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NOTE

First Record of *Corophium mucronatum* Sars (Crustacea: Amphipoda) in the Great Lakes

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ABSTRACT. Corophium mucronatum *Sars, a small amphipod native to the Caspian and Black Sea basins, was discovered in September 1997 in Lake St. Clair. A single individual was collected using a bottom sled dredge in littoral waters adjacent to Seaway Island, Ontario. The specimen was found on silty-sand substrate in an area populated by submerged macrophytes. Because no other* Corophium *individuals were found despite repeated sampling over two years at a total of 60 sites in the corridor between the St. Clair River and western Lake Erie, it is highly unlikely that this species has established in the Great Lakes.*

KEY WORDS: *Amphipod,* Corophium*, Lake St. Clair, nonindigenous species.*

INTRODUCTION

The Laurentian Great Lakes have been invaded by many by nonindigenous species (Mills *et al.* 1993). Most of the recent invasions reported in the lakes have been by taxa native to the Ponto-Caspian region (i.e., Black, Azov, and Caspian seas basins) (Mills *et al.* 1993). For example, the Ponto-Caspian amphipod *Echinogammarus ischnus* and waterflea *Cercopagis pengoi* were discovered at a single locality in the Detroit River in 1995, and throughout Lake Ontario during 1998, respectively (Witt *et al.* 1997, MacIsaac *et al.* 1999). Witt *et al.* (1997) were unsuccessful in their attempt to find *Corophium curvispinum*, another Ponto-Caspian amphipod with an invasion history in Europe (van den Brink *et al.* 1993), in samples collected in the Lake Huron-Lake Erie corridor.

The genus *Corophium* consists of at least 50 species, most of which are native to marine and brackish water environments (Dediu 1980). Only six *Corophium* species, namely *C. curvispinum* [synonym = *C. sowinskyi*], *C. robustum*, *C. maeoticum*, *C. chelicorne*, *C. nobile*, and *C. mucronatum,* are confined exclusively to fresh and brackish water habitats (Mordukhai-Boltovskoi 1960, 1964). These *Corophium* species have diverged ecologically from marine congeners since their isolation in early Miocene times (Mordukhai-Boltovskoi 1960, 1964). These species are considered native to the Caspian Sea, to freshened estuarine regions of the Black and Azov seas, and to the lower courses of rivers draining into these seas (Mordukhai-Boltovskoi 1960). The original distribution of these species was apparently determined primarily by the salinity and ionic composition of the water (Mordukhai-Boltovskoi 1960). In the Caspian Sea, the ratio of total ion to chloride ion is ~2.4 and *Corophium* occur in habitats ranging in salinity from 0.3 to 13‰ (Mordukhai-Boltovskoi 1960). In the Black and Azov Seas, where this ratio is 1.8, Ponto-Caspian *Corophium* spp. do not occur at salinity values > 5‰. (Mordukhai-Boltovskoi 1960, Dediu 1967).

Corophium spp. have been widely introduced in Eurasian fresh waters owing to human activities including canal and reservoir construction, changes to hydrological regimes of rivers, transfers by com-

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mercial ships, and intentional transplantations (Mordukhai-Boltovskoi 1978). *C. curvispinum* is the most widespread species. It has spread to upper reaches of many Ponto-Caspian rivers and has penetrated or been introduced to Lake Balkhash, to the Baltic and Northern Sea basins, and to the Rivers Ob, Ural and Danube (Mordukhai-Boltovskoi 1964, Dediu 1980). Other Ponto-Caspian corophiid amphipods (e.g. *C. robustum*, *C. chelicorne*, *C. nobile*, *C. maeoticum*) have extended their ranges in the lower and middle courses of Ponto-Caspian rivers, and to adjacent canals and reservoirs. Some of these range extensions apparently resulted from natural dispersal, although intentional transplantations were also important (Zhuravel 1965, Pligin and Emelianova 1989). *C. robustum* also has been discovered beyond the Ponto-Caspian basin in a lake in the Marmara Sea basin (Mordukhai-Boltovskoi *et al*. 1969).

To date, no *Corophium* species have been reported in North America. In this study, a single specimen of the amphipod *Corophium mucronatum* discovered in Lake St. Clair during autumn 1997 is reported.

METHODS

Between 8 August and 8 October 1997 samples were collected from 37 stations on the Detroit and St. Clair rivers, on Lake St. Clair, and on the western basin of Lake Erie. An additional 23 sites in the same area were sampled between 27 May and 17 September 1998. Exact locations of the sites are available from the authors. These sites represented a combination of riverine and lacustrine habitats. Bottom substrates at the sites ranged from sand and silt to gravel and bedrock. Sites < 1.5 m depth were sampled using a bottom sled dredge (100 m tow) or by sweeping a dip net through submerged vegetation, and across rocks and bottom substrates. At deeper sites (2 to 18 m), samples were collected using a combination of ponar grab and/or bottom sled dredge. Samples were washed and retained on 250-µm mesh, and preserved in 7% formalin. *C. mucronatum* was identified using Sars (1895), Mordukhai-Boltovskoi *et al*. (1969), and Grigorovich (1989).

RESULTS AND DISCUSSION

Corophium mucronatum (Sars 1895) was discovered in a sample collected on 9 September 1997, in the Lake St. Clair delta, in flowing waters adjacent to Seaway Island, Ontario (42°31.1′N, 82°40.8′W). A single subadult individual was collected using a bottom sled dredge in waters between 0.2 and 0.7m depth. The animal was apparently alive and healthy at the time of collection as its integument was normal in appearance. The specimen was found on silted sandy habitat overgrown by pondweed (*Potamogeton* sp.) and Eurasian water milfoil (*Myriophyllum spicatum*). Its body length (rostrum to telson) and width were 1.88 mm and 0.45 mm, respectively. No other specimens of *C. mucronatum* were found despite extensive sampling of habitats between Stag Island, Ontario, in the St. Clair River, and North Bass Island, Ohio in western Lake Erie. In total, species identity of approximately 4,000 amphipods was examined. Water temperature at the collection site was 20°C.

Corophium mucronatum is one of the smallest species in the genus, with an adult body length that rarely reaches 5 to 6 mm (Sars 1895, Birshtein and Romanova 1968, Mordukhai-Boltovskoi *et al*. 1969). *C. mucronatum* belongs to the family Corophiidae, which exhibit marked morphological differences from amphipod families in the Laurentian Great Lakes. For example, Corophiidae amphipods can be easily distinguished from members of the Gammaridae (e.g., *Gammarus*, *Echinogammarus*), Talitridae (e.g., *Hyalella*) and Haustoriidae (e.g., *Diporeia*) by their possession of a dorso-ventrally compressed body, and enlarged antennae II that are modified for grasping (Grigorovich 1989; Fig. 1). The families Gammaridae, Talitridae, and Haustoriidae are characterized by a laterally compressed body and antennae I and II that are of almost equal widths (Pennak 1989). *Corophium* also differs from these families in that it possesses a mandible palp with two segments, while the other families have either a three segmented palp (Gammaridae, Haustoriidae) or lack a palp (Talitridae). *Corophium* can be further discriminated from Gammaridae and Haustoriidae by the absence of an accessory flagellum on antennae I, and by its possession of an entire telson. *Corophium* can be discriminated from Talitridae in that its coxal plates are small, while in the latter group they are large.

Features of *C. mucronatum* include a urosome with separate segments, a well-developed and sharply pointed rostrum, and the presence on segment 4 of antenna II of a large curved process that extends beyond the side tooth on segment 5 and which extends at least half the length of segment 5 (Sars 1895; Fig. 1). A single tooth less than half as

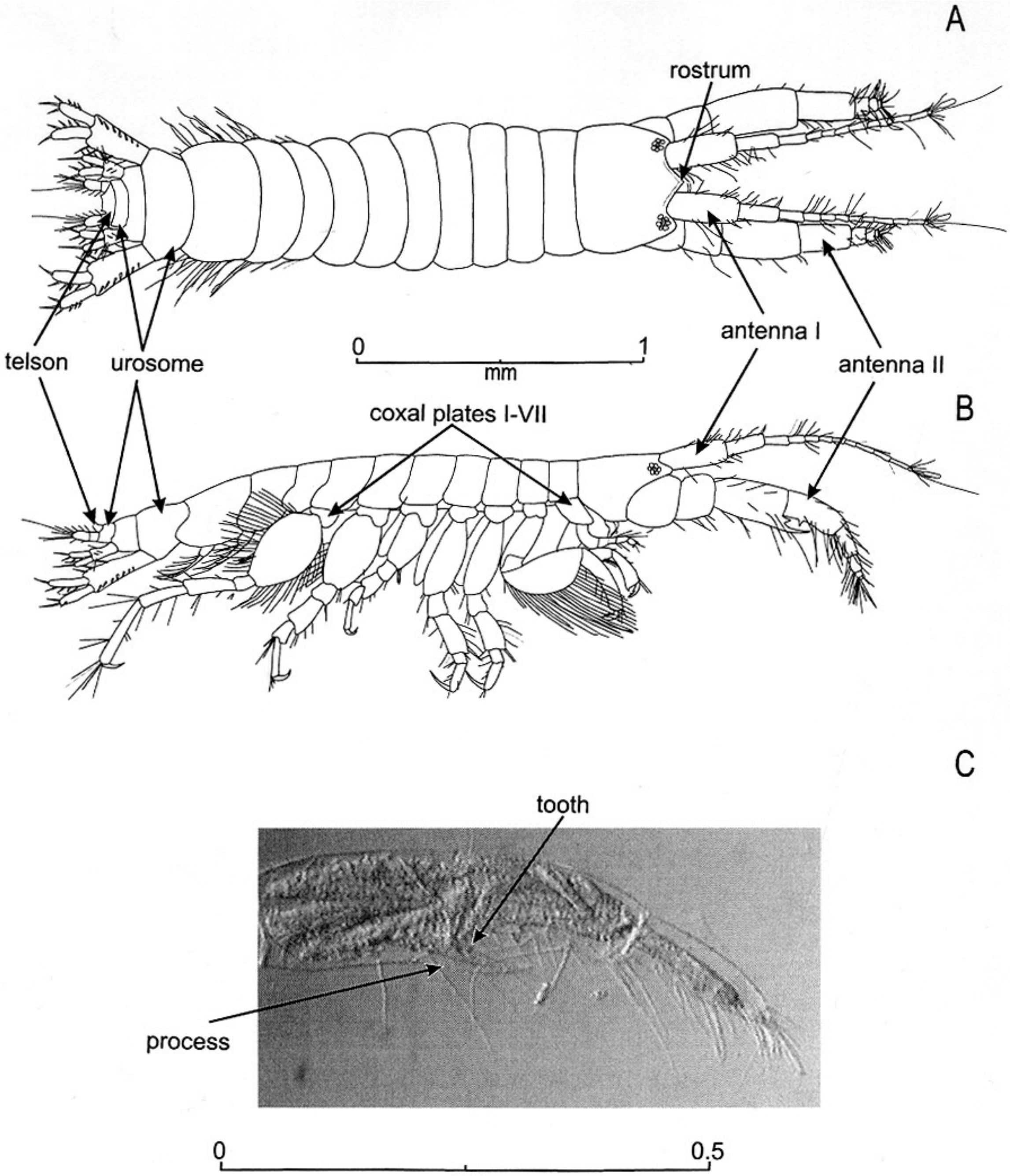

FIG 1. Dorsal (A) and lateral (B) views of* Corophium mucronatum. *Segment 4 of antenna II bears a large curved process with a tooth at its base (C). Basal segments of antenna II are not shown in (C).

long as the process is present at its base. Also, segment 5 of antenna II lacks teeth (tooth) on its distal edge (Fig. 1). Antenna II is more strongly developed in males than in females. Because the specimen described in this study lacked both penial papillae and oostegites, it was not possible to determine its sex.

C. mucronatum is multivoltine, producing either two or three generations per year depending on water temperature (Dediu 1980). In the Dniester tidal estuary the species has been observed at temperatures between 0 and 30°C (I. Grigorovich, pers. observ.), although Dediu (1980) argued that 7 to 27°C is the optimal range for Ponto-Caspian *Corophium* species. As with other corophiid amphipods, *C. mucronatum* constructs mud tubes attached to, or by burrowing in, benthic substrates (Sars 1895, Dediu 1980). *C. mucronatum* inhabits both lotic and lentic waters (Birshtein and Romanova 1968). It tolerates current velocities between 0.1 and 2.0 m/sec (Dediu 1980). In the Dniester River estuary, *C. mucronatum* occurs at a variety of depths, though it is most commonly encountered at 0.5 to 3 m (I. Grigorovich, pers. obs.). In the Caspian Sea it occurs down to 50 m depth, although it achieves its highest density between 3 and 4 m where fresh and saline waters meet (Birshtein and Romanova 1968, Dediu 1980). In the Dniester tidal estuary, *C. mucronatum* occurs frequently in areas where salinity is low (0.3 to 3‰) and infrequently in brackish water (3 to 5‰) (I. Grigorovich, pers. obs.). *C. mucronatum* has also been reported in the Dnieper and Danube river basins (Dediu 1980, Zimbalevskaya 1989, Shevtsova 1991, Moroz 1993, Romanenko 1993), although it is unlikely that the species is established in these areas (Dediu 1980).

C. mucronatum occurs on a wide array of substrates including clay, gray mud, silted sand, sand, stones, smashed mollusc shells, on macrophytes and wooden structures, and in amongst colonies of zebra mussels (*Dreissena polymorpha*)(Markovskii 1953; Dediu 1967, 1980; Shevtsova 1991). Population density may be as high as 1,000 indiv/m^2 (Dediu 1980), although densities of between 1 and 140 indiv/m^2 is typical (Dediu 1967). Thus if the species were to establish in the Great Lakes, it would almost certainly occur at very low density with little ecological impact. By contrast, *C. curvispinum* achieved population densities as high as 200,000 to 750,000 indiv/m^2 on stone substrates after it invaded the lower River Rhine, and adversely affected *D. polymorpha via* competition for food and space (van den Brink *et al*. 1993).

It is not clear why species from the Ponto-Caspian basin have been so successful in invading the Great Lakes in recent years, although a number of possibilities invite examination. First, these invasions may simply reflect ballast water discharge patterns. Most ballast water discharged in the Great Lakes originates in European ports, and dispersal of Ponto-Caspian species through European waterways during this century increases the likelihood of their representation in ballast water and ballast sediment transported to North America. Tolerance of brackish or saline conditions permits many of these species to survive in estuarine habitats where ballast water is frequently loaded, again increasing the likelihood of transport to North America (see Witt *et al*. 1997, MacIsaac *et al*. 1999). Finally, because waterbodies of the Ponto-Caspian basin are much older and contain many more species (Dumont 1998) than those of the Laurentian Great Lakes, species from this region that invade new habitats may be particularly formidable competitors. Prevention of further invasions of Ponto-Caspian species will require examination of the efficacy of the ballast water exchange program currently employed on the Great Lakes.

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REFERENCES

Birshtein, Ya.A., and Romanova, N.N. 1968. Order sideswimmers. Amphipoda. In *Atlas of invertebrates of the Caspian Sea*, ed. Ya.A. Birshtein, L.G. Vinogradov, N.N. Kondakov, M.S. Astakhova and N.N. Romanova, pp. 241–289. Moscow: Pishchevaya Promyshlennost Press. (In Russian).

Brink, F.W.B. van den, van der Velde, G., and bij de Vaate, A. 1993. Ecological aspects, explosive range extension and impact of a mass invader, *Corophium curvispinum* Sars, 1895 (Crustacea: Amphipoda), in the Lower Rhine (The Netherlands). *Oecologia* 93:224–232.

Dediu, I.I. 1967. *Amphipods and mysids of the basins of rivers Dniester and Prut. Systematic ecology, zoogeographical analysis and economic importance. Moscow:* Nauka Press. (In Russian).

______. 1980. *Amphipods of fresh and brackish waters of the southwestern USSR*. Kishinev: Shtiintsa Press. (In Russian).

Dumont, H.J. 1998. The Caspian Lake: history, biota, structure, and function. *Limnol. Oceanogr.* 43:44–52.

Grigorovich, I.A. 1989. *Guide for identification of amphipods of fresh and brackish waters of the southwestern USSR*. Kiev: VINITI. (In Russian).

MacIsaac, H.J., Grigorovich, I.A., Hoyle, J.A., Yan, N.D., and Panov, V.E. 1999. Invasion of Lake Ontario by the Ponto-Caspian predatory cladoceran *Cercopagis pengoi*. *Can. J. Fish. Aquat. Sci.* 56:1–5.

Markovskii, Yu.M. 1953. *Invertebrate fauna in the lower courses of Ukrainian rivers. Conditions of its existence and ways of use. 1. Waterbodies of the Dniester delta and Dniester tidal estuary.* Kiev: Izdatelstvo Akad. Nauk USSR. (In Russian).

Mills, E.L., Leach, J.H., Carlton, J.T., and Secor, C.L. 1993. Exotic species in the Great Lakes: a history of biotic crises and anthropogenic introductions. *J. Great Lakes Res.* 19:1–54.

Mordukhai-Boltovskoi, F.D. 1960. *Caspian fauna in the Azov and Black Sea Basin.* Moscow-Leningrad: Izdatelstvo Akad. Nauk SSSR. (In Russian).

______. 1964. Caspian fauna beyond the Caspian Sea. *Int. Revue ges. Hydrobiol.* 49:139–176.

______. 1978. Composition and distribution of the Caspian fauna by the modern data. In: *Elements of Aquatic Ecosystems*, ed. G.G. Vinberg, pp. 100–139. Transactions of Academy of Sciences of the USSR, Zoological Institute, All Union Hydrobiological Society. Volume 22. Moscow: Nauka. (In Russian).

______, Greze, I.I., and Vasilenko, S.V. 1969. Order amphipods, or scuds—Amphipoda. In *Guide for identification of the fauna of Black and Azov Seas*. 2. Freeliving invertebrates. Crustaceans, ed. V. A. Vodianitskii, pp. 440–524. Kiev: Naukova Dumka. (In Russian).

Moroz, T.G. 1993. *Macrozoobenthos of tidal estuaries and lower reaches of the rivers of the northwestern part of the Black Sea.* Kiev: Naukova Dumka Press. (In Russian).

Pennak, R.W. 1989. *Freshwater invertebrates of the United States*. New York: Wiley.

Pligin, Yu.V., and Emelianova, L.V. 1989. Results of acclimatization of invertebrates of the Caspian fauna in the River Dnieper and its reservoirs. *Gidrobiol. Zhurn.* 25(1):3–11. (In Russian).

Romanenko, V.D. 1993. *Aquatic ecology of Ukrainian section of the Danube River and adjacent waterbodies*. Kiev: Naukova Dumka. (In Russian).

Sars, G.O. 1895. Crustacea caspia. Contributions to the knowledge of the carcinological fauna of the Caspian Sea. Amphipoda. *Bull. Imp. Sci. St. Petersburg* 3(3):276–314. + Supplements.

Shevtsova, L.V. 1991. *Bottom dwelling animals in the canals of different natural zones.* Kiev: Naukova Dumka. (In Russian).

Witt, J.D.S., Hebert, P.D.N., and Morton, W.B. 1997. *Echinogammarus ischnus*: another crustacean invader in the Laurentian Great Lakes basin. *Can. J. Fish. Aquat. Sci.* 54:264–268.

Zhuravel, P.A. 1965. On acclimatization of the fauna of tidal estuary-Caspian type in reservoirs of Ukraine. *Gidrobiol. Zhurn.* 1(3):59–65. (In Russian).

Zimbalevskaya, L.N. 1989. Zoophytos. In *Invertebrates and fishes of the Dnieper River and its reservoirs*, ed. G. I. Scherbak, pp. 54–73. Kiev: Naukova Dumka Press. (In Russian).

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