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A Tribute to Prof. N.M. Knipovich (1885-1925)

Notes on the Crustacean Fauna of the Caspian Sea

by

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Having had the opportunity of acquiring a rather close knowledge of the Crustacea of the Caspian Sea by the examination of several gatherings placed in my hands for elaboration and taken at different times by different naturalists, as also more recently by a careful study of the rich collections procured during the extensive and very productive Expeditions carried on under the charge of the eminent biologist, Prof. N. Knipowitsch, I have ventured to think that a few remarks about the general character of this part of the Caspian Fauna and its probable origin might perhaps be of some interest, and that the present short paper may of course be found suitable for being included in the commemorial writing to be published in honour of the above-named distinguished biologist.

The class of animals here spoken of has indeed proved to display in the Caspian Sea quite a wonderful richness, both as to individual number and to diversity of forms, nearly all the leading groups being represented, some of them very abundantly. Moreover most of the species present a pronouncedly endemic character, differing as they do more or less conspicuously from those otherwise known, although in the more essential features manifesting their real consanguinity.

In accordance with the well known fact that the water in the Caspian Sea is not fresh, as in most other inland basins, but of a composition nearly answering to that in the Ocean, it is found that the far greater bulk of the Caspian Crustacea bear an unmistakable marine stamp.

Indeed, there is full evidence that the Caspian Sea not always has had its present character of an isolated water-basin, but that, in some remote period it had a much wider extent and moreover stand in open communication with the Ocean, from which of course it must have received its primary fauna.

Several reasons would seem to support the assumption that this communication with the Ocean has been of two different kinds. In the one case a northward connection with the Arctic Ocean has certainly existed, in the other case a more southwards connection, through the Black Sea, with the Mediterranean must be supposed to have occurred.

It is not likely to believe that these two kinds of communication with the Ocean have existed simultaneously. In my opinion the connection with the Arctic Ocean is the earlier one, that with the Mediterranean of a rather more recent date. I do not however know, whether this is in full accordance with the results to which the geologists have arrived. In any case the derivation of the Caspian Crustacea from two very different sources appears to me to be indisputable, some of them being quite certainly of true Arctic origin, whereas most of the other forms manifest as evidently more southern provenience.

In addition to the strictly marine forms spoken of above, a number of brackish-water Crustacea have also found their way to the Caspian Sea, and even genuine fresh-water forms are occasionally met with, especially in the northern part of the basin.

It is thus an assemblage of very heterogeneous faunistic elements which have congregated in the Caspian Sea, to form the basis on which the present peculiar fauna has been built, and it is not improbable that the mutual contact between these alien forms might have had some influence on the subsequent fate of the species.

Yet, a partial dislocation of the faunistic elements appears soon to have taken place. Thus the primary Arctic forms gradually retired to the great deeps occurring in the southernmost part of the basin, whereas the other Crustacea spread over the shallower middle and northern tracts, some of them keeping close to the shores, together with the brackish water forms, others descending to greater depths.

In the great abysses of the Caspian Sea the Arctic forms found rather uniform conditions of life, with a sufficiently low and constant temperature of the water and a suitable amount of nourishing matters, and on that account their original characters have been kept nearly unchanged until the present time.

The case is rather different with those forms which remained in the more northern parts of the basin. Here the conditions of life are far less uniform, and no doubt considerable changes must have taken place during the time when the basin became shut off from its connection with the Ocean and its limits retired to their actual extent. At present also the physical and biological relations in this part of the Caspian Sea are found to be rather various and unlike those farther south. Thus the temperature of the water is subjected to considerable changes according to the seasons, and its salinity is considerably reduced on the northern shores, particularly that of the big Volga stream, rendering the water in some places almost perfectly fresh. In accordance therewith the original constitution of the bottom has also been more or less altered.

In spite of these apparently unfavourable conditions of life for the originally marine Crustacea, they are in reality present here in great abundance, more so indeed than in any other part of the basin. The explanation of this striking fact must be sought for in the rich amount of nourishing matter found here and apparently due to the continual conveyance into the Caspian Sea, through the above mentioned rivers, of certain valuable elementary substances (nitrates). These substances would seem to exercise as it were a manuring agency upon the Caspian water, giving rise to a flourishing development of those lowermost organic beings (Protists), which in reality constitute the primary nutriment, on which, in the last instance, the subsistence of higher organisms, up to the fishes, is dependent.

Indeed, it is well known, that the most important fisheries of the Caspian Sea are carried on even in this part of the basin, and particularly at the mouth of the Volga, the great abundance of economically valuable fishes here occurring being accounted for by the rich and suitable food which they have in the numerous Crustacea (Mysida, Cumacea) swarming in these tracts.

For the adjustment to the above mentioned various physical relations prevailing in the North-Caspian Sea certain alterations in the organisation of the Crustacea here occurring were required, chiefly affecting the external characters. Such alterations may be easily induced by the faculty of variability, and, owing to the variations, may have had a tendency to be fastened and to develop further to the benefit of the species during their struggle for existence, thus leading to a more or less complete transformation and at last to a divergence of new endemic species.

That such a development in reality has taken place in the Caspian Sea, appears to me to be beyond doubt, and is clearly

manifested by the mutual relationship of the species in most of the groups. The development may in some cases have proceeded quite gradually. In other cases, however, it must certainly have been accompanied by more sudden changes, or so-called mutations, as is particularly apparent in the case of the Cumacea. In both cases the final result has been the evolution of forms more or less conspicuously differing from those from which they have originally descended.

Indeed, several circumstances seem to have combined to make the Caspian Sea particularly apt for such evolutionary processes, and I am convinced that these processes are still going on rather actively, as particularly very apparent in the case of the two Clado-ceran genera *Cercopagis* and *Evadna* (see my account of the Polyphemida of the Caspian Sea).

The Caspian Sea constitutes, as it were, a concentrated piece of the Ocean, and it is very likely to believe that in the organisms left here the inherent powers, as to variability on adaptation, have been much stimulated owing of the great changes in the surroundings, and that of course some of the aboriginal forms have been subjected to considerable transformations leading to the evolution of entire-new species and even genera.

The remarkable distribution of a number of the originally marine Caspian Crustacea within the Volga stream, at a considerable distance from its mouth, may have been briefly mentioned. The occurrence of some of these Crustacea, as far up as Saratow, was first stated by Prof. Skorikow, and more recently Dr. A. Behning has made the Volga Crustacea the subject of a very careful investigation, several additional species being recorded, and at the same time the occurrence of some of them still farther north, viz., to the chief affluents of the Volga, was ascertained.

As to the explanation of the above mentioned remarkable distribution, I was at first inclined to believe that it was due to a gradual immigration from the Caspian Sea of such forms, which had adapted themselves to live in the almost perfectly fresh water of the Volga mouth. Another very different theory has however been set forth by some authors and has also been approved by Dr. Behning. According to this theory, the said Crustacea more properly represent a kind of relicts, being left back here from the time when the limits of the Caspian Sea extended far more northwards than at present. Although I believe that the possibility of an active progression of the Crustacea upwards the stream cannot be absolutely rejected, I find that there is much to speak in favour of the above mentioned relicttheory.

In the Black Sea, resp. the Asov Sea, moreover a number of Crustacea have been found, which unquestionably are identical with Caspian species, thus clearly proving the existence of an earlier connection between this Sea and the Caspian basin, and a distribution of some of them within the affluent rivers has also here been noted. But all these forms, like the Volga Crustacea, are of evidently southern extraction, no Arctic forms having even been met with in the Black Sea. It may be allowed thereon to conclude, that this basin, unlike the Caspian Sea, has never had any direct communication with the Arctic Ocean, whereas its connection with the Mediterranean certainly has formerly been much more open than at present.

As regards the Arctic relicts of the Caspian Sea, the supposition generally entertained by biologists seems to be, that these Crustacea are originally derived from the Baltic basin, and that in a comparatively recent geological period they have been, in some manner or other, transferred to the domain of the Volga, through which river they are supposed to have been transported into the Caspian Sea.

I am by no means prepared to assent to the above hypothesis, which appears to me in several respects, and more particularly as regards the supposed transport of Arctic relicts through the Volga stream, to be quite unreasonable. The whole hypothesis seems indeed to have been built up on the evidently erroneous presumption of the identity of the Caspian relicts with those of the Baltic basin.

Consequently I feel justified to insist on the view in the head of this paper, viz., that the origin of the Caspian Arctic relicts ought to be put back to a very remote geological period, when the relation between land and sea was quite unlike that now existing. At that period the Caspian Sea, together with the Aral Sea, formed, as I believe, the inner part of a large gulf extending from the Polar Ocean southwards through the Siberian lowland, east of the Ural. mountains and accordingly far apart from the Baltic domain. Through this open communication with the Arctic Ocean the Caspian Sea has apparently received its primary fauna, which of course had a purely Arctic character, the mixture with more southern elements being a process which must have going on at a much later period.

I think that no serious objections against the above theory can be made from the side of the geologists, and I am indeed in the state to adduce an important biological fact in support of its correctness. Among the Arctic relicts of the Caspian Sea there is a very characteristic Lysianassid genus, *Pseudalibrotus*, of which 2 forms occur very abundantly in the abyssal region of the basin. This genus is quite alien to the Baltic domain, no trace of it having ever been found either in

the basin itself or in the great lakes formerly in connection with it. Nor has this genus, as far as I know, been recorded from the White Sea, through which the Baltic basin has received its Arctic elements. On the other hand, two species of this genus, closely resembling and perhaps even identical with those living in the Caspian Sea, have been recorded by the present author from the Glacial Ocean north of Siberia, being obtained during Nansen's Polar Expedition. It thus seems to be full evidence that at least the forms of this genus have arrived to the Caspian Sea through the way just mentioned, and it is of course very likely to believe that the same has been the case also with the other Arctic relicts of the Caspian Sea. Indeed, they all are found to exhibit characteristic differences with the corresponding forms of the Siberian Glacial Sea.

As to the present carcinological fauna of the Caspian Sea, we may conveniently distinguish the 5 following partitions, though of course no sharply defined boundaries between them can be drawn.

1. The abyssal fauna is confined to the southernmost part of the Caspian Sea, where depths occur down to nearly 500 fathoms. It is prominently distinguished by an assemblage of genuine Arctic forms living close to, or at least near to, the bottom, some of them being found here in great abundance. The following genera belonging to 3 different orders, may have been named: *Mysis*, *Chiridothea*, *Pseudalibrotus*, *Pontoporeia*, *Gammaracanthus*, all of them unquestionably of Arctic extraction, and constituting the remnants of the primordial fauna prevailing in the Caspian Sea, when still in open communication with the Glacial Ocean.
2. The deep water fauna occupies the middle part of the Caspian Sea, where depths occur ranging from 30 to about 150 fathoms. At the bottom which, like that of the abyssal region, chiefly consists of a loose muddy deposit, numerous Amphipoda of the Gammarid family occur, and moreover some Mysida and Cumacea are here met with. Two species of Gammarids (*Amatellina spinosa* and *Dikerogammarus grimmi*) descend more or less deeply within the abyssal region, and also one of

the Mysida (*Austromysis laxolepis*) is occasionally met with at very considerable depths, so as more properly to be adduced to the abyssal Fauna. Northwards however the deepwater fauna quite gradually passes over into the sublittoral one, no sharp limits between both being possible to draw.

3. The littoral fauna extends all round the borders of the Caspian Sea from the beach to about 6 fathoms. It is particularly rich in Crustacea of different kinds, comprising, as it does, the far greater bulk of the Mysida and Cumacea, as also numerous Amphipoda, among which especially several species of the genus *Corophium* may be obtained in enormous numbers together with their tubular abodes. As to the nature of the bottom in this region, it somewhat differs from that in the deepwater and abyssal ones, being, as a rule, mingled with sand and gravels or dead shells. Near the beach it is moreover often overgrown with *Zostera* or algae, which give abodes to multitudes of small Copepoda, chiefly belonging to the Harpacticoid group.
4. The pelagic fauna comprises the forms, which are quite independent of the bottom, being found constantly moving freely in the water more or less near the surface and generally at some distance from the shores. They consist in the Caspian Sea exclusively of lower Crustacea (Entomostraca) and are referable to 2 different orders, Copepoda and Branchiopoda. Of the firstnamed order 2 Calanoid species may principally be named, because they occur in quite an extraordinary abundance throughout the Caspian Sea, forming the chief part of the so called plankton. The one of these species, *Eurytemora grimmi*, is apparently confined to the more northern tracts of the basin, whereas the other species, *Limnocalanus grimaldi*, is more frequent in the southern part. The latter is evidently of Arctic origin, having been recorded, besides from the Baltic, also from the Siberian Glacial Sea, and in accordance therewith it is only found at some greater distance below the surface, thus presenting itself more properly as a bathypelagic form. The pelagic Branchiopoda are represented in the

Caspian Sea by 3 genera belonging to the family Polyphemida, viz., Cercopagis, Apagis and Evadne. The 2 first-named genera are closely related to the wellknown fresh-water genus Bythotrephes, from which they in reality may be assumed to have originally descended, whereas the 3rd genus (Evadne) is pronouncedly marine, though far less abundantly represented in the Ocean than in the Caspian Sea.

5. The limnetic fauna is chiefly confined to the northernmost part of the Caspian Sea, and more particularly to the estuaries at the mouth of Volga, where a great assemblage of well known genuine fresh water Entomostraca of different kinds have been ascertained to occur. Some of these forms are occasionally also met with at a more or less considerable distance outside the estuaries and must of course be added to the Caspian Fauna. Moreover 2 somewhat transformed species, *Heterocope caspia* and *Polyphemus exiguus* may be more properly referred to this part of the fauna, though both of them have been met with as far south as the bay of Karabugas.

A brief survey of the principal groups (orders) represented in the Caspian Sea may here be added.

Decapoda.

Of this order 2 species belonging to the freshwater genus *Astacus* (*Potamobius*) have been recorded from several places of the Caspian Sea, in the littoral region. Both species are well known from freshwater streams throughout Europe and Asia; but in the Caspian Sea they have adapted themselves to live in more or less saline water, without however therewith to have been subjected to any noticeable transformation.

Schizopoda.

This order is represented in the Caspian Sea by a considerable number of forms, all of them however only referable to one of the chief divisions or families comprised within it, viz., that of the Mysida. No less than 25 different species have been recorded, belonging to 10 more or less nearly allied genera. One of these genera, *Mysis* (sens. strict.)

is unquestionably of Arctic origin, and the 4 species observed in the Caspian Sea are, in accordance therewith, only met with in the abyssal region of the basin together with the other Arctic relicts. The remaining Caspian Mysida are undoubtedly of more southern extraction, and are spread over the shallower tracts, occurring in some places of the North-Caspian Sea in such an abundance as most probably constituting an important part of the food for fishes.

Cumacea.

The presence of this order in the Caspian Sea is of quite a particular interest. In no other inland basin Cumacea have ever been met with, and these Crustacea have therefore generally been considered as exclusively peculiar to the Ocean, where many distinct types occur, most of them derived from very considerable depths. In the Caspian Sea a rather great number of Cumacean species have been detected, almost all of them found in the shallow northern part of the basin, where some of them occur in such abundance as very probably, together with Mysida and Amphipoda, serving as food for fishes. In their outward appearance the species exhibit a remarkable diversity, some of them being of a rather short and clumsy shape, others again extremely slender, thus imitating in a perplexing manner the aspect of some of the more prominent oceanic types. Yet, all these species are in reality closely related, as clearly proved by the almost identical structure of the several appendages, and indeed on this cause I at first felt justified to combine all of them into one and the same genus, *Pseudocuma*. More recently however I have found it appropriate, in view of the considerable diversity in the outward appearance, to dispose them into 6 nearly-allied genera. Yet, on the real consanguinity of the Caspian Cumacea no doubt can arise, and I am of opinion that they in all probability originally have descended from a few, or perhaps even a single ancestral form immigrated at some remote period from the Mediterranean. This form has most probably been a genuine *Pseudocuma*, and indeed 2 well-marked species of this genus, nearly allied to those described by the present author from the Mediterranean, are still found in the Caspian Sea. The remarkable divergence of the other forms may be accounted for by a highly developed faculty of adaptation which has led to considerable changes in the outward appearance of the body. As to occurrence, the far greater number of the species are met with along the northwestern shores of the Caspian Sea, whereas no trace of Cumacea is detected in the southern abyssal region of the basin. This would seem to confirm pretty well the assumption of the southern extraction of the Caspian Cumacea. Of the 17 species recorded only a single one has been found out of the Caspian Sea, viz., *Pterocuma pectinata*, which was originally described by Sowinsky from the Sea of Azov. All the other species are unquestionably endemic and must of course have been developed within the limits of the Caspian Sea.

Isopoda.

Of this order one very characteristic form may in the first place be named, viz., the big Arctic Idotheid, *Chiridothea en-tomon*, of which a well-marked variety (or perhaps species) is found rather abundantly in the great abysses of the Caspian Sea. Otherwise this order is very scantily represented, only solitary specimens of 3 additional forms having as yet been recorded, all from the littoral region. Two of these forms, *Asellus aquaticus* and *Jaera nordmanni*, are well-known and widely distributed species. The 3rd however *Nannoniscus caspius*, belongs to a family (*Desmosomida*) otherwise only known from greater depths in the Ocean.

Amphipoda.

This is perhaps of all the orders that which is most richly represented in the Caspian Sea. Amphipoda are indeed found in all parts of the basin, from the beach down to the greatest deeps explored, and their individual number is also in most places very considerable. The far greater bulk of them belongs to the extensive family *Gammarida*; but also 3 other families are represented, viz., the *Lysianassida* by the arctic genus *Pseudalibrotus*, the *Haustoriida* by the likewise arctic genus *Pontoporeia*, and the *Corophiida* by the typical genus *Corophium*. The number of Caspian species of this order as yet noted amounts to no less than 54 in all. Of these only a few forms have been recorded also from localities out of the Caspian Sea, all the others present a prominently endemic character.

Branchiopoda.

Of the suborder *Phyllopoda* the well-known Branchiopodid *Artemia salina* has been ascertained to occur in the highly saline water of the bay of Karabugas, some larva, unquestionable referable to this peculiar form, having been picked up from a plankton-sample taken here by Mr. Maximowitsch. Moreover some specimens of a *Leptestheria* have been collected at Astrachan from saline pools close to the beach, and this form may thus perhaps also be adduced to the Caspian Fauna. The suborder *Cladocera* is more richly represented, though the greater number of the forms, as above mentioned, is chiefly confined to the estuaries at the mouth of the Volga. Of the genuine Caspian *Cladocera* the 3 Polyphemid genera *Cercopagis*, *Apagis* and *Evadne* have already been spoken of above as members of the pelagic Fauna. The species of the 2 first-named genera seem to be rather local in their occurrence, almost all the specimens examined being derived from some plankton-samples taken by Mr. Grimm in the southern part of the Caspian Sea, at a considerable distance below the surface. The genus *Evadne*,

on the other hand, seems to be distributed in all parts of the basin, exhibiting quite a wonderful richness of more or less striking forms.

Copepoda.

This very extensive order is well represented in the Caspian Sea, both by free-living and parasitic forms. The Caspian Calanoids are referable to 3 different families, the Centropagida, Diaptomida and Temorida. To the first-named family belongs the genus *Limnocalanus*, to the 2nd the typical genus *Diaptomus*, to the 3rd the 3 genera *Popella*, *Eurytemora* and *Heterocope*. As mentioned above, 2 of the Caspian Calanoids, *Limnocalanus grimaldi* and *Eurytemora grimmi*, are pronouncedly pelagic in occurrence. The other Calanoids are chiefly littoral, though some of them, for instance *Popella guernei*, are occasionally met with also at a greater distance from the shores. Of the division Harpacticoida numerous forms of different kinds have been examined by the present author from samples taken in the littoral zone. Some of them 1 have been enabled to identify with elsewhere known brackish-water forms; but there are also several forms apparently new to science. The 3rd division, Cyclopoida, is far less richly represented in the Caspian Sea, and only comprises a single family, the Cyclopoida. One of the forms, a small species of the genus *Halocyclops*, has been found very abundantly in some plankton-samples taken in the North Caspian Sea, and may thus perhaps be adduced to the pelagic Fauna; but all the other forms are strictly littoral. Of parasitic Copepoda several forms have been secured, taken from different kinds of fishes. They have not yet been more thoroughly studied; but seem for the most part to be identical with species elsewhere known, particularly from fresh-water fishes.

Ostracoda.

Of this order only a limited number of forms have as yet been found in the Caspian Sea, all of them in the littoral region. They belong to the 2 chief families of the division Podocopa, Cyprida and Cytherida.

Systematic List of Caspian Crustacea.

Decapoda.

Macrura.

Fam. Astacida.

Gen. Astacus, Fabr.

1. leptodactylus, Eschholtz.
2. pachypus, Rathke.

Schizopoda.

Fam. Mysida.

Gen. 1. Paramysis, Czern.

1. baeri, Czern.
2. armata, Czern.
3. kessleri, Grimm.
4. bakuensis, G. O. Sars.
5. eurylepis, G. O. Sars.

Gen. 2. Mesomysis, Czern.

6. ullskyi, Czern.
7. kowalevskyi, Czern.
8. czerniavskyi, G. O. Sars.
9. intermedia, Czern.
10. aberrans, Czern.
11. incerta, G. O. Sars.

Gen. 3. Austromysis, Czern.

12. loxolepis, G. O. Sars.

Gen. 4. Schistomysis, Norman.

13. elegans, G. O. Sars.

Gen. 5. Caspiomysis, G. O. Sars.

14. knipowitschi, G. O. Sars.

Gen. 6. Metamysis, G. O. Sars.

15. strauschi, Czern.
16. grimmi, G. O. Sars.
17. inflata, G. O. Sars.

Gen. 7. Katamysis, G. O. Sars.

18. warpachowskyi, G. O. Sars.

Gen. 8. Mysis, Fabr.

19. caspia, G. O. Sars.
20. macrolepis, G. O. Sars.
21. microphthalma, G. O. Sars.
22. amblyops, G. O. Sars.

Gen. 9. Limnomysis, Czern.

23. benedeni, Czern.

Gen. 10. Euxinomysis, Czern.

24. pusilla, G. O. Sars.

Gen. 11. Hemimysis, G. O. Sars.

25. anomala, G. O. Sars.

Cumacea.

Fam. Pseudocumida.

Gen. 1. Pseudocuma, G. O. Sars.

1. cercaroides, G. O. Sars.
2. laevis, G. O. Sars.

Gen. 2. Pterocuma, G. O. Sars.

3. pectinata, Sowinsky.
4. sowinskyi, G. O. Sars.
5. rostrata, G. O. Sars.
6. grandis, G. O. Sars.

Gen. 3. Stenocuma, G. O. Sars.

7. gracilis, G. O. Sars.
8. graciloides, G. O. Sars.
9. tenuicauda, G. O. Sars.
10. diastylodes, G. O. Sars.

Gen. 4. Schizorhynchus, G. O. Sars.

11. bilamellatus, G. O. Sars.
12. eudorelloides, G. O. Sars.
13. abbreviatus, G. O. Sars.
14. obesus, G. O. Sars.
15. scabriusculus, G. O. Sars.

Gen. 5. Caspiocuma, G. O. Sars.

16. campylaspoides, G. O. Sars.

Gen. 6. Volgocuma, Derzhavin.

17. telmatophora, Derzhavin
(=Cercopodia monilaris
G. O. Sars).

Isopoda.

Fam. Idotheida.

Gen. 1. Chiridothea, Harger.

1. entomon, Lin. (forma caspia).

Fam. Aseilida.

Gen. 2. Aseillus, Geoffr. St. Hillaire.

2. aquaticus, Lin.

Fam. Janirida.

Gen. 3. Jaera, Leach.

3. nordmanni, Rathke.

Fam. Desmosomida.

Gen. 4. Nannoniscus, G. O. Sars.

4. caspius, G. O. Sars.

Amphipoda.

Fam. Lysianassida.

Gen. 1. Pseudalibrotus, Della Valla.

1. caspius, Grimm.
2. platyceras, Grimm.

Fam. Haustoriida.

Gen. 2. Pontoporeia, Kröyer.

3. microphthalma, Grimm.

Fam. Gammarida.

Gen. 3. Axelboeckia, Stebbing.

4. spinosa, Grimm.

Gen. 4. Gmelina, Grimm.

5. costata, Grimm.
6. kusnezowi, Sowinsky.
7. laeviuscula, G. O. Sars.
8. pusilla, G. O. Sars.

Gen. 5. Gmelinopsis, G. O. Sars.

9. tuberculata, G. O. Sars.
10. aurita, G. O. Sars.

Gen. 6. Gammaracanthus, Bate.

11. caspius, Grimm.

Gen. 7. Amathillina, Grimm.

12. cristata, Grimm.
13. affinis, G. O. Sars.
14. spinosa, Grimm.
15. maximowitschi, G. O. Sars.
16. pusilla, G. O. Sars.

- Gen. 8. *Niphargoides*,
G. O. Sars.
17. *caspius*, Grimm.
18. *corpulentus*, G. O. Sars.
19. *compactus*, G. O. Sars.
20. *quadrimanus*, G. O. Sars.
21. *aquimanus*, G. O. Sars.
22. *borodini*, G. O. Sars.
23. *grimmi*, G. O. Sars.
- Gen. 9. *Carinogammarus*,
Stebbing.
24. *caspius*, Pallas.
- Gen. 10. *Dikerogammarus*,
Stebbing.
25. *haemobaphes*, Eichwald.
26. *grimmi*, G. O. Sars.
27. *macrocephalus*, Grimm.
- Gen. 11. *Gammarus*, Lin.
28. *placidus*, Grimm.
29. *ischnus*, Stebbing (=G. *tellus* G. O. Sars).
30. *warpachowskyi*, G. O. Sars.
31. *robustoides*, Grimm.
32. *crassus*, Grimm.
33. *abbreviatus*, G. O. Sars.
34. *obesus*, G. O. Sars.
35. *platycheir*, G. O. Sars.
36. *weidemanni*, G. O. Sars.
37. *maeoticus*, Sowinsky.
38. *subnudus*, G. O. Sars.
39. *andrussowi*, G. O. Sars.
40. *pauillus*, Grimm.
41. *deminatus*, Stebbing (=G. *minutus* G. O. Sars).
42. *macrurus*, G. O. Sars.
43. *compressus*, G. O. Sars.
44. *similis*, G. O. Sars.
- Gen. 12. *Iphigenella*,
G. O. Sars.
45. *acanthopoda*, Grimm.
- Gen. 13. *Pandorites*,
G. O. Sars.
46. *podoceroideis*, Grimm.
- Gen. 14. *Cardiophilis*,
G. O. Sars.
47. *baeri*, G. O. Sars.
- Fam. *Corophiida*.
- Gen. 15. *Corophium*, Latr.
48. *nobile*, G. O. Sars.
49. *chelicorne*, G. O. Sars.
50. *curvispinum*, G. O. Sars.
51. *bidentatum*, G. O. Sars.
52. *mucronatum*, G. O. Sars.
53. *monodon*, G. O. Sars.
54. *spinulosum*, G. O. Sars.
- Branchiopoda.**
- Phyllopoda.*
- Fam. *Branchipodida*.
- Gen. 1. *Artemia*, Leach.
1. *salina*, Lin. (bay of Karabugas).
- Fam. *Limnadiida*.
- Gen. 2. *Leptestheria*,
G. O. Sars.
2. *tenuis*, G. O. Sars (pools at Astrachan).
- Cladocera.*
- Fam. *Sidida*.
- Gen. 3. *Sida*, Strauss.
3. *crystallina*, O. Fr. Müller
- Gen. 4. *Diaphanosoma*,
Fischer.
4. *brachyurum*, Liévin.
- Fam. *Daphniida*.
- Gen. 5. *Daphnia*,
O. Fr. Müller.
5. *magna*, Strauss.
6. *longispina*, O. Fr. Müller (forma major).

estuaries of Volga.

Gen. 6. *Hyalodaphnia*,
Schoedeler.

7. *jardini*, Baird.

8. *cucullata*, G. O. Sars,
var. *turrita*.

9. *magniceps*, Litheb.

10. *cristata*, G. O. Sars, var.
occurva.

Gen. 7. *Simosa*, Norman.

11. *vetula*, O. Fr. Müller.

Gen. 8. *Ceriodaphnia*,
Schoedeler.

12. *reticulata*, Jur.

Gen. 9. *Moina*, Baird.

13. *brachiata*, Jur.

14. *micrura*, Kurz.

Fam. *Bosminida*.

Gen. 10. *Bosmina*, Baird.

15. *cornuta*, Jur.

16. *coregoni*, Baird.

Fam. *Macrothricida*.

Gen. 11. *Macrothria*,
Baird.

17. *laticornis*, Jur.

Fam. *Chydorida*.

Gen. 12. *Chydorus*,
Baird.

18. *sphaericus*, O. Fr. Müller.

Gen. 13. *Eurycercus*,
Baird.

19. *lamellatus*, O. Fr. Müller.

Gen. 14. *Leydigia*, Kurz.

20. *acanthocercoides*, Fischer.

Gen. 15. *Alonella*,
G. O. Sars.

21. *rostrata*, Kock.

Gen. 16. *Camptocercus*,
Baird.

22. *macrurus*, O. Fr. Müller.

Fam. *Polyphemida*.

Gen. 17. *Polyphemus*,
O. Fr. Müller.

23. *exiguus*, G. O. Sars.

Gen. 18. *Cercopagis*,
G. O. Sars.

24. *socialis*, Grimm.

25. *robusta*, G. O. Sars.

26. *micronyx*, G. O. Sars.

27. *prolongata*, G. O. Sars.

28. *tenera*, G. O. Sars.

29. *anonyx*, G. O. Sars.

30. *neonilae*, G. O. Sars.

31. *gracillima*, G. O. Sars.

Gen. 19. *Apagis*, G. O. Sars.

32. *cylindrata*, G. O. Sars.

33. *longicaudata*, G. O. Sars.

Gen. 20. *Evadne*, Lovén.

34. *anonyx*, G. O. Sars.

subspecies: *producta*.

35. *camptonyx*, G. O. Sars.

subspecies: *attenuata*.

" *angusta*.

" *similis*.

" *orthonyx*.

" *macronyx*.

" *hamulus*.

" *podonoides*.

36. *trigona*, G. O. Sars.

subspecies: *trigonoides*.

" *intermedia*.

" *pusilla*.

37. *hircus*, G. O. Sars.

38. *maximowitschi*, G. O. Sars.

Fam. *Leptodorida*.

Gen. *Leptodora*, Lilljeb.

39. *kindti*, Foka; estuaries of
Volga.

Branchiura.

Fam. *Argulida*.

Gen. *Argulus*, O. Fr. Müller

1. *coregoni*, Thorell.

Copepoda.		Fam. Diosaccida.
<i>Calanoida.</i>		Gen. 9. Schizopera, G. O. Sars.
Fam. Centropagida.		
Gen. 1. Limnocalanus, G. O. Sars.	19. major, G. O. Sars, n. sp.	
1. grimaldi, de Guerne.	20. propinqua, G. O. Sars, n. sp.	
	21. ciliata, G. O. Sars, n. sp.	
	22. pusilla, G. O. Sars, n. sp.	
Fam. Temorida.		Fam. Canthocamptida.
Gen. 2. Eurytemora, Giesbr.	Gen. 10. Mesochra, Boeck.	
2. lascinulata, Fischer.	23. lilljeborgi, Boeck.	
3. affinis, Poppe.	Gen. 11. Nitokra, Boeck.	
4. grimmi, G. O. Sars.	24. hibernica, Brady.	
5. minor, G. O. Sars, n. sp.	25. incerta, Richard.	
Gen. 3. Popella, Richard.	Gen. 12. Woltersdorffia, Schmeil.	
6. guernei, Richard.	26. blanchardi, Richard.	
Gen. 4. Heterocope, G. O. Sars.	27. confluens, Schmeil.	
7. caspia, G. O. Sars.	Fam. Laophontida.	
Fam. Diaptomida.	Gen. 13. Laophonte, Phil.	
Gen. 5. Diaptomus, Westw.	28. mahomed, Richard.	
8. coeruleus, Fischer; estuaries of Volga.	Fam. Cletodida.	
9. gracilis, G. O. Sars; estuaries of Volga.	Gen. 14. Cletodes.	
	29. exiguus, G. O. Sars, n. sp.	
<i>Harpacticoida.</i>	Gen. 15. Cletodina, G. O. Sars, n.	
Fam. Ectinosomida.	30. knipowitschi, G. O. Sars, n. sp.	
Gen. 6. Ectinosoma, Boeck.	31. dubia, G. O. Sars, n. sp.	
10. barroisi, Richard.	Gen. 16. Nannopus, Brady.	
11. curticorne, Boeck.	32. palustris Brady.	
12. curvifrons, G. O. Sars, n. sp.	<i>Cyclopoida.</i>	
13. porrectum, G. O. Sars, n. sp.	Fam. Cyclopida.	
14. ischnum, G. O. Sars, n. sp.	Gen. 17. Cyclops, O. Fr. Müller.	
Fam. Tegastida.	33. vulgaris, Koch.	
Gen. 7. Tegastes, Norman.	34. vicinus, Uljanin.	
15. inopinatus, G. O. Sars, n. sp.	Gen. 18. Mesocyclops, G. O. Sars.	
Fam. Idyoida.	35. obsoletus, Koch.	
Gen. 8. Idyoda, Phil.	36. crassus, Fischer.	
16. caspia, G. O. Sars, n. sp.		
17. media, G. O. Sars, n. sp.		
18. brevicornis, G. O. Sars, n. sp.		

Estuaries of Volga.

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| Gen. 19. Tachycyclops,
G. O. Sars. | } Estuaries of Volga. | Gen. 27. Lernaepoda,
Blainville. | } Estuaries of Volga. |
| 37. annulicornis, Koch. | | 48. sp.? | |
| Gen. 20. Cryptocyclops,
G. O. Sars. | | Ostracoda. | |
| 38. varicans, G. O. Sars. | | Fam. Cyprida. | |
| Gen. 21. Leptocyclops,
G. O. Sars. | | Gen. 1. Cypris, O. Fr.
Müller. | |
| 39. agilis, Koch. | | 1. pubera, O. Fr. Müller. | |
| 40. orthostylis, G. O. Sars. | | Gen. 2. Cypricercus,
G. O. Sars. | |
| Gen. 22. Platycyclops,
G. O. Sars. | | 2. affinis, Fischer. | |
| 41. dilatatus, G. O. Sars, n. sp. | | Gen. 3. Cyclocypris,
Brady. | |
| Gen. 23. Halicyclops,
Norman. | | 3. minuta, O. Fr. Müller. | |
| 42. oblongus, G. O. Sars, n. sp. | Fam. Cytherida. | | |
| 43. robustus, G. O. Sars, n. sp. | Gen. 4. Cythere, O. Fr.
Müller. | | |
| 44. pygmaeus, G. O. Sars, n. sp. | 4. amnicola, G. O. Sars. | | |
| Fam. Ergasilida. | Gen. 5. Leptocythere,
G. O. Sars. | | |
| Gen. 24. Ergasilus, Nordman. | 5. oblongata, G. O. Sars, n. sp. | | |
| 45. sp.? | 6. crispata, Brady. | | |
| <i>Caligoida.</i> | Gen. 6. Cytheromorpha,
Hirschman. | | |
| Fam. Caligida. | 7. fuscata, Brady. | | |
| Gen. 25. Lepeophtheirus,
Nordm. | Gen. 7. Cyprideis, Jones. | | |
| 46. sp.? | 8. littoralis, Brady. | | |
| <i>Lernaeoidea.</i> | Gen. 8. Loxoconcha,
G. O. Sars. | | |
| Fam. Lernaepodida. | 9. umbonata, G. O. Sars, n. sp. | | |
| Gen. 26. Actheres, Nordm. | 10. abbreviata, G. O. Sars, n. sp. | | |
| 47. parcarum, Nordm. | | | |