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TRACKING NON-NATIVE SPECIES IN THE ANTARCTIC MARINE BENTHIC ENVIRONMENT

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Abstract: *Antarctica is not as isolated as once thought. Although persistent and invasive species have not been detected in the marine environment, some transient species have been. In the present study we investigate the biogeographical patterns of 529 benthic species of 5 target phyla recorded in the Admiralty Bay considering that it is an important tool for the identification of species origin. Most species of Admiralty Bay of the studied phyla are endemic to Sub Antarctica and Antarctica. The second highest percentage was of species with continuous distribution. Chordata and Annelida presented the highest number of disjoint species. However most disjoint species predominate in Antarctica and Sub Antarctica indicating their origin in the Southern Ocean. Cosmopolitan patterns appear to be correlated to taxonomic misidentification or to the occurrence of cryptic species that are being revealed by molecular studies. Only a few disjoint species deserve further investigation.*

Keywords: bioinvasion, biogeographical patterns, endemism

Introduction

Bioinvasion means the movement of species into an area beyond their natural range, as a result of human activity. In Antarctica this includes movement of species between biogeographic zones. The main barrier to introductions of non indigenous species (NIS) in the Southern Ocean is the physical dissimilarity between donor and recipient areas. There are no records of persistent and invasive non indigenous species in the Antarctic marine environment. So, why are we concerned about bioinvasion in maritime Antarctica?

We know now that Antarctica is not as isolated as once thought (Clarke *et al.*, 2005). Non native organisms including terrestrial invertebrates and plants, marine Crustacean (adult and larvae) and algal dense mats of an introduced species (*Enteromorpha intestinalis*) have already been found in the Antarctic environment (Frenot *et al.*, 2005). The rapid regional warming of the Antarctic Peninsula during the last 50 years also leads to more favorable conditions of establishment of non indigenous species (Convey, 2006). Another factor that influences bioinvasion rates is the transport of people and goods that are increasing due to logistic, scientific, fisheries and tourism activities every year. Finally, non native species is the highest priority issue in the CEP (Committee on Environmental Protection) five year work plan highlighting that we need to be proactive.

Carlton (2009) listed 12 potential sources of errors that have led to invader underestimation. The lag time in recognizing that an introduced species has been mistakenly redescribed ranges from months to over 100 years. Although two hundred terrestrial plants and animals have been recognized as introduced in the sub Antarctic islands there are no records for the marine environment.

Considering these facts, the investigation of biogeographical patterns is an important tool for the identification of species origin. This study has investigated biogeographical patterns of benthic species recorded in Admiralty Bay.

Materials and Methods

The study of species distribution focused on species of five target phyla (Mollusca, Echinodermata, Annelida, Artropoda and Chordata) found in Admiralty Bay and are available in a list at the site www.abbed.uni.lodz.pl, referring to the survey conducted by Sicinski *et al.* (2011). The study was made using the online database OBIS – Ocean Biogeography Information System (OBIS, 2012) and GBIF – Global Biodiversity Information Facility (GBIF, 2012). According to the distribution pattern in marine biogeographic zones proposed by Rass (1986), species were classified as: I) **cosmopolitan**: for those of wide distribution and that are present in at least three ocean basins; II) **continuous**: for species located in adjacent biogeographic areas (but at a lower rate than required for classification as cosmopolitan), III) **disjoint**: species that have occurrences in distinct biogeographic regions (separated by areas of non-occurrence); IV) **endemic**: for species distributed within the boundaries of the Southern Ocean (Sub Antarctica and Antarctica).

Results

The number of macrozoobenthos taxa of the phylum Annelida, Arthropoda, Mollusca, Echinodermata and Chordata recorded by Sicinski *et al.* (2011) was 603. In this study, we analyzed the distribution pattern of taxa identified at species level, totalling 529 species (87.7%). The phylum Arthropoda showed the largest number of taxa (257), proving to be the one with the greatest biodiversity in the marine environment of Admiralty Bay from the phyla studied. The phylum Chordata registered the lowest number of taxa (16).

Most species of Admiralty Bay phyla studied are endemic to Sub Antarctica and Antarctica (Figure 1). The highest percentage of endemic species was found to the phylum Echinodermata. The second highest percentage was of species with continuous distribution. The phylum Chordata had the highest percentage of species with this distribution. Most cosmopolitan species were from the phyla Annelida. The percentage of disjoint species of Chordata and Annelida were the highest among the phyla studied. Some species were not found in databases, and the phylum Annelida presented the highest percentage of species with no data (Figure 1). Cosmopolitan (Table 1) and Disjoint (Table 2) species were classified according to their dominance pattern in Antarctica, Sub Antarctica, South America and other bioregions.

Discussion

The introduction of a species is not always documented. Species that were introduced many years ago (historical introductions) are already in complete equilibrium with the native biota (Villac *et al.*, 2008). Cosmopolitan species are often classified as cryptogenic, species that cannot be recognized as native or introduced (Carlton, 2009). In NIS surveys cryptogenic species are often indicated as potential introduced species to avoid underestimation of bioinvasion under a precautionary approach.

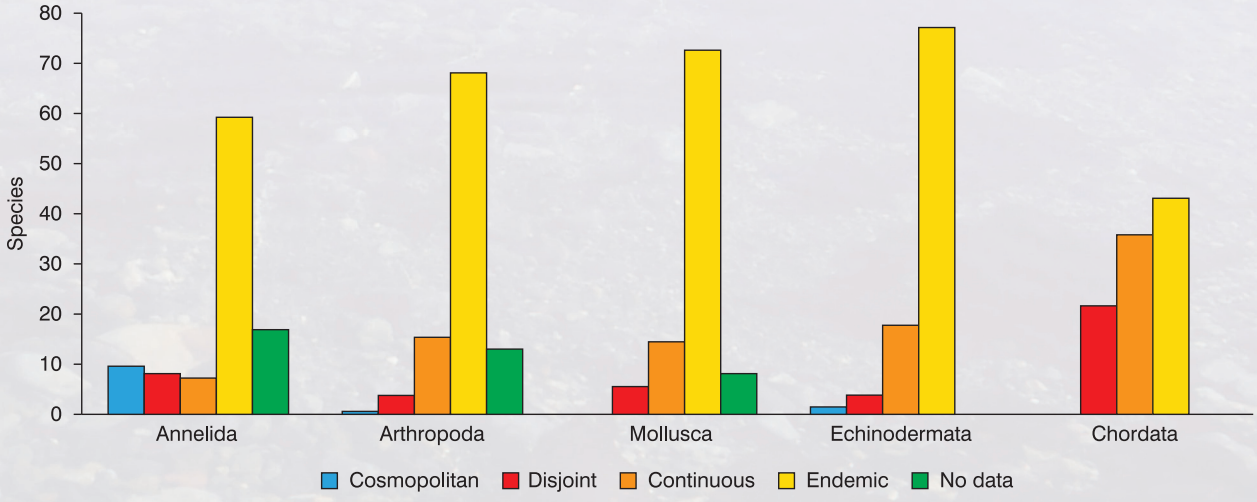

Figure 1. Distribution patterns of the 539 benthic species of Admiralty Bay of five target phyla (Mollusca, Echoinodermata, Annelida, Artropoda and Chordata).

Table 1. Percentage of records in the Southern Ocean, South America and other bioregions of cosmopolitan species with their respective dominance pattern.

I- Substantial number of records in Antarctic and Sub Antarctic					
	Number of records	Antarctic	Sub Antarctic	South America	Others
Hauchiella tribullata	88	15.9	0	0	84.1
Leucothoe spinicarpa	527	11.2	3.4	5.1	80.3
Molpadia musculus	283	16.6	2.5	12.4	68.5
Neanthes kerguelensis	271	18.8	5.5	2.2	73.5
II-Few records in Antarctic an Sub Antarctic in relation to total					
	Number of records	Antarctic	Sub Antarctic	South America	Others
Artacama proboscidea	320	1.2	0	0	98.8
Brada villosa	673	0.9	0	0	99.1
Capitella capitata	6468	0.1	0	0.6	99.3
Levinsenia gracilis	3684	0.3	0	0.5	99.2
Mystides borealis	184	6.5	0	0	93.5
Notomastus latericeus	5967	0.6	0.1	0.4	98.9
Ophelina cylindricaudata	862	4.9	0	1.0	94.1
Pista cristata	1773	0.4	0	0	99.6
Scalibregma inflatum	4600	0.05	0.05	0.05	98.5
Syllis armillaris	589	3.9	0	0.8	95.3
Thelepus cincinnatus	827	6.2	0.4	0.1	93.3

In the present study we investigated the species origin of 44 species that presented a disjoint or cosmopolitan pattern of distribution from their dominance pattern in Antarctica, Sub Antarctica, South America and other bioregions. The biogeographical patterns of species with few records cannot be well established. Cosmopolitan patterns appear to be correlated to taxonomic misidentification or to the occurrence of cryptic species. Particularly cosmopolitan patterns with few records in Antarctica and Sub Antarctica are probably a complex of species that are being revealed by molecular studies. Most disjoint species predominate in Antarctica and Sub Antarctica indicating their origin in the Southern Ocean. Only a few disjoint species, especially for the most number of records in South America, deserve further investigation.

Conclusion

The great majority of investigated species were endemic to the Southern Ocean. The second highest percentage was of species with continuous distribution. Disjoint and cosmopolitan species represented only 8.3% of the total. The results obtained do not allow us to make conclusions about which species were introduced to the Southern Ocean. However they provide detailed information about disjoint and cosmopolitan species indicating which species deserve further investigation.

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Table 2. Percentage of records in the Southern Ocean, South America and other bioregions of disjoint species with their respective dominance pattern.

I- Dominance in Antarctic and Sub Antarctic					
	Number of records	Antarctic	Sub Antarctic	South America	Others
Cirrophorus brevicirratus	21	81.0	0	0	19.0
Hippomedon kergueleni	46	74.0	21.7	0	4.3
Iathrippa sarsi	18	66.7	27.8	0	5.5
Laetmonice producta	199	66.3	9.1	1.5	23.1
Mirandotanais vorax	37	70.3	10.8	0	18.9
Neobuccinum eatoni	190	91.0	8.4	0	0.6
Ophiolimna antarctica	120	61.7	16.2	1.7	20.0
Ophioplocus incipiens	202	54.5	44.0	0.5	1.0
Praxillella kerguelensis	7	85.7	0	0	14.3
Syllides articulosus	42	92.9	0	0	7.1
Synoicum adareanum	173	96.5	0	0.6	2.9
Tanaopsis gallardoi	9	88.9	0	0	11.1
II- Dominance in Antarctic. Sub Antarctic and South America					
	Number of records	Antarctic	Sub Antarctic	South America	Others
Amphiura joubini	245	49.4	3.7	46.5	0.4
Cnemidocarpa verrucosa	257	82.9	10.5	5.8	0.8
Laevilitorina caliginosa	66	16.7	34.8	42.4	6.1
Laonice weddellia	92	81.5	15.2	3.3	0
Lissarca miliaris	52	25.0	9.6	63.5	1.9
Polycheria antactica	63	35.0	25.4	19.0	20.6
Travisia kerguelensis	66	59.1	9.1	21.2	10.6
Yoldia eightsi	132	78.1	11.4	8.9	1.6
III- Dominance in Antarctic and South America					
	Number of records	Antarctic	Sub Antarctic	South America	Others
Astyra antarctica	5	80.0	0	20.0	0
Brania rhopalophora	28	50.0	0	3.6	46.4
Corella eumyota	187	65.8	0.5	8.6	25.1
Lumbrineris magalhaensis	137	48.9	0.7	18.2	32.2
Natatolana meridionalis	28	78.6	0	21.4	0
Pista corrientis	13	76.9	0	23.1	0
Pseudharpinia dentata	61	63.9	0	34.4	1.7
Scoloplos marginatus	82	90.2	0	7.3	2.5
Trypanosyllis gigantea	24	66.7	0	12.5	20.8

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