominance in substrate availability for each site. Canto beach was dominated by algae and the gorgonian *Phyllogorgia dilatata*, while Ossos and João Fernandes beach were mainly composed of the sponge *Aplysina fulva*. Seahorses were recorded in Canto beach in association with seven different types of substrate, namely the algae *Sargassum* sp. C. Agardh, *Amphiroa* sp. (J. V. Lamouroux, 1812) and turf algae; the gorgonian *Phyllogorgia dilatata* (Esper 1806), the sponge *Aplysina fulva* (Pallas 1766), rocks and fishing nets. Of all the recorded substrates, the highest occurrence frequency was the seaweed *Sargassum* sp., representing 47 % of the records. Seahorses from João Fernandes Beach were observed associated with only three types of substrate, namely turf algae, the sponge *Aplysina fulva,* and the gorgonian *Lepto-*

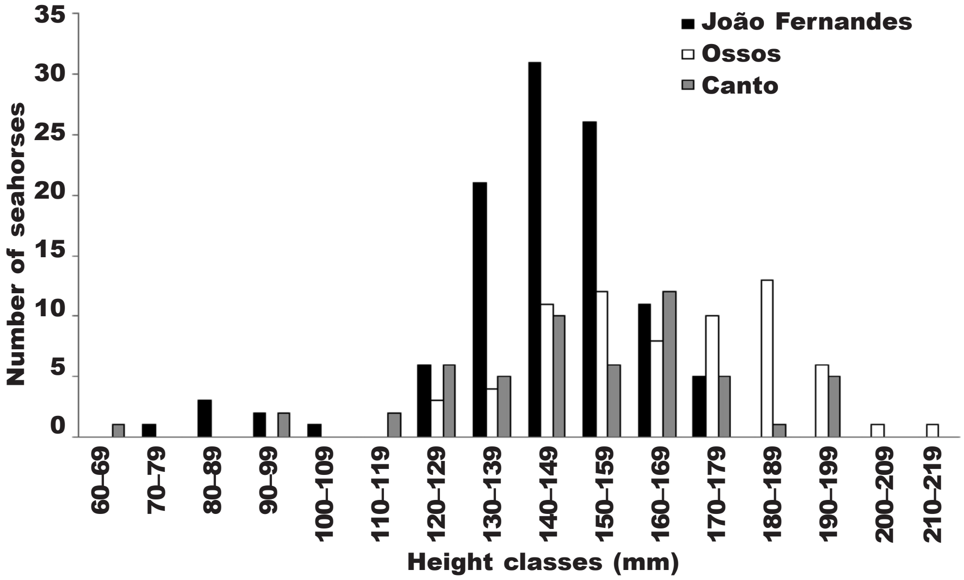

Fig. 4. Height classes (mm) of *H. reidi* seahorses at the three study areas João Fernandes, Ossos and Canto beaches, Armação de Búzios (RJ).

Fig. 4. Clases de altura (mm) de los caballitos de mar H. reidi *en las tres zonas del estudio, en las playas de João Fernandes, Ossos y Canto, en Armação de Búzios (RJ).*

gorgia sp. Milne–Edwards, 1857. The substrate most used by *H. reidi* in this study area was the sponge *A. fulva*, with an occurrence frequency on this substrate of 92 % (n = 21). The other substrates accounted for only 4 % (n = 1) of occurrence each. Seahorses from Ossos Beach were found associated with five different types of substrate, with the *Aplysina fulva* sponge being that most frequently used, in 85 % (n = 33) of the total cases. Other substrates used were the bryozoan *Schizoporella unicornis* (Johnston *in* Wood 1844) (2 %; n = 1), the ascidian *Phallusia nigra* (Savigny 1816) (2 %; n = 1), seaweed *Sargassum* sp. (9 %, n = 3) and a submerged tree branch with epiphytes (2 %, n = 1) (fig. 6).

The seahorses were found in association with a greater number of substrates at Canto Beach, followed by Ossos Beach and João Fernandes Beach. Of note was the relevance of the *Aplysina fulva* sponge as a substrate, recorded at all beaches. Behavioral diversity was greatest at Canto Beach, followed by João Fernandes and Ossos Beach (fig. 7). Despite greater behavioral diversity at Canto Beach, the most frequent behavior was resting at all beaches.

The individuals showed the broadest behavior repertoire attached to the sponge *Aplysina fulva* and the seaweed *Sargassum* sp. (table 2). The other substrates were used basically to rest.

Environmental characteristics

The environmental variables at Canto Beach remained relatively stable over the study months, except for transparency. The maximum recorded temperature was in March 2012, being 26 ºC, with a minimum of 20.2 ºC in May 2012 (fig. 8). Salinity showed subtle variations during the study period, with a recorded maximum of 40 in May and September 2012, and a minimum of 35 in November and December 2011, February to April 2012 and October 2012 (fig. 9).

João Fernandes beach showed a normal curve, with peak temperatures in March and April 2012, and a gradual decrease in the other study months. The temperature varied by up to 7 ºC between months, with a maximum of 27 ºC in March/12 and a minimum of 20 ºC in October/12 (fig. 8). Salinity showed increasing values over the study months, with peaks at 40 in June and August 2012. Lower salinity values were observed from November/11 to April/12 (fig. 9).

Ossos beach presented the warmest waters, from 24 to 25 ºC, from February to June 2012, and the coldest periods, 19 and 21 ºC, from November/11 to January/12 and from September to October 2012 (fig. 8). Salinity also presented marked periods, with lowest values, of 35 from November/11 to April/12, and highest values, ranging from 37 to 40, from May to October 2012 (fig. 9).

Environmental variables were similar between areas, with no significant differences in temperature (p = 0.882; F = 0.125, df = 35) or salinity (p = 0.882; F = 0.125, df = 35). The environmental trends could not explain the variation in seahorse density variation at the three beaches (p = 0.743; R^2 = 0.85; df = 71).

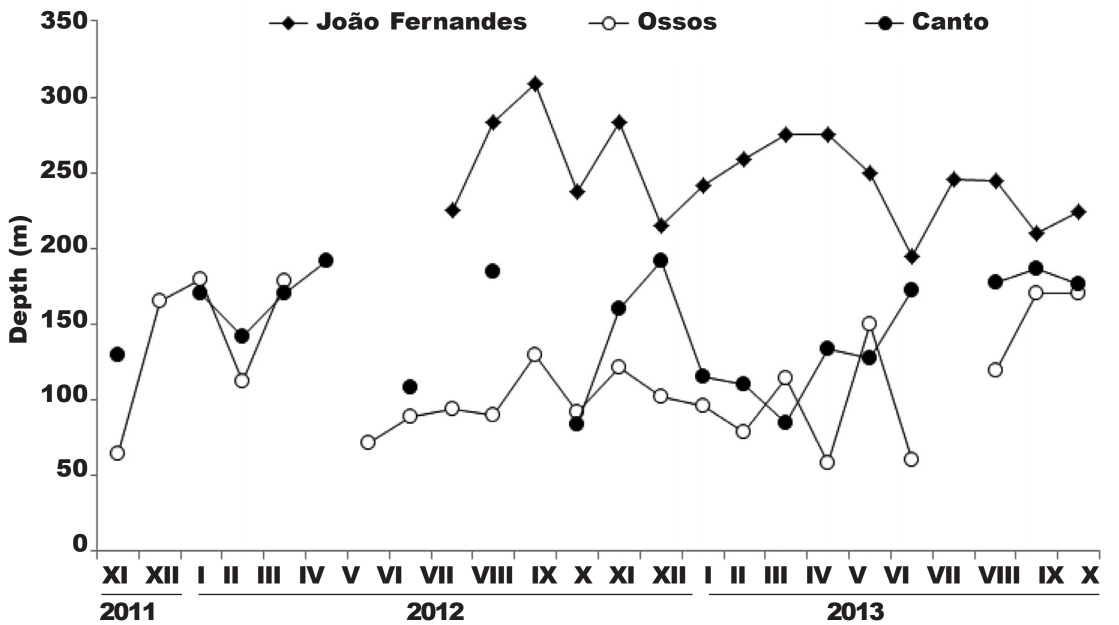

Fig. 5. Occurrence depth (m) of *H. reidi* seahorses at the three study areas João Fernandes, Ossos and Canto beaches, Armação de Búzios (RJ).

Fig. 5. Profundidad de la presencia (m) de los caballitos de mar H. reidi *en las tres zonas del estudio, en las playas de João Fernandes, Ossos y Canto, en Armação de Búzios (RJ).*

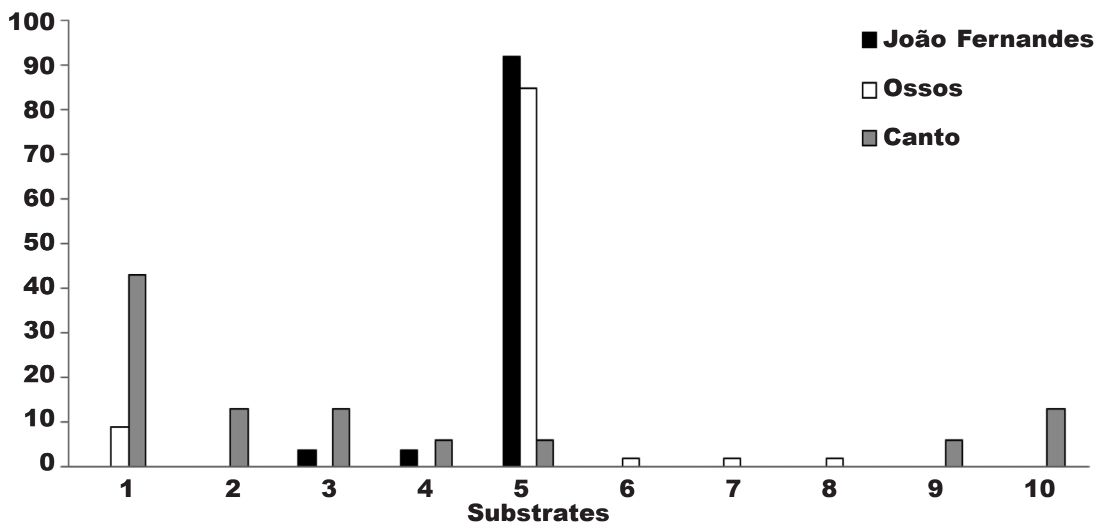

Fig. 6. Number of substrates used by *H. reidi* seahorses at the three study areas João Fernandes, Ossos and Canto beaches, Armação de Búzios (RJ): 1, *Sargassum* sp.; 2, *Amphiroa* sp.; 3, Turf algae; 4, *Phillogorgia* dilatata; 5, *Aplysina fulva*; 6, *Schizoporella unicornis*; 7, *Phallusia nigra*; 8, branch; 9, net gear; 10, rock.

Fig. 6. Número de sustratos utilizados por los caballitos de mar H. reidi *en las tres zonas del estudio, en las playas de João Fernandes, Ossos y Canto, en Armação de Búzios (RJ). (Para las abreviaturas de los sustratos, véanse arriba).*

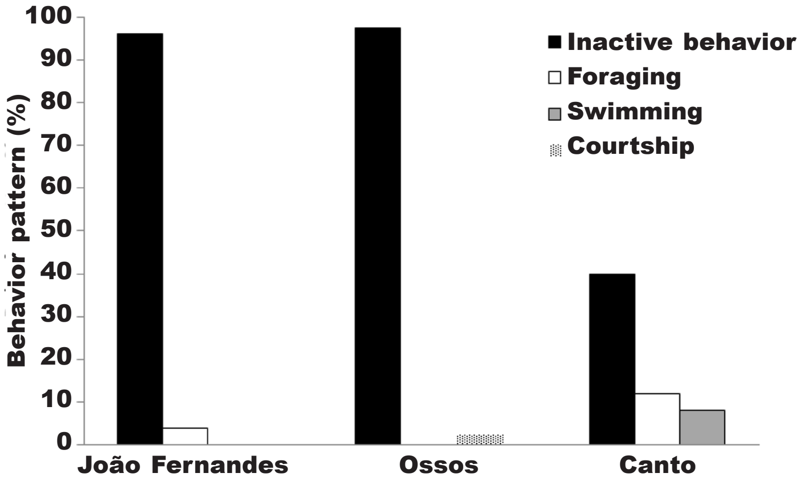

Fig. 7. Percentage of behaviors exhibited by *H. reidi* seahorses at the João Fernandes, Canto, and Ossos beaches, Armação de Búzios (RJ).

Fig. 7. Porcentaje de comportamientos exhibidos por los caballitos de mar H. reidi *en las playas de João Fernandes, Canto y Ossos, en Armação de Búzios (RJ).*

Discussion

Population densities at the three Armação de Búzios beaches were low when compared to *H. reidi* populations found in mangrove ecosystems in Northeastern Brazil (Pernambuco, Ceará, Piauí) (Silveira, 2005; Osório, 2008; Mai and Rosa, 2009; Aylesworth et al., 2015). Rosa et al. (2007) conducted a survey on the occurrence of *H. reidi* along the Brazilian coast, observing a total density of 0.026 ind/m^2, similar to what was found herein. Freret–Meurer and Andreata (2008) found similar densities for this species on a rocky reef at Ilha Grande, Angra dos Reis, also Southeastern Rio de Janeiro, while Freret–Meurer (2010) reported densities of 0.003 ind/m^2 for João Fernandes Beach and 0.001 ind/m^2 for Geribá Beach in 2006. No seasonality has been identified for the three populations, as reported by Freret–Meurer and Andreata (2008).

Table 2. Frequency of occurrence behavior x holdfast: R, resting; S, swimming; C, courtship; F, foraging.

Tabla 2. Frecuencia de comportamiento de presencia x substrato: R, descansando; S, nadando; C, cortejo; F, buscando comida.

	R	S	C	F
Turf algae	100 %	0 %	0 %	0 %
Alga filamentosa	50 %	50 %	0 %	0 %
Sargassum sp.	63 %	25 %	0 %	12 %
Caulerpa racemosa	100 %	0 %	0 %	0 %
Dictyota sp.	100 %	0 %	0 %	0 %
Amphiroa sp	50 %	0 %	0 %	50 %
Padina sp.	100 %	0 %	0 %	0 %
Aplysina fulva	97 %	0.6 %	1.2 %	0.6 %
Millepora alcicornis	100 %	0 %	0 %	0 %
Palythoa sp.	100 %	0 %	0 %	0 %

	R	S	C	F
Protopalythoa sp.	100 %	0 %	0 %	0 %
Phillogorgia sp.	83 %	0 %	17 %	0 %
Schizoporella unicornis	100 %	0 %	0 %	0 %
Phallusia nigra	100 %	0 %	0 %	0 %
Iron box (Anthopogenic waste)	100 %	0 %	0 %	0 %
Fishing net	100 %	0 %	0 %	0 %
Branch	100 %	0 %	0 %	0 %
Rock	100 %	0 %	0 %	0 %

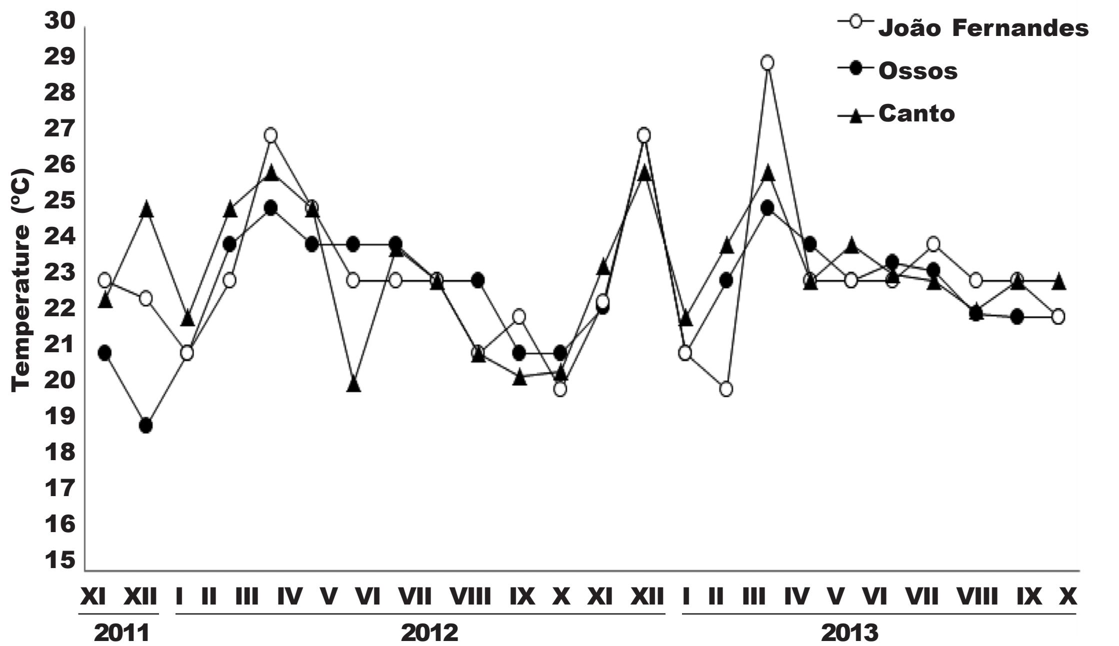

Fig. 8. Temperature (ºC) recorded during the study at the João Fernandes, Ossos and Canto beaches, Armação de Búzios (RJ).

Fig. 8. Temperatura (ºC) registrada durante el estudio en las playas de João Fernandes, Ossos y Canto, en Armação de Búzios (RJ).

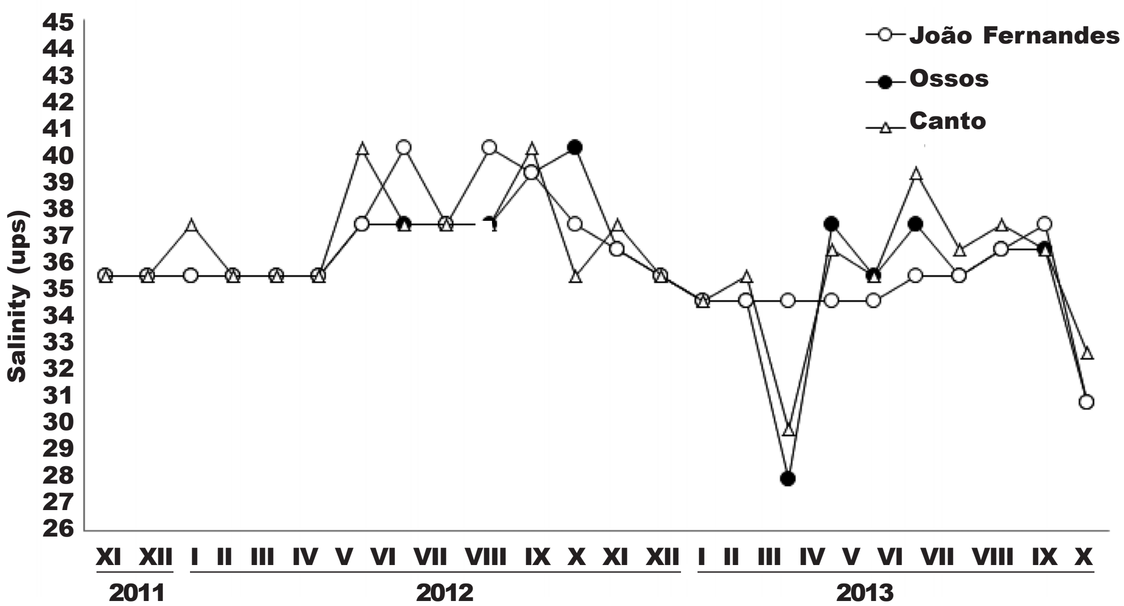

Fig. 9. Salinity (ups) recorded during the study at the João Fernandes, Ossos and Canto beaches, Armação de Búzios (RJ).

Fig. 9. Salinidad (psu) registrada durante el estudio en las playas de João Fernandes, Ossos y Canto, en Armação de Búzios (RJ).

Low densities are often found for several other seahorse species in other regions of the world, such as *Hippocampus capensis* in South Africa (Bell et al., 2003), *Hippocampus comes* in the Philippines (Perante et al., 2002; Morgan and Vincent, 2007) and *Hippocampus whitei* in Australia (Vincent et al., 2005). These densities are considered low and reflect the pressure suffered by these species over the years (Costa–Neto, 2000). Correia et al. (2015) also reported a variation of densities over time for *H. guttulatus* in Rio Formosa. Despite low densities, the populations studied herein remained stable throughout the study, with no major changes, except for João Fernandes Beach. Although seahorses were not marked, it has previously been reported that *H. reidi* has a home range exceeding 100 m^2 (Freret–Meurer and Andreata, 2008), which suggests that seahorses herds move along the rocky reef. These movements could occur when males increase their home ranges, when they are not pregnant and become more active (Freret–Meurer et al, 2012). This could explain the density fluctuation, what may lead to misinterpretation of the population dynamics. These displacements are commonly observed (Freret–Meurer, pers. observ.) and can lead to erroneous inferences regarding the abundance of individuals in a given area.

The distribution and abundance of some species of seahorse appeared to be related to the availability of habitat (Curtis and Vincent, 2005; Rosa et al., 2007; Aylesworth et al., 2015; Gristina et al., 2015; Harasti, 2016). The habitat structure and complexity is clearly important to maintain healthy populations of *H. reidi* and could influence their behavior. The holdfasts most commonly used by the seahorses in the present study were *A. fulva* and *Sargassum* sp. Both substrates apparently provide a good habitat for the seahorses to feed, protect and reproduce, particularly *A. fulva.* Other studies found seahorses resting on the substrate, a behavior also described for *H. reidi* (Rosa et al., 2007), *H. abdominalis* (Martin–Smith and Vincent, 2005) and *H. capensis* (Bell et al., 2003). This was also the most frequent behavior observed in our research.

Hippocampus reidi is known to occur between depths of about 10 cm (Rosa et al., 2002) and 55 m Vari (1982), but we did not find any relation between size and depth. Although these data are not consistent with those of Dauwe (1992), who recorded larger individuals of this species in deeper water, they support findings of Oliveira and Freret–Meurer (2012), who neither found any relation between size and depth in a rocky reef in Arraial do Cabo, Rio de Janeiro.

Population characteristics, such as sex ratios for juveniles and adults, were specific for each beach, indicating that each area may play an important role in maintaining the Armação de Búzios subpopulations.

Canto Beach is directly influenced by currents that bring large amounts of solid waste to the area, with soda/beer cans and plastic bags constantly being found. João Fernandes and Ossos Beaches attract many swimmers and amateur divers who ignorantly trample the rocky shore to capture organisms out of curiosity or to take pictures. The low occurrence of seahorses at the studied beaches increases the vulnerability of these animals to captures. Despite their cryptic nature, these are animals arouse interest when seen, making them frequent targets for curious people and the aquarium market. Besides tourists, fishermen are often seen stretching their nets along the rocky reefs, without any concern regarding specific animal populations in these areas.

Seahorses from Armação de Búzios have a small population, although they reproduce all year long. This is of note in terms of conservation, because although they reproduce all year long, they are unable to increase their population density. This is probably due to a reef fish dispersal strategy. After birth, seahorses become planktonic for about 15 days (Foster and Vincent, 2004), being carried by currents and tides for kilometers before they settle. Studies about seahorse settlement are lacking, although it has been reported that the clownfish *Amphiprion clarkia*, which has a 7–11 day planktonic larval duration, is able to disperse 36 km (Green et al., 2014). The population font of *A. clarkia* may thus establsh other populations kilometers away. This dispersion is also likely among seahorses, so the stocks at our study site are possibly replenished from a nearby, non–studied population of seahorses.

In spite of the studied populations of *H. reidi* are not driven by seasonality, stocks appear to remain stable. Temperature and salinity do not seem to have a major influence on density or the reproductive period. Each population has a particular structure and particularities should be considered for management plans.

Although we did not record a decrease in seahorse abundance, the density was low. To conserve the small population from Búzios, we recommend controlled ecotourism on rocky reefs and projects of environmental education. Such actions could help the natural restoration of *H. reidi* populations in the area.

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