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Amphipods (Amphipoda: Gammaridea) from the Piltun Gray Whale Pasturing Region, Northeastern Sakhalin Island (Sea of Okhotsk)

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Abstract Gray whales (*Eschrichtius robustus*) depend on amphipods as a food source. At present there are only two pasturing regions of gray whales along the shore of Sakhalin Island, Sea of Okhotsk. The Piltun pasturing region characterized by a large supply of forage benthos, is the most traditionally used region.

Macrobenthic samples were taken by collaborators at the Institute of Marine Biology for three years between 2003-2005 from the period from July to September during research expeditions to the region. About 46 species of amphipods belonging to 30 genera and 12 families were found at depths between 8-36m in the Piltun region. Only 5 species had a frequency of occurrence of more than 50%. They were: *Monoporeia affinis* (56%), *Eohaustorius eous eous* (79%), *Eogammarus schmidti* (81%) *Grandifoxus longirostris* (53%), *Anonyx nugax* (54%).

The most abundant species in this region were: *M. affinis, E. schmidti, E. eous eous, Anisogammarus pugettensis, Protomedeia fasciata* and *G. longirostris*. The species *M. affinis* had high abundance (77% of total abundance) as well as great values of biomass (54% of total biomass). The species *E. schmidti* had low abundance (5%), but high biomass (30%). In contrast, the species *E. eous eous* had relatively high abundance (7%), but low biomass (3%). The size-structure of three dominant species (*M. affinis, E. schmidti, E. eous eous*) was studied from more than 9000 individuals. The results showed that the size of *M. affinis* varied from 2.6 to 16.8mm, the size of *E. schmidti* from 8.5-27.0mm, and the size of *E. eous eous* from 1.6-8.2mm. Thus, the large size of the species *M. affinis, E. schmidti* may help there contribution to total biomass and abundance but the small species *E. eous eous* contributes to total abundance despite its size due to high densities.

Key words: Sea of Okhotsk, Piltun region, amphipods, species composition, dominant species, *Monoporeia affinis, Eogammarus schmidti, Eohaustorius eous eous,* gray whale feeding area.

Introduction

Amphipod crustaceans are very diverse, abundant and widely distributed. They are found in nearly all marine and freshwater habitats and act as a food source for many organisms including gray whales (Blokhin and Pavluchkov, 1999). The summer pasturing places of the western population of gray whales are situated near the oil and gas drill holes on the shelf of northeastern Sakhalin Island (Berzin and Vladimirov, 1996). Longstanding observations show that gray whales mainly feed on the rather limited shallow zone of the shelf, which is dominated by silty-sandy sediments (Sobolevskyi *et al*., 2000). The highest occurrence of the gray whales is found at the coastal area (Piltun region), which extends from the Odoptu Bay to the southern part of Piltun Bay (Sobolevskyi, 1998; Sobolevskyi *et al.,* 2000). This region is characterized by high supply of forage benthos (Fadeev, 2006). Amphipods are the main component of the benthic community in this region. In samples taken between 2002 and 2005 amphipods contributed the greatest abundance and biomass within the benthic community at depths down to 20m, their significance decreased at greater depths (Fadeev, 2006).

There are currently no detailed data available on the composition of amphipod species in the Piltun region. The only published record (Budnikova and Bezrukov, 2003) gives a common list of amphipod species for the eastern part of Sakhalin Island on the basis of 102 sublittoral stations in the depth range of 20-280m as well as literature data. The present work will greatly enhance our understanding of amphipod community composition in the Piltun pasturing region of the gray whales with its aim of identifying the quantitative and qualitative characteristics of amphipods in this region.

Materials and Methods

For three years between 2003-2005, macrobenthic samples were collected by collaborators at the Institute of Marine Biology, from July to September during expeditions to the Piltun region (Fig. 1). Fine sand sediments characterized almost all stations. Salinity at the stations varied from 28.0 to 34.4 ‰. Zones with low salinities were registered at the mouths of Piltun and Odoptu Lagoons where

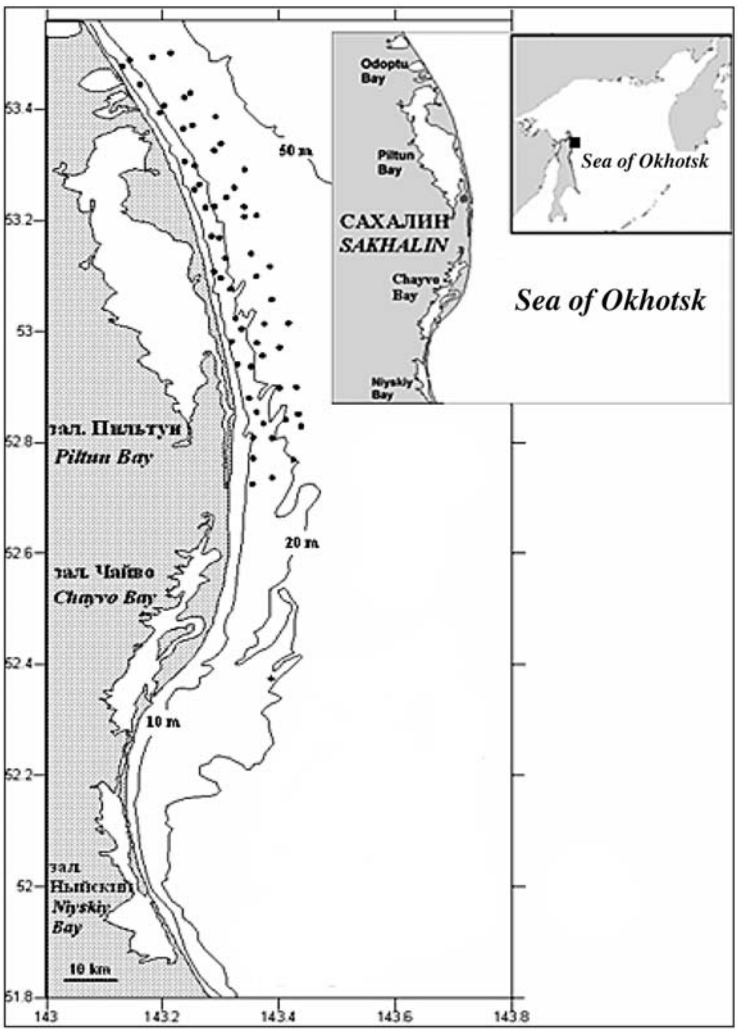

Fig.1. Distribution of stations sampled for amphipod community composition in the study region (From Fadeev, 2006).

salinity reached as low as 15.2 ‰ (Fadeev, 2006). The quantitative samples were taken by means of a van Veen grab with a sampling area of 0.2 m^2. The samples were sieved through 1mm and 0.5mm nested sieves. The organisms remaining on the 0.5mm mesh were preserved in 4% buffered formaldehyde solution. After 48 hours to a week the specimens were transferred from the fixative to a 75% ethanol solution. Amphipods from 87 stations from depths of 8 to 36m were sorted in the laboratory. Amphipods were identified to species level and both abundance and biomass were measured for each species. Species identification was based on the classification of amphipods suggested by Barnard and Karaman (1991) for the marine families of the suborder *Gammaridea*. Morphometric analyses were conducted for three dominant species at the Piltun region: *Monoporeia affinis* (Lindstrom, 1855), *Eogammarus schmidti* (Derzhavin, 1929) and *Eohaustorius eous eous* Gurjanova, 1962. The length of each amphipod specimen was measured from the tip of rostrum to the beginning of the telson with rectifying of specimen's body. The length of more than 9000 individuals was measured.

Results and Discussion

The total amphipod abundance in the Piltun region changed from 7 to 10590 specimens/m^2 with a mean ($\pm$ SD) of 1421 $\pm$ 486.25 specimens/m^2. The total amphipod biomass ranged from 0.14 to 240 g/m^2 with a mean ($\pm$ SD) of 35.41 $\pm$ 6.05 g/m^2. The highest values of amphipod biomass and abundance were observed in the near shore area, which borders the Piltun and Odoptu Lagoons (Fig.2).

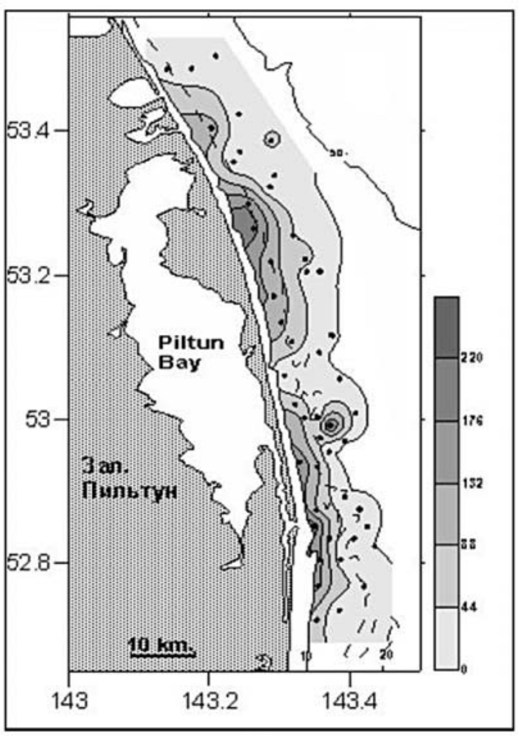

Fig.2. Distribution of total amphipod biomass in the Piltun region in 2005 (scale bar in g/m2) (From Fadeev, 2006).

Taxonomical analysis

Amphipods were observed at all 87 stations from the Piltun region. A total of 46 amphipod species belonging to 30 genera and 12 families were found (Table 1). Four species *Atylus carinatus* (Fabricius, 1793), *Harpiniopsis similis* Stephensen, 1925, *Gammaropsis nitida* (Stimpson, 1853) and *Eyakia* sp., were new records for the eastern part of Sakhalin Island. According to data of Budnikova and Bezrukov (2003), about 189 species belonging to 73 families and 27 genera were known from this eastern part of Sakhalin Island. Only five species had a frequency of occurrence of more than 50% in the Piltun region. These were *Monoporeia affinis* (56%), *Eohaustorius eous eous* (79%), *Eogammarus schmidti* (81%) *Grandifoxus longirostris* (53%), and *Anonyx nugax* (54%). Among them, two species (*M. affinis* and *E. eous eous*) are burrowing deposit-feeders.

The most abundant species in the research region were the following: *M. affinis*, *E. schmidti, E. eous eous, Anisogammarus pugettensis, Protomedeia fasciata* and *G. longirostris*. As it is shown in Fig. 3 and 4, *M. affinis* had high abundance (77% of total abundance) as well as high biomass (54% of

Table 1. List of amphipod species from the Piltun region.

Ampeliscidae
Ampelisca eschrichti Krøyer, 1842
Anisogammaridae
Anisogammarus pugettensis (Dana, 1853)
Eogammarus schmidti (Derzhavin, 1929)
Corophiidae
Gammaropsis nitida (Stimpson, 1853)
Photis sp.
Protomedeia epimerata Bulycheva, 1952
Protomedeia fasciata Krøyer, 1842
Protomedeia sp.
Dexaminidae
Atylus carinatus (Fabricius, 1793)
Atylus collingi (Gurjanova, 1938)
Haustoriidae
Eohaustorius eous eous Gurjanova, 1962
Ischyroceridae
Ischyrocerus sp.
Lysianassidae
Anonyx lilljeborgi Boeck, 1871
Anonyx nugax (Phipps, 1774)
Anonyx sp.
Boeckosimus krassini (Gurjanova, 1951)
Boeckosimus derjugini (Gurjanova, 1929)
Hyppomedon denticulatus orientalis Gurjanova, 1962
*Orchomene gurjanova*e Budnikova, 1999
Orchomene sp.
Orchomenella minuta (Krøyer, 1846)
Orchomenella nana (Krøyer, 1846)
Orchomenella pinguis (Boeck, 1861)
Psammonyx kurilicus (Gurjanova, 1962)
Wecomedon minusculus (Gurjanova, 1938)
Melitidae
Maera prionochira Brüggen, 1907
Melita sp.
Oedicerotidae
Acanthostepheia behringiensis (Lockington, 1877)
Bathymedon sp.
Bathymedon subcarinatus Bulycheva, 1952
Monoculodes crassirostris Hansen, 1887
Monoculodes sp.
Monoculodes zernovi Gurjanova, 1938
Oedicerotidae gen. sp.
Synchelidium gurjanovae Kudrjaschov et Tzvetkova, 1975
Westwoodilla sp.
Weswoodilla sp.1
Westwoodilla (?) sp.
Phoxocephalidae
Eyakia sp.
Grandifoxus longirostris (Gurjanova, 1938)
Grandifoxus nasuta (Gurjanova, 1936)
Grandifoxus robustus (Gurjanova, 1938)
Harpiniopsis similis Stephensen, 1925
Paraphoxus simplex Gurjanova, 1938
Pleustidae
Pleusymtes spp.
Pontoporeiidae
Monoporeia affinis (Lindström, 1855)

total biomass). *E. schmidti* had low abundance (5%) but relatively high biomass (30%). In contrast, *E. eous eous* had relatively high abundance (7%) but low biomass (3%).

Morphometric analysis

The size-structure of three dominant species (*M. affinis, E. schmidti, E. eous eous*) was studied. The main statistical parameters (mean length, standard error, minimum and maximum values of length and the number of measurements for the three study years) are presented in the Table 2.

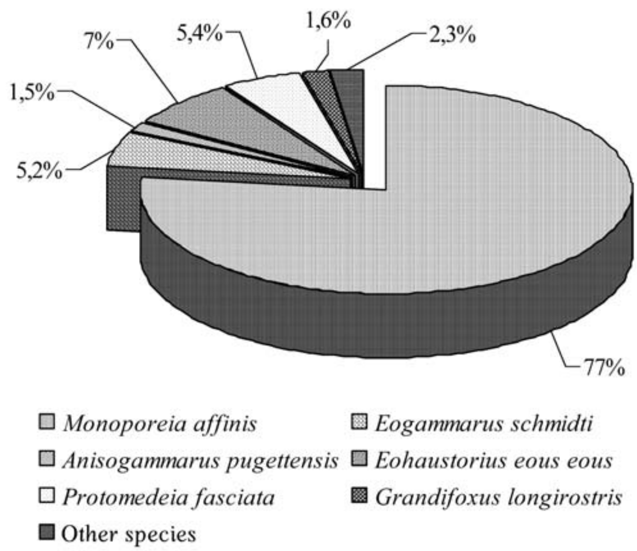

Fig.3. Abundance (% of total abundance) of dominant amphipod species.

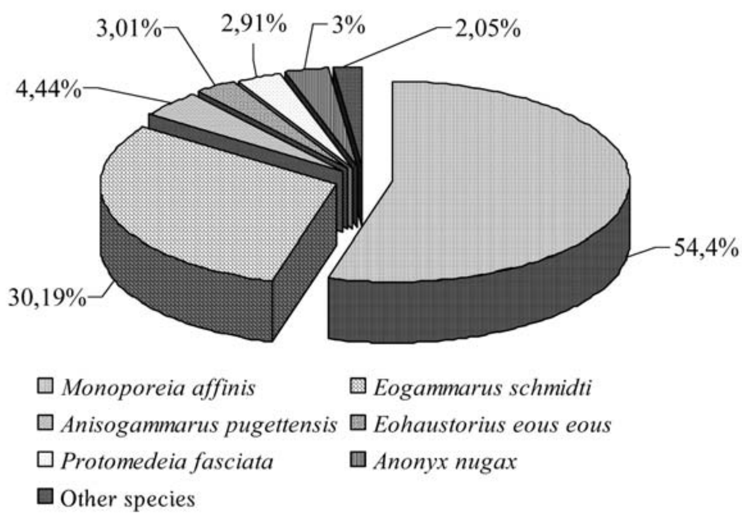

Fig.4. Biomass (% of total biomass) of dominant amphipod species.

Table 2. Morphometric characteristics measured for three dominant amphipod species in 2003-2005.

	Monoporeia affinis			*Eohaustorius eous eous*			*Eogammarus schmidti*		
	2003	2004	2005	2003	2004	2005	2003	2004	2005
Mean length (mm)	8.69	10.87	11.62	5.1	3.77	5.02	14.41	19.77	18.35
Standard error	0.06	0.07	0.04	0.07	0.05	0.05	0.13	0.1	0.3
Min.	2.9	2.7	2.6	1.9	1.6	2	9.6	15.3	8.5
Max.	16.8	15.5	15.9	8	8	8.2	25.2	27	24.6
N	2052	1944	3116	522	390	543	754	293	205

The size-structure analysis showed that the size of *M. affinis* varied from 2.6-16.8mm, the size of *E. schmidti* ranged from 8.5-27.0mm, and the size of *E. eous* eous varied from 1.6-8.2mm. The especially large size of *E. schmidti* may explain this species' relatively large contribution to overall biomass while its abundance was relatively low.

Bogoslovskaya (1996) noted that gray whales consume benthic organisms that are more than 6mm in length. Therefore, all dominant species from the Piltun region can be part of the diet of gray whales, because their lengths generaly exceeded 6mm. However this may mean that only a part of population (the individuals exceeded 6mm) of *E. eous eous* is foraged. The high abundance and biomass of *M. affinis* and *E. schmidti* may partly explain why the Piltun region is a traditional gray whale feeding area.

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