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# CONCEPTION OF CROSSED POPULATIONS: APPLICATION IN CYCLOPOIDA TAXONOMY

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**Conception of Crossed Populations: Application in Cyclopoida Taxonomy. Monchenko V. I., Samchyshyna L. V.** — The conception of crossed populations in wide practice of taxonomic investigations in Cyclopoida is used for the first time. Applying this conception in taxonomy of cyclopoid copepods we based on revealed facts of the coexistence of sibling species which keep a little morphological hiatus. Hence, next pairs of species we consider as independent ones: *Eucyclops speratus* (Lilljeborg) and *E. serrulatus* (Lilljeborg); *Paracyclops poppei* (Rehberg) and *P. fimbriatus* (Fischer); *Megacyclops latipes* (Lowndes), *M. viridis* (Jurine) and *M. gigas* (Claus); *Diacyclops clandestinus* (Kiefer) and *D. languidoides* (Lilljeborg)*; D. hypnicola* (Gurney) and *D. languidoides* (Lilljeborg)*; D. odessanus* (Schmankevitsch) and *D. bicuspidatus* (Claus)*; Microcyclops rubellus* (Lilljeborg) and *M. varicans* (Sars); *Halicyclops septentrionalis* (Kiefer) and *H. neglectus* (Kiefer). Facts of coexistence of *Acanthocyclops americanus* (Marsh) and its form *A. americanus* f. *spinosa* (Monchenko) differing by only one qualitative feature (spine or seta on outer edge on endopodite P4 distal segment) that has no transitive manifestation do not allow us to consider morphological form *A. americanus* f. *spinosa* as a separated species from the type *A. americanus*.

Key words: Cyclopoida, sibling species, coexistence, morphological hiatus, crossed populations.

**Концепция скрещивающихся популяций: применение в таксономии Cyclopoida. Монченко В. И., Самчишина Л. В.** — Концепция скрещивающихся популяций в широкой практике таксономических исследований Cyclopoida используется впервые. Применяя эту концепцию в систематике циклопоидных копепод, мы основываемся на найденных фактах сосуществования криптических видов, которые сохраняют некоторый морфологический гиатус. Таким образом, следующие пары видов мы рассматриваем как самостоятельные: *Eucyclops speratus* (Lilljeborg) и *E. serrulatus* (Lilljeborg); *Paracyclops poppei* (Rehberg) и *P. fimbriatus* (Fischer); *Megacyclops latipes* (Lowndes), *M. viridis* (Jurine) и *M. gigas* (Claus)*; Diacyclops clandestinus* (Kiefer) и *D. languidoides* (Lilljeborg)*; D. hypnicola* (Gurney) и *D. languidoides* (Lilljeborg)*; D. odessanus* (Schmankevitsch) и *D. bicuspidatus* (Claus)*; Microcyclops rubellus* (Lilljeborg) и *M. varicans* (Sars)*; Halicyclops septentrionalis* (Kiefer) и *H. neglectus* (Kiefer). Факт сосуществования *Acanthocyclops americanus* (Marsh) и его формы *A. americanus* f. *spinosa* (Monchenko) с сохранением между ними только одной качественной разницы (шипа или щетинки на внешнем краю дистального сегмента эндоподита P4), которая не имеет транзитивного характера, не позволяет нам рассматривать морфологическую форму *A. americanus* f. *spinosa* как самостоятельную от *A. americanus*.

Ключевые слова: Cyclopoida, криптические виды, сосуществование, морфологический гиатус, скрещивающиеся популяции.

## Introduction

Experimental interpopulation crossings of species with very poor morphological differences (sibling species) are essential to prove their species independence (Monchenko, 2000). However, coexistence of closely related forms with obscure morphological hiatus is a known fact in natural environment. It is an analogue of laboratory experiments on crossings with negative results. V. Grant (1977: 169) about natural cases of coexistence writes: “Simpatric population systems of sexually reproducing organisms are, ipso facto, separate biological species. The maintenance of separate character combinations under conditions of sympatry is a natural test, and our best criterion, of the species status of the population systems involved.” Such records

of natural coexistence of closely related forms (narrow sympatry) show the reproductive sterility even more convincing than negative experimental crossings, whereas individuals from the populations, which were isolated ecologically or ethologically in natural conditions, sometimes could cross in laboratory.

**Material and methods**

The analysis of sibling species of the Cyclopoida is based on 5,500 samples collected by standard methods in different types of water-bodies in Ponto-Caspian marine and freshwater basin.

## Results and discussion

In total 125 species of freshwater and marine cyclopoid copepods were found in the Ponto-Caspian basin. Between them eight pairs of sibling species were identified.

Species rank of *Eucyclops speratus* (Lilljeborg) was considered doubtful for a long time. It was mentioned either as a *E. serrulatus* f. *speratus* or as the subspecies *E. serrulatus serrulatus*. Some authors identified it with *Eucyclops serrulatus* (Fischer) (see in Monchenko, 2003). A case of coexistence of *E. speratus* with superficially resemble *E. serrulatus* was found in the pond near village Samsonove (Donetsk Region, Ukraine, 1976). Females of both species differ by their lengths at average 1.55 times (n = 15 and 24, correspondingly). In the second case, the difference in female sizes was almost double (n = 3 and 4), in the pond near village Stepanivka (Kyiv Region, Ukraine, 1958). We consider such cases of natural coexistence of two close related "populations" having obscure morphological differences as a confirmation of their species independence. Later, the negative results from laboratory crossing experiments with *E. speratus* and *E. serrulatus* (Monchenko, 1974) conformed our preliminary assumption about species rank of both.

*Paracyclops poppei* (Rehberg) earlier was mentioned either as a form (Smirnov, 1930, etc.) or as a subspecies of *Paracyclops fimbriatus* (Fischer) (Gurney, 1933; Yeatman; 1959; etc.). Many facts of coexistence of *P. poppei* and *P. fimbriatus* in the middle basin of Dnipro River are known for us for a long time (Monchenko, 1974). Those natural coexistences are considered by us as verification of the both species rank.

*Megacyclops laticeps* (Lowndes) is morphologically similar to *M. viridis* (Jurine) and *M. gigas* (Claus). Gurney (1933) considered it as a subspecies of *M. gigas*, Rylov (1948) as its form, Lindberg (1951) as a subspecies of *M. viridis*. The cohabitation of *M. laticeps* with *M. viridis* in Latorytsya River flood-lands near Chop (Zakarpattya, Ukraine, 1969) is the fact that supports their species rank. Some authors (see: Monchenko, 2003) considered *M. laticeps* as a distinct species as well.

Nowadays, the species status of *Diacyclops clandestinus* (Kiefer) does not have any doubt (see: Monchenko, 2003). However, earlier some authors had considered it as a subspecies of *Diacyclops languidoides* (Lilljeborg) (see: Monchenko, 2003), whereas others had even synonymized it with nominative subspecies of *D. languidoides* (Ito, 1957; etc.). As reasons for separation of *D. clandestinus* from the typical *D. languidoides* are serve a few cases of coexistence that we found in samples from Tlumachyk River (Ivano-Frankivsk Region, Ukraine, 1965) and in the interstitial of Mala Ugolka River (Zakarpattya, Ukraine, 1965). These facts confirm that *D. clandestinus* deserve status as species.

Earlier considered as a subspecies, *D. languidoides hypnicola* (Gurney), is found to coexist with *D. clandestinus* (which is closely related to mentioned *D. languidoides*) in the interstitial of stream near Perechin (Zakarpattya, Ukraine, 1969), as well as in 41 km from the settlement Bakhmaro (Georgia, 1967) and in the Katekh River (Azerbaijan, 1973). These evidences of coexistence verify that *Diacyclops hypnicola* (Gurney) has species rank and should be separated from *D. languidoides*. Based on detailed study of minor morphological features, Petkovski (1984) raised *D. hypnicola* to the species rank.

Although *Diacyclops bicuspidatus* (Claus) and *Diacyclops odessanus* (Schmankevitsch) differ in number of antennula segments, the last taxon was considered either as a form or as a subspecies of *D. bicuspidatus* (summarized in: Monchenko, 1974). Conclusion about their reproductive isolation follows from the experiments done by the nature. So, in the draw well near Novoeconomichne town (Donetsk Region, Ukraine, 1976) two females of *D. odessanus* were found among 27 individuals of the first species. Morphological hiatus between these two "forms" was remained. The fact of coexistence with preservation of minor morphological differences may serve as a reason to separate *D. odessanus* as distinct species. It is remarkable, that only Schmankevitsch (1875), who described it for the first time, had been considered *D. odessanus* at the species level.

*Microcyclops rubellus* (Lilljeborg, 1901) and *M. varicans* (G. O. Sars, 1863) were originally described as separate taxa. Subsequently, several authors (Yeatman 1944**;** Pennak. Ward, 1985) considered *M. rubellus* as a subspecies of *M. varicans* rather than a distinct species. Quite often *Microcyclops rubellus* was considered also as a form *Microcyclops varicans* f. *rubellus* (Rylov; 1948; etc.). Sometimes, it was not differentiated from the closely related *M. varicans* Sars at all (Sars, 1913). However, Einsle (1993) and Reid (1992) considered it to be a distinct species. We found the *Microcyclops rubellus* together with *M. varicans* in a pool on the Caspian Sea coast (Astara, Azerbaijan, 1975). This fact of cohabitation we consider as a confirmation of species independence of *Microcyclops rubellus* and *M. varicans.*

*Halicyclops septentrionalis* Kiefer described based on two females, had extremely uncertain systematic position. It is clear from its taxonomic allocations from one species to another — *Halicyclops thermophilus septentrionalis* Kiefer (Kiefer, 1935) and *Halicyclops neglectus septentrionalis* Kiefer (Dussart; 1969; etc.). Kiefer (1935); and V. I. Monchenko (1979) considered *H. septentrionalis* as a distinct species. Detailed investigation of interpopulation variability in connection with its coexistence with *Halicyclops rotundipes* Kiefer, which is very close to *H. neglectus*, in the interstitial of split near Eisk town (Sea of Azov), shows the presence of reproductive isolation between them. Both species preserve the differences in the majority of quantitative diagnostic features, except one: the relation of the inner apical spine to outer one on the distal segment of P4 has no significant difference ($t = 1.1$), while other diagnostic features have normalized deviates of value from 4.6 up to 16.0 (Monchenko, 1979).

In all the cases of sibling species sympatry described above the morphological hiatuses in quantity characters between them are found to be remained. This allowed us to make a conclusion about species rank of number before doubtful species, and with uncertain status ones, or forms.

However, we distinguish from above the facts of coexistence of *Acanthocyclops americanus* (Marsh) and its form *A. americanus* f. *spinosa* (Monchenko) with maintenance by them only one qualitative difference, which has no transitive manifestation (either spine or seta on the outer edge of distal segment P4 endopodite). Describing the last form for the first time (Monchenko, 1961), author considered it as a morphological variation, the evolutionary parallelism like as with *Acanthocyclops vernalis* typ. and *A. vernalis* f. *robusta* (G. O. Sars). Coexistence of *A. americanus* f. *spinosa* (with spine) with *A. americanus* (with seta) is an example of wide morphological variability and does not mean, in our opinion, existence of the reproductive sterility between them but frequency-inherited dependences of corresponding alleles, which are under the environmental control or under any genetic factors. Cases of coexistence of both forms are those: two ponds near Ganiri and Kondoli villages (Transcaucasia, Georgia, 1969, 1970); Poplavskyj and Vasyliv ponds (Sivash, Kherson Region, Ukraine, 1966).

The concept of crossed populations is used for the first time in wide practice of taxonomic investigations in Cyclopoida. Such recognition of the species rank in Copepoda is supported also by other colleagues who studied cases of coexistence of

closely related forms with small morphological differences (e. g., Petkovski, 1984, Lazzaretto et al., 1985; etc.). It increased the number of new species descriptions in the genus *Diacyclops*, poorly differentiated morphologically: *D. paolae* Pesce et Galassi, *D. sardous* Pesce et Galassi, *D. paralanguidoides* Pesce et Galassi, *D. maggii* Pesce et Galassi (Pesce, Galassi, 1987).

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