Remarks on the morphology, taxonomy and distribution of *Corophium curvispinum* G.O. Sars, 1895 and *Corophium sowinskyi* Martynov, 1924 (Crustacea, Amphipoda, Corophiidae)

Abstract

A rather complicated history of discrimination between *Corophium curvispinum* and *C. sowinskyi* is presented. Morphological characters differentiating these two species are described and figured. The distribution of both species is discussed.

*Key words:* Amphipoda, *Corophium*, European freshwater

Introduction

Exactly 100 years ago *Corophium curvispinum* was described by G.O. Sars (1895) from the northern Caspian Sea. A new name for this species was introduced when Wundsch (1912) has found a “new” corophiid in Lake Müggel near Berlin (Havel river system) naming it *Corophium devium*. Soon appeared that this form is conspecific with *Corophium curvispinum*, deserving at most the subspecific rank (Behning 1914, Wundsch 1915). Wundsch (1915) was the first who has properly suggested the way of expansion of this Ponto-Caspian amphipod through the system of canals joining the Dnieper river system (Black Sea basin) with the Baltic Sea and North Sea catchment areas. Starting from the discoveries by Wundsch, who insisted (1915) that freshwater form morphologically differs from that of the Caspian Sea, a trinominal name for freshwater populations - *Corophium curvispinum* forma (or varietas) *devium* - was often used (Kulmatycki 1923, 1925, 1931, Dudich 1927, 1947, Wolski 1930, Sebestyen 1934, Crawford 1935, Ertl et al. 1961, Pygott and Douglas 1989). The name "*Corophium devium*" appeared not only in an old paper by Unger (1918) who has found it in the Danube, but reappeared even in a rather late paper on the Danube fauna by Dudich (1967) - curiously enough along with two other forms - *C. curvispinum* and *C. curvispinum sowinskyi*.

Sovinskij (1904) was the first who observed differences between *C. curvispinum* and another form collected in the Black Sea lagoons without giving it any name. Martynov (1924a) who has studied materials from the lower course of the Don river observed the same differences and named this new form
C. curvispinum subsp. sowinskyi. A rather near similarity of two forms in question, reinforced by the lack of sufficient knowledge of their age variability and poor quality of figures presenting morphology of these taxa, has led to various misunderstandings and introduction of strange names, like C. curvispinum subsp. sowinskyi praenatio devium (Martynov 1924a, Buchalova 1929).

Velickovskij (1914), in river Oskol (Doniec river system, near Voronez) has found on the sponge a corophiid, wrongly assigning it to the genus Cyrtophium Dana (fam. Podoceridae) and naming Cyrtophium spongicola. Comparatively good figures allowed already Martynov (1924a) to ascertain that it is simply Corophium curvispinum. In his second paper Martynov (1924b) gave this form of Velickovskij the name Corophium curvispinum praenatio fluviatilis.

This real mess was nearly fully solved by Morduchaj-Boltovskoj (1947) who has seen original materials of G.O. Sars. After detailed morphological analysis of the structure of antennae and pereopods of two sympatrically occurring forms - C. curvispinum and C. sowinskyi - this author has proved that they are good species and that Caspian form of G.O. Sars is identical with C. curvispinum g. Sars (= C. c. devium Wundsch) and "C. sowinskyi Mart. (= C curvispinum auct.)", most probably to remind that in his earlier works preceding the revision of 1947 he has considered C. sowinskyi as "typical" C. curvispinum, and even in the first half of this 1947 paper, under the name C. curvispinum (auct.? - K.J. & A.K.) he describes in details C. sowinskyi and under the name C. devium - true C. curvispinum.

More or less parallelly to these findings by Morduchaj-Boltovskoj, and not being aware of them, Rumanian authors (Carauș 1943, Carauș et al. 1955) have described in the lakes of the Danube delta the cooccurrence of two forms of C. curvispinum - a typical one and the second, more hairy form called in their 1955 paper C. curvispinum var. villosus Carauș, 1943. Detailed figures and ample description allowed Straškraba (1962) to identify C. curvispinum villosus with C. sowinskyi. The paper by Straškraba, where some additional features discriminating C. curvispinum and C. sowinskyi are presented in figures and in synoptic table, would be a definite resolution of these half a century long misunderstandings in taxonomy of two allied species, however in some cases Straškraba's description of C. sowinskyi in the text is not fully concordant with the data in the tables (the width of joints is sometimes erroneously said as the length and some quotients are contrariwise calculated). Nevertheless it seems that Straškraba (1962), writing in German, has drew nearer the problem to all scientists having troubles with Russian or Rumanian languages and thus looking over the basic papers by Morduchaj-Boltovskoj (1947) and Carauș et al. (1955).

Straškraba (1962) has mentioned also a possibility that the corophiid of Velickovskij (1914, "Cyrtophium spongicola") could be C. sowinskyi as well. In such case the name "spongicola" would have priority over "sowinskyi". However this problem is probably impossible to be solved since the original material of Velickovskij, deposited in Museum of Natural History in Vienna is evidently lost* (* Thanks are due to Prof. dr Andrzej Wiktor for his attempts to find this material in Vienna).

The view that C. sowinskyi is a good, independent species was later expressed in the papers by Dedju (1967), Strańkra (1967), Dedju and Polischutuk (1968), Morduchaj-Boltovskoj and Dzjuban (1976), Pînkster (1978), Russev (1979), Jazdewski (1980), J.L. Barnard and C.M. Barnard (1983), and Jazdewski and Konopacka (1988), however Dedju has later changed his mind and in his 1980 monograph he has expressed the opinion, that C. sowinskyi falls within natural variability of C. curvispinum and is not a different species. Worth mentioning, however, is the fact, that the remarks of Dedju are not supported by any drawings or numbers and are therefore not convincing.

Taking into account all this complicated history of two allied species and having at our disposal materials of both forms coming from different European localities we are attempting to add some new observations that could help in safe discrimination between two species.
Material

Following samples were studied by the present authors:

*Corophium curvispinum*

Poland:

1) River Rega, some 30 m upstream its mouth to the Baltic Sea (distr. Kolobrzeg), 20.08.1968, leg. K. Jażdżewski, 8 ♂, 11 ♀ 2.5 - 5 mm in length.


Hungary:

3) Lake Balaton, near Tihany peninsula, 14.10.1986, leg. I.B. Muško, 10 ♂, 10 ♀ 3.5 - 4.5 mm in length.

France:

4) River Saone, near Alleriot, 04.1991, leg. B. Genin (?), 5 ♂, 5 ♀ 3-6 mm in length.

Rumania:

5) Lake Rosu in the Danube delta, 14.11.1978, leg. O. Ciolpan, 13 ♂, 12, 2♀ 2.5 -5,5 mm in length (out of rich material of hundreds of individuals).

Russia:

6) Caspian Sea, date and place unknown, leg. F.D. Morduchaj-Boltovskoj, 10 ♂, 10 ♀ 3.5 - 5.5 mm in length.

*Corophium sowinskyi*

Russia:

1) River Wolga, date and place unknown, leg. F.D. Morduchaj-Boltovskoj, 7 ♂, 13 ♀ 3.5 - 4.8 in length.

Ukraine:

2) River Dniester, upstream of Chocim (= Chotin), 19-21.07.1928, leg. I. Jarocki and S. Krzysik (?), 3 ♂, 3 ♀ 3-5 mm in length.

3) Old river bed of Dniester River, near the village of Gruszowce, 28.07.1928, leg. I. Jarocki and S. Krzysik (?), 6 ♂, 4 ♀ 3 - 4.7 mm in length.

Results and discussion

1. Morphology

The two species differ morphologically quite well and the differences are to be observed in both sexes but in different appendages or in different parts of appendages. Generally *C. sowinskyi* is evidently a more hairy form (hence the name “villosus” introduced by Carauşu et al. 1955). This hairiness is better visible in males and especially on the lower side of peduncle of Ist antennae and the anterior edge of basis and merus of P III. Successive figures (Figs. 1-4) show the most important features allowing, in our opinion, the safe discrimination between both species. Most of these features were already observed by Martynov (1924a), Morduchaj-Boltovskoj (1947), Carauşu et al. (1955),Straškraba (1962) and Morduchaj-Boltovskoj et al. (1969) but they were usually mixed with other characters that we do not recognize now as reliable, being age- and size- dependent ones.

In Fig. 1 presenting the Ist antennae of males, note especially the length proportions of the flagellum and the peduncle. The flagellum is half as long as the peduncle in *C. curvispinum*, whereas in *C. sowin-
Skyi it is nearly as long as the peduncle. The impression of much richer setosity of the 1st antennae peduncle in *C. sowinskyi* comes not from the higher total number of setae on the joints, but from the fact, that the peduncle of A I in *C. sowinskyi* male is comparatively shorter and is armoured with proportionally longer seate. The longest setae of peduncle in *C. sowinskyi* surpass twice the length of the third peduncular joint, whereas in *C. curvispinum* these longest setae are more or less equal the length of the third joint of peduncle.

In Fig. 2 where male A II is shown attention should be paid to the different structure of the distal end of the penultimate (IVth) joint of the peduncle. In *C. sowinskyi* it is simple whereas in *C. curvispinum* this distal end is protruding in a kind of a collar around the insertion of the next joint. This "collar" is better visible on the inner side and sometimes can form a short rounded lappet.

![Antenna I in males](image1)

**Fig. 1** - Antenna I in males: A - *Corophium curvispinum*, ♂ 5 mm, Danube delta, B - *Corophium sowinskyi*, ♂ 4.8 mm, Volga river.

![Antenna II in males](image2)

**Fig. 2** - Antenna II in males: A - *Corophium curvispinum*, ♂ 4.8 mm, Caspian Sea, B - *Corophium sowinskyi*, ♂ 4.8 mm, Volga river.
The setosity of male pereopod III presented in Fig. 3 is clearly different in two species. Especially the anterior edges of basis and merus (including apical part of this last joint) are densely covered with numerous long setae in *C. sowinskyi*, whereas in *C. curvispinum* these setae are shorter and not numerous. As usually such feature is size dependent. In smaller specimens (3 -3.5 mm in length) in *C. sowinskyi* there are 20-40 setae on both joints combined, in *C. curvispinum* of the same length -only 10-15 setae; in larger individuals (4-5 mm) in *C. sowinskyi* this number surpasses 40 and reaches over 70 setae, whereas in large *C. curvispinum* the number of these setae rarely surpasses 25.

![Fig. 3](image)

Fig. 3 - Pereopod III in males: A - *Corophium curvispinum*, ♂ 5 mm, Danube delta, B - *Corophium sowinskyi*, ♂ 4.8 mm, Volga river.

![Fig. 4](image)

Fig. 4 - Antenna II in females: A - *Corophium curvispinum*, ♀ 5 mm, Danube delta, B - *Corophium sowinskyi*, ♀ 5 mm, Volga river.

Finally, in Fig. 4, where second antennae of females are shown, one can observe a characteristic forward directed distal tooth of the penultimate (IVth) joint of the peduncle in *C. curvispinum* (better visible from the inner side). Such tooth is lacking totally in *C. sowinskyi*. At the same time the last (Vth) joint of the A II peduncle in *C. sowinskyi* is richly armoured with setae (up to 20, usually 2-3 tufts), whereas there are only several setae on this joint in *C. curvispinum* (usually one tuft). It is worthy to
mention that according to Straškraba (1962) the drawing of Karaman (1953) presenting female IIInd anten-
tenna of *C. curvispinum* shows in fact this appendage in *C. sowinskyi*. We fully agree with this opinion.
These and some other features of both species are compared in Table I.

<table>
<thead>
<tr>
<th>Feature</th>
<th><em>C. curvispinum</em></th>
<th><em>C. sowinskyi</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>A I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of joints in the flagellum</td>
<td>7-8, very rarely 9</td>
<td>10-11, very rarely 9</td>
</tr>
<tr>
<td>Ratio: flagellum length: peduncle length</td>
<td>0,4-0,7</td>
<td>0,8-1,0</td>
</tr>
<tr>
<td>Lower side of the Vth joint of the peduncle</td>
<td>with 8-11 setae tufts</td>
<td>with 5-7 setae tufts</td>
</tr>
<tr>
<td>Distal end of the IVth joint of the peduncle (inner side)</td>
<td>with collar-like structure</td>
<td>without any collar, simple</td>
</tr>
<tr>
<td>Distal end of the IVth joint of the peduncle (inner side)</td>
<td>with anteriorly directed tooth</td>
<td>without any tooth</td>
</tr>
<tr>
<td>Lower side of the Vth joint of the peduncle</td>
<td>few setae, usually 1 tuft</td>
<td>many setae, 2-3 tufts or more</td>
</tr>
<tr>
<td>A II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total number of setae on the anterior margin of basis and merus</td>
<td>3-3,5 mm</td>
<td>maximally 15</td>
</tr>
<tr>
<td>4-4,5 mm</td>
<td>maximally 25</td>
<td>not less than 40</td>
</tr>
<tr>
<td>&gt;5 mm</td>
<td>maximally 30</td>
<td>not less than 40</td>
</tr>
</tbody>
</table>

What concerns the armature of the peduncles of both antennae with spines - the features used by Morduchaj-Boltovskoj (1947), Straškraba (1962) and Morduchaj-Boltovskoj et al. (1969) to differentiate both species in question - we do not recognize them as real discriminating characters, since the variability ranges of these characters widely overlap and one can merely say about some tendency in *C. sowinskyi* to have larger number of spines on these joints. The number of spines on the inner side of the dactyl of gnathopod II cannot be a discriminating character for the two species. There is a tendency in *C. sowinskyi* for a lower number of these spines (2-3), but in *C. curvispinum* 3 spines more often occur than 4 or 5, that was presented as typical by Wundsch (1915) and Schellenberg (1942). Evidently it is also a size-dependent feature. In medium sized animals the ranges of this character can overlap definitely.

The co-occurrence of both species in question - *C. curvispinum* and *C. sowinskyi* - was stated several times - by Martynov (1924a), Carauş (1943), Morduchaj-Boltovskoj (1947), Carauş et al. (1955) and by Straškraba (1962). All these authors have stressed that morphological differences are quite easy to be observed; that concerned even the pigmentation that is lesser in *C. sowinskyi* than in *C. curvispinum* (Straškraba 1962). However these observations concern fresh material. The practice of the present authors indicates that these comparatively small amphipods, to be properly determined in preserved mate-
rials, and especially when smaller specimens are in question, should be necessarily dissected and the appendages should be observed, mounted preferably in a drop of glycerine, under the low microscope magnification. The distal tooth (♀) or a "collar" (♂) ornamenting the penultimate A II peduncular segment of *C. curvispinum* is better visible on the inner side of the antenna and this surface should be mounted upside or one should have a possibility to move, if necessary, the appendage under the covering glass. For males the most useful discriminating feature is the setosity of the anterior edge of basis and merus of P3, that is definitely more dense in *C. sowinskyi* than in *C. curvispinum* (Fig. 4, Tab. I).

2. Ecology

There is an evidence in the literature that both species simply co-occur in the same stations (were collected in the same samples). This information can be found in the papers by Carasu (1943), Morduchaj-Boltovskoj (1947), Straškraba (1962) and Dedju (1967). However already in his 1947 paper Morduchaj-Boltovskoj has signalized that in fact the exact preferences of both species differ. Similar suggestions were expressed by Dedju (1967). In the papers by Morduchaj-Boltovskoj (1960, 1979b) and Morduchaj-Boltovskoj and Dzjuban (1976) one can find information that *Corophium curvispinum* is a typical periphytic species and prefers more shallow parts like phytal zone and submerged constructions, whereas *C. sowinskyi* inhabits more willingly deeper water and compact grounds of muddy sand with detritus. It is suggested also that *C. sowinskyi* is a more eury-edaphic species than *C. curvispinum*.

3. Distribution

Information on the general distribution of *C. sowinskyi* was never presented in detail in one paper. Data on the occurrence of this species are scattered over a vast literature. A summary of our present knowledge of this distribution (Fig. 5) indicates that it is a typical Pontic-Caspian one. For the Caspian Sea itself, but without any precise localities, *C. sowinskyi* is mentioned by Morduchaj-Boltovskoj et al. (1969). In his discussion with the authors of the "Atlas of the Caspian Sea" - Birstejn and Romanova (1968) - who have not mentioned this species at all, Morduchaj-Boltovskoj (1979a) stressed that "...*Dikerogammarus palatus* and *Corophium sowinskyi* Mart., which are definitely present there" (p. 6). Small sample labelled only "Caspian Sea" was sent to the present authors by Morduchaj-Boltovskoj himself. The occurrence of *C. sowinskyi* in the Caspian Sea is also indicated by Straškraba (1967) and Pinkster (1978) in both editions of Limnofauna Europaea.

From Wolga river and its main affluents - Oka and Kama - this species was given by Morduchaj-Boltovskoj (1960, 1979b), Morduchaj-Boltovskoj et al. (1969) and Morduchaj-Boltovskoj and Dzjuban (1976). In this last paper and in the paper by Morduchaj-Boltovskoj (1979a) there is an information that a far upstream occurrence of many Pontic-Caspian Malacostraca in upper Wolga system is strongly endangered and has been changed in last decades due to strong pollution and large hydrotechnical constructions on these rivers. Therefore the data on *C. sowinskyi* distribution in this area (Fig. 5) can be now only of historical value.

In the middle and lower Don river, together with Cimlanskoe dam reservoir and its affluents Askaj and Manyč *C. sowinskyi* was recorded by Martynov (1924a) and Morduchaj-Boltovskoj (1947, 1960). In the Azov Sea catchment area it was also mentioned in the Miuss river lagoon and the estuary and Kuban river by Morduchaj-Boltovskoj (1960). Off the eastern coast of the Black Sea this species was recorded from the Lake Abrau, from the Rion river and Lake Paleostom (Sowinskij 1904, Morduchaj-Boltovskoj 1960). Following authors have mentioned *C. sowinskyi* for the rivers emptying to the northern and western part of the Black Sea: Dnieper river and its lagoon (common with Boh river) -Sowinskij (1904), Morduchaj-Boltovskoj (1947, 1960); Dniester river and its lagoon - Sowinskij (1904), Morduchaj-Boltovskoj (1960), Dedju (1967) and Jażdżewski and Konopacka (1988); Danube river and its estuary - Bacescu (1949, 1966), Morduchaj-Boltovskoj (1960, 1969), Straškraba (1962), Rudich (1967), Dedju and Polischuk (1968), Russev (1979). Straškraba (1962) has found *C. sowinskyi* (co-occurring with *C. curvispinum*) in Lake Balaton, whereas Carasu (1943) and Carasu et al. (1955) have recorded *C. sowinskyi* in the lakes Katlapug and Jalpug (Danube delta system) and Lake Šabla at the Bulgarian Black Sea coast. A summary of the knowledge of the *C. curvispinum* distribution in Europe until 1978 was presented by Jażdżewski (1980). From that time, many papers appeared showing that this species is permanently expanding its range in western Europe (Germany - Waterstraat and Köhn 1989, Köhn and Water-
straat 1990, Schöll 1990; Holland - van den Brink et al. 1989, den Hartog et al. 1989, 1992, Pinkster et al. 1992, van den Brink et al. 1993; Belgium - Wouters 1985, d'Udekem and Stroot 1988; France - Genin 1992). Worth noticing is an incredible colonization success of *C. curvispinum* in the river Rhine. According to den Hartog et al. (1992) this could be partly due to the Sandoz factory disaster that has emptied Rhine in 1986 from large part of its hydrofauna making free place for newcomers. Pinkster et al. (1992) have recorded *C. curvispinum* already from IJsselmeer and it is most possible that this species can take now the place of brackish water corophiids (like *C. volutator*, *C. multisetosum* or *C. lacustre*) that have disappeared from there after the closure of Zuider Zee and the decrease of its salinity (Pinkster et al. 1992). However one should also remember that *C. curvispinum* hitherto was probably not always distinguished from *C. sowinskyi*. Therefore we do hope that our note will bring attention to the possibility that these two akin species, co-occurring in their original Ponto-Caspian area, could be also mixed outside this primary distribution range. This possibility is also suggested by Straškraba (1967) and Pinkster (1978).

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