BENTHIC ALIEN INVERTEBRATES IN THE BAÍA DA ILHA GRANDE, SOUTHWEST ATLANTIC.[1]

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Invasive alien species are a significant threat to gbbal biodiversity, second only to habitat destruction (Vitousek *et al.*, 1997). It has been recognized that the littoral and infra-littoral biota in many regions have undergone rapid and profound change because of alien introductions (Carlton, 1996). The region of Baía da Ilha Grande, on the southeast coast of Brazil, is sited at the transition between tropical and temperate faunas, and harbors a variety of marine ecosystems which include rocky shores (De Paula & Creed, 2004). The region is subjected to intense ship traffic due to the presence of three important ports, a shipyard that receives oil platforms and a "safe haven" area where shipping can lay over. These shipping movements have served as vectors for the introduction of alien species to the region. In 2003 a Rapid Assessment of Marine Biodiversity was carried out in the region of Baía da Ilha Grande in order to inventory the biodiversity of the region. To quantify and qualify threats to biodiversity, alien species within the region were also quantified. The present study describes the distribution and abundance of three aliens, the sun corals *Tubastraea coccinea* Lesson, 1829 *and T. tagusensis* Wells, 1982 and the bivalve *Isognomon bicolor* (C. B. Adams, 1845) and examines whether their distributional patterns can be explained by local environmental parameters. The identification of the factors driving invasion success or failure can improve the efficacy of control efforts.

The quantification was carried out at 36 locations in the Baía da Ilha Grande, Rio de Janeiro State (23° S e 44° W) between October and December 2003. At each location a diver swum 5 periods of 1 minute (approximately 25 m.min^{-1}) and estimated the abundance of each species as dominant, abundant, frequent, occasional, rare or not present in each period. A Relative Abundance Index was calculated by substituting observations with values of 10, 8, 6, 4, 2 and zero respectively. In order to investigate what physical and chemical parameters of shore and water could potentially explain the patterns in abundance found, the following variables were measured: latitude, longitude, depth of interface with sediment plain, temperature and salinity of surface waters, Secchi depth, degree of exposure to waves, slope and rugosity of the rocky shore. For locations with complete data sets (n = 33) a Multi-Dimensional Scaling (MDS) ordination, based on Bray Curtis similarity measures on standardized and vx transformed data was carried out to investigate differences in the environmental measures. In order to test for the existence of a relationship between the abundance and distribution of the alien organisms and the environmental site characteristics, two MDS axes were correlated with the abundance of each of the three species.

The bivalve *Isognomon bicolor* was the most frequent alien species and generally the most abundant found in the region (Table 1). In contrast *Tubastraea coccínea* was the species least frequent and least abundant (Table 1). However, where they occurred, the corals were as or more abundant than the bivalve. The two coral species had similar distributional and abundance patterns (Pearson Correlation, n = 33, *T. tagusensis*: *T coccinea* = 0.59, p < 0.001; *T. tagusensis*: *I bicolor* = 0.26, p = 0.072; *T. coccinea*: *I bicolor* = 0.24, p = 0,090).

In the MDS ordination the first two axes showed a clear separations for depth, degree of exposure to waves, Secchi depth and rocky shore slope. However, the ordination did not explain the distribution of the alien species in the region and no significant correlation was found between the first two axes of the MDS and the abundance of the alien species (Table 2).

The mechanisms for rapid increase in populations following establishment success are not well understood. Dispersal ability, fecundity, characteristics of the gene pool and the matching of climates of origin and new habitat are thought to promote invasive spread (Lee & Klasing, 2004). The escape from natural predators or pathogens has been put forward as an important mechanism which could also explain fast population expansion and invasive spread.

The alien corals and bivalve are well established within the Baía da Ilha Grande. De Paula and Creed (2004) described *Tubastraea coccinea* and *T. tagusensis* as distributed on the shores of Ilha Grande, the largest

island in the region. *T. coccinea* is recognized as a tan-tropical invasive species but *T. tagusensis*, which was the most abundant and widespread sun coral at Baía da Ilha Grande, has not previously be recognized as an alien in other parts of the world. The bivalve *Isognomon bicolor* has also been reported for the Baía da Ilha Grande and originated from the Caribbean. *I. bicolor* is now well established in Brazil.

Despite the clear ordination of the locations and the fact that physical and chemical characteristics vary quite substantially throughout the region, no evidence of a relationship was found between the environmental parameters and the distribution and abundance of the three alien invertebrates. All organisms exhibit limits to tolerance to environmental factors, but successful invasive species are thought to have more ample limits, as this characteristic allows for their wider geographical distribution. It seems therefore, that either these species have not yet found their ecological limits within the Baía de Ilha Grande or the whole range of conditions found there is suitable for their survival and growth. In either case, we must conclude that these are well established populations which will continue to expand and as such they pose a serious and real threat to the biodiversity of the rocky shore communities of the region.

Table 1 Abundance and frequency of three benthic alien invertebrates in Baía da Ilha Grande, Brazil

Species	Frequency of occurrence (%)	Relative abundance Index					
		Region-wide			Sites where the alien occurred		
		Mean	SE	Signifies	Mean	SE	Signifies
Tubastraea tagusensis	30.5	1.3	0.4	very rare	4.4	0.8	occasional/frequent
T. coccinea	22.2	0.5	0.2	extremely rare	2.1	0.6	occasional / rare
Isognomon bicolor	80.5	2.8	1.4	occasional / rare	3.5	0.4	occasional / rare

*Relative Abundance index (0-10)

Table 2. Correlation coefficients for species abundance and MDS axes 1 & 2 from the environmental data.

	Tubastraea tagusensis		*T. coccinea*		*Isognomon bicolor*	
	Pearson´s r	p	Pearson´s r	p	Pearson´s r	p
Axis 1	-0.102	0.571	0.052	0.772	0.281	0.113
Axis 2	0.263	0.139	0.301	0.089	-0.025	0.892

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