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Preface

Currently, more than a hundred species are known as man introduced into the Baltic. Among them are organisms living in bottom and littoral habitats and those occupying pelagic zone, there are a few parasites, also. Taxonomically introduced species belong to collection of different taxa. There are plants (algae and vascular plants), Coelenterata, Mollusca, Annelida, Crustacea, fish and some species belonging to the other taxonomic groups. Introduced species live in diverse habitats. Some of them are common in the whole Baltic, whereas the others occur only in specific regions.

Man has introduced new species into the Baltic from numerous geographically far regions. New species were mainly introduced by shipping (predominately in ballast waters), intentionally for stocking and other purposes and in association with aquaculture. Importance of each transport vector varies depending on species origin, but in each case shipping is one of the most significant.

This year is a 20th anniversary of the Erkki Leppäkoski's publication: Leppäkoski, E., 1984. Introduced species in the Baltic Sea and its coastal ecosystems. Ophelia Suppl. 3: 123-135, where he for the first time pointed out that introduced species may pose a threat to the Baltic Sea environment. This was a pioneering work for that time not only for the Baltic Sea, but probably for the whole northern and central Europe.

10 years ago, in 1994 the Baltic Marine Biologists Working Group Non-indigenous Estuarine and Marine Organisms was established to coordinate exchange of knowledge of alien species in the Baltic Sea.

After years of investigations we know that case of each introduction is different. Each species has its own biological features promoting invasion. Most probably a lot of foreign species is introduced deliberately into the Baltic every year, but invasion of only a small part of them succeeds.

Humans can change the physical conditions of the environment and these are either global, for example climate warming, or local, such as altered water chemistry, sea bottom shape or local sea current profiles. Human activities can also significantly change the structure of the biocenosis thus creating new, empty ecological niches and decreasing the pressure of autochthonous components of the biocenosis on newly introduced species.

The transport of representatives of a particular species to new areas is usually accidental. The fate of these newly introduced organisms depends on their adaptive abilities and the environmental conditions with which the organism must deal.

Some invasions are interesting from scientific point of view, the others are very important economically, can pose treat for functioning of invaded ecosystem and involve big financial loses. Consequences of many species introduction are still unknown.

We hope that the conference “Baltic – the Sea of Aliens” will let to present the latest results of investigations on invasive species and make plans for future.

Dr. Mariusz Sapota

Prof. Anna Szaniawska

Program

24.08.2004

16:00 – 19.00 – Get together, registration of participants
19.00 – 22.00 – The Organ Concert in the Oliva Cathedral - Gdańsk

25.08.2004 Chair Persons: Anna Szaniawska, Sergej Olenin

9.00 – 9.30 – official opening of the conference
9.30 – 9.50 – **Erkki Leppäkoski** – How we got started – the first twenty years of invasion biology in the Baltic Sea area
9.50 – 10.10 – **Marjo Pienimäki, Sergej Olenin and Erkki Leppäkoski** – European brackish waters exposed to biological invasion – the Remane's curve redrawn?
10.10 – 10.40 – coffee break
10.40 – 11.00 – **Vladimir S. Shestakov and Vadim E. Panov** – Towards an effective early warning system on aquatic invasive species for the Baltic Sea area
11.00 – 11.20 – **Vadim E. Panov, Piotr I. Krylov and Natalie V. Rodionova** – Long–term changes in population dynamics of invasive species in recipient area: the *Cercopagis pengoi* case study
11.20 – 11.40 – **Tomas Zolubas, J. Maksimov and Š. Toliušis** – Impact of C*ercopagis pengoi* on Lithuanian coastal fishery
11.40 – 12.00 – **Henn Ojaveer, Jonne Kotta, Helen Orav-Kotta, Mart Simm, Ilmar Kotta, Ain Lankov, Arno Põllumäe and Andres Jaanus** – Alien species in the NE Baltic Sea: monitoring and assessment of environmental impacts
12.00 – 12.20 – coffee break
12:20 – 12:40 **Gordon H. Copp, Keith J. Wesley and Lorenzo Vilizzi** – The introduction of ornamental and aquarium fish into ponds is not by chance
12:40 – 13:00 – **Kathe R. Jensen –** A summary of alien marine invertebrates in Danish waters
13:00 – 13:20 – **Wojciech Solarz –** NOBANIS Nordic-Baltic Network on Invasive species
13.20 – 16.00 – Lunch break
16.00 – 18.00 – Poster session

26.08.2004 Chair Persons: Krzysztof Jażdżewski, Erkki Leppäkoski

9.15 – 9.35 – **Gustaf Almqvist, Magnus Appelberg, Krzysztof E. Skóra and Sture Hansson** – Life history traits of the invasive fish Round goby (*Neogobius melanostomus*) in the Bay of Gdansk, Poland, in relation to habitat
9.35 – 9.55 – **Krzysztof E. Skóra –** Zoogeographical Range of the Expansion of *Neogobius melanostomus* in Europe
9.55 – 10.15 – **Lynda D Corkum, Arbuckle W., Belanger A.J., Gammon D.B., Li W., Scott A.P., and Zielinski B.,** – Potential Control of the Round Goby using Pheromone Signaling
10:15 – 10:35 – **Mariusz R. Sapota** – Changes in the Gulf of Gdansk biocenosis by round goby (*Neogobius melanostomus*) – invasive Ponto–Caspian fish
10.35 – 11.20 – coffee break

11.20 – 11.40 – **Irina Olenina** – Abiotic factors controlling abundance of the invasive dinoflagellate *Prorocentrum minimum* (Pavillard) Schiller in the coastal waters of Lithuania, Baltic Sea

11.40 – 12.00 – **Aleksandra Zgrundo, Monika Dziengo, Anna Winiarowska and Bożena Bogaczewicz-Adamczak** – Immigration Components of Diatoms in the Baltic Sea

12.00 – 12.20 – **Dan Minchin, Frances Lucy and Monica Sullivan** – Ireland: a new frontier for the zebra mussel *Dreissena polymorpha*

12.20 – 12.40 – **Leszek Rolbiecki and Jerzy Rokicki** – Infection of European eels *Anguilla anguilla* with *Anguillicola crassus*, an exotic swim bladder nematode, in the southern Baltic Sea and adjacent waters

12.40 – 15.00 – Lunch break

15.00 – 18.00 – Round table discussion

19.00 – Conference dinner

27.08.2004 Chair Persons: Lynda D. Corkum, Vadim Panov

9.15 – 9.35 – **Krzysztof Jażdżewski, Alicja Konopacka and Michał Grabowski** – Native and alien malacostracan Crustacea along the Polish Baltic coast over the last century

9.35 – 9.55 – **Monika Normant and Anna Szaniawska** – Non-native brachyuran species Eriocheir sinensis and Rhithropanopeus harrisii in the Polish brackish waters

9.55 – 10.15 – **Sergej Olenin and Darius Daunys** – Trophic types of the invasive benthic invertebrates: insight into functional homogenization of the coastal waters

10.15 – 10.35 – **Artūras Razinkovas, Rita Jankauskienė and Jūratė Lesutienė** – Ponto–Caspian Crustaceans in the Curonian lagoon ecosystem: four decades after introduction

10.35 – 11.00 – **Nadya Berezina, Sergey Golubkov and Julia Gubelit** – Grazing effects of alien gammarids on macroalgae in the littoral zone of the Neva estuary (eastern Gulf of Finland, Baltic Sea)

11.00 – 11.20 – coffee break

11.20 – 11.40 – **Kęstutis Arbačiauskas** – Dispersal, distribution and abundance of Ponto–Caspian mysids and amphipods in Lithuanian waters

11.40 – 12.00 **Aloyzas Burba** – Effects of Invasive Crayfish Species Introduction and Spread in Lithuanian Fresh Waters

12:00 – 12:30 – coffee break

12.30 – 14.00 – Poster session

14.00 – 16.00 – Lunch break

16.00 – 17.00 – Round table discussion

17.00 – Closing of the conference

28.08.2004

9.00 – 16:00 – post conference excursion to the Teutonic Knights Castle in Malbork

List of Posters

Poster number

List of Participants

Gustaf Almquist
National Board of Fisheries
Institute of Coastal Research
Öregund, Sweden
Gustaf.Almqvist@fiskeriverket.se

Kestutis Arbaciauskas
Institute of Ecology of Vilnius University
Akademijos St. 2,
LT-08412 Vilnius-21, Lithuania
Arbas@ekoi.lt

Egidijus Bacevicius
Lithuanian State Center for Pisciculture
and Fishery Research
Fishery Research Laboratory
ebacevicius@mail.lt

Nadezhda Berezina
Zoological Institute of the Russian Academy
of Sciences
199034 St.Petersburg, Russia
nber@zin.ru

Luiza Bielecka
Institute of Oceanography
University of Gdańsk
Al. Marszałka Piłsudskiego 46
81-378 Gdynia, Poland
ocelb@univ.gda.pl

Michał Bochenek
Institute of Oceanography
University of Gdańsk
Al. Marszałka Piłsudskiego 46
81-378 Gdynia, Poland
jagon2@wp.pl

Bożena Bogaczewicz-Adamczak
Institute of Oceanography
University of Gdańsk
Al. Marszałka Piłsudskiego 46
81-378 Gdynia, Poland
oceba@univ.gda.pl

Aloyzas Burba
Institute of Ecology of Vilnius University
Akademijos 2
LT-08412 Vilnius, Lithuania
aburba@ekoi.lt

Gordon H. Copp
Salmon & Freshwater Team, CEFAS
Pakefield Road, Lowestoft, Suffolk
NR33 OHT England
G.H.Copp@cefas.co.uk

Lynda D. Corkum
Department of Biological Sciences
University of Windsor, Windsor, ON
N9B 3P4 Canada
corkum@uwindsor.ca

Aldona Dobrzycka
Institute of Oceanography
University of Gdańsk
Al. Marszałka Piłsudskiego 46
81-378 Gdynia, Poland
aldona@sat.ocean.univ.gda.pl

Marcin Dziekoński
Institute of Oceanography
University of Gdańsk
Al. Marszałka Piłsudskiego 46
81-378 Gdynia, Poland
suscrofa@wp.pl

Elena Ezhova
Atlantic Branch of P.P.Shirshov's Institute of Oceanology
Pr.Mira 1
236000 Kaliningrad, Russia
ezhova@pisem.net

Piotr Gruszka
Department of Marine Ecology and Environmental Protection
Agricultural University of Szczecin
Królewicza Kazimierza 4
71-550 Szczecin, Poland
pgruszka@fish.ar.szczecin.pl

Aleksandr Gusev
Atlantic Scientific Research Institute of Marine Fisheries and Oceanography
Dm. Donskoy str. 5
Kaliningrad 236000, Russia
andgus@rambler.ru

Urszula Janas
Institute of Oceanography
University of Gdańsk
Al. Marszałka Piłsudskiego 46
81-378 Gdynia, Poland
ula@sat.ocean.univ.gda.pl

Krzysztof Jażdżewski
Department of Invertebrate Zoology & Hydrobiology, University of Łódź
Banacha 12/16
90-237 Łódź, Poland
kryjaz@biol.uni.lodz.pl

Kate Rose Jensen
Zoological Museum
Universitetsparken 15,
DK-2100 Copenhagen, Denmark
KRJensen@zmuc.ku.dk

Vadims Jermakovs
Institute of Aquatic Ecology
University of Latvia, Marine Monitoring Centre
8 Daudavgrivas st.
LV-1007, Riga, Latvia
vadims@monit.lu.lv

Agnes Karlson
Stockholm University
Sweden
agneskarlson@hotmail.com

Alicja Konopacka
Department of Invertebrate Zoology & Hydrobiology, University of Łódź
Banacha 12/16
90-237 Łódź, Poland
alikon@biol.uni.lodz.pl

Yuriy Kvach
Odessa Branch of the Institute of Biology of the Southern Seas
National Academy of Science of Ukraine,
Odessa, Ukraine
quach@paco.net

Rafał Lasota
Institute of Oceanography
University of Gdańsk
Al. Marszałka Piłsudskiego 46
81-378 Gdynia, Poland
rlasota@sat.ocean.univ.gda.pl

Erkki Leppäkoski
Environmental and Marine Biology
Åbo Akademi University
FIN-20500 Turku/Åbo, Finland
eleppako@abo.fi

Jūratė Lesutienė
Coastal Research and Planning Institute
University of Klaipėda
Klaipėda, Lithuania
kubiliute@corpi.ku.lt

Monika Michałowska
Institute of Oceanography
University of Gdańsk
Al. Marszałka Piłsudskiego 46
81-378 Gdynia, Poland
mona@sat.ocean.univ.gda.pl

Dan Minchin
Marine Organism Investigations
3, Marina Village, Ballina, Killaloe
Co Clare, Ireland
minchin@indigo.ie

Jolanta Morozińska-Gogol
Division of Ecology and Protection of the Sea
Pomeranian Pedagogical Academy
Arciszewskiego 22 b
76-200 Słupsk, Poland
jolamorozinska@poczta.onet.pl

Ewa Nieckuła
Wiedza i Życie
Warszawa, Poland
ewa.nieckula@agora.pl

Monika Normant
Institute of Oceanography
University of Gdańsk
Al. Marszałka Piłsudskiego 46
81-378 Gdynia, Poland
monika@sat.ocean.univ.gda.pl

Henn Ojaveer
Estonian Marine Institute
University of Tartu
Mäealuse 10a
Tallinn, 12618 Estonia
henn@pc.parnu.ee

Irina Olenina
Centre of Marine Research
Taikos 26
LT-5802 Klaipeda, Lithuania
irina.olenina@balticum-tv.lt

Sergej Olenin
Coastal Research and Planning Institute
Klaipeda University
Klaipeda, Lithuania
serg@gmf.ku.lt

Anna Olszewska
Institute of Meteorology and Water Management, Maritime Branch
Waszyngtona 42
81-342 Gdynia, Poland
Anna.Olszewska@imgw.pl

Irina Ovcharenko
Coastal Research and Planning Institute
Klaipeda University,
Klaipeda, Lithuania
irinaovcarenko@yahoo.com

Vadim Panov
Zoological Institute of the Russian Academy of Sciences
199034 St. Petersburg, Russia
rbic@zin.ru

Anna Pawelec
Institute of Oceanography
University of Gdańsk
Al. Marszałka Piłsudskiego 46
81-378 Gdynia, Poland
ankal@sat.ocean.univ.gda.pl

Marjo Pienimäki
Environmental and Marine Biology
Åbo Akademi University
FIN-20500 Turku/Åbo, Finland
mapienim@abo.fi

Marcin Pliński
Institute of Oceanography
University of Gdańsk
Al. Marszałka Piłsudskiego 46
81-378 Gdynia, Poland
ocemp@univ.gda.pl

Julia Polunina
Russian Academy of Sciences, P.P. Shirshov
Institute of Oceanology
Atlantic Branch, 1 Pr. Mira,
236000 Kaliningrad, Russia
elin@mail.ru

Jerzy Rokicki
Institute of Oceanography
University of Gdańsk
Al. Marszałka Piłsudskiego 46
81-378 Gdynia, Poland
rokicki@univ.gda.pl

Leszek Rolbiecki
Institute of Oceanography
University of Gdańsk
Al. Marszałka Piłsudskiego 46
81-378 Gdynia, Poland
rolbieck@sat.ocean.univ.gda.pl

Agata Rychter
Institute of Technology
The Higher School of Vacational Education
Wojska Polskiego 1,
82-300 Elblag, Poland
a.rychter@truso.pwsz.elblag.pl

Grażyna Sapota
Institute of Meteorology and Water
Management, Maritime Branch
Waszyngtona 42,
81-342 Gdynia, Poland
Grazyna.Sapota@imgw.pl

Mariusz R. Sapota
Institute of Oceanography
University of Gdańsk
Al. Marszałka Piłsudskiego 46
81-378 Gdynia, Poland
ocems@univ.gda.pl

Vladimir Shestlakov
Zoological Institute of the Russian Academy
of Sciences
199034 St.Petersburg, Russia
cyan@zin.ru

Krzysztof E. Skóra
Hel Marine Station
Institute of Oceanography
University of Gdansk
Morska 9
84-150 Hel, Poland
oceks@univ.gda.pl

Wojciech Solarz
Institute of Nature Conservation
Polish Academy of Sciences
Mickiewicza 33
31-120 Kraków, Poland
solarz@iop.krakow.pl

Olga Spirido-Peretertova
Atlantic Branch of P.P.Shirshov's Institute
of Oceanology
Pr.Mira 1
236000 Kaliningrad, Russia
igelin@mail.ru

Solvita Strake
Institute of Aquatic Ecology
University of Latvia
Ryga, Latvia
solvita@hydro.edu.lv

Anna Szaniawska
Institute of Oceanography
University of Gdańsk
Al. Marszałka Piłsudskiego 46
81-378 Gdynia, Poland
oceasz@univ.gda.pl

Maciej T. Tomczak
Sea Fisheries Institute
Kołłątaja 1
81-332 Gdynia, Poland
tmac@mir.gdynia.pl

Jan Warzocha
Sea Fisheries Institute
Kołłątaja 1
81-332 Gdynia, Poland
janw@mir.gdynia.pl

Katarzyna Waligóra – Borek
Institute of Oceanography
University of Gdańsk
Al. Marszałka Piłsudskiego 46
81-378 Gdynia, Poland
kasiawb@poczta.onet.pl

Jan Marcin Węsławski
Institute of Oceanology
Polish Academy of Sciences
Powstańców Warszay 55
81-712 Sopot, Poland
weslaw@iopan.gda.pl

Ewa Włodarczyk
Sekretariat ds. Konwencji Helskińskiej
Kossaka 1,
80 - 249 Gdańsk, Poland
skh@rzgw.gda.pl

Maciej Wołowicz
Institute of Oceanography
University of Gdańsk
Al. Marszałka Piłsudskiego 46
81-378 Gdynia, Poland
ocemw@univ.gda.pl

Tomas Zalubas
Lithuanian State Center for Pisciculture
and Fishery Research
Fishery Research Laboratory
ztl@is.lt

Aleksandra Zgrundo
Institute of Oceanography
University of Gdańsk
Al. Marszałka Piłsudskiego 46
81-378 Gdynia, Poland
aleks@sat.ocean.univ.gda.pl

Ilona Złoch
Institute of Oceanography
University of Gdańsk
Al. Marszałka Piłsudskiego 46
81-378 Gdynia, Poland

Abstracts

Life history traits of the invasive fish Round goby (Neogobius melanostomus) in the Gulf of Gdansk, Poland, in relation to habitat

Gustaf Almqvist[2,1], Magnus Appelberg[1,2], Krzysztof E. Skora[3] and Sture Hansson[2]

[1] National Board of Fisheries, Institute of Coastal Research, Öregund, Sweden
[2] Department of Systems Ecology, Stockholm University, Sweden
[3] Hel Marine Station, Institute of Oceanography, University of Gdansk, Poland

In 1990, the Round goby (*Neogobius melanostomus*), Pallas 1811, was first observed in the Gulf of Gdansk, Baltic Sea. It has a Ponto-Caspian origin and was most likely introduced via ballast water from shipping traffic. Today, the species is well established and abundant in Gulf of Gdansk, and has spread to adjacent regions. Round gobies are highly plastic and adapt to different environments. Food and nesting site abundance are likely to affect certain traits of the species, e.g. age at first reproduction (females spawn for several years and in several batches over one season, males die after one spawning season), growth rate and adaptation to food composition and availability.

The present study focuses on relative abundance, individual growth rate, age and size at maturity, population size and age structure in relation to habitat. It was conducted during two periods in the summer of 2003. More than 1500 Round gobies from three localities were analyzed. The localities differed substantially from each other in terms of depth, bottom substrate, vegetation, exposure to water currents and fish community. The inner Puck Bay area is a vast and shallow area, characterised by vegetation on sandy bottom. The maximum sampled depth was four meters and water current was medium strong. The second studied area in Oksywie is characterised by sandy bottom with few stones and some vegetation. Maximum sampled depth was 13 meters with a stronger current compared to inner Puck Bay. At the third area at Hel**,** the bottom is sandy, vegetation is absent and water currents are relatively strong. The deepest sampling were done at 40 meters. Sampling was performed using Nordic coastal survey nets, fyke nets and minnow traps.

The results indicate that the Round goby had a higher growth rate, was larger, and males reproduced at a higher age at Hel compared to Puck Bay. The population in Oksywie showed a large variability in these traits, averaging in between the two other localities. The abundance of Round goby varied largely by locality and time, however, it was among the dominating species at all sampling occasions. Round goby was the single dominating species in shallow areas at Hel during the first sampling period, and at all depths during the second period in Oksywie.

In conclusion, data supports our hypotheses that life history characteristics such as growth rate, size structure and age at reproduction of the Round Goby vary in relation to habitat.

(Ref.1): Skora, K E. Rzeznik, J. Observations on diet composition of *Neogobius melanostomus* Pallas 1811 (*Gobiidae, Pisces*) in the Gulf of Gdansk (Baltic Sea) 2001 (27(3)) pp 290-299 J. Gt. Lakes Res.

(Ref.2): Charlebois, P M. Corkum, L D. Jude, D J. Knight, C. The round goby (*Neogobius melanostomus*) invasion: Current research and future needs 2001 (27(3)) pp 263-266 J. Gt. Lakes Res.

Dispersal, distribution and abundance of Ponto-Caspian mysids and amphipods in Lithuanian waters

Kęstutis Arbačiauskas

Institute of Ecology of Vilnius University, Akademijos St. 2, LT-08412 Vilnius-21, Lithuania

Ponto-Caspian crustaceans are among the most successful invaders of new aquatic environments. Their dispersal frequently is human-mediated. The most species of Ponto-Caspian amphipods and mysids were intentionally introduced in Lithuanian waters in order to improve the fish-food basis. Forty years ago, amphipods *Pontogammarus robustoides*, *Obesogammarus crassus* and *Chaetogammarus warpachowskyi*, and mysids *Paramysis lacustris*, *Limnomysis benedeni* and *Hemimysis anomala* had been introduced into the Kaunas Water Reservoir located on Nemunas river. Here these crustaceans have established sustainable populations. Later they have been transferred, in all, into two water reservoirs and 103 lakes of Lithuania. The establishment of populations of Ponto-Caspian mysids and amphipods, was documented for both water reservoirs and 10 lakes (Gasiūnas 1972). Recently, however, alien amphipods have vanished from a few lakes, in which the establishment of populations of these crustaceans was reported earlier. Investigations of current distribution of these non-native species suggest that Ponto-Caspian amphipods may establish sustainable populations only in large mesotrophic lakes, meanwhile mysids could also survive in large and open eutrophic lakes. Both these crustaceans can also live in well-drained lakes. In addition to human-mediated spread, Ponto-Caspian mysids and amphipods also exhibited ability of natural dispersal. The dispersal vectors of Ponto-Caspian crustaceans in Lithuanian waters, environmental factors that may limit the establishment of sustainable populations and effect the abundance of these animals will be discussed, and information on effects of aliens on native communities will be presented.

Literature

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The New Data on Ecology of Allien Fish Species and Fish Metazoan Parasites in the Curonian Lagoon and Lithuanian Coastal Zone

Egidijus Bacevicius

Lithuanian state center for pisciculture and fishery research, Fishery research laboratory

The main objective of the research was to summarise the data on alien fish species in the Curonian lagoon and coastal zone of the Baltic sea as well as to overview the biological features of their native and allien metazoan parasites and to describe some of the parasitological phenomena.

There are several facts known about the possible introduction of new parasite species in Nemunas River and Curonian lagoon: in 1953, 1954, 1959 and 1960 together with unsuccessful introduction of sterlet (Gaigalas, 1998) and in 1963 with the wild carp (Носков, 1963).

In August 2002 round goby (*Neogobius melanostomius* Pallas 1811) was first time observed near Klaipėda. In 2004 around 20 specimens (4- 26 cm lenght, 0+-3 years old) were catched in Klaipeda port area. They were infected by internal metazoan parasites, typical for Baltic Sea estuarine fishes: acanthocephalans (*Echinorhynchus gadi* Müll.), (*Pomphorhynchus laevis* Müll.), (*Acanthocephalus lucii* Müll.) and nematodes (*Hysterothylacium aduncum* Rud.). No alien parasite species were found. Round goby is paratenic host of native parasitic helmints.

The eel parasite *Anguillicola crassus* Kuwahara, Niimi & Itagaki 1974 was found in swimblader of the eel (*Anquilla anquilla* L.), catched in the Lithuanian coastal zone in 1998. No parasite-caused mass death of eel was observed in the lagoon, as it happens in the fish pond in Central Lithuania in hot summer of 1999. It is supposed, that eels are infected in freshwater part of the lagoon or Nemunas River. Two new parasite species were found in this region: *Deroprystis hyspida* Rudolphi, 1819 in the eel and *P. gracilacanthus* Mayer, 1932 in the ruff and ide (Bacevicius 2003). The later parasite species is also noticed in Germany (Engelbrecht, 1958), Poland (Grabda, 1967), upper reaches of the Nemunas River (Rauckis, 1988) and Siberia rivers (Amur, Lena) (Bauer, 1988).

In 1960 – 1963 new amphipod species from Dniepr - Simferopol water basine (Ukraine) were introduced to Kauno marios (middle part of Nemunas) and later into Curonian lagoon. Parasitological analysis of these species was done in 1973, however, new parasite species were not found (Гецевичюте, Симсонене, 1974). After the chronological analysis of parasitological data we could conclude, that above mentioned new fish helminth species are not cryptogenic invaders, but rather relicts.

Literature

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The Chinese Mitten Crab (*Eriocheir sinensis* Edw., Decapoda: Grapsidae) in the Curonian Lagoon and Lithuanian Coastal Zone

Egidijus Bacevicius

Lithuanian state center for pisciculture and fishery research, Fishery research laboratory

The main objective of this research was to overview both historical and recent data on Chinese mitten crab (*Eriocheir sinensis* Milne-Edwards, 1854) in the Curonian lagoon and coastal zone of the Baltic sea. The first specimens to be found in Europe were reported from German waters near Hamburg (in 1912th, Aller river). In the early 1930s crab appearied in the inlet area to the Baltic Sea and ever since, large specimens have been reported from almost all parts of the Baltic (Willer 1920, Planning 1950). In the Southeastern part of the Baltic Sea this allien crustacean was for the first time observed in Curonian lagoon and Lithuanian coastal area (Melnrage) in 1934-1935, and in Dauguva in 1932 (Anonim 1936, Urtans 2000). We summarised the long-term data (1934 to 2003) on findings and distribution of this species in the Lithuanian waters. During the summer season in the oligohaline area of the Curonian lagoon crabs usually are catched with eel traps (3-8 individuals; 1-3 ind. per trap). The abundance varied between years. According to domination crabs could be attributed to very rare species. The diameter of carapax varied from 20 to 60 mm, the average age is about 2-6 years. Both males and females are found. The outermost finding was in the Nemunas River near Smalininkai (60 km from Kaunas towards the Nemunas delta, 80 km from the Klaipeda strait and 120 km from polyhaline waters of the Baltic sea) (S. Karalius pers. comm.). Young specimens are usually observed in the northern part of the Curonian lagoon in the Klaipeda port area and coastal zone of the Baltic sea. The female with eggs was catched in July 2003 in the coastal area (Bacevičius E. unpubl. data), however, zoea and megalopa stages are still not found in the plankton samples. It is supposed, that crabs could not reproduce here due to low salinity. The larval stages probably are originated from the south-western Baltic sea. The crabs have no economical impact in the Lithuania as it was in Germany at the beginning of last century.

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Grazing effects of alien gammarids on macroalgae in the littoral zone of the Neva estuary (eastern Gulf of Finland, Baltic Sea).

Nadezhda Berezina, Sergey Golubkov and Julia Gubelit

Zoological Institute of Russian Academy of Sciences, Universitetskaya nab. 1, St.-Petersburg, Russia

Filamentous algae, developing on hard substrates in littoral zone, are known to cause the extensive "macroalgal blooms" in the whole coastal range of the Baltic Sea. Nutrients (bottom–up control) and grazing (top-down control) regulate the biomass of the filamentous algae assemblages. Gammarids are one of the most effective grazers among invertebrates due to ability to alternative feeding strategies and higher resistance to chemical defense of algae. Two species of gammaridean amphipods, Gmelinoides fasciatus (Stebbing) and Pontogammarus robustoides (Sars), recently invaded the eastern Gulf of Finland (inner Neva Estuary), have established self-reproducing populations in some locations of the littoral zone (Berezina & Panov 2003). To test the suggestion that grazing gammarids are able to control macroalgae biomass, we studied seasonal dynamics of G. fasciatus and P. robustoides populations and filamentous algae (mainly Cladophora glomerata) assemblages in stone littoral of the Neva Estuary and analyzed changing diets

of the grazers during season 2003. Absolute abundance of gammarids ranged between 200 and 4800 ind.m^{-2} with maximum during June and July. The biomass of Cladophora was increasing from June to August, reaching 1,760–2,025 kgWW per m^2. Gut content analysis showed that both gammarid species are omnivorous animal, however significant differences in diets between species were revealed. P. robustoides is more successful grazer on C. glomerata than G. fasciatus but not abundant species at studied location. Alga tissue were actively consumed by specimens P. robustoides with body lengths between 6 to 16 mm. Part of the algae in diet of P. robustoides changed depending on body lengths and prevailed in diet of specimens with body lengths in the range 7.5–12 mm. To evaluate the importance of different feeding strategies for consumer fitness we experimentally studied P. robustoides fitness traits (survival, growth rate and clutch size) during algal, animal and mixed nutrition. Significant differences in growth rates and clutch sizes of gammarids between different treatments were revealed. In the case of algal diet clutch sizes of P. robustoides are the largest while growth rates are the lowest. Mixed nutrition (algae and animals) is the most optimal feeding strategy for consumer fitness.
We conclude that in the case of further increase of P. robustoides abundance in littoral zone of the eastern Gulf of Finland this species may control of Cladophora algae biomass.

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Metabolic rate of the invasive amphipod *Gammarus tigrinus* (Sexton) from the Gulf of Gdańsk

Michał Bochenek, Marcin Dziekoński and Monika Normant

Institute of Oceanography, University of Gdańsk, Al. Marszałka Piłsudskiego 46, 81-378 Gdynia, Poland

Gammarus tigrinus Sexton, 1939 originated from the North America is one of the alien species in the Gulf of Gdańsk. The first apperance of that species was recorded there in summer 2001. Since this time a rapid increase in the abundance of *G. tigrinus* has been observed in the inner part of the Gulf of Gdańsk, where only native gammarids occured before. The reason of its succesful competition is a high tolerance to environmental changes and pollutants as well as the reproductive capacity.

Metabolic rate is regarded as a significant element in the studies of energy flow in marine organisms and populations. The total energy metabolised by an animal per time unit is also immensely useful in comparative studies of animal adaptation and performance. The aim of our study was to determine the metabolic rate of *G. tigrinus* from the Gulf of Gdańsk by means of direct calorimetry (heat production measurements) at the habitat salinity 7 psu and temperature of 10 ^{o}C. Animals exhibited locomotor activity during the measurements, but for calculations only the resting periods were used. The highest ratio between resting and active

metabolic rates was 1 : 2.1, whereas the lowest one was 1 : 1.1. The metabolic rate of *G. tigrinus* varied between 2.01 and 26.16 J g^{-1} ww h^{-1} and on average amounted to 7.56 ± 5.68 J g^{-1} ww h^{-1} (n = 28, av. wet weight 19 ± 8 mg). There was a significant negative correlation ($r = - 0.60$, $p < 0.05$) between the specific metabolic rate of *G. tigrinus* (SMR) and its wet weight (WW) decribed by the power function $SMR = 0.18\ WW^{-0.86}$.

Effects of Invasive Crayfish Species Introduction and Spread in Lithuanian Fresh Waters

Aloyzas Burba

Institute of Ecology of Vilnius University, Akademijos 2, LT-08412 Vilnius, Lithuania

There are four crayfish species in Lithuania, but crayfish *Astacus astacus* is the only native species. *A. astacus* was widely distributed, and in the period 1890-1914 about 250 tonnes were caught and exported from Lithuania.

At the end of the 19th century and the beginning of the 20th century after the crayfish plaque, which eradicated native crayfish in European waters *Astacus leptodactylus* began spreading. Private owners had an opinion that *A. leptodactylus* could not get crayfish plaque and could compensate the decrease of *A. astacus* stocks, but this action was not widely spread.

In 1972 crayfish *Pacifastacus leniusculus* was introduced. It was done in order to increase the stocks of crayfish as the stocks of native crayfish *A. astacus* became very poor because of water pollution and the conditions in water bodies suitable for crayfish becoming worse.

For the first time invasive crayfish *Orconectes limosus* was accidentally found in an isolated lake in 1994, and the intensive natural spread of this species was established in the south and southwest of Lithuania in 1995. In 2000 distribution of the *O. limosus* covered area limited by the River Nemunas and the state boundary with Belarus, Poland and Kaliningrad enclave of Russia. This area makes up 1/7 of Lithuanian territory. *O. limosus* inhabited rivers and lakes of all trophic stages. Baited crayfish traps are not effective to estimate the abundance of *O. limosus*, especially in the places of their concentration at dams. About 300 crayfish were picked per hour by hand in daytime on a sandy beach of the eutrophic river, and baited traps were empty. High resistance of this species to pollution and tolerance to wide limits of habitat and water quality parameters make it a good colonizer of Lithuanian waters. The territory of Lithuania is a basin of the River Nemunas, and we expect total spread of *O. limosus* in the nearest future.

In the course of the 20 century euthrophication remarkably influenced native crayfish *A. astacus* distribution and abundance. A massive eel introduction devastated crayfish from large mesotrophic lakes. Large fecundity, early maturity, short period of the egg bearing clearly demonstrated the advantage of the American crayfish *O. limosus* over the native *A. astacus*.

A contradictory situation is observed in the largest lakes. The stocks of the main crayfish enemy – the eel – are decreasing and the stocks of crayfish *A. astacus* are increasing. At the same time the stocks of the alien crayfish *O. limosus* are increasing dramatically.

What are the results of invasive crayfish introduction into Lithuanian waters? Since the year of 1970 the official statistic has shown the commercial catches of only *A. leptodactylus*. The crayfish *P. leniusculus* has no commercial nor recreational value for the country. Having in mind that *P. leniusculus* is the vector of crayfish plaque it can be stated that the introduction of this species in Lithuania has very negative effect. Crayfish *O. limosus*, being spread intensive now, has poor commercial value. It can be foreseen that the spreading of *O. limosus* will also have a negative effect on the freshwater ecosystems and especially on native crayfish *A. astacus*. The crayfish stocks increase at present is the result of *A. astacus* restoration but not the result of invasive species introduction or spread.

The main problem in Lithuania is the status of *P. leniusculus* and absence of species related management system for crayfish. The main aim of crayfish management in Lithuania must be protection, restoration and enhancement of the native crayfish *A. astacus* populations.

The introduction of ornamental and aquarium fish into ponds is not by chance

Gordon H. Copp[1], Keith J. Wesley[2] and Lorenzo Vilizzi[3]

[1]Salmon & Freshwater Team, CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 OHT, England; [2]Bedwell Fisheries Services, 22 Puttocks Lane, Welham Green, Hertfordshire, AL9 7LP, England; [3]Viale Italia 56, 07100, Sassari, Italy

We examined the frequency of occurrence and density of non-native fishes in restored ponds of Epping Forest (Essex, England) to determine whether colonisation of these ponds by non-native fish was by chance or dictated by environmental or human factors. In the restoration process, the ponds were drained of water, voided of fish (or treated with rotenone) and restocked with non piscivorous, native fish species. For each pond, the period of time since pond restoration, pond area, distance to nearest residential housing, distance to nearest footpath, distance to nearest water body or stream, and the proportion of pond vegetated were measured. Chance as a natural phenomenon appears to play little or no role, as the number of ornamental varieties was found to increase with decreasing distance of the pond from the nearest road. Variety richness of each of three categories of fish (non-native, goldfish *Carassius auratus*, and native) was significantly correlated with at least two of the following variables: distance from nearest road, nearest footpath and nearest pond. The rate of non-native fish introductions (adjusted variety richness per year) could also be estimated from pond distance to the nearest road, being about 3.5 ornamental varieties introduced per year in ponds adjacent to roads, but the rate appears to be much greater in ponds that had recently (< 1.5 years) undergone restoration. Implications for conservation and management, as well as the potential role of societal issues such as recreational activities, cultural and religious practices, are discussed.

Potential Control of the Round Goby using Pheromone Signaling

Corkum, L.D.[1], Arbuckle, W[1]. Belanger, A.J. [1], Gammon, D.B. [1], Li, W.[2], Scott, A.P.[3], and Zielinski, B.[1]

[1]Department of Biological Sciences, University of Windsor, Windsor, ON, N9B 3P4; [2]Departnent of Fisheries and Wildlife, Michigan State University, East Lansing, MI, 48824; [3]Centre for Environment, Fisheries & Aquaculture Sciences, Weymouth Laboratory, Dorset, DT4 8UB, UK.

In freshwater ecosystems, non-indigenous species are the most significant threat to biodiversity. Despite efforts to control the entry of invading species into countries, there are relatively few practices in place to control established aquatic invasive species without affecting non-target species or causing environmental damage. The round goby, *Neogobius melanostomus* (Pallas) of the family Gobiidae and native to the Ponto-Caspian region, was first discovered in June 1990 in both the Baltic Sea (Gulf of Gdansk) and the Laurentian Great Lakes of North America. Once established, the round goby has quickly spread on both sides of the Atlantic. In North America, all stages of the non-indigenous round goby feed on the eggs of smallmouth bass (*Micropterus dolomieu*), lake trout (*Salvelinus namaycush*), and lake sturgeon (*Acipenser fulvescens*). As successful management of the fishery depends on minimizing sources of mortality, we plan to develop a control strategy using natural

pheromones to disrupt the reproductive behaviour of the invasive round goby and to curtail its effects on native fishes.

We hypothesize that a nesting round goby male releases a sex pheromone to attract females to spawn. To test the hypothesis and to characterize the pheromone, we first collected and concentrated water into which potential pheromones from round gobies are washed (released). Histological and biochemical studies showed that specialized glandular tissue in the testes of the round goby produce androgen steroids, two of which (11-keto etiocholanolone (ETIO) and 11-keto-ETIO-sulfate) are novel compounds in teleost gonads. The presence of pheromones in reproductive male conditioned water has been implicated by electro-olfactogram responses recorded from female round gobies. Results of electro-olfactogram (EOG) responses showed that both reproductive females (RF) and non-RF discriminated between HPLC fractionated reproductive male (RM) and non-RM odours. However, the EOG responses of RF were about 8-fold higher than non-RF exposed to RM odours.

The round goby uses a polygynous mating system in which many reproductive females deposit eggs in the nests of a single male. We tested the behavioural responses of RF and non-RF to water conditioned by RM and non-RM. The behavioural responses of RF exposed to odour of reproductive males included increased time spent near the source of the odour ($P<0.05$), elevated swimming velocities ($P<0.05$), and directed movement to and around the odour source when compared with their responses to control water. These findings confirm that reproductive male round gobies release pheromone signals to attract reproductive females that are ready to spawn. Pheromonal-signaling systems will likely be useful in controlling the effects of round gobies on native fishes.

Osmoregulatory capacity of the invasive amphipod *Gammarus tigrinus* (Sexton, 1939) in different salinity conditions

Dobrzycka-Krahel A. and Szaniawska A.

Institute of Oceanography, Gdańsk University, Al. Marszałka Piłsudskiego 46, 81-378 Gdynia, Poland.

Gammarus tigrinus (Sexton, 1939) is the alien species in the Baltic Sea. It's native for the north-eastern part of North America.

Animals using to the investigations were collected from the Puck Bay (from Rzucewo), at the depth of about 0,5-1 m, from May 2004. Amphipods were acclimatized to laboratory conditions for 1 week in water of environmental salinity and under temperature of 10 ºC .

Later the experiments in the laboratory were investigated in 10 different salinity conditions within the range from 1 to 39 PSU, under the constant temperature of 10 ºC. Haemolymph was taken after acclimation for 1 day at each of the salinities. The osmotic concentration of body fluid was than determined in WESCOR vapor pressure osmometer 5520.

G.tigrinus is hyperosmotic at salinities below 21 PSU and hypoosmotic at higher medium concentrations.

Alien invertebrates in the Vistula and Curonian lagoon (Baltic Sea)

Elena E. Ezhova and Julia Y.Polunina

Atlantic Branch of P.P.Shirshov's Institute of Oceanology, Pr.Mira 1, 236000, Kaliningrad, Russia

First records of alien species in the Curonian and Vistula lagoons relate to the beginning of 19th century. Since that a lot of species were introduced in these water-bodies, both ntentionally or un-intentionally.

On base of our (1996-2003) and literary data establishing of invading species in both lagoons is considered. Percentage of non-native species are higher in the brackish-water Vistula lagoon. In the Vistula lagoon alien species of Ponto-Caspian and North American origin are represented in equal proportions. In the Curonian lagoon share of alien species is not sufficient and species of Ponto-Caspian origin prevail.

In both lagoon some of non-native species become dominant ant can sufficiently control benthic situation. It is *Dreissena polymorpha* in the Curonian lagoon and *Marenzelleria viridis* in the Vistula lagoon.

Lists of alien species for both lagoon, distribution maps, history and vectors for key invaders are discussed.

Comparative study of *Marenzelleriz viridis* population in the lagoon and marine environment of South-Eastern Baltic - 5 years after introduction

Elena E. Ezhova and Olga V. Spirido-Peretertova

Atlantic Branch of P.P.Shirshov's Institute of Oceanology, Pr.Mira 1, 236000, Kaliningrad, Russia,

North-American spionid was firstly recorded in the Vistula lagoon and coastal marine zone of Kaliningrad region in 1988. State of *Marenzelleria viridis* populations in the lagoon and marine environment, is considered.

High density and biomass, high frequency of occurrence, almost everywhere distribution and significant role in bottom communities in the Vistula lagoon point out that euthrophic lagoon environment in contrast to coastal marine zone, much more favorable for *M.viridis.* It can be explained by abundance of easy consuming organic matter and phytoplankton in the lagoon.

Supposed that *M.viridis* referred as obligatory deposit-feeder in the area of origin and as suspension-feeder in the South Baltic, can easy switch their feeding mode depending on food condition.

Palaemon elegans Rathke as food for cod in the Gulf of Gdańsk

Piotr Gruszka[1] and Beata Więcaszek[2]

[1)] Department of Marine Ecology and Environmental Protection
[2)] Department of Fish Systematics
Agricultural University of Szczecin
ul. Królewicza Kazimierza 4, 71-550 Szczecin, Poland

Rapid development of *Palaemon elegans* Rathke population in recent years can have a significant impact on the Baltic ecosystem in the area of the Gulf of Gdańsk. Analysis of stomach contents of cod (*Gadus morhua callarias*) (n = 52, total length 37 to 58 cm, individual weight varying from 510 to 2070 g) fished from the Gulf of Gdańsk (fishing ground R4, at depth not exceeding 30 m) in November 2003 showed that this shrimp is a very attractive food item for cod feeding in the inshore waters there. Stomachs of 88 % of fish examined contained *P. elegans*. The shrimp constituted more than 50 % of organisms ingested in more than half of the studied fish. Biomass analysis of 25 stomach contents also showed importance of this species for cod: *P. elegans* dominated in 12 of them (the highest biomass was more than 8 g). The individual weight of shrimps consumed by cod ranged from about 0.2 to 0.5 g. Thus, up to about 30 specimens can be eaten by cod. Slight increase in the shrimp length in relation to cod size was noticed. However, fish constitute the most important food for adult cod. Round goby (*Neogobius melanostomus*) was the fish species most frequently preyed upon by the studied cod (it dominated in the terms of biomass in 9 stomachs), and it was followed by eelpout (*Zoarces viviparus*). Moreover, in one stomach a pikeperch (*Sander lucioperca*) was recorded. Other malocostracan species such as *Crangon crangon* were less important. Only single specimens of bivalves like *Cerastoderma lamarcki*, *Macoma balthica*, and *Mytilus edulis,* as well as Gammarids and *Praunus flexuosus* were also found in studied stomachs.

Distribution and abundance of *Marenzelleria Cf. Viridis* (VERRILL, 1873) (POLYCHAETA, SPIONIDAE) in the Kaliningrad Zone of the Baltic Sea in September 2001

A. Gusev

Atlantic Scientific Research Institute of Marine Fisheries and Oceanography, Dm. Donskoy str. 5, Kaliningrad 236000, Russia

The benthos samples were collected at the 46 stations (140 samples) at the depths from 9 to 111 m in the Kaliningrad zone of the Baltic Sea in September 2001 with a 0.1 m^2 Van Veen grab. *M. cf. viridis* was observed in both benthos communities (*Macoma balthica* and *Mytilus edulis*) at the 19 stations, which were located at the depths from 10 to 54 m. It was occurred in the studied area under salinity 7-8.5‰, bottom temperature 7-18.5°C and oxygen content more than 2 ml/l. Its relative values were ranged 0.1-11.3% of total numbers of zoobenthic organisms and 0.01-3.8% of their biomass. The highest number and biomass values in the

sample of *M. cf. viridis* were found on the fine sand in the cape Taran area at the depth 41 m (510 ind.·m^{-2} and 1.7 g·m^{-2}) and near port Baltiysk at the depth of 28 m (430 ind.·m^{-2} and 2.1 g·m^{-2}). The values of number and biomass density of *M. cf. viridis* were the largest at the depths between 21-30 and 41-50 m on the fine sands (Table). Minimal values were observed at the depths 51-55 m on the coarse slit.

Table. Bathymetric distribution of *Marenzelleria cf. viridis* on the different bottom types in the Kaliningrad zone of the Baltic Sea in September 2001 (M ± SE)

Depth, m	Bottom type					
	Number, ind.·m^{-2}			Biomass, g·m^{-2}		
	coarse sand	fine sand	coarse silt	coarse sand	fine sand	coarse silt
10-20	73 ± 25	94 ± 40	–	0.32 ± 0.13	0.55 ± 0.25	–
21-30	49 ± 16	233 ± 36	–	0.08 ± 0.03	0.99 ± 0.22	–
31-40	20 ± 9	45 ± 8	–	0.04 ± 0.03	0.07 ± 0.01	–
41-50	88 ± 76	254 ± 129	–	0.03 ± 0.01	0.67 ± 0.54	–
51-55	–	–	14 ± 8	–	–	0.01 ± 0.007

Distribution of *M. cf. viridis* depends on the bottom type and the worm size. The studied worms range in length from 0.6 to 29.7 mm with modal group 7 mm (20%). There is known (Ezhova 2000) that small specimens (less than 30-40 mm) are concentrated in the surface layer of 0-5 cm, and middle-sized (40-80 mm) and large (more 80 mm) – in 12-20 cm. The Van Veen grab takes sample in layer of bottom till 8-12 cm and main part of large and middle-sized worms probably were not sampled. So our data on number and biomass density are minimal-accounted vales and characterize just layer of 0-12 cm. For the first time *M. cf. viridis* was observed in Polish waters in 1986 and it reached Lithuanian waters in 1988/89 (Zettler et al. 2002). Kaliningrad zone's waters it probably occupied in same time and to 2001 this invasive species is common member of the benthos communities on the suitable bottom types.

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Palaemon elegans– a new prawn in the Gulf of Gdańsk

Urszula Janas

Institute of Oceanography, University of Gdańsk, Al. Marsz. J. Piłsudskiego 46, 81-378 Gdynia, Poland

The glass prawn *Palaemon elegans* Rathke is widespread along the Atlantic coast of Europe, in the North Sea, the Mediterranean and the western Baltic. This species was accidentally introduced into the Caspian Sea and Aral Sea in the first half of 20th century.

In the Polish waters very large numbers of *P. elegans* were observed in 2002 and 2003 in the coastal zone of the Gulf of Gdańsk and in the Dead Vistula River (Janas et al., 2004). The species was found on in port waters and around piers and wrecks as well as on stones and rocks inhabiting not only hard bottom but also the algae**.** *P. elegans* may play a significant role in the trophic web, since its diet consists, among others, of molluscs, crustaceans, polychaetes, bryozoans, fish larvae, as well as algae and detritus (Kohn & Gosselck 1989).

It may itself be consumed by fish that feed on *Palaemon adspersus*, such as eel, perch, round goby and eelpout (Sapota, pers. comm.).

Our work regards the distribution and the biometric characteristic of *P. elegans* from the Gulf of Gdańsk. Additionally, the preliminary results of laboratory studies on behaviour and survival in brackish water (salinity < 7 PSU) will be presented.

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Native and alien malacostracan Crustacea along the Polish Baltic coast over the last century

Krzysztof Jażdżewski, Alicja Konopacka and Michał Grabowski

Department of Invertebrate Zoology & Hydrobiology, University of Łódź, Banacha 12/16, 90-237 Łódź, Poland

There are 50 species of malacostracan Crustacea ever recorded along the coasts of the Baltic Sea within the limits of Polish 12 mile wide coastal area. In this number there are 11 species of Isopoda, 1 species of Tanaidacea, 22 species of Amphipoda, 8 species of Mesidacea and 8 species of Decapoda. The majority of these species are native ones, however 10 alien species account for 20% of the total malacostracan fauna. These species are *Hemimysis anomala* (a mysid), *Chelicorophium curvispinum*, *Chaetogammarus ischnus*, *Gammarus tigrinus*, *Dikerogammarus haemobaphes*, *Pontogammarus robustoides*, *Obesogammarus crassus* (amphipods) and *Orconectes limosus*, *Rhithropanopeus harrisi* and *Eriocheir sinensis* (decapods). Six species – one mysid and 5 amphipods are of Ponto-Caspian origin, three

species come from American waters (one amphipod and two decapod species), whereas one decapod, mitten-crab, is of far-East origin. The authors present a history of the discovery of particular taxa in Polish Baltic offshore waters, stressing that the main wave of invasion of alien malacostracan species have started quite recently – some decade ago.

A summary of alien marine invertebrates in Danish waters

Kathe R. Jensen

Zoological Museum, Universitetsparken 15, DK-2100 Copenhagen, Denmark

The Danish waters, Skagerrack, Kattegat, Öresund and the Belt Sea form the Transition Area, connecting the North and Baltic Seas. Surface salinity decreases gradually from 35‰ in the North Sea to 8-10‰ in the western Baltic. Bottom water has a high salinity until the shallow thresholds in Öresund and the western Baltic, where extensive mixing takes place. The special salinity distributions from north to south and from surface to bottom in this area form a barrier for the dispersal of truly marine alien species from the North Sea, and also for many estuarine or freshwater species, which have invaded the Baltic Sea through rivers and canals. Out of the approximately 75 marine alien invertebrates recorded from the North and Baltic Seas, 27 species from 7 phyla have been recorded in Danish waters. Nine of these may not be permanently established.

Maritime traffic is heavy through the Danish waters, but relatively few transoceanic vessels call at Danish ports at the present time. Hence most recent invasions of alien marine species have been through secondary dispersal from introductions to the Netherlands or the U.K. This is the case with the dispersal of the American razor clam, *Ensis americanus*. Many older introductions have been through hull fouling. Most parasitic alien species have been accidentally introduced with aquaculture organisms.

This presentation will summarize the known histories of introduction, vectors, origin and secondary dispersal of alien marine invertebrates in Danish waters.

Marenzelleria cf. viridis (Verrill) in the Gulf of Riga - history of invasion and it impact on zoobenthos.

Vadims Jermakovs and Maija Ceitlina

Institute of Aquatic Ecology, University of Latvia, Marine Monitoring Centre, 8 Daudavgrivas st. LV-1007, Riga, Latvia

Marenzelleria cf. viridis in the Gulf of Riga was recorded first time in 1988 in the Southern part of the Gulf. During 1989-1990 *M. cf. viridis* spreaded along the coastal area of the southern part of the Gulf (Lagzdins, Pallo, 1994). In 1991 the *M. cf. viridis* was encountered around all coastal zones of the Gulf and sound of Irbene. During 1992-1994 *M. cf. viridis* continue of invasion in the deep areas in the southern and central parts of the Gulf. And finally

in 1994-1995 *M. cf. viridis* was recorded in northern and northeastern parts of the Gulf (Kotta and Kotta, 1998).

After initial increase, whose maximum was observed in 1993-1995, the population of *M. cf. viridis* show's decreasing trend in the southern part of the Gulf. However, still high abundance of *M. cf. viridis* occur in the southwestern and northeastern parts of the Gulf.

In the end of 1980th and beginning of 1990th in the Gulf of Riga was observed decrease in the abundance and biomass of zoobenthos. It was primarily due to environment conditions, and not due to arrival of *M. cf. viridis*. Our field studies in the Gulf don't show negative correlation between *M. cf. viridis* and native macrobenthic species. We also can't find negative correlations between distributions of age groups of *M. cf. viridis* and distributions of age groups of *Macoma balthica*, *Monoporeia affinis* and *Pontoporeia femorata* in the Gulf of Riga.

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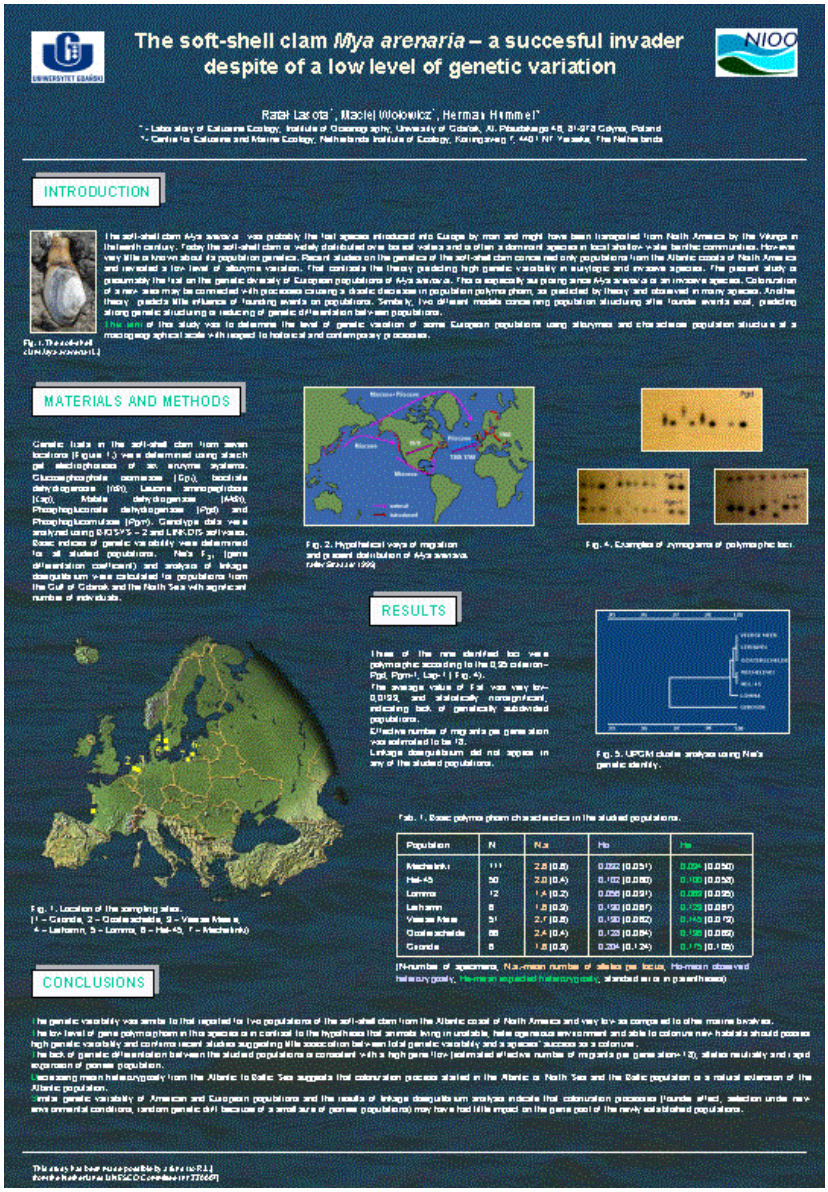
Parasitization of the invasive round goby *Neogobius melanostomus* (Pallas) (Gobiidae: Osteichthyes) in the Gulf of Gdańsk (Baltic Sea)

Yuriy Kvach[1] and Krzysztof E. Skóra[2]

[1]Odessa Branch of the Institute of Biology of the Southern Seas, National Academy of Science of Ukraine, Odessa, Ukraine; [2]Hel Marine Station, Institute of Oceanography, University of Gdańsk, Hel, Poland;

The round goby *Neogobius melanostomus* (Pallas 1811) is the bottom dwelling Ponto-Caspian gobiid fish species that was mentioned in the Baltic Sea off Hel in 1990. The metazoa parasite fauna of the invasive round goby *Neogobius melanostomus* consists of 13 species includes four Trematoda species, one Cestoda, three Nematoda, two Acanthocephala, one Hirudinea, and also one Crustacea species. Two species, *Anguillicola crassus* larvae, *Piscicola geometra*, are noted for the round goby for the first time. The round goby in the Gulf of Gdańsk takes a part of definitive, second intermediate and paratenic host for different parasite species. The fish species is entered to parasite system that includes fish-eating birds, fishes of different ecological groups (predatory, planktivorous, benthivorous), and invertebrates. During the last period the process of formation of the round goby parasitofauna in the place of invasion was coming on. The round goby adapts to the typical parasite fauna for the species. But the fauna consists no specific for the fish species parasites and no Ponto-Caspian ones.



The soft-shell clam *Mya arenaria* – a successful invader despite of a low level of genetic variation

Rafał Lasota[1], Maciej Wołowicz[1] and Herman Hummel[2]

[1]Laboratory of Estuarine Ecology, Institute of Oceanography, University of Gdańsk, Al. Marszałka Piłsudskiego 46, 81 – 378 Gdynia, Poland
[2]Centre for Estuarine and Coastal Ecology, Netherlands Institute of Ecology, Korringaweg 7, 4401 NT Yerseke, The Netherlands.

Although the soft-shell clam *Mya arenaria* is considered the first species introduced into Europe by man and today often plays an important role in local shallow – water benthic communities, surprisingly little is known about its population genetics. Recent study on the

genetics of the clam from the Atlantic coasts of North America revealed a low level of allozyme variation in this species that contrasts the hypothesis that the animals living in heterogeneous environment and able to colonize new habitats should posses high genetic variability. Therefore, this study was aimed at determining the level of genetic variation of some European populations using allozymes and characterising population structure at a macrogeographical scale with respect to historical and contemporary processes. The genetic traits in *Mya arenaria* from seven locations in Europe (two sites in the southern Baltic Sea (the Gulf of Gdansk) and two in the North Sea (Veerse Meer and Oosterschelde), and three additional sites in the Danish Straits and Bay of Biscay) were determined using standard starch gel electrophoresis of six enzyme systems (nine scorable loci in total). The results showed a low level of genetic variability and a lack of genetic differentation among the populations studied. Basic polymorphism characteristics calculated for populations from the North Sea estuaries and the Gulf of Gdansk were: He 0.094 – 0.145, Ho 0.092 – 0.130, percentage of polymorphic loci 33 (0.95 criterion) and mean number of alleles per locus 2.0 – 2.7. The mean value of F_{ST} was 0.0133 and statistically insignificant. It is concluded that in spite of a low level of genetic polymorphism the soft-shell clam is a successful colonizer. The genetic homogeneity among the populations reflects a rapid population extension, alleles neutrality and a high gene flow.

How we got started – the first twenty years of invasion biology in the Baltic Sea area

Erkki Leppäkoski

Environmental and Marine Biology, Åbo Akademi University, FIN-20500 Turku/Åbo, Finland

Looking for a history of aquatic invasive species arrival in the Baltic Sea we can agree upon the fact that a lot of the early history likely remains as a best guess whereas the short history of research into invasion biology can be described in very detail: the history of systematic research covers a period of no more than 20 years.

The aim of this review is to summarize the development of scientific awareness of the occurrence, distribution and impacts of aquatic nonindigenous species (NIS) in the Baltic Sea (the Kattegat included).

The first faunistic notes on newcomers date back to the 1820s. There was some interest in this topic during the inter-war period, expressed by the ICES Combined Baltic and Transition Area Committee. In a document from 1935 this body "recommended that the report concerning the occurrence of non-endemic animals in the Baltic Sea and the causes of their appearance...should be printed." The fate of this report remains unknown.

In 1951, the first paper focussing specificly on NIS was published in Russian (*On new introductions in fauna and flora of the North and the Baltic Seas from distant areas*). In this paper, 15 NIS were mentioned. In a review from 1984, the distribution of 35 NIS was shown; the first national report listed ca. 40 alien species from Swedish waters.

Marine research is inherently an internationally oriented field of science. In 1994 the aquatic invasion biology in northern Europe took the first step in this direction when the Baltic

Marine Biologists' (BMB) Working Group on Non-indigenous Estuarine and Marine Organisms (NEMO) was founded, probably being the first regional cooperative network on aquatic NIS. Main activities of this group are to (i) facilitate contacts between marine biologists working on NIS, (ii) maintain the Baltic Alien Species Database since 1997, (iii) present results of joint investigations at BMB biannual Symposia and elsewhere, and (iv) contribute to intergovernmental/interna-tional bodies such as HELCOM, ICES and the IMO (Marine Environment Protection Committee - Ballast Water Working Group) and to the IMO based GloBallast Programme.
Other activities initiated by the NEMO Group are (i) a Nordic Risk Assessment project (a book published in 1999), (ii) involvement in a European Union funded Concerted Action "Introductions with Ships" in 1998-2000, and (iii) publishing a comprehensive book "Invasive Aquatic Species of Europe: Distribution, Impacts and Management" in 2002.

An ecologisation of invasion biology took place in the late 1990s. During the last five years, the shift from descriptive work to studies on the functional impacts of NIShas become apparent from the increasing interest in the experimental studies of trophic interactions.

Ponto-Caspian Crustaceans in the Curonian lagoon ecosystem: four decades after introduction

Artūras Razinkovas[1], Rita Jankauskienė[2] and Jūratė Lesutienė[1]

[1]Coastal Research and Planning Institute, University of Klaipėda; Klaipėda, Lithuania,
[2]Departament of Biology University of Klaipėda; Klaipėda, Lithuania

To improve the feeding recourses for the commercial fish two species of Ponto-Caspian Mysidacea- *Paramysis lacustris*, *Limnomysis benedeni*, *Hemimysis anomala* and four species of Gammaridae- *Obesogammarus crassus*, *Pontogammarus robustoides*, *Chaetogammarus warpachowskyi*, *Ch. ischnus* were introduced into Lithuanian lakes and reservoirs in 1960-1961.Later these crustaceans reached the Curonian lagoon via Nemunas river (Gasiunas, 1963). The investigations of Ponto-Caspian crustaceans over two last decades were used to summarize the existing information on distribution, reproduction and feeding ecology and their function in the Curonian lagoon food web.
P. lacustris and *L. benedeni* became the most common mysid species in the lagoon: *P.lacustris* prefer the open sandy-aleuritic bottom biotopes at the depth of1-3m, while *L. benedeni* is associated to the littoral vegetation (Razinkovas, 1996). Three peaks of abundance and biomass in June, at the end of July-August and at the and of August- early autumn were reported in the Curonian lagoon (Razinkovas, 1990). The daily cycle and ontogenetic changes of mysid feeding pattern were reported. Both mysid species are described as efficient feeders on detritus during the daytime, while *P.lacustris* during nocturnal vertical migrations mostly consumes zooplankton (Jankauskienė, 2001). The diet differences between the juveniles and adult mysids are related to the food particle size: the particles in the intestines of juveniles are represented by phytoplankton, Rotatoria, copepods nauplii, whereas adults ingest oligochets, chironomids and various planktonic organisms (Jankauskienė, 2001). The Curonian lagoon gammarids are also dominated by the introduced Ponto-Caspian species: *O. crassus*, *P. robustoides*, *Ch. warpachowskyi.* In the littoral of the northern part of the lagoon they

constitute 60-90% of the total macrozoobenthos biomass and reach the abundance and biomass peak in the August (Daunys, Oleninas, 1999). The introduced gammarids feed predominantly on detritus and macrophyte particles (Jankauskienė, 2001). The Ponto-Caspian crustaceans aggregating in the littoral of Curonian lagoon are important consumers of primary production transferring it to the higher trophic levels and taking part in organic matter transport and habitat coupling during their ontogenetic and diurnal migrations.

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Ireland: a new frontier for the zebra mussel *Dreissena polymorpha*

Dan Minchin[1], Frances Lucy[2] and Monica Sullivan[2]

[1]Marine Organism Investigations, 3, Marina Village, Ballina, Killaloe, Co Clare, IRELAND
[2]Environmental Services Ireland, Aughamore, Lough Allen, Carrick-on-Shannon, IRELAND

The zebra mussel spread from it's native Black Sea regions *via* canals to the Baltic Sea and was probably exported from there to Britain on fouled timber before 1824. It was first recorded in Ireland in 1997; the first established populations probably occurred in Lough Derg (1993/94), the southernmost lake on the Shannon navigation. The likely vector was fouled imported British leisure craft. It would appear that the species subsequently spread up the Shannon Navigation from 1996 on boat hulls and moved onwards to the Erne Navigation *via* the Shannon-Erne Waterway. It has subsequently spread to 28+ isolated lakes chiefly attached to angling boats but also by some unidentified vectors. Highest densities were recorded in Shannon lakes ~ +4kg m^{-2}. There has been a trend of increasing biomass to 2001 and no significant increase since then.

Individuals from 6mm are capable of spawning once water temperatures attain ~15°C. Larvae appear from May to October; small numbers have been found in the winter. Post-settlement stages have been found in the plankton on windy days. They are also distributed within lakes on buoyant rafts of *Cladophora* or with macrophyte debris, and so can become well spread within lakes. As adults they can attain 38mm shell length and live to three or more years.

Extensive sampling has not revealed any live Unionids in infested lakes where they were formerly abundant before zebra mussel invasion. It is also likely that there are direct

impacts on other benthic invertebrates. Aquatic plants provide important substrata for the zebra mussel, particularly in muddy lakes. Water clarity has increased since its arrival and aquatic macrophytes are now rooting in the deeper euphotic zone. Other impacts include laceration of bathers feet, blocked abstraction pipes, fouling and water tainting. Exotic amphipods that have become associated with zebra mussel druses may provide a source of food for some fish.

Zebra mussels are likely to continue to expand their range. Other species introduced to mainland Europe are likely to become established in Ireland, particularly those entering Britain. Precautionary methods of control are required to prevent their spread.

Research has been funded by the EU within the FP 6 Integrated Project "ALARM" (GOCE-CT-2003-506675), by the Irish Marine Institute and Environmental Protection Agency.

Occurrence of Asiatic nematode *Anguillicola crassus* in European eel from the Łebsko Lagoon (Middle Coast)

Jolanta Morozińska-Gogol

Division of Ecology and Protection of the Sea, Pomeranian Pedagogical Academy, ul. Arciszewskiego 22 b, 76-200 Słupsk, Poland

Anguillicola crassus Kuwahara, Niimi and Itagaki, 1974 is a natural parasitic nematode of the swim bladder of Japanese eel, *Anguilla japonica*. *A. crassus* was introduced to the Europe in the 1980's by infected A. japonica imported for aquacultural restocking.

Once introduced to the lake or river, *A. crassus* my spread rapidly among the eel population. Young eels infected by feeding on invertebrates and oldest on fishes. This parasite is normally found in freshwater and brackish water coastal localities, including in the Baltic. This species has been noted also in hosts in the open sea.

The place of investigation, Łebsko Lagoon (locally known as coastal lake) is located in the middle coast of Poland. It is a part of the Słowiński National Park. Considering the area it is the largest coastal lake in Poland (7142 ha). Łebsko is a shallow body of water (max. depth 6.3m). This reservoir is separated from the Baltic Sea by a narrow stripe of land (Mierzeja Łebska) and connected with the sea by the Łeba River.

Occurrence of *A. crassus* in eels from the Łebsko Lagoon was studied from 2001 to 2003 and continued. In all, 60 European eels, *Anguilla anguilla* were sampled. The eels length range was 40-81 cm and weight range 110.3-992.6 g. 78% of examined eels has been infected with *A. crassus* with mean intensity 6.2 indiv. (from 1 to 26 indiv.). Changes in the infection level have been observed. The prevalence and mean intensity of infection increased from 2001 to 2003. In 2001 nearly 54% of eels were infected with mean intensity 6.4 indiv. (range 1-13 indiv.), in 2002 74% with 5.8 indiv. (1-20 indiv.) and in 2003 increased to the 100 % infected eels with mean intensity 7.5 indiv. (1-26 indiv.).

The life cycle of this nematode includes one intermediate host – predominantly copepods and ostracods, but also many other invertebrates, and very often paratenic hosts – many species of

fishes and one final host - eels. Widespread in all Europe and in the Baltic is a reason of absence of native swim bladder parasites and broad specifity of *A. crassus* - many species of intermediate and paratenic hosts. Nematodes have been transmitted to the eels by many species of invertebrates and fishes by the food-web.

Non-native brachyuran species *Eriocheir sinensis* and *Rhithropanopeus harrisii* in the Polish brackish waters

Monika Normant and Anna Szaniawska

Institute of Oceanography, University of Gdańsk, Al. Marszalka Pilsudskiego 46, 81-378 Gdynia, Poland

The Chinese mitten crab *Eriocheir sinensis*, a species that originated from eastern Asia, and the American mud crab *Rhithropanopeus harrisii* from the Atlantic coast of North America, are two brachyuran immigrants to the European waters. In Poland, specimens of both species have been caught annually since the 1940s and 1950s, respectively.

E. sinensis is the largest crustacean species inhabiting Polish waters. It has been recorded in all parts of the Polish coastal zone, from the Pomeranian Bay through the central coast and the Gulf of Gdańsk to the Vistula Lagoon. The biggest recorded specimen had a carapace width of 88 mm and wet weight of 281.9 g. *E. sinensis* has been reported along the Polish coast from spring til late autumn with the numbers peaking during the summer. Mitten crabs are caught as bycatch in the traps used for eel fishery and the species is considered a pest because it damages the nets. Among catched specimens males are prevalent.

R. harrisii has found a suitable ecological niche in the Polish brackish waters, especially in the Dead Vistula River and Vistula Lagoon. Based on the last years observations the *R. harrisii* seems to also be abundant in the region of the Gulf of Gdańsk, i.e. in waters with slightly higher salinity. The maximum carapace width of the catched specimen was 22.4 mm and the wet weight 3.14 g.

The aim of our studies was to improve our knowledge on biology and ecology of *E. sinensis* and *R. harrisii* occurring in the Polish brackish waters. We studied distribution and morphology as well as energy value and chemical composition of both species.

Alien species in the NE Baltic Sea: monitoring and assessment of environmental impacts

Henn Ojaveer, Jonne Kotta, Helen Orav-Kotta, Mart Simm, Ilmar Kotta, Ain Lankov, Arno Põllumäe and Andres Jaanus

Estonian Marine Institute, University of Tartu, Mäealuse 10a Tallinn, 12618 Estonia

Several alien species are important constituents of both planktonic and benthic invertebrate communities in the Estonian marine waters of the Gulf of Finland, Gulf of Riga and West-Estonian Archipelago Sea. These include, amongst others, the predatory cladoceran *Cercopagis pengoi*, the polychaete *Marenzelleria viridis*, the zebra mussel *Dreissena polymorpha* and the soft shelled clam *Mya arenaria*. The study financed from the US State Department was concentrating on selected alien species (incl. those named above) in order to track their spatio-temporal abundance and distribution patterns in the NE Baltic. In addition, field experiments were carried out in order to reveal ecological impacts of some selected alien benthic invertebrates. First laboratory experiments with *Cercopagis* for clarification of taxonomic matters of the genus and getting insight into the feeding ecology of the species were undertaken. Similarly, first biological sampling directly in one of the largest ports of the Baltic Sea – Port of Tallinn (Muuga Harbour) – was performed.

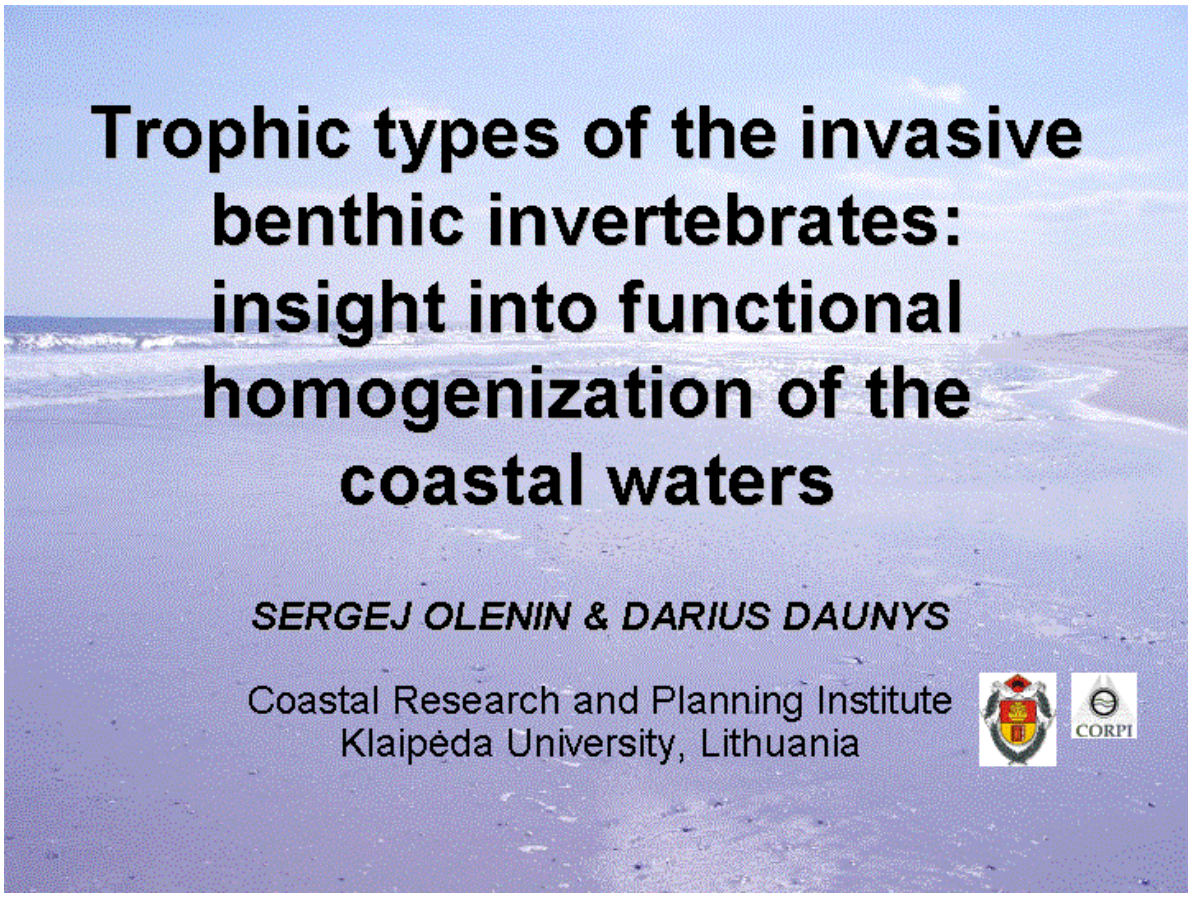
Abiotic factors controlling abundance of the invasive dinoflagellate *Prorocentrum minimum* (Pavillard) Schiller in the coastal waters of Lithuania, Baltic Sea

Irina Olenina

Centre of Marine Research, Taikos 26, LT-5802 Klaipeda, Lithuania

The dinoflagellate *Prorocentrum minimum* is the only invasive plankton microalgae known so far from the aquatic environment of the Lithuanian coastal zone, Baltic Sea. This species was first recorded in the North Sea in 1976, (Smayda 1990) and since that it gradually penetrated into the inner parts of the Baltic (Hajdu et al 2000). In the Lithuanian coastal waters, where the phytoplankton monitoring is performed since 1980, *P. minimum* appeared in 1992. This dinoflagellate has a wide environmental tolerance being found in brackish as well as fully marine water. Presently, this species became a common element of summer phytoplankton in the south-western parts of the Baltic Sea (Belt Sea, Arkona Basin), while in the Lithuanian waters (south-eastern Baltic) *P. minimum* appears only in late summer and usually reaches the peak of density in September – October. With saline water inflows, this invasive species penetrates also into the Curonian Lagoon, mainly freshwater body. The lower limit of salinity under which this species was found is 0.7 PSU. The abundance of *P. minimum* shows a very

high annual variability: in some years the species caused blooms with abundance up to 7.9 mln cells/litre, while during other periods it was absent in plankton. The present paper summarises results of the 12 years observations of *P. minimum* abundance in relation to environmental data (water temperature, salinity, nutrients).



Trophic types of the invasive benthic invertebrates: insight into functional homogenization of the coastal waters

Sergej Olenin and Darius Daunys

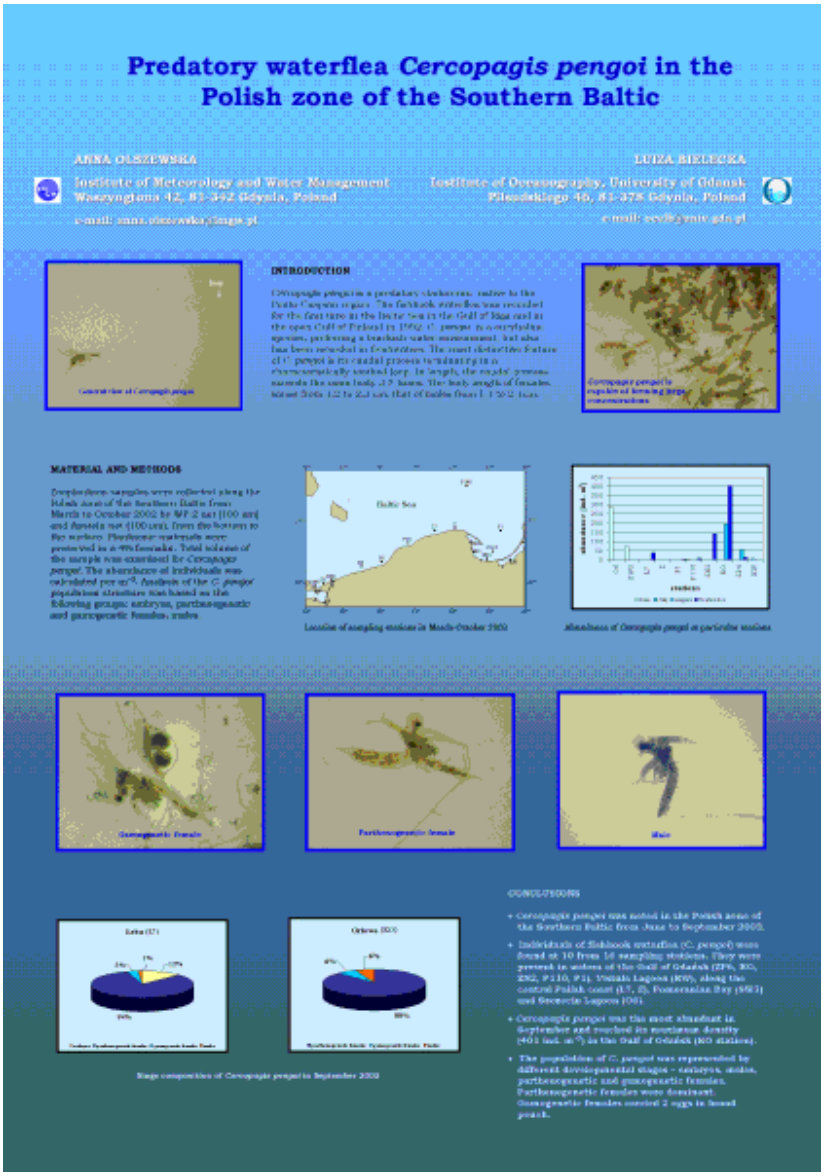
Coastal Research and Planning Institute, Klaipeda University, Klaipeda, LITHUANIA

We analysed trophic composition of benthic invasive invertebrates in several European seas at different scales: from a coastal lagoon up to the whole sea basin. Trophic classification of benthic invertebrates found was based on works of Turpaeva (1953), Fauchald and Jumars (1979), Järvekülg (1979), Kuznetzov (1980), Lee and Swartz (1980), Tsikhon-Lukanina (1987) and Pearson (2001) with modifications discussed in our earlier papers (Olenin 1997; Olenin and Leppäkoski 1999). We have found that among the invasive benthic invertebrates, the suspension-feeders are the most widespread type: species belonging to that trophic group constitute from half to two thirds of total invasive species in various European seas.

Recently, Asmus and Asmus (2004) showed that in native communities, the share of suspension-feeding species in total species number is much lower than that of non suspension-feeders on different scales from global to local ones, suggesting a minor influence of suspension-feeding type to total diversity of systems. Our study, however, showed an opposite result in regard to the invasive benthic macrofauna. In all major European brackish water bodies (Baltic, Black and Caspian seas) as well as in the fully saline North Sea, suspension-feeding was the prevalent trophic type among benthic invertebrate invaders. It is unclear, how the species ability to filter-feed may promote their invasion success. Possibly, suspension-feeding as the most optimal foraging strategy (Gili and Coma, 1998) adds to other common traits of invaders: ecological plasticity, profitable reproductive strategy, ability to use different substrates, etc (Ruiz and Hewitt 2002 and references therein). Increased pelagic food through eutrophication may also promote the relative success of suspension-feeder invaders, especially in the coastal areas, which are mostly exposed to new introductions. Further studies on these observations may help to better identify potential successful benthic invaders.

Olden et al. (2004) consider ecological and evolutionary consequences of biotic homogenization caused by invasions, including the functional ones. Our findings indicate that the suspension-feeders are the prevalent group among invasive benthic invertebrates and assume the vector of that functional homogenization. If the rate and the scope of invasions remain at the recent high level then the role of suspension-feeding as a trophic type will grow in the future.

Research has been funded by the EU within the FP 6 Integrated Project “ALARM” (GOCE-CT-2003-506675)



Predatory waterflea *Cercopagis pengoi* in the Polish zone of the Southern Baltic

Anna Olszewska[1] and Luiza Bielecka[2]

[1]Institute of Meteorology and Water Management, Maritime Branch, Gdynia, Poland
[2]Institute of Oceanography, University of Gdansk, Gdynia, Poland

Distribution and population structure of *Cercopagis pengoi* were studied in the Polish zone of the Southern Baltic in 2002. Individuals of fishhook waterflea were observed from June to September, at 10 from 16 sampling stations. Maximum density of the species was noted in September (about 400 ind. m^{-3}) in the Gulf of Gdańsk. The population of *C. pengoi* comprised

various developmental stages - embryos, gamogenetic and parthenogenetic females, as well as males. Parthenogenetic females were the dominant group.


New distribution of the Northern Ponto-Caspian mysids

Irina Ovčarenko *, A. Audzijonytė, Z. Gasiunaitė, S. Olenin

Fig.4 Distribution map of the Northern Ponto-Caspian mysids

Distribution of the Northern Ponto-Caspian mysids

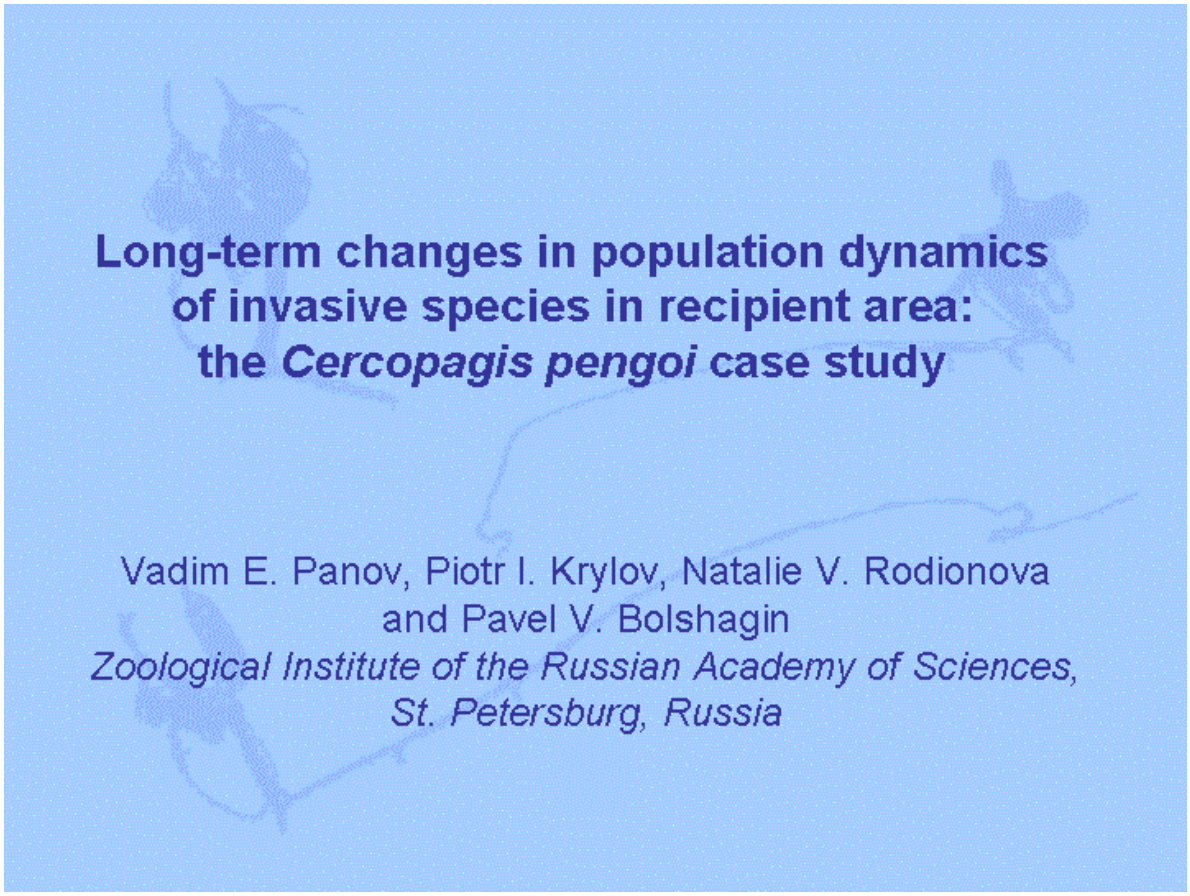
Irina Ovcharenko[1], Asta Audzijonyte[2], Zita Gasiunaite[1] and Sergej Olenin[1]

[1]Coastal Research and Planning Institute, Klaipeda University, Klaipeda, LITHUANIA
[2] Finnish Museum of Natural History University of Helsinki, FINLAND

Among eight species of mysids (Crustacea, Mysida) of the Northern Ponto-Caspian region, five have been listed as potential invaders to the North American Great Lakes and all of them were transplanted during intentional introductions in the former USSR. Two of these species

have already spread in a number of European inland waters. The aim of this study is to overview the new distribution of Northern Ponto-Caspian mysids, i.e. their natural distribution, and areas reached via intentional or unintentional introductions. In total, 26 literature sources were reviewed to summarize the distribution into specific maps. The review shows that for the intentional introductions mainly mysids of the Black/Asov seas mysids were used. The most commonly transplanted species were *P. lacustris* spp. and *L. benedeni*. However, currently the most successful invaders in Europe are *H.anomala* and *L.benedeni*.

Research has been funded by the EU within the FP 6 Integrated Project "ALARM" GOCE-CT-2003-506675 (I.O., Z.G., S.O.) and by Walter and Andrée de Nottbeck Foundation, Helsinki, Finland (A.A.).



Long-term changes in population dynamics of invasive species in recipient area: the *Cercopagis pengoi* case study

Vadim E. Panov, Piotr I. Krylov, Natalie V. Rodionova and Pavel V. Bolshagin

Zoological Institute of the Russian Academy of Sciences, 199034 St. Petersburg, Russia

The invasive Ponto-Caspian cladoceran *Cercopagis pengoi* was first found in the Baltic Sea area (Gulf of Riga and Gulf of Finland) in 1992, most likely as result of the discharge of ballast water (Ojaveer *et al*. 2000). After first records in the Gulf of Finland in 1992,

Cercopagis pengoi was first found in the Neva River estuary in 1995, already at high densities, and since then it become a common zooplankton species in the eastern Gulf of Finland (Krylov *et al.* 1999; Panov *et al.* 1999; Panov *et al*. 2003). We studied population dynamics of the invasive Ponto-Caspian cladoceran *Cercopagis pengoi* in the eastern Gulf of Finland since 1996, after mass occurrence of this species in the gulf.

In the intensively studied location in the Neva estuary (zooplankton was sampled every 10-14 days during May – October from 1996 to 2003), *C. pengoi* successfully coexists with native cercopagid cladoceran *Bythotrephes longimanus* (source population for North American Great Lakes, see Berg *et al*. 2002). However, observed strong seasonal and annual differentiation in development of *C. pengoi* and *B. longimanus* most likely reflect strong negative relationships between these predatory cladocerans, with bigger predator *Bythotrephes* suppressing *Cercopagis*. During summers in 1999 and 2001, with exceptional high densities of *Bythotrephes* in zooplankton, only few *Cercopagis* were recorded, so it was not possible to make estimations of its population structure. Despite severe negative relationships with native *Bythotrephes* and strong selective fish predation, *C. pengoi* obviously successfully established in the Neva estuary, even causing economic losses for local fishery via clogging fishing nets during its mass development (Panov *et al.* 1999).

The population of *C. pengoi*, established in the Neva estuary, has showed a remarkable reproductive strategy, producing a large number of resting eggs during summer months in 1996 (Panov *et al.* 1996; Krylov & Panov 1998). However, the maximal registered during season (July –October) and mean seasonal percentage of both males and gamogenetic females in *C. pengoi* population in the studied part of the Neva estuary gradually declined during 1996 - 2000. It has been suggested that large pool of resting eggs in *Cercopagis* population in the Neva estuary has enabled this species to achieve fast population growth in new environments, and an increasing risk of *C. pengoi* being dispersed by ships' ballast water (Panov *et al*. 1996; Panov *et al.* 1999). In summer 1998 *C. pengoi* was found in North America in Lake Ontario, snagged on sport fishing lines (MacIsaac *et al.* 1999). Most likely this is a question of secondary introduction by ships ballast waters via the eastern Baltic via an existing invasion corridor, identified in case of *Bythotrephes* invasion by Berg *et al*. (2002). Recent genetic study by Cristescu *et al*. (2001) demonstrated that the source population of *Cercopagis* in North American Great Lakes is most likely originated from the Baltic Sea population, namely Neva estuary (eastern Gulf of Finland).

Ability to develop diapausing resting stages facilitates species survival during movement across geographical barriers under extreme conditions, such as in ballast tanks of ships. Case studies for invasive species such as *Cercopagis pengoi* show that some invaders may possess adaptive life cycles, switching to the early prolonged gamogenetic reproduction, which facilitates their invasion success in the recipient ecosystem and further dispersal by both natural and human-mediated vectors.

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European brackish waters exposed to biological invasion – the Remane's curve redrawn?

Marjo Pienimäki[1], Sergej Olenin[2] and Erkki Leppäkoski[1]

[1]Åbo Akademi University, Environmental and Marine Biology, Turku/Åbo, Finland;
[2]Klaipeda University, Coastal Research and Planning Institute, Lithuania

The brackish seas of Europe are subject to intense invasion of non-indigenous species (NIS) – they have a long history of species introductions and there has been a considerable increase in their numbers since the 1960s. The first stage of invasion biology in these seas has been directed towards establishment of lists of NIS, time scales of their arrival, and describing their likely vectors for introduction (for regional overviews, see Leppäkoski et al. 2002). The second stage focus on ecological impacts of aquatic invasive species (AIS) and risk analysis of potential future invasions, both of which require good knowledge of species- and area specific ecology and the vectors involved in the process.

On the basis of very fragmentary information, this study aims to develop a more cohesive understanding of species introductions into brackish waters. The classic Remane's curve from 1934 was tested for the established NIS in the Baltic, Caspian and Black Seas and in the Sea of Azov. The salinity ranges of almost 100 species in all, both in their native and new area, were collected from various literature to see if NIS distribution unites with the Remane's curve as native species seem to do in brackish water seas (Figure). The main questions to be answered are: 1) Does the salinity range determine ecosystem invasibility? 2) Can data on salinity tolerance and preferences of key NIS be considered as a tool for ecological risk assessment of brackish waters as receiver and donor areas of AIS?

The salinity range in the four seas concerned was classified according to the Venice system from 1959: limnetic 0-0,5 psu; β-oligohaline 0,5-3 psu; α-oligohaline 3-5 psu; β-mesohaline 5-10 psu; α-mesohaline 10-18 psu; polymixohaline 18-30 psu; euhaline 30-40 psu; hyperhaline >40 psu. The salinity range of established alien species in these seas was plotted against those salinity classes. For some species this salinity range was compared to the range in their native area. The preliminary results of the study will be ready in summer 2004.

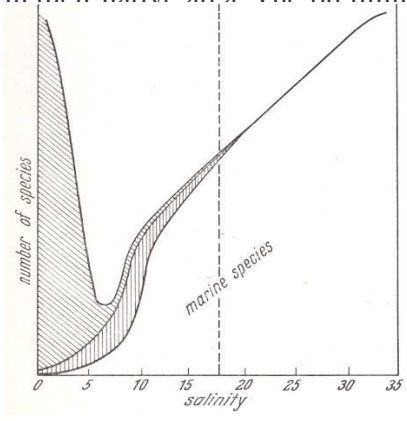

Figure: The Remane's curve (Remane 1934)

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Populations of two predatory cladocerans in the Vistula lagoon - native *Leptodora kindtii* and invasive *Cercopagis pengoi*

Julia Yu Polunina

Russian Academy of Sciences, P.P. Shirshov Institute of Oceanology, Atlantic Branch, 1 Pr. Mira, 236000 Kaliningrad, Russia

Zooplankton fauna of the brackish-water Vistula lagoon is represented by 80 species. Specific hydrology of the lagoon allows to run up to mass development only few species populations. Only *Eurytemora affinis* Poppe can be a dominant species in the lagoon (more than 50 % in term of biomass). From point of view of feeding mode 95 % of total species amount and all mass species belong to the filter-feeders (phyto- and zoophagous). Percentage of predators is not high. Two cladocerans from predators play prominent role in the community – native *Leptodora kindtii* and invasive *Cercopagis pengoi*.

L. kindtii has been recorded by different authors in the Vistula lagoon since 40thies of XX century (Schmidt – Ries, 1940). *C.pengoi*, species of Ponto-Caspian origin, was brought into lagoon by the sea stream in August 1999 (Naumenko, Polunina, 1999).

Literature data and our study at 1996-2002 show that native species is recorded in the lagoon zooplankton not every year, despite the fact that *L. kindtii* presents annually in zooplankton of the Pregel river inflowing in the lagoon. In general, *Leptodora* occurs in the most freshwater parts of the Vistula lagoon and riches sometimes high density only here (maximum 1900 ind.m^{-3}, 30 - 100 ind.m^{-3} in average). Population consists of juveniles and partenogenetic females, while sexual generation was not recorded. It is interesting that in 2000, the first year after *Cercopagis* invasion, significant increase of density and area of *Leptodora* distribution took place.

Character of *C.pengoi* population development in 1999-2002 was typical for the dynamic of newcomer population establishing in a new area: high densities (maximum 7000 ind.m^{-3}, 100-300, in average), early shift to sexual reproduction, increase of sexual generation percentage up to 30 %, production of the resting eggs pool. *Cercopagis* is occurred almost everywhere in the Russian part of the Vistula lagoon. Population density arises in direction of salinity increase, but salinity values typical for the study area is not a limiting factor of *C.pengoi* population development. We consider the most negative factor for *Cercopagis* is wind-wave re-suspension in the Vistula lagoon conditions.

It is possible to conclude that *C.pengoi* reveals higher than *Leptodora* adaptation abilities in specific hydrologic conditions of the Vistula lagoon. The reason of it can be wider range of salinity tolerance of *Cercopagis* and, probably, some features of feeding preferences and feeding behavior.

Infection of European eels *Anguilla anguilla* with *Anguillicola crassus*, an exotic swim bladder nematode, in the southern Baltic Sea and adjacent waters

Leszek Rolbiecki and Jerzy Rokicki

University of Gdańsk, Department of Invertebrate Zoology, Al. Marsz. Piłsudskiego 46, 81-378 Gdynia, Poland

Nematodes of the genus *Anguillicola* live in the swim bladder of the eel. Of the five known *Anguillicola* species, only two (*A. crassus* and *A. novaezelandiae*) have been recorded in Europe. They are, however, not autochthonous as they appeared in Europe in the early 1980s along with the eel imported for stocking and consumption. *A. novaezelandiae* is known from *Anguilla australis* and *A. dieffenbachii* in New Zealand; it is a rare species in Europe. On the other hand, *A. crassus*, known earlier only from eastern Asia, is nowadays of economic importance. During a very short time after its introduction, the nematode attacked natural populations of the European eel (*Anguilla anguilla*) and, at present, occurs almost throughout Europe.

The European eel proved less resistant to *A. crassus* invasion than the Japanese eel (an autochthonous host), exposed to invasion for a long time. In Japan, *A. crassus* is present in 40% of the eel at most and causes no major damage to the population. On the other hand, the prevalence of invasion in the European eel may be as high as 100%, the invasion intensity reaching several tens specimens in a fish. Such a heavy infection frequently produces anguillicolosis, a serious pathological condition.

Since the first Polish record (Własow 1991, Rolbiecki et al. 1996) of *A. crassus* in 1988, the nematode has been attracting a particular attention of numerous scientists, fishermen, and fish farmers. This work summarises a long-term research on *A. crassus* in the eel caught in the southern Baltic and adjacent waters (the Puck Bay, Gulf of Gdańsk, Pomeranian Bay, Dead Vistula, Vistula Lagoon, and Szczecin Lagoon).

As observed by various authors (Garbacik-Wesołowska and Szkudlarek 1994, Grawiński 1994, Rząd 1998, Rolbiecki et al. 2000, Rokicki et al. 2002, Bystydzieńska et al. 2003), the extent of infection differed between areas of study and even between different seasons. The lowest prevalence was recorded in the Dead Vistula (25.3%), Szczecin Lagoon (26.4%), and Pomeranian Bay (30-37.5%). Somewhat higher prevalence values were reported from the Gulf of Gdańsk (41.9%), while a twice as high prevalence was observed in the Puck Bay (74.4%), Vistula Lagoon (75-100%), and – in another season – in the Szczecin Lagoon (65%). On the other hand, invasion intensity seldom exceeded 10 nematodes per infected fish, except for the Szczecin Lagoon where it exceeded 30 nematodes.

Worth mentioning are also studies focusing on droppings of black cormorants that live in a breeding colony at Kąty Rybackie on the Vistula Lagoon (Własow et al. 1997). The cormorant food included an eel with larval *A. crassus*.

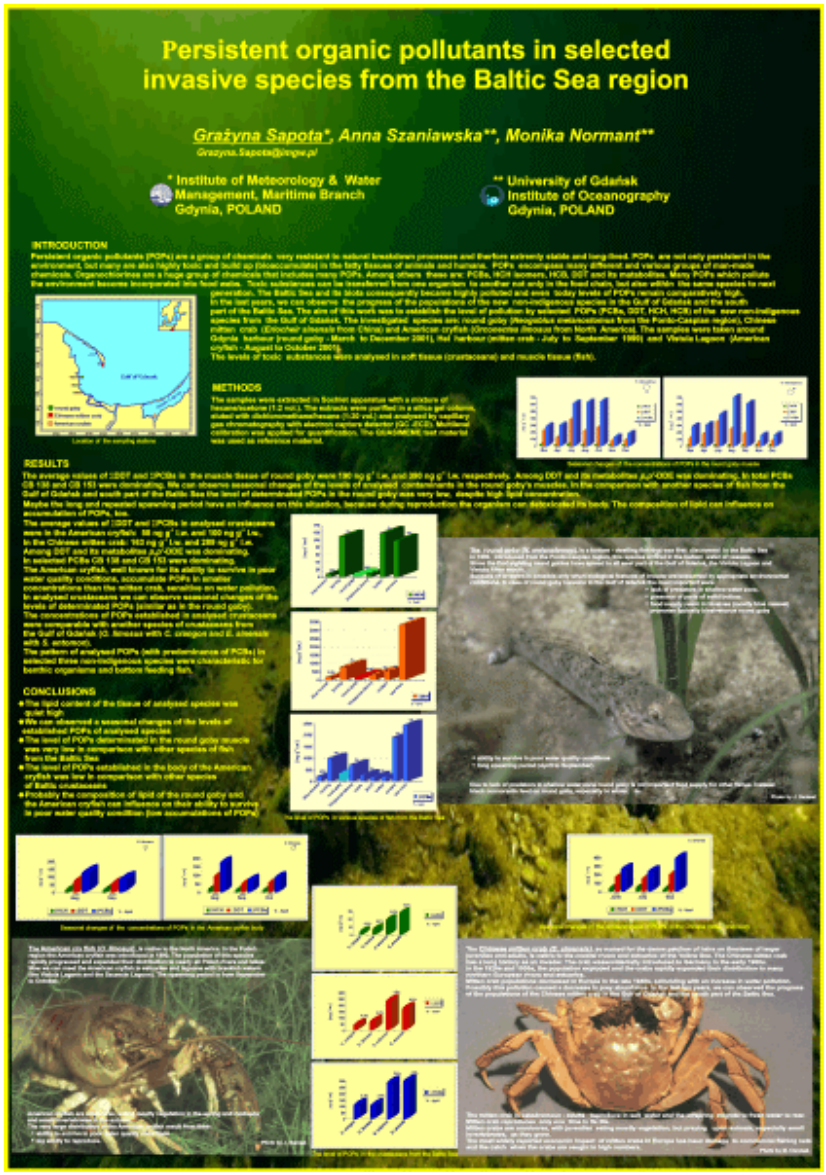
In conclusion, it has to be pointed out that infection of the eel in the southern Baltic and its adjacent waters is high and growing. This is most probably related to the still lacking equilibrium of the host-parasite (*A. anguilla* - *A. crassus*) system, the lack of equilibrium resulting from a relatively recent, on the evolutionary time scale, invasion of the nematode in the European eel.

The mud crab *Rhithropanopeus harrisii tridentatus* (Maitland) from the Polish brackish waters

Agata Rychter[1], Monika Normant[2] and Anna Szaniawska[2]

[1] Institute of Technology, The Higher School of Vacational Education in Elblag, ul. Wojska Polskiego 1, 82-300 Elblag, Poland
[2] Institute of Oceanography, University of Gdańsk, Al. Marszałka J. Piłsudskiego 46, 81-378 Gdynia, Poland

Rhithropanopeus harrisii ssp. *tridentatus* Maitland, 1874 is one of several crustacean species which now inhabit Polish waters as a result of human activity. This crustacean originates from the Atlantic coast of North America and along with *Eriocheir sinensis* and *Carcinus maenas*, is the third crab species to be noted in Polish waters. *R. harrisii tridentatus* has found a suitable ecological niche in the waters of the Vistula Lagoon and the Dead Vistula. For over fifty years, this crab has been a component of the fauna in these areas and has coexisted with indigenous species. The aim of this study was to characterise the mud crab *R. harrisii* ssp. *tridentatus* occurring in the Vistula Lagoon (VL) and Dead Vistula River (DVR). Of the 1105 specimens collected in VL in 1994 and 1995, 66 % were males and 34% were females. Among the 220 specimens sampled in DVR, 57% were males and 43% were females. The carapace width of the crabs from VL varied from 1.9 to 21.9 mm, whereas the width of those from DVR varied from 4.9 to 22.4 mm (avg. 12.85 ± 3.47 mm). Among studied crustaceans sexually mature specimens from average age classes dominated (width class 9.1 to 13.5 mm). *R. harrisii tridentatus* was found to reproduce in the study areas between June and August. The specimen wet weight (WW)/ carapace width (CW) ratios for both males and females of *R. harrisii tridentatus* from VL and DVR are determined by the functions $WW = 0.00022\ CW^{3.1}$ ($r = 0.97$) and $WW = 0.0004\ CW^{2.94}$ ($r = 0.98$), respectively.



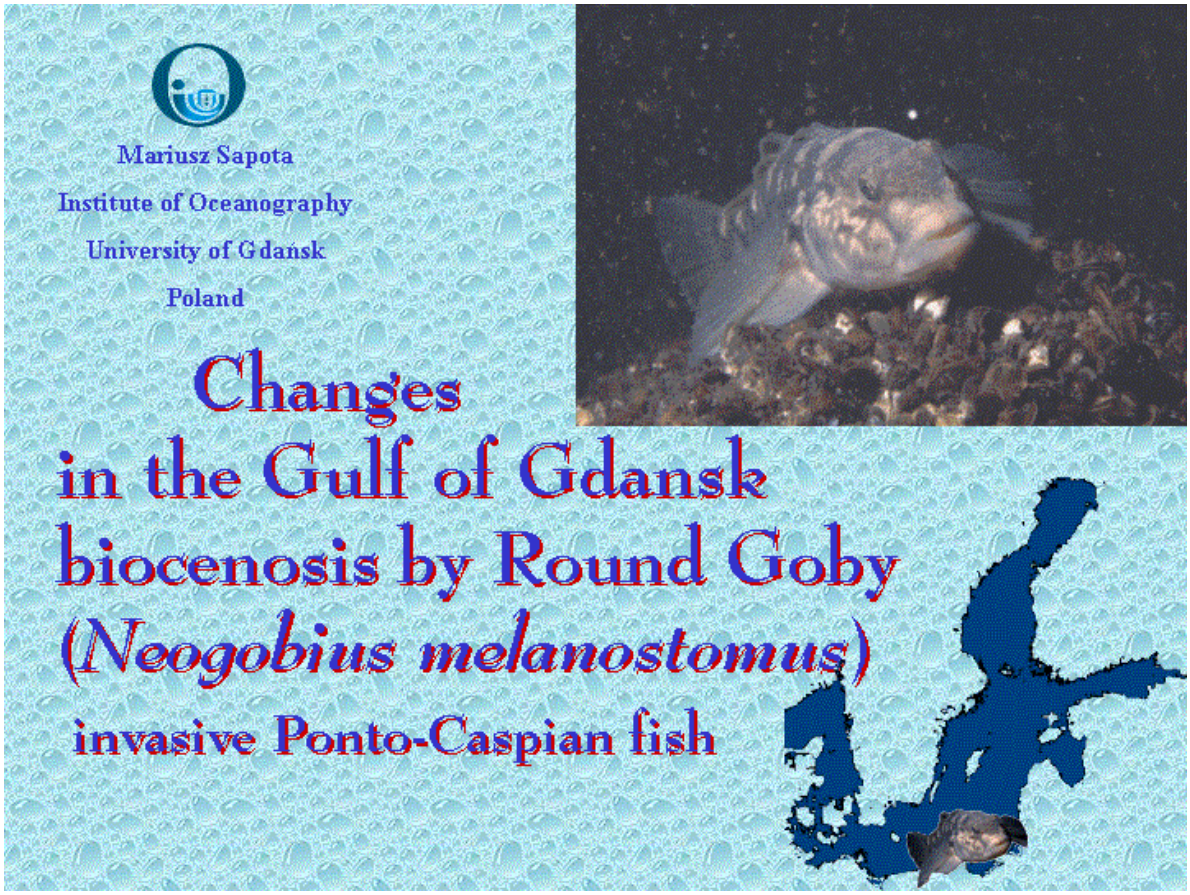
Persistent organic pollutants in selected invasive species from the Baltic Sea region

Grażyna Sapota[1], Anna Szaniawska[2] and Monika Normant[2]

[1]Institute of Meteorology and Water Management, Maritime Branch, ul. Waszyngtona 42, 81-342 Gdynia, POLAND
[2]University of Gdańsk, Institute of Oceanography, Al. M.Piłsudskiego 46, 81-378 Gdynia, POLAND

Persistent organic pollutants (POPs) are a group of chemicals very resistant to natural breakdown processes and therefore extremely stable and long-lived. POPs are not only

persistent in the environment, but many are also highly toxic and build up (bioaccumulate) in the fatty tissues of animals and humans.
POPs encompass many different and various groups of man-made chemicals. Organochlorines are a huge group of chemicals that includes many POPs. Among others these are: PCBs, HCH isomers, HCB, DDT and its metabolites. Many POPs, which pollute the environment, become incorporated into food webs. Toxic substances can be transferred from one organism to another not only in the food chain, but also within the same species to next generation. The Baltic Sea and its biota consequently became highly polluted and even today levels of POPs remain comparatively high.
In the last 10 years, we can observed the progress of the populations of the new non-indigenous organisms in the Gulf of Gdańsk and the south part of the Baltic Sea. The aim of this work was to establish the level of pollution by selected POPs (PCBs, DDT, HCH and HCB) of the new non-indigenous species from the Gulf of Gdańsk. The investigated species are: round goby (*Neogobius melanostomus* – fish originating from the Ponto-Caspian region), Chinese mitten crab (*Eriocheir sinensis* from China) and American crayfish (*Orconectes limosus* native to the North America). The levels of toxic substances were analysed in soft tissue (crustaceans) and muscle tissue (fish).
The concentrations of selected POPs established in muscle tissue of the round goby changed with the seasons and are lower than in another fish species from this region of the Baltic Sea.
The concentrations of analysed POPs in Chinese mitten crab and American crayfish are comparable with the levels of the same substances in another crustaceans from the Gulf of Gdańsk (e.g. *Saduria entomon* and *Crangon crangon*).



Changes in the Gulf of Gdansk biocenosis by round goby (*Neogobius melanostomus*) – invasive Ponto-Caspian fish

Mariusz R. Sapota

University of Gdańsk, Institute of Oceanography, Department of Marine Biology and Ecology, Al. M. Pilsudskiego 46, 81-378 Gdynia, Poland

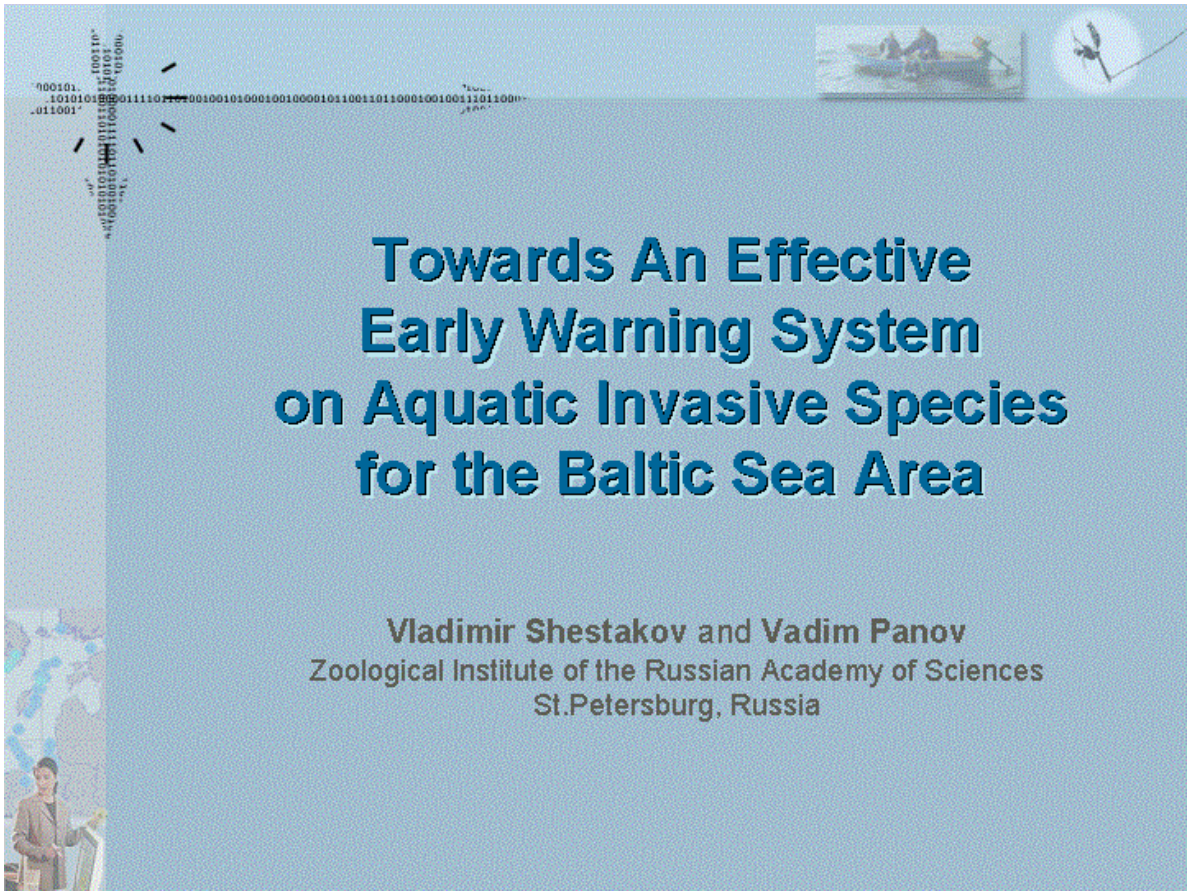
Functioning of each ecosystem tends to stay in its specific dynamic equilibrium. Structure of the trophic net, its complicity and richness are governing factors in ecosystem stability. Changes in species content can influence the structure of the trophic net, flow of energy and circulation of matter. Invasion by the round goby (*Neogobius melanostomus*), the Ponto-Caspian fish, has been observed in the Gulf of Gdańsk in 1990. Gobies were of small importance during the first few years of the invasion, but soon they became the dominant of the shallow water fish community in the west part of the Gulf of Gdańsk. The invasion process in this area involves a number of different species and a stable and complex ecosystem. This unusual situation provokes some important questions. How was such successful invasion possible? What changes in the ecosystem of shallow water of the Gulf of Gdańsk were caused by the invader? We are trying to answer the second question by concentrating on the portion of the ecosystem where the biggest changes are likely to happen and document the scale of the change.

Round goby is a typical shallow water fish. Adult gobies feed primarily on bivalves. Filter feeders, primarily bivalves, are treated as dead end in the trophic net of shallow water zones of seas. This also applies to the Gulf of Gdańsk. There are some fish species feeding sporadically on bivalves but for none of the species do bivalves represent such an important source of food. Additionally general changes in the biocenosis during last thirty years resulted in increased bivalve quantity and areas covered by them. New invasive fish species removed part of this bottom deposit. A fraction of organic matter caught in bivalves is moved back to the trophic net. Colonies of bivalves do not only represent deposits of organic matter but also act as a sink for many toxic substances. Round goby feeding on bivalves returns toxic substances into the food web. It is uncertain what impact the returned toxins might be on the ecosystem.

Up to now the round goby has been documented only in the west part of the Gulf of Gdańsk. It inhabits the shallow water zone of an area of about 400^2 km. The quantity of round goby varies from less than one to 600 individuals on 100^2 m. Each year on average an adult round goby consumes about 1.5 kg of bivalves. Given the density of round gobies, thousands of tons of bivalves are consumed by this species each year. This is likely to be an important change to the Gulf of Gdańsk food web. Tons of blue mussel (dominant bivalve in the Gulf of Gdańsk) consumed represent a large quantity of copper being returned to the trophic net.

Due to degradation of ichthyofauna structure in the Gulf of Gdańsk (lack of predators in shallow water zone) the round goby is not an important food source for other fish. Instead, the round goby is the main food supply for birds – black cormorants feeding in that area. The round goby is also potentially a market fish.

Concluding, the invasion of round goby greatly changed the shallow water biocenosis of the Gulf of Gdańsk.



Towards an effective early warning system on aquatic invasive species for the Baltic Sea area

Vladimir S. Shestakov and Vadim E. Panov

Zoological Institute of the Russian Academy of Sciences, 199034 St.Petersburg, Russia

Development of the open databases and information systems on aquatic invasive species (AIS) is essential for effective international cooperation in data and expertise sharing, and provides support for risk assessments, management and control efforts. Internet-based information systems on AIS may serve also as essential elements of early warning systems, providing timely access to geo-referenced data on invasive species distribution from monitoring efforts. In the Baltic Sea region, open informational resources on AIS are located in several national and regional databases, including Baltic Sea Alien Species Database (Klaipeda, Lithuania) and on-line GIS application "Invasive Species of the Baltic Sea" (St.Petersburg, Russia, http://www.zin.ru/rbic/). Despite formal status of last two databases as parts of the HELCOM project on development of open informational resources on invasive species for the Baltic Sea area (at present supported via Baltic Sea Regional Project), there are several organizational and technical constrains for free flow of information, which can be resolved only in case of

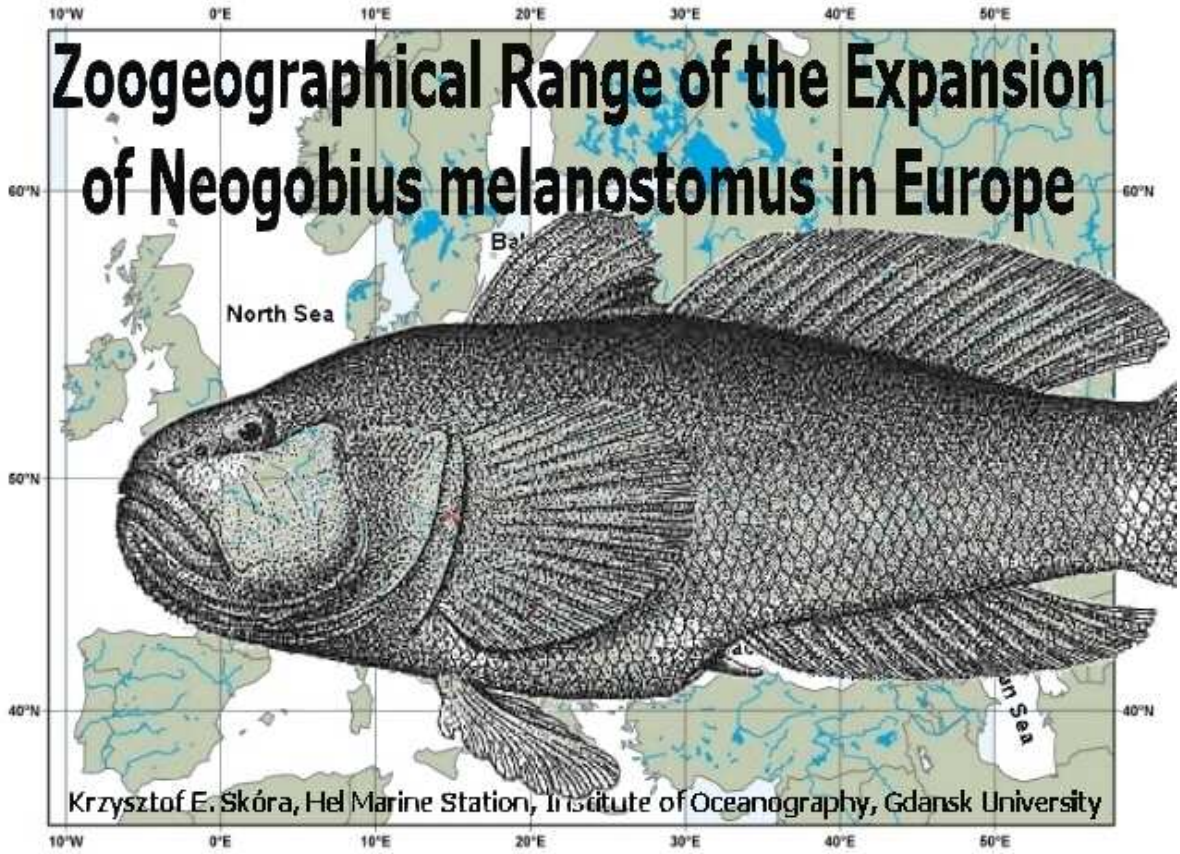
active involvement in the national and regional databasing of all holders of primary biodiversity and/or invasive species monitoring and survey data.

Currently we are developing a system for collecting and analyzing scientific information on AIS of inland and coastal waters of Europe. This system will combine four main blocks: Web portal, relational database server, analytical tools and electronic scientific journal. Combining advantages of these blocks will allow to enhance efficiency of delivering relevant information to scientific community, authorities and other stakeholders, providing actual early warning service. In order to make the developing system effective, establishment of Pan-European electronic scientific journal on biodiversity and invasive species records for publication of primary data is a priority objective. The journal will communicate with the authors by means of distributed applications and databases. Articles are intended to be created with the application in database table format. After obtaining such an article by the server, author's rights are registered following by opening data with corresponding reference on the Web portal of the journal. Experts of the European Research Network on Aquatic Invasive Species (ERNAIS, `http://www.zin.ru/rbic/projects/ernais/`) would participate in reviewing such publications. Ideally, suggested approach may shorten time between obtaining primary data by the scientist and their electronic publication to several days.

Main features of the system include:

- collection of scientific information approved by designated experts;
- author's rights protection;
- storing data on single server of the Web portal (MS SQL Server);
- access to data from the Internet (client-server applications using ASP or .NET technology);
- data analyzing and result performance using analytical tools and GIS applications located on the Web portal (applications of ArcGIS family: ArcView with ArcGIS Spatial Analyst extension, ArcIMS server);
- publishing and using applications simulating and forecasting ecosystem processes;
- technical support of databases and original software installed on the computers of the data providers;
- developing and distribution of applications available for use on computers with different characteristics of the system and software as well as different regime of access to the Internet;
- dissemination of information on records of invasive species among decision makers.

At the first stage, we suggest to use this approach for the Baltic Sea area, the region highly sensitive to AIS introductions, intensively studied by high-level experts in frameworks of national and international programmes, including ongoing Baltic Sea Regional Project.



Zoogeographical Range of the Expansion of *Neogobius melanostomus* in Europe

Krzysztof E. Skóra

Hel Marine Station, Institute of Oceanography, Gdansk University, Morska 9, 84-150 Hel, Poland

The expansion of *N.melanostomus* was first evidenced in the 1980s when the individuals of the species were found in the Moskva River (Sokolov et al.1989). The species was supposed to have been migrating to the Baltic Sea at that time to reach the Gulf of Gdańsk in the ballast waters of ships shuttling between the Black Sea and the Caspian Sea (Skóra, Stolarski 1993). The first Baltic specimen of the species was caught near the harbour of Hel in 1990 (Skóra, Stolarski 1993). In 1994 the fish was reported to be present in almost the whole of the Polish part of the Gulf of Gdańsk, whilst in the next year the first individuals were found outside the Gulf (Grygiel 1995, Kuczyński 1995). At the end of the 1990s, *N.melanostomus* migrated apparently through the estuaries of rivers to the littoral lakes of Łebsko and Gardno in the Słowiński National Park (Ciepielewski and Hornatkiewicz-Żbik, 2003).

Observations of the continually increasing population of *N.melanostomus* (Sapota 2002), also showed that the fish started penetrating the estuary of the Vistula River. At the end of the 1990s, the fish was present in the Motlawa and in the Wisła Śmiała Rivers near

Przegalin (Skóra, Kozik unpublished). In 1999, individuals of the species were found for the first time in the Polish part of the Vistula Lagoon (Borowski 1999), and two years later in the Russian zone of the Lagoon (Tylik 2001). According to latest reports, *N.melanostomus* is expanding up the river and its tributaries. The most distant site (i.e. 130 km) from the estuary of the Vistula River in which *N.melanostomus* was found is situated near Świecie (Kostrzewa, Grabowski 2003). The zoogeographic reach of *N.melanostomus* overlaps that of *Neogobius fluviatilis*, another Ponto-Caspian species that is migrating from the south-eastern regions of Europe and has reached the area between Gniew and Tczew. (kol. 9.07.2003. Skóra K.E., unpublished).

Until recently there were no reports of the occurrence of *N.melanostomus* along the middle and western parts of the Polish coastal zone of the Baltic Sea. The only report from the Pomeranian Bay, dated 1996, was not properly evidenced. A reconnaissance held in 2003 helped to collect complementary data. Underwater research and interviews with anglers provided data from a number of new sites. It was determined that *N.melanostomus* was found in the area of coast revetments near Jarosławiec and in the river-mouth channel in Dziwnów. Reports showed that the fish had been first caught by anglers in the Piastowski Channel in Świnoujście (Skóra, Woźniewska unpublished, Wolnomiejski N. and Stepanowska K. pers.com.).

The evidence of *N.melanostomus* in Łeba, previously predicted according to reports by Ciepielewski and Hornatkiewicz-Żbik (2003), was confirmed with respect to the harbour basin of Łeba and the estuary of a river flowing from the Łebsko Lake to the Baltic Sea. Large populations of the fish were also found inhabiting the area of the underwater constructions of the harbour of Władysławowo.

Reports on single specimens having been fished in the German costal zone in 1999 (H.Winkler unpublished) have been complemented with observations held in 2003 year at Darss Cap on Zingst Island (Skóra 2003). Currently, this is the most distant westerly location where the species has been found in the Baltic Sea.

In the eastern part of the Baltic Sea, *N.melanostomus* was reported to have occurred a year earlier, when single specimens were caught in the end of August 2002 on the Lithuanian coast in Smiltyne district of Klaipeda port city (Bacevičius 2003, Zolubas 2003) and in the Estonian Parnu Bay (Ojaver 2002). For the time being, there is no evidence that *N.melanostomus* has occurred on the northern coasts of the Baltic Sea. However, the species may be expected to quickly invade that part of the sea because Scandinavian habitats, with their characteristic and natural features, provide optimal living conditions for the species.

It is worth noting that *N.melanostomus* also migrates up the rivers of the Black Sea. According to Simonovic et al. (2001), in 1997 and 1998 individuals of the species were found near Prahovo, former Yugoslavia, 861 km off the estuary of the Danube River. Two year later, the round goby was found as far in as the area of Vienna (Wiesner, 2000) and in 2001 in the some river near Wolfsthal and Krems (Wiesner 2003).

It seems that it is only a matter of time before *N.melanostomus* will migrate along the route of *N.fluviatilis* and *N.gymnotrachelus,* leading from the Dnieper River, through the Pripet River, the Krolewski Channel to the basin of the Vistula River (Danilkiewicz 1996, 1998). The anthropogenic mechanism of the upstream migration of this species is best illustrated by the fact that *N.melanostomus* has penetrated up to Zlobin, Belarus (Guljugin 1998). Also the Danube-Men Channel seems open to this species to quickly penetrate up to the North Sea.

We may assume that such a successful expansion of *N.melanostomus* – the species has reached the Great Lakes basin in North America (Jude, et al 1991) – is significantly related to anthropogenic factors: the development of shipping, and the modification of river beds and coastal zones by hydro-engineering constructions. We cannot exclude, though, that environmental changes favourable to the species occur in and near the regions of its natural habitats and as well as in the areas to which the species was brought. These changes may be explained, but only to some extent, by the natural evolution of biotopes and biocenosis. The aforementioned processes are mostly driven by anthropogenic factors that indirectly affect climate and result in the eutrophication of water basins, or the disappearance of the species that are the natural predators of *N.melanostomus.* The biological and ecological features of the species will predispose it to a continuation of its expansion.

NOBANIS Nordic-Baltic Network on Invasive species

I.R.Weidema and W. Solarz

Institute of Nature Conservation, Polish Academy of Sciences, Mickiewicza 33 31-120, Kraków, Poland

The Nordic/Baltic Network on Invasive Alien Species (NOBANIS) will develop a distributed but integrated network of common databases encompassing national and regional specialist databases in the Nordic/Baltic countries. A common portal will facilitate access to the IAS-related data, information and knowledge in the region. NOBANIS will provide a tool for exchanging information on invasive alien species from Greenland to Northern Russia and from Northern Norway to Germany and Poland. NOBANIS will provide administrative tools for making the precautionary approach operational in preventing the unintentional dispersal of invasive alien species and mitigating adverse effects of IAS on biological diversity. NOBANIS will include searchable lists of alien species, a catalogue of experts on alien species, species accounts, species distributions and recommended preventative, eradication and control measures. The lists of introduced species in NOBANIS will be used to identify species that are invasive at present and species that may in the future become invasive. NOBANIS will also provide the foundation for the future development of an early warning system for invasive alien species. It will be possible to extract information from NOBANIS for facts sheets for dissemination to authorities, specialists, the news media and the general public. NOBANIS will establish a network for cooperation between competent authorities of the region and contribute to implementing recommendations from CBD's COP6 and Bern Convention to establish regional cooperation to aid in eradication, control and mitigation of ecological effects of invasive alien species.

Alien species in Poland – an online database (www.iop.krakow.pl/ias)

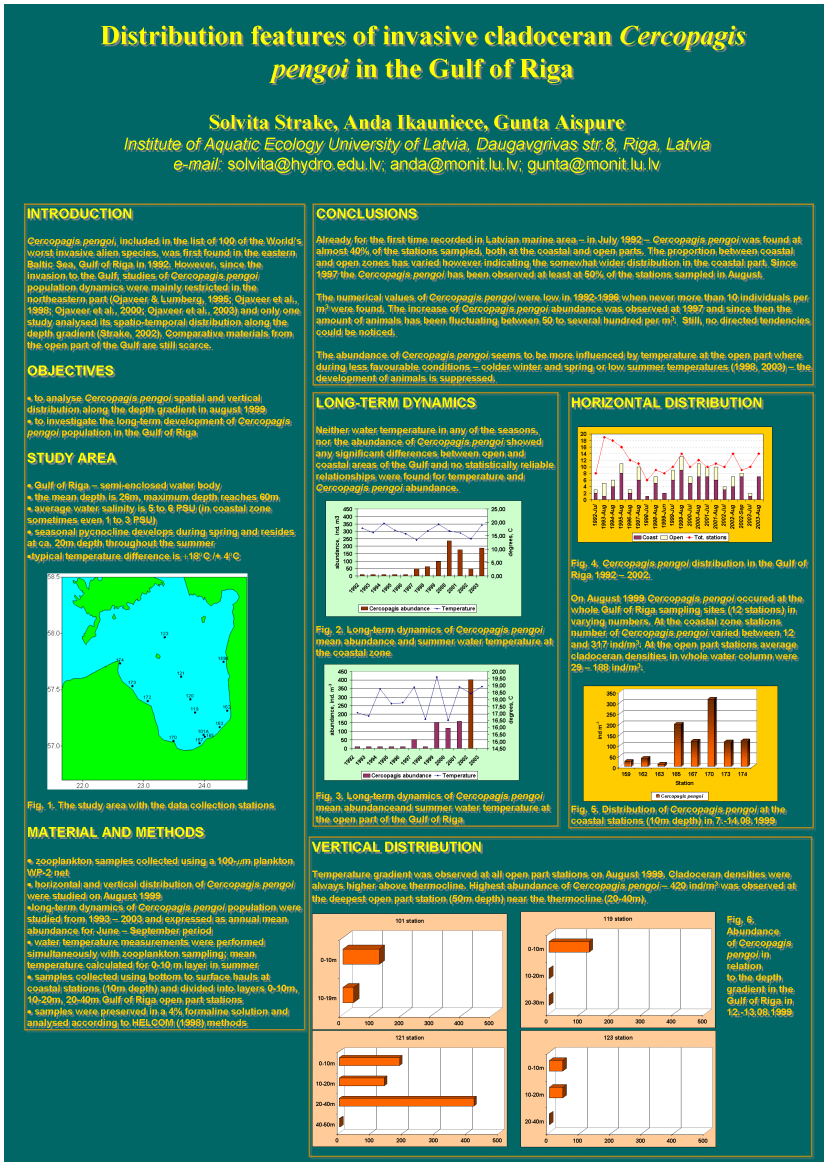
Wojciech Solarz, Wieslaw Król and Grzegorz Cierlik

Institute of Nature Conservation, Polish Academy of Sciences, Mickiewicza 33 31-120, Kraków, Poland

Invasive Alien Species (IAS) are considered to be second-largest threat for global biodiversity nowadays. Collection and dissemination of information on IAS are key elements to solve the problems caused by invasions. In 1999, a database on species introduced in Poland was developed at the Institute of Nature Conservation, Polish Academy of Sciences in Cracow. The database was prepared for the Ministry of Environment. In 2003, thanks to a grant from the US Department of State, part of the data was made accessible via the Internet at www.iop.krakow.pl/ias.

Currently there are 522 alien species in the database. For each species, information on biology, natural distribution and distribution in Poland is compiled, as well as data on the population numbers and trend, invaded habitats and impact upon native species. Details on the introduction are also gathered, including time, place, number of introduced individuals and pathway of introduction. For each species, need and methods of control are determined.

In future, new alien species will be added to the database and data on the species already included will be updated. The database will be linked to the Nordic-Baltic Network on Invasive Species (NOBANIS) and Global Invasive Species Information Network (GISIN).



Distribution features of invasive cladoceran *Cercopagis pengoi* in the Gulf of Riga

S. Strake, A. Ikauniece and G. Aispure

Institute of Aquatic Ecology, University of Latvia

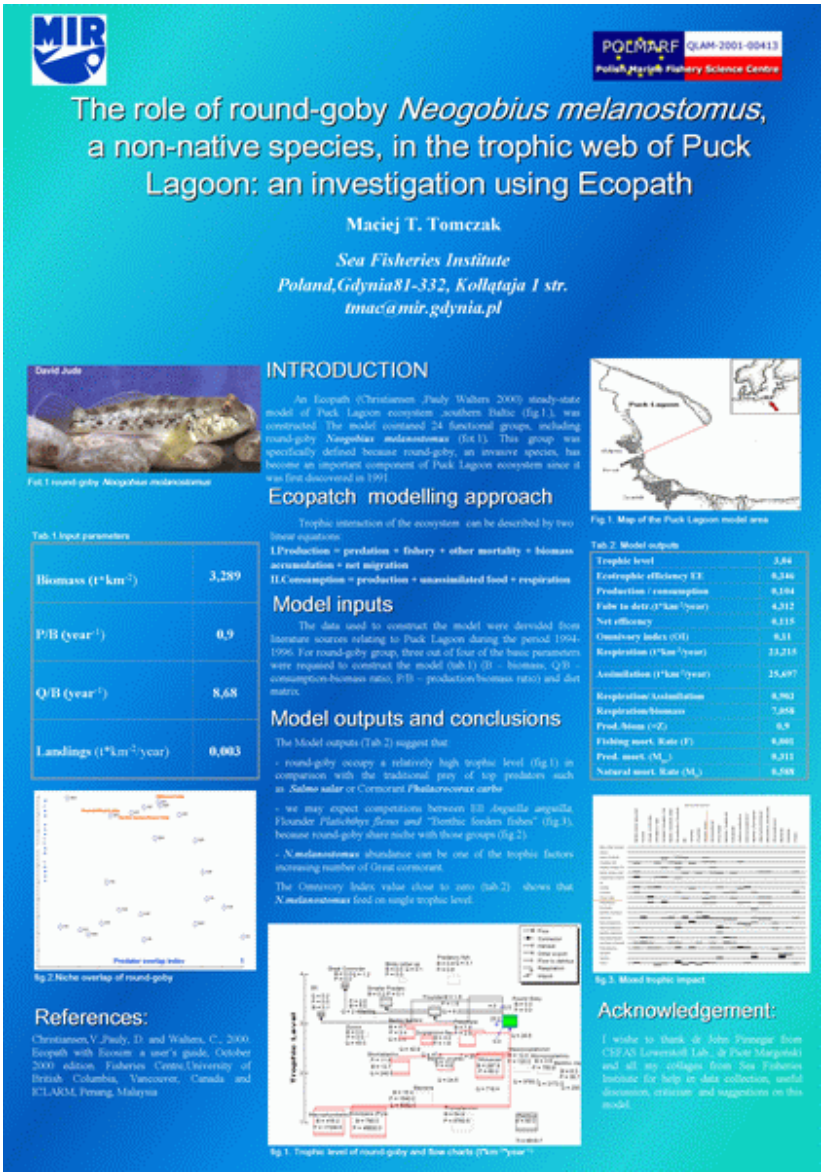
Cercopagis pengoi (Ostroumov, 1891), a spiny water flea that introduced into Gulf of Riga – brackish water ecosystem of the Baltic Sea from Ponto-Caspian region in the early nineties, has spread rapidly and now might be an dominant element of the cladoceran population in some years. Regardless of many comprehensive studies performed on this cladoceran species, data on *Cercopagis pengoi* spatial and vertical distribution in the open part of the Gulf of Riga

are still scarce. Therefore, the biology of the species was studied in the Gulf of Riga open part from 1995 to 2003, attention being concentrated on population dynamics and vertical distribution. In addition, *Cercopagis pengoi* spatial
distribution as well as influence on the other mesozooplankton species was studied in 1999.

On the base of seasonal survey in 1999 *Cercopagis pengoi* were not registered in the plankton samples till end of June, when the surface water temperature reached 15°C. From the beginning of July to the end of September distribution of the species embraces both – open and shallow parts of the Gulf, but density of *Cercopagis pengoi* was very different from site to site. In the open part of the Gulf *Cercopagis pengoi* population reached its higher abundance in the mid-August (150 ind. m^{-3} in average), but in the shallow part mass occurence of cladocerans was found in July.

The time-series analysis revealed gradual increase of *Cercopagis pengoi* abundance in the open part however it seemed to be more temperature dependent. Water stratification according to temperature also influenced the vertical distribution of *Cercopagis pengoi* – high numbers of individuals were often found near and in the thermocline.

The results of the study shows that mesozooplankton community was more affected in the coastal than open part of the Gulf of Riga.



The role of round-goby *Neogobius melanostomus*, a non-native species, in the trophic web of a southern Baltic lagoon: an investigation using Ecopath

Maciej Tomasz Tomczak

Sea Fisheries Institute Kołłątaja 1 81-332 Gdynia

An Ecopath (Chrstianen, Pauly, Walters 2000) steady-state model of the Puck Lagoon ecosystem (northern Poland), was constructed. The model contained 24 functional groups, including round-goby *Neogobius melanostomus*. This group was specifically defined because round-goby, an invasive species, has become an increasingly very important component of the Puck Lagoon ecosystem since it was first discovered in 1991, having been transferred via the European river network from the Caspian Sea.

The data used to construct the model were derived from literature sources relating to Puck Lagoon during the period 1994-1996. For round-goby biomass (B) was estimated at 3,289 t/km^2; the production to biomass ratio (P/B) was estimated at 0,9 t/km^2/year; and the consumption to biomass ratio (Q/B) at 8,68 t/km^2/year. To describe the role of *N. melanostomus* in the trophic web of the lagoon, trophic level, omnivory, mixed-trophic-impact and niche overlap (predators and prey) were calculated.

Preliminary results show that round goby occupy a relatively high trophic level in comparison with the traditional prey of top predators such as *Salmo salar; Gadus morhua* or the Cormorant *Phalacrocorax carbo*. Total mortality (Z) was estimated as the sum of fishing mortality (*F*) predation mortality (*Pr*) and 'other' natural mortality (M_0). The level of fishing mortality inflicted on *N.melanostomus* was extremely low ($F = 0.001$), which is in contrast to high natural mortality ($M_0 = 0{,}587$) and predation ($Pr = 0.313$). The implication of this is that, in order to redress some balance, the ecosystem (and local fisheries) might benefit from commercial exploitation of round-goby stocks.

Such findings, and the model which has been developed, provide some basis for further scenario-testing and fishery 'experiments', also for exploring 'optimal' exploitation strategies in the lagoon.

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The distribution of *Marenzelleria viridis* (POLYCHAETA-SPIONIDAE), in the Polish waters of the Baltic Sea in 1993- 2003

Jan Warzocha, Sławomira Gromisz, Adam Woźniczka and Marta Koper

Sea Fisheries Institute Kołłątaja 1 81-332 Gdynia

Marenzelleria viridis a North American spionid *Polychaete* immigrated to the Baltic Sea in early eighties, and into Polish waters in 1985/1986 (Gruszka 1991). The geographic, depth and sediment type-related and vertical distribution is presented, based on the samples collected with 25 kg Van Veen grab and 200 kg box corer in 1993 to 2003.

M. viridis was found within the entire study area. The highest frequency and abundances reaching 2000-3000 individuals per square meter, were encountered in the Gulf of Gdańsk and Pommeranian Bay. Lower abundances were found in the middle part of the Polish coast. The highest biomass (160 g wet weight*m^2) were found in the vicinity of River Vistula mouth. The dynamic of the population of *M. viridis* within the study period is also presented.

Literature

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INPACT OF *CERCOPAGIS PENGOI* ON LITHUANIAN COASTAL FISHERY

T. Zolubas, J. Maksimov and Š. Toliušis

Fishery Research Laboratory, Lithuania

Coastal fishery of Lithuania (down to 20 m depth) began to develop in 1992 y. Total catches fluctuate around 450 t. There is 115 small coastal companies and 3 – 6 fisherman's are working in each of it. At all 1500 people are involved in this activity.

First specimens of *C. pengoi* were found near Klaipeda in July of 1999. After *C. pengoi* abundance peak critical, nets fills with mass of crustaceans and nets can't to catch fish anymore. Nets' cleaning becomes possible only after 3-4 days of drying. This phenomenon fisherman called "nets plague" or simply "crustaceans". "Nets plague" for coastal fishermen means less fish and more additional work. Big unemployment levels, decreasing of fish resources force fishermen's high – stung react to this phenomenon.

By 4 monitoring stations data the peak of C. p. density and "nets plague" is in July. For analyses of C. p. impact on coastal fishery we used statistical data of fishery: sum of fishing days, fishing effort, total catches and catches by main species. Because size of resources can fluctuate and it can to have influence on results, we used not absolute but relational values

(%). Two July periods was analysed and compared: before *C. pengoi* (1997 – 1998) invasion and after it (2000 – 2002). After *C. pengoi* invasion number of fishing days decreased from 6,3 to 4 %, fishing effort from 4,8 to 1,8 %, total catch from 3,3 to 1,3 % in July. Catches of main fishing species at this period decreased: for flounder from 11,2 to 5,6 %, vimba from 21,9 to 6,5 % and pikeperch from 15,0 to 7,7. %. For other freshwater species (roach, perch, bream) catches decreased marginally – from 12,1 to 11,7 %.
Part of coastal fishery activity in period of "nets plague" was shifted to other months. Summer all time was bad season for Lithuanian coastal fishermen, but after *C. pengoi* invasion it became like famine and more fishermen's at this period seeks seasonal employment in other economic branches. Fisherman's hopes that scientists have develop methods against unwished phenomenon.

Immigration Components of Diatoms in the Baltic Sea

Aleksandra Zgrundo, Monika Dziengo, Anna Winiarowska, and Bożena Bogaczewicz-Adamczak

University of Gdańsk, Institute of Oceanography, Department of Marine Ecosystems Functioning, Laboratory of Marine Environments Bioindication, Al. Pilsudskiego 46, 81-378 Gdynia, Poland

Diatoms are unicellular, eucaryotic, photosynthetic organisms distributed in all waters except the hottest and most hypersaline. They are abundant in the phytoplankton and phytobenthos of marine and fresh waters, whatever the latitude (Round *et al*. 1990).

Small shells dimensions, morphological diversity, species richness and poor literature information for some world regions cause diatoms have been often overlooked or misidentified and contribute problems with attributing of newcomers dignity.

Last observations of marine diatom flora indicate a predominance of cosmopolitan species, which are distributed in a wide amplitude from the Arctic to Antarctic, but not restricted to the Polar regions (Witkowski *et al*. 2000). For example more than 40% of the freshwater diatoms of the New Caledonia, a tropical island in the South Pacific, represent endemic taxa. Detailed studies showed that not a single one of the marine taxa could be assigned as endemic. On the other hand, five diatom species were inserted in the Baltic Sea Alien Species Database (www.ku.lt/nemo/mainnemo.htm). In publications on diatom species in the Baltic Sea prepared by the Baltic Marine Biologists, Working Group 27, eleven taxa were considered as non-indigenous of mainly arctic origin (Snoeijs 1993, Snoeijs & Vilbaste 1994, Snoeijs & Potapova 1995, Snoeijs & Kasperovičiene 1996, Snoeijs & Balashova 1998). Our data from the Gulf of Gdańsk suggest presence of over fourty diatom species that could be classified as non-native.

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Spiny – cheek crayfish Orconectes limosus (Raf.) from Vistula Lagoon

Monika Michałowska, Katarzyna Staszak and Anna Szaniawska

Institute of Oceanography, University of Gdańsk, Al. Marszałka Piłsudskiego 46, 81-378 Gdynia, POLAND

American crayfish *Orconectes limosus* (Raf.) was the first crustacean species introduced to the Polish waters. Approximately 100 specimens originated from North America were imported in Europe to repopulate two native crayfish populations of *Astacus astacus* and *Astacus leptodactylus*, which were weakened by the fungal disease caused by *Aphanomyces astaci*. Over the last decade this species propagated rapidly to almost all Polish inland water reservoirs, both oligotrophic and eutrophic, except those occurring in the south-eastern part of Poland. It has been noticed in Szczecin Lagoon (4 PSU) Pomeranian Bay (7 PSU), Gulf of Gdańsk (7.5 PSU) and Vistula Lagoon (2 PSU). In May 2002 and July 2004 few small specimens were found near Jastrzębia Góra (8-9 PSU) and Władysławowo (8 PSU).

The aim of this work was to investigate adaptation ability of *O. limosus* to Baltic brackish waters. To realize this aim morphometric measurements were taken, weight, the energy value of the whole individual and in its abdominal part were determined, feeding rates in 12°C and 18°C were investigated, and haemolymph osmolality in different salinities in 10, 16, 22°C were measured.

Of the 109 specimens collected in Vistula Lagoon, 33% were females and 67% males. The body length varied from 7.7 cm to 11.8 cm (av. 9.51 ± SD 0.86 cm). Frequency was greatest in the 9.01-9.50 cm length class 23%. The wet weight of the specimens varied from 13.0 g to 47.4 g (25.23 ± 8.12 g). Females of this species are characterized by lower wet weight than males of the same length. The abdominal soft tissue consist 13.7 % of the total wet weight of O. limosus on average (n = 20). Comparing to individuals from Polish lakes (4.6-10.0 cm) specimens from brackish waters did not differ significantly in size.

The energy value of O. limosus is relatively low, in relation to other Decapoda, and equals to 14.09 ± 1.66 Jmg – 1 DW (18.03 ± 2.50 Jmg – 1 AFDW). The energy value of the abdomen muscle is significantly higher and equals to 17.48 ± 1.6 Jmg – 1 DW (20.38 ± 2.48 Jmg – 1 AFDW).

There were no differences observed in quality of consumed food in fresh-water in both temperatures. In both temperatures T = 18°C and T = 12°C the most preferable food was fodder (consumption C1 = 388.44 J·indiv-1·h-1; C2=308.72 J·indiv-1·h-1 respectively). Second preferable food item was abdominal muscle (C1 = 217.80 J·indiv-1·h-1, C2=228.70 J·indiv.-1·h-1), then green algae (C1 = 50.88 J·indiv-1·h-1;C2=43.77 J·indiv-1·h-1) and cod (C1 = 19.59 J·indiv-1·h-1; C2 = 15.02 J·indiv-1·h-1). Larger consumption of each food type was notice in higher temperature (T = 18°C).

Isoosmotic point was similar in all experimental temperatures: in 10 ± 1°C and 16 ± 1°C was equal app. 440 mOsm (~13,6 PSU), and in 22 ± 1°C was equal app. 445 mOsm (~13,8 PSU). Differences in isoosmotic point in these three temperatures were not statistically significant.

On the basis of examined parameters, it is reasonable to regard this species as a stable component of the Baltic fauna.