SPECIES COMPOSITION OF THE BENTHIC MACROINVERTEBRATES ON THE COASTLINE VEGETATED ROCKY SUBSTRATES OF THE SOUTHERN CASPIAN SEA

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ABSTRACT

For studying benthic macrofaunal composition associated with seagrass rocky beds of the southern Caspian Sea, two time samplings were carried out along the coast line in the winter and summer of 2013. In total, 1,286 specimens of the five species were identified: *Pontogammarus maeoticus*, *Balanus improvisus*, *Mytilaster lineatus*, *Palaemon elegans* and *Alitta succinea*. The total recorded abundance was 5,675 and 755 ind./m^2, with a biomass of 147,271 and 31,238 mg/m^2 in the winter and summer respectively. The collected species in this study are generally non-indigenous (except *P. maeoticus*) and could potentially have an effect on native benthic fauna, as an additional food source could facilitate the commercially exploited fish stocks. Thus further studies are required to monitor their potential interactions on the Caspian Sea fauna.

RÉSUMÉ: La composition spécifique des macroinvertébrés benthiques des fonds rocheux à végétation de la région côtière du sud de la Mer Caspienne.

Pour cette étude, les auteurs ont effectué deux échantillonnages côtiers, durant l'été et l'hiver 2013. Ont été identifiés 1.286 individus de cinq espèces: *Pontogammarus maeoticus*, *Balanus improvisus*, *Mytilaster lineatus*, *Palaemon elegans* et *Alitta succinea*. L'abondance totale a atteint 5.675 ind./m^2 en hiver et 755 ind./m^2 en été, et a correspondu respectivement aux biomasses de 147.271 mg/m^2 et de 31.238 mg/m^2. Bien que les espèces collectées dans cette étude soient allochtones (excepté *P. maeoticus*) et pourraient potentiellement avoit un impact sur la faune indigène, elles sont aussi une source de nourriture supplémentaire qui pourrait faciliter le renouvellement des stocks des poissons dédiés à l'exploitation commerciale. D' autres études sur les interactions de ces espèces avec la faune Caspienne sont nécessaires.

REZUMAT: Compoziția specifică a comunităților de macronevertebrate bentonice de pe substratele costiere pietroase cu vegetație, din sudul Mării Caspice.

Pentru acest studiu s-au efectuat două eșantionări în lungul liniei de coastă în 2013. Au fost identificate 1.286 exemplare din cinci specii: *Pontogammarus maeoticus*, *Balanus improvisus*, *Mytilaster lineatus*, *Palaemon elegans* și *Alitta succinea*. Abundența totală a avut valoarea hivernală de 5.675 ind./m^2, cu o biomasă totală de 14.7271 mg/m^2 și valori estivale de 755 ind./m^2 respectiv 31.238 mg/m^2. Deși, speciile colectate în timpul prezentului studiu sunt în general specii alohtone (cu excepția lui *P. maeoticus*) și ar putea avea impact asupra faunei bentonice indigene, ele constituie și o sursă de hrană suplimentară ce ar putea facilita refacerea stocurilor piscicole exploatate comercial. Sunt necesare studii suplimentare pentru a monitoriza interacțiunile potențiale ale acestor specii cu fauna caspică.

INTRODUCTION

The Caspian Sea is the largest enclosed water body containing 40% of the earth's continental water mass with one of the most unique brackish water ecosystems in the world (Dumont, 1998). Great parts of its fauna are endemic (Dumont, 2000) and they are derived from the origins of the Caspian, the Arctic, and the Atlantic-Mediterranean freshwater. In comparison to the other seas, the biodiversity of the Caspian Sea is three to five times lower than the Black and the Barents seas, respectively (Zenkevich, 1963).

Aquatic ecosystems vegetated substrates usually support higher species abundance and diversity than unvegetated substrates (Everett et al., 1995; Bostrom and Bonsdorf, 1997; Bowden et al., 2001; Lee et al., 2001). Seagrass beds are distributed widely in the coastal areas of temperate and tropical zones, and they are one of the most productive marine ecosystems in the biosphere. These habitats play a key role and are very important in the marine ecological environment, such as improving shallow seawater quality, being the direct food resource of many organisms, providing important habitat and concealment from predation, and a natural barrier resisting against waves and thus protecting the coasts and their associated animals (Orth et al., 1984; Castel et al., 1989; Hemming and Duarte, 2000; Bowden et al., 2001; Boese, 2002; Xiaoping et al., 2006; Novac and Shurova, 2008).

Generally, these habitats, and their associated macrofaunal communities, are poorly known, and for the seagrass patch structures of the Caspian Sea, the information is very limited. This study tries to provide preliminary data on the species composition, abundance, and the biomass of benthic macroinvertebrates associated with vegetated rocky substrates along the coastline of the southern Caspian Sea. Since the frequent supervision of the ecosystem represents a priority task for water resource assessment, the results obtained in this study can help us to monitor and manage these habitats in the future.

MATERIAL AND METHODS

Study area. The Mazandaran Province is located in the middle of the southern beach of the Caspian Sea (Mazandaran Sea) along the Iranian coasts (Fig. 1).

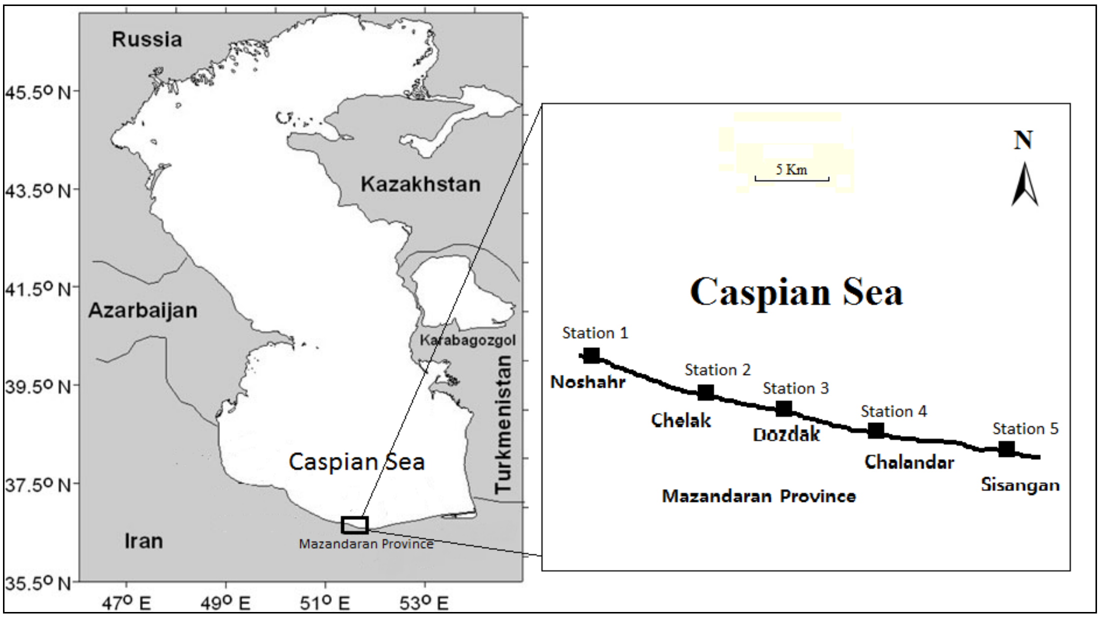

Figure 1: Sampling area map and location of sampling stations in Mazandaran Province.

There is almost no tidal range, and the gradient and structure of the seabed are uniform. The surface salinity and temperature to 20 m depth vary negligibly (Hadjizadeh et al., 2007). No major rivers exist in the vicinity of the sampling sites, but the most important phenomenon in these areas is strong rip currents (Shafiei and Barani, 2011). Besides, floating fishing nets are widely used annually from December to June.

Samples collection. Samplings were carried out along the coast line at five different stations at Mazandaran Province coasts (between Noor and Noshahr cities) within 51°31’11” to 51°49’06”E and 36°35’10” to 36°39’55”N in winter (March) and summer (August) of 2013 (Fig. 1). At each station, five duplicate samples were collected by scraping the surface with a quadrate frame of 80 cm^2 (totally 400 cm^2 at each station).

In the field, the content of each frame was stored in separate plastic containers. In the laboratory, each sample was gently sieved over one millimeter mesh, and the retained material fixed in 4% buffered formalin and stained with Rose Bengal. Then macrofauna separated, identified and counted under an Olympus stereomicroscope and a Carl Zeiss Jena Laboval 4 microscope, and photographed with CCD and Nikon digital cameras. The wet-weight of specimens was determined by a 0.0001 g sensitive balance. The biomass and abundance data were calculated in one square meter separately. The analyses and figures were made using Microsoft Excel.

RESULTS

In total, 1,286 specimens of the five species were identified. Results of the abundances (individuals/m^2) and biomass (wet weight, mg/m^2) of the collected species are given in table 1. Total abundances were recorded 5,675 and 755 ind./m^2 in winter and summer respectively. Among the collected species, *Pontogammarus maeoticus* was the dominant species, with relative abundance of 84.14 and 21.85% in winter and summer respectively. After that *Balanus improvises* with relative abundance of 8.45 and 38.41%, *Mytilaster lineatus* with 5.72 and 33.77%, and *Palaemon elegans* with 1.67 and 3.97% were observed in winter and summer respectively. *Alitta succinea* with 2% abundance was observed only in summer (Fig. 2).

Table 1: Abundance (individuals/m^2) and biomass (wet weight, mg/m^2) of the collected species in this study.

Taxa name	Summer (August 2013)		Winter (March 2013)	
	Abundance	Biomass	Abundance	Biomass
Alitta succinea	15	91.65	0	0
Pontogammarus maeoticus	165	4,950.5	4,775	95,500
Balanus improvises	290	796.65	480	1,232.64
Mytilaster lineatus	255	741.03	325	855.18
Palaemon elegans	30	24,658.22	95	49,683.57
Total	755	31,238.05	5,675	147,271.39

Total biomasses were recorded at 147,271.39 and 31,238.05 mg/m^2 in winter and summer, respectively (Tab. 1). Among the collected species, *P. elegans* had the highest relative biomass, with 33.74 and 78.94% in winter and summer respectively. After that, *P. maeoticus* has a relative biomass of 64.85 and 15.85%, *B. improvises* with 0.84 and 2.85%, and *M. lineatus* with 0.58 and 2.37% were observed in winter and summer respectively. *Alitta succinea* with 0.29% biomass was saw only in summer (Fig. 2).

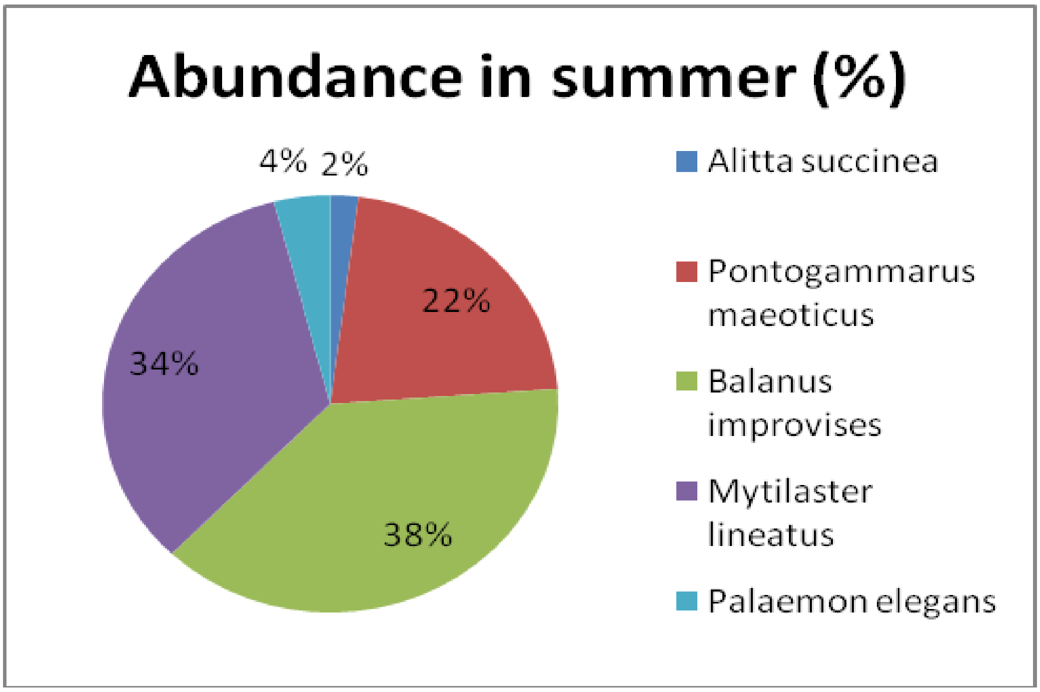

Figure 2a: Percentages of abundance and biomass
of the collected species in this study.

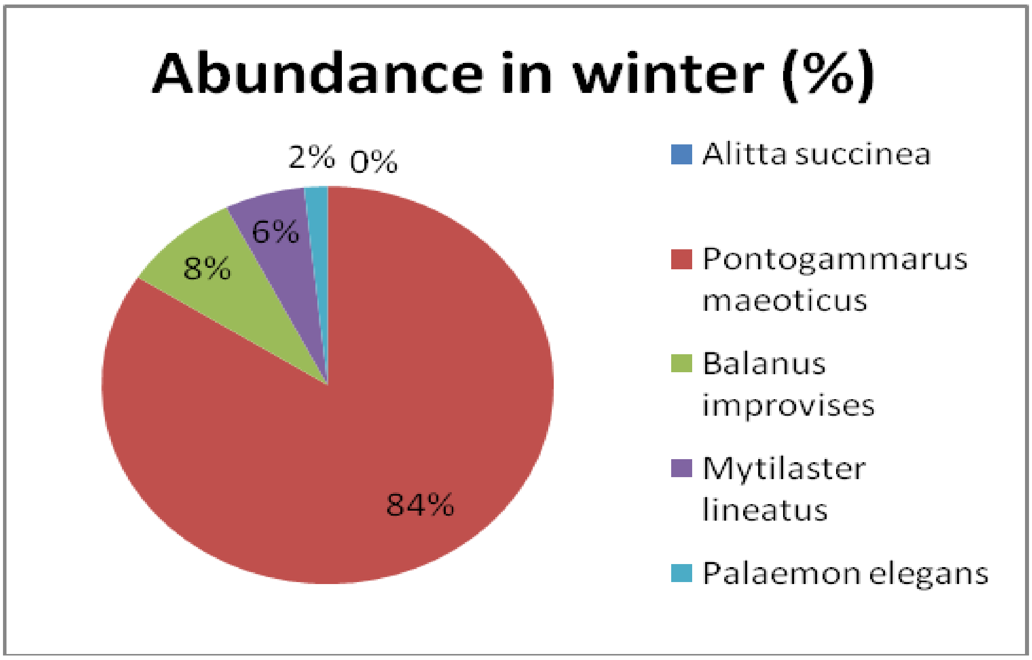

Figure 2b: Percentages of abundance and biomass
of the collected species in this study.

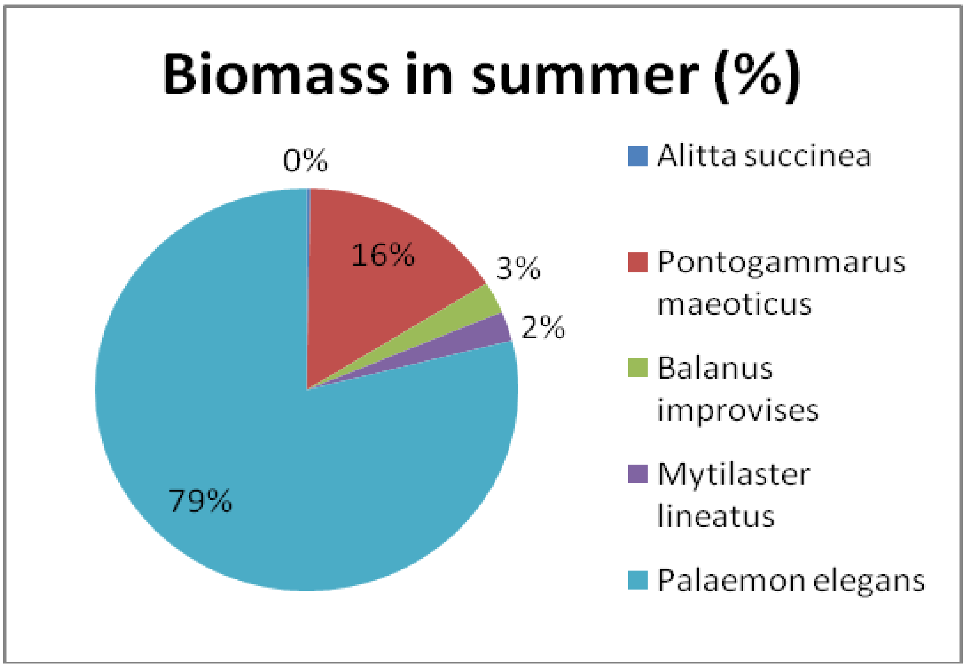

Figure 2c: Percentages of abundance and biomass
of the collected species in this study.

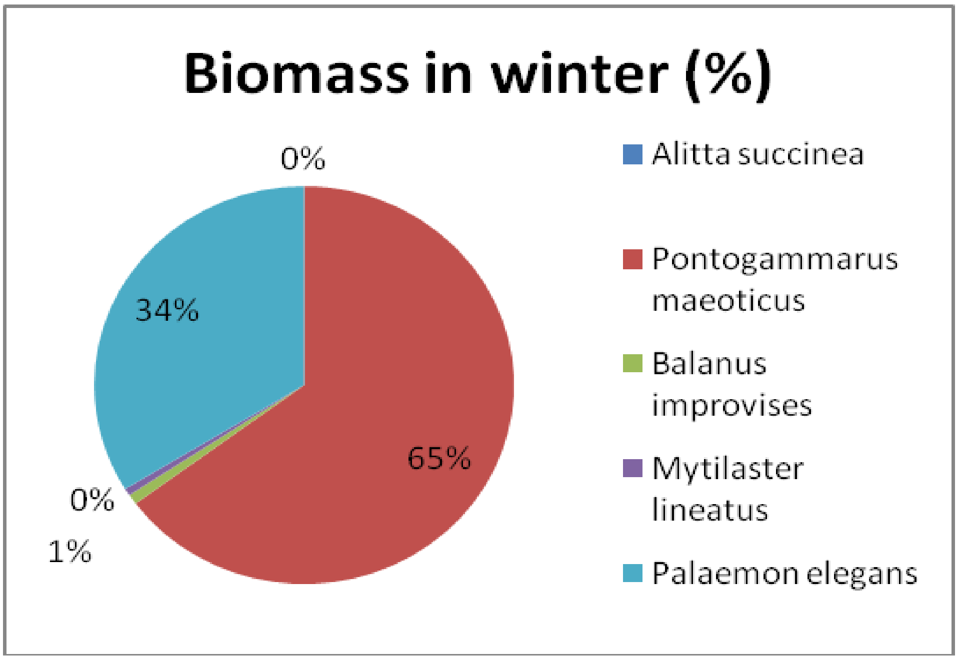

Figure 2d: Percentages of abundance and biomass
of the collected species in this study.

DISCUSSIONS

High productivity (abundance and biomass) and biodiversity of these habitats may result from an arrangement of natural factors and mechanisms (Bostrom and Bonsdorf, 1997; Bowden et al., 2001; Lee et al., 2001). It seems that food availability could be an important factor (Castel et al., 1989). *P. maeoticus* with feeding on suspend plant residues could establish in these habitats very well. Other omnivorous species such as *P. elegans* and *A. succinea* could easily feed on vegetations and small crustaceans (Fauchald and Jumars, 1979; Smaldon, 1993). The wave-generated hydrodynamic force is another factor in determining the abundances and dynamics of communities (Lewis, 1984). In this case, the seagrass beds biota remained more stable than other substrate types and the faunal restoration did not last as long in these habitats by reduction of the wave-generated hydrodynamic force (Lewis, 1984). Due to the vegetated coverage, demersal predatory fish are not able to feed on associated animals efficiently (Orth et al., 1984). The leaves and root-rhizome system of seagrass create habitats of relatively high structural complexity, which by contrast to bare sediments, provide many spatial niches for a variety of fauna (Heck and Wetstone, 1977; Knowles and Bell, 1998).

Other influencing factors on the presence and dynamic of benthic animals include environmental variables related to seasonal changes e.g. salinity, temperature and day length. Due to their effects on the reproduction activity of macrofauna and their predators, affected directly the abundances and dynamics of communities (Yazdani et al., 2010; Taheri and Yazdani, 2010; Ghasemi et al., 2013). Salinity is one of the most important factors influencing distribution of animals in brackish waters (Leppakoski and Olenin, 2000). Within the Caspian Sea, it is the main structuring abiotic factor in species establishment (Aladin and Plotnikov, 2004; Ghasemi et al., 2013).

CONCLUSIONS

In the present study, except *P. maeoticus*, the other collected species are non-indigenous. Although a large number of the Caspian Sea fauna are endemic and adapted to live in waters with low salinity, in the seagrass beds located in fresher waters we have observed two non-indigenous species *Hediste diversicolor* and *Gammarus aequicauda* instead of *A. succinea* and *P. maeoticus*. So it seems that the Caspian native fauna was not well specialized to colonization in the vegetated rocky substrates. These introduced marine origin species with strong competitive abilities may co-exist with Caspian native species and force them out. On the other hand, they may inhabit vacant ecological niches on the poorly colonized vegetated substrates and feed on plants, and suspend residues, practically unlimited food resources. So they could play a key role as a significant food resource for commercially exploited fish, especially sturgeons. Thus, further studies are required to monitor their impacts and interactions on the native fauna of the Caspian Sea.

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