

Invasion of the Ponto–Caspian Predatory Cladoceran *Cornigerius maeoticus maeoticus* (Pengo, 1879) into the Baltic Sea

N. V. Rodionova, P. I. Krylov, and V. E. Panov

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

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Abstract—The Ponto–Caspian predatory cladoceran *Cornigerius maeoticus maeoticus* (Pengo, 1879) (Polyphemidae family) was first encountered in the Baltic Sea at two stations in the eastern part of the Gulf of Finland in August and September 2003. Most likely, this alien species was brought to the Baltic Sea from the Ponto–Caspian basin via the Volga–Baltic waterway with the ballast waters of ships. In the future, one can expect a rapid increase in the abundance of the newly formed population and its expansion over the Baltic Sea.

INTRODUCTION

Over the past two centuries, about 100 alien species were found in the Baltic Sea; the appearance of the greater part of them is related to navigation (with the ballast waters of ships and with ship fouling communities) or results from intentional introductions [13]. The Ponto–Caspian basin is one of the principal donor regions of alien species for the Baltic Sea; at present, it is connected with the Baltic basin by a complicated hydrographic network, in which the Volga–Baltic waterway represents an invasion corridor [15]. The Gulf of Finland is the terminal link of this corridor and is regarded as the part of the Baltic Sea most vulnerable with respect to the invasion of alien species. Over the past two decades, three Ponto–Caspian species of invertebrates penetrated into the Gulf of Finland; at present, they have become mass species in the near-shore waters of the gulf. They are the mollusk *Dreissena polymorpha* (Pallas), the amphipod *Pontogammarus robustoides* (G.O. Sars), and predatory planktonic cladoceran *Cercopagis pengoi* (Ostroumov) [16]. The latter species was probably brought to the gulf with ship ballast waters via the Volga–Baltic waterway [12]. A preliminary estimate of the risk of introduction of Ponto–Caspian species into the Gulf of Finland via the invasion corridor cited showed that *Cornigerius maeoticus* (Pengo, 1879) is one of the most probable future Ponto–Caspian invaders to the gulf [15].

This species was first described by N. Pengo in 1879 as *Corniger maeoticus* (Cladocera, Polyphemidae) in the Sea of Azov. F.D. Mordukhai-Boltovskoi compiled a general review on the *Cornigerius* genus [14]. Original studies and analysis of published data allowed this scientist to distinguish four species in the *Cornigerius* genus and four subspecies in the typical species *Cornigerius maeoticus*. Subsequently, Mordukhai-Boltovskoi and Rivier [8] revised polyphemids from the Sea of Azov and the Black, Caspian, and Aral seas and showed the existence of two subspecies in the typical

species *Cornigerius maeoticus*: *C. m. maeoticus* (Pengo) and *C. m. hircus* (Sars) differing in their shell structure.

The long-term studies of the dynamics of the biological diversity in the zooplankton communities of the eastern part of the Gulf of Finland organized by the Zoological Institute of the Russian Academy of Sciences allowed us, for the first time, to obtain data confirming the hypothesis on the possible invasion of *Cornigerius maeoticus* into the eastern part of the Baltic Sea.

MATERIALS AND METHODS

Zooplankton samples were collected every 10–14 days in June–October over eight years (1996–2003). Sampling was performed at two stations: at a deep-water (25 m) station in the region of the Primorsk oil-loading terminal (60°20' N, 28°44' E) and a shallow-water (14 m) station off St. Petersburg (60°06' N, 29°42' E). The samples were collected with the use of a quantitative Juday net 0.21 m in diameter with a mesh size of 100 µm in three replicates from two layers (20–10 and 10–0 m) at the deep-water station and from a single layer (10–0 m) at the shallow-water station. The samples collected were fixed with a 4% formalin solution and subsequently processed under laboratory conditions using techniques that included determination of the species composition of the zooplankton and the abundance of the organisms, as well as the size and sex structures of the populations of alien species.

RESULTS AND DISCUSSION

C. m. maeoticus was first encountered in the eastern part of the Gulf of Finland on August 24, 2003 (it was the first finding in the Baltic Sea) at the deep-water station in a sample from the surface layer, where two juvenile individuals 0.6 mm in size were recognized. A month later (on September 30), two mature females without eggs in their brood chambers (Figs. 1, 2) were

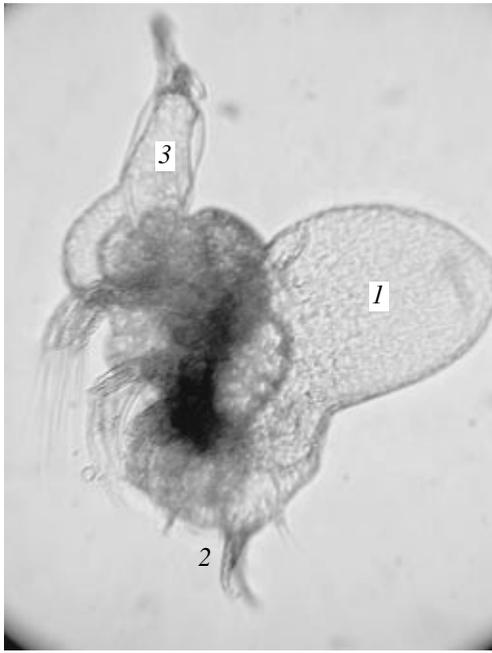


Fig. 1. Parthenogenetic female of *C. m. maeoticus* from the Gulf of Finland of the Baltic Sea. Side view: (1) brood chamber; (2) caudal claws; (3) excrescence with cornua.

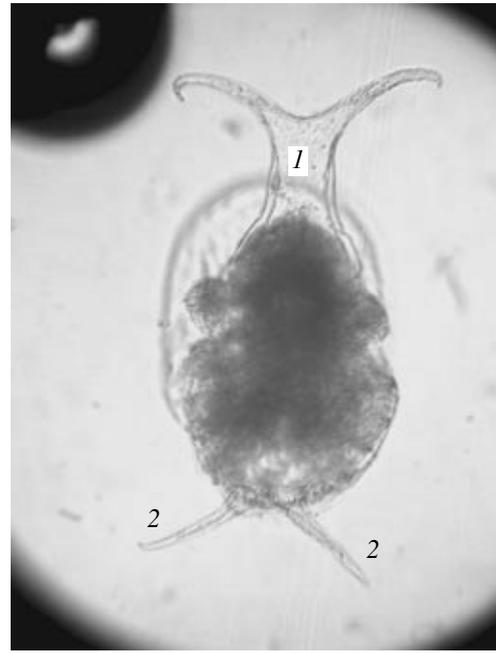


Fig. 2. Parthenogenetic female of *C. m. maeoticus* from the Gulf of Finland of the Baltic Sea. Front view: (1) excrescence with cornua; (2) caudal claws.

found in samples from the shallow-water station (with sizes of 0.75 and 0.85 mm). Despite the small abundance (1.3–1.7 ind./m³), the simultaneous findings of *C. m. maeoticus* individuals in two different regions of the Gulf of Finland may point to the establishment of a new population of this species in the eastern part of the Baltic Sea.

The expansion of *C. maeoticus* outside the limits of its initial range (the Sea of Azov and Caspian Sea) started after the creation of reservoirs on the Don, Dnieper, and Volga rivers, when certain operations aimed at the acclimatization of benthic invertebrates for the “enhancement” of the food base of the fish were implemented. *C. maeoticus* consequently appeared in the Kakhovka (1959), Tsimlyansk (1961), Zaporozhsk (1965), and Kremenchug (1969) reservoirs [4, 6, 7, 9]. In the 1980s, this species was widespread in the summer plankton of all the reservoirs of the Dnieper River (the Kiev, Kanev, Kremenchug, Dneprodzerzhinsk, Zaporozhsk, and Kakhovka), where its abundance in the plankton samples comprised 17–54% [3]. *C. maeoticus* also invaded the Volga River: in 1970, it was encountered in the middle part of the Volgograd Reservoir [1].

It should be noted that, at the time of the first findings of *C. maeoticus* in the reservoirs of the Volga and Dnieper rivers, its abundance, as a rule, was relatively small and could be compared with its abundance in the Caspian Sea—from single individuals to 300 ind./m³ [6, 9, 10]. However, in the subsequent years, the density of the populations of *C. maeoticus* in the plankton

sharply increased. For example, in the Zaporozhsk Reservoir in 1972, it was 4000 ind./m³; in the Tsimlyansk Reservoir in 1968, it averaged 6200 ind./m³; and in the Kremenchug Reservoir in 1971, it reached 10 000 ind./m³ [2, 3, 7]. One can suppose that, in the near future, we will observe a significant growth of the abundance of this species in the Gulf of Finland, as in the case of the preceding Ponto–Caspian invader—predatory cladoceran *Cercopagis pengoi*. In the Baltic Sea, this species was first noted in 1992 in the Gulf of Riga and in the Gulf of Finland. During the member 5–6 years, this species became a permanent constituent of the zooplanktonic communities of these gulfs as well as of the central and southern parts of the Baltic Sea [5].

As in the case of *Cercopagis pengoi*, one can suppose the further successful expansion of *C. m. maeoticus* over the Baltic Sea area. Taking into account the existence of an invasion corridor from the eastern Baltic Sea to the Great Lakes of North America, which is proved by genetic studies, one can also foresee the possible penetration of this Ponto–Caspian species to the North American continent with the ballast waters of ships.

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