

UDC 593.176

COMPARATIVE MORPHOLOGY OF *DENDROCOMETES PARADOXUS* (CILIOPHORA, SUCTOREA) FROM TWO DISTANT REGIONS (UKRAINE AND MEXICO) AND DIFFERENT HOST SPECIES

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Comparative Morphology of *Dendrocometes paradoxus* (Ciliophora, Suctorea) from two Distant Regions (Ukraine and Mexico) and Different Host Species. Dovgal I. V., Mayén-Estrada R. — Comparative analysis of *Dendrocometes paradoxus* Stein, 1852 cell morphology from various gammarid amphipod species in different regions of Ukraine, and those attached to several host body parts of *Hyalella azteca* collected in two Mexican lakes, was carried out in order to demonstrate the morphological variability, due to the hosts species or their geographical distribution. For hosts species and corporal distribution, no significant differences between the two populations were shown. As the result, it was found the suctorians common for amphipod crustaceans from Ukraine and Mexico all are conspecific and belong to *D. paradoxus*.

Key words: suctorians, *Dendrocometes paradoxus*, distribution, morphology, variability, hosts, Ukraine, Mexico.

Сравнительная морфология *Dendrocometes paradoxus* (Ciliophora, Suctorea) из удалённых регионов (Украина и Мексика) и с разных видов хозяев. Довгаль И. В., Майен-Эстрада Р. — Приводятся результаты сравнительного анализа морфологии суктории *Dendrocometes paradoxus* Stein, 1852 из различных регионов Украины (с разных видов гаммарид) и с амфиподы *Hyalella azteca*, собранной в двух мексиканских озерах. Существенных отличий между особями инфузории с разных хозяев, при разной локализации на теле хозяев, а также связанных с географическим распространением хозяев, обнаружено не было. Таким образом, на амфиподах из пресных водоёмов Украины и Мексики обитает один вид сукторий — *D. paradoxus*.

Ключевые слова: суктории, *Dendrocometes paradoxus*, распространение, морфология, изменчивость, хозяева, Украина, Мексика.

Introduction

The suctorian *Dendrocometes paradoxus* Stein, 1852 is the type species of the genus *Dendrocometes* Stein, 1852. This freshwater species is widely distributed in Eurasia. There are some records of *D. paradoxus* in European countries as well as from Siberia, Russian Far East and Japan (Jankowski, 2007).

The first record of *D. paradoxus* in North America was done by Stokes (1888), but no accurate pictorial species description from the region was done. Moreover, Jankowski (2007) reported that it is still unknown if this species really exists in North America. However, Dovgal and Grigorovich (2000) found typical *D. paradoxus* on the gills of *Gammarus lacustris* Sars, 1863 collected from Lake Pyramid, Alberta, Canada and *Eulimnogammarus ischnus* (Stebbing, 1898) sampled from Detroit River, Ontario, Canada.

According to Jankowski (2007), *D. paradoxus* is a commensal on gills of various gammarid amphipods such as *Gammarus pulex* (Linnaeus, 1758), *G. lacustris*, *G. balcanicus* Schäferna, 1922, *G. ochridensis* (Schäferna, 1926), *G. fossarum* Koch, 1835, *G. ambulans* (O. F. Müller, 1846), *G. kischineffensis* Schellenberg 1937, *G. roeselii* Gervais, 1835, *Niphargus puteanus* (Koch, 1836), *Jesogammarus* sp., and *Chaetogammarus ischnus* (Stebbing, 1898). Also, in Lake Baikal the species was observed on *Eulimnogammarus hyacinthinus* (Dybowski, 1874), *Pallasea* sp., and *Micrurops* sp. (Jankowski, 2007).

There are some observations of *Dendrocometes* species on the representatives of other amphipod families, and the unusual localization of suctorian at the host body in such cases is usually observed. For example, *Dendrocometes* sp. was found on the coxal gills of *Paramoera myslenkovi* Sidorov, 2010 (family Eusiridae Stebbing, 1888) from rivers near Laso, Southern Prymorye, Russia (Sidorov, 2010).



Fig. 1. Collecting sites (marked by black spots) of *Dendrocometes paradoxus* in Ukraine.

Рис. 1. Пункты сбора *Dendrocometes paradoxus* на территории Украины (обозначены чёрными точками).

Dendrocometes peregrinus Small et Lynn, 1985 was found only once on the North American amphipod crustaceans *Hyaella azteca* (Saussure, 1858) (family Dogielinotidae Gurjanova, 1953), *Crangonyx forbesi* (Hubricht et Mackin, 1940) and *C. obliquus* (Hubricht et Mackin, 1940) (family Crangonyctidae Bousfield, 1973) attached to the body tergites (Morado, Small, 1995).

It has been documented that cell size and shape of commensal suctorians varies according to the host species and localization on their bodies (Matthes, 1954 a, b; Dovgal, 2008; Mariño-Pérez et al., 2011). The cell size and shape of commensal suctorians was documented to vary depending on the host species and localization on their bodies (Matthes, 1954 a, b; Dovgal, 2008; Mariño-Pérez et al., 2011). Thus, to test these differences, we present some data about cell morphology and host distribution in two populations of *D. paradoxus*, one Ukrainian and the other Mexican, from different crustacean taxa.

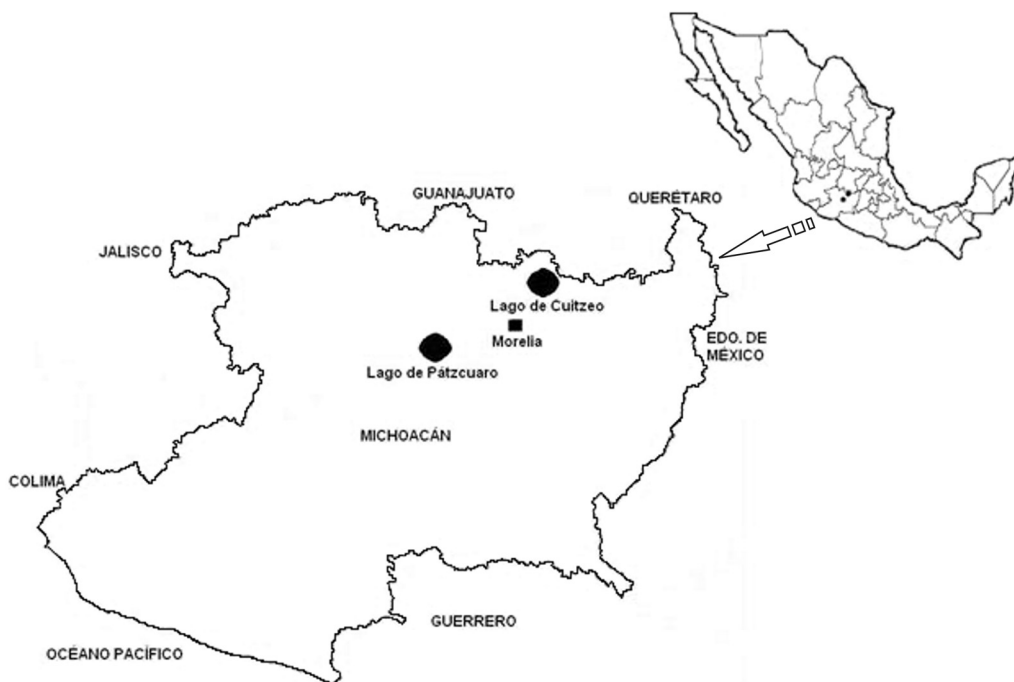


Fig. 2. Collecting sites (marked by black spots) of *Dendrocometes paradoxus* in Mexico.

Рис. 2. Пункты сбора *Dendrocometes paradoxus* на территории Мексики (обозначены чёрными точками).

Material and methods

Ukrainian amphipods were collected in 20 localities (fig. 1) with a mesh net or by manual sampling, and then sorted on the spot from the living material, fixed and preserved with 4 % formalin. Mexican amphipods were obtained from two localities (fig. 2) at Michoacán State, Mexico by using a mesh net; some specimens were fixed with 70 % alcohol and some were maintained alive for observation.

Through fine microscopical observation, the suctorian ciliates were recorded and identified, by using several stain techniques such as Harris haematoxylin (Aladro-Lubel et al., 1990).

Measurements were made by means of the ocular micrometer. Statistical analysis was performed with the aid of PAST 1.92 software (Hammer et al., 2001).

Results and discussion

Ukrainian specimens. *Dendrocometes paradoxus* was found on gills of *Gammarus balcanicus* from spring at the right bank of the river Dniester near village Petryliv, and in the river Suchava near village Shepot of Ivano-Frankivsk Region; on gills of *G. lacustris* in the lake Khotin near village Radichev and in the lake Verben' near village Spasskoe of Chernihiv region, in the river Goryn' near villages Stavok and Velyki Tseptsevychi of Rivne Region, in the river Sluch near village Prisluch of Rivne Region, in the river Oster near Oster of Chernihiv Region, in the river Vovk near urban village Letychiv of Khmelnytsky Region, in the river Seversky Donets near village Morozivka of Kharkiv Region; on gills of *Gammarus* sp. in the river Sluch near village Marinin of Rivne Region, in the river Kolomak near village Verkholy of Poltava Region, in the stream near village Krasnolesye, in the stream Karasu-Bashy near village Perevalnoe and in the stream at the East flank of the Ayu-Dag mountain near urban village Partenit of Crimean Autonomous Republic, in the lake Nobel' near village Nobel' of Rivne Region and on gills of *G. kischineffensis* from the river Mala Uhol'ka near village Mala Uhol'ka of Transcarpathian Region.

The suctorians have hemispherical or rarely flattened up to discal cell body. The macronucleus is ellipsoidal, centrally located. There is single contractile vacuole. 1–7 ramified tentacles are allocated near body edge.

It should be mentioned that in our material the individual of *D. paradoxus* with strongly diminished tentacle similar to characteristic marginal tentacles of *D. peregrinus* was found from *G. lacustris* (fig. 3).

Measurements (in μm). Body diameter from 25.0 to 100.0 (mean 56.8 ± 4.1), macronucleus diameter from 7.0 to 42.0 (mean 21.0 ± 1.91), tentacle length from 20.0 to 92.1 (mean 52.6 ± 3.3).

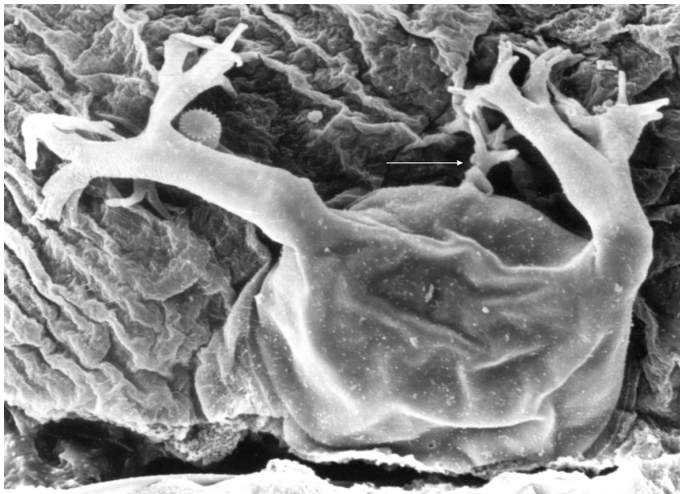


Fig. 3. *Dendrocometes paradoxus* on the gill of *Gammarus lacustris*. Diminished tentacle is marked by arrow. Scanning electron microscopy (x860).

Рис. 3. *Dendrocometes paradoxus* на жабре *Gammarus lacustris*. Редуцированное щупальце обозначено стрелкой. Сканирующая электронная микроскопия (x860).

Mexican specimens. *Dendrocometes paradoxus* was found attached to coxae and pereopods of *Hyalella azteca* from Pátzcuaro Lake and Cuitzeo Lake, Michoacán (fig. 4, *a-d*).

Unstalked trophonts are hemispherical in outline, in lateral view with a dome-like shape. With 5–7 wider radiating tentacles, dichotomously branched with digitiform ramifications at their tip. There is a central ovoid macronucleus, one contractile vacuole and several food vacuoles.

Measurements (in μm). Body diameter from 40.0 to 82.0 (mean 63.2 ± 1.3), macronucleus diameter from 10.0 to 16.0 (mean 14.2 ± 0.7), tentacle length from 34.8 to 59.2 (mean 51.6 ± 3.7).

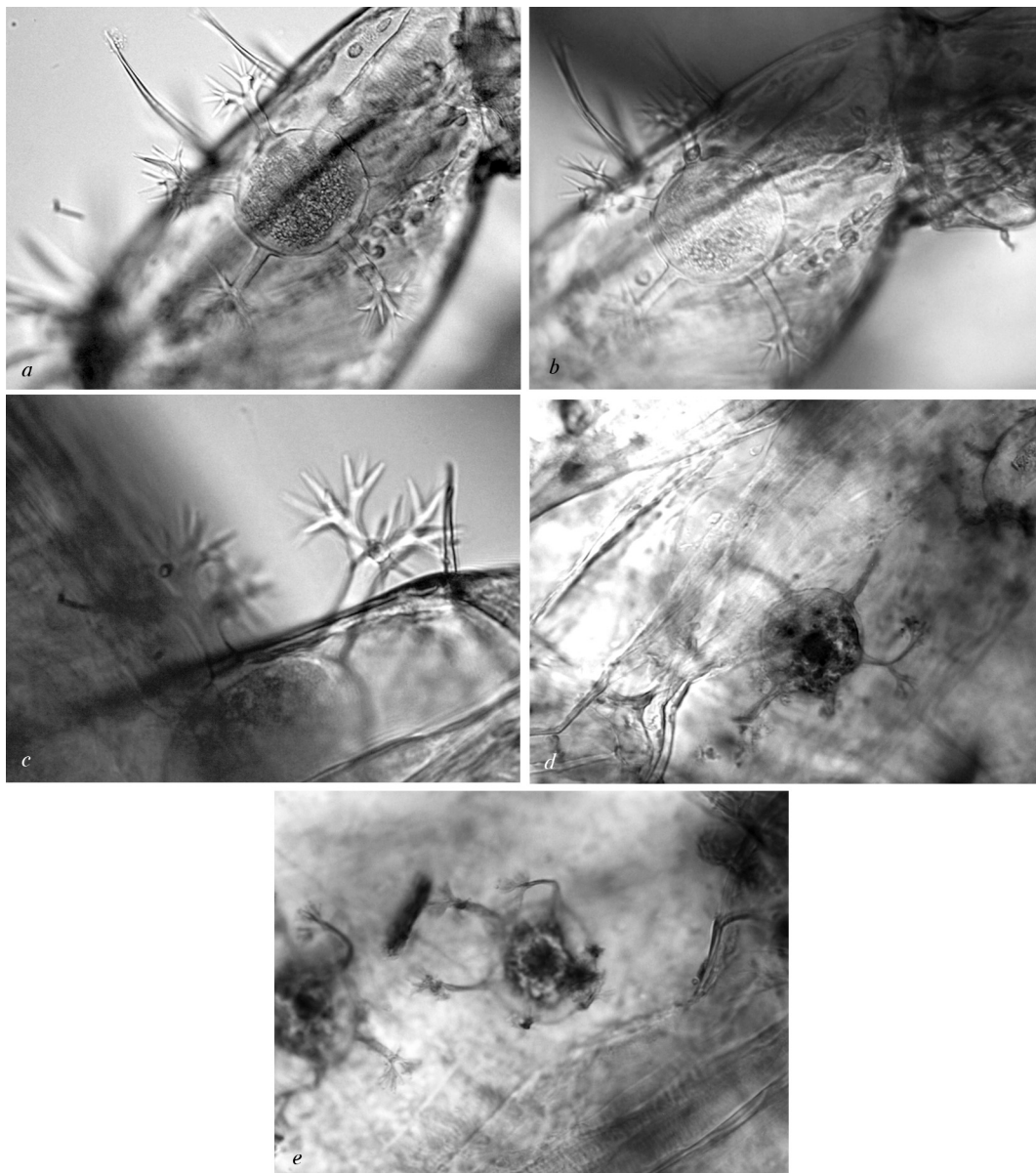


Fig. 4. *Dendrocometes paradoxus* attached to Mexican *Hyalella azteca*: *a, b, c* — individuals from Cuitzeo lake, live; *d, e* — specimens from Pátzcuaro lake, stained with haematoxylin.

Рис. 4. *Dendrocometes paradoxus* с *Hyalella azteca* из Мексики: *a, b, c* — живые особи из озера Куитцео; *d, e* — особи из озера Патскваро, окраска гематоксилином.

Population comparison. The cell measurements of *D. paradoxus* from different host species are presented in table 1. By comparing the means of morphometric parameters of *D. paradoxus*, with Student's t-test, showed reliable differences only between means of the macronucleus diameter ($t = 2.51$ under $p = 0.02$).

The discriminant analysis displayed the overlaps in the two first canonical variables between the dimensional parameters in *D. paradoxus* specimens from the two continents (fig. 5), and demonstrating that dendrocometid suctorians from Ukraine and Mexico are closely analogous both in body morphology and measurements.

However, morphological and morphometric differences according to the host and localizations on the host body have been documented in other suctorian species (Matthes, 1954 a, b; Dovgal, 2008, Mariño-Pérez et al., 2011).

In this connection comparisons of the means of dimensional parameters of *D. paradoxus* with Student's t-test, showed reliable differences in means of body diameter between specimens from *G. balcanicus* and *G. lacustris* ($t = 3.33$ under $p = 0.01$) as well as from *G. balcanicus* and *H. azteca* ($t = 3.45$ under $p = 0.004$), and *G. kischineffensis* and *H. azteca* ($t = 3.91$ under $p = 0.05$). However no differences by this parameter were found between *G. lacustris* and *H. azteca*.

Table 1. Morphometry of *D. paradoxus* from different host species

Таблица 1. Размерные характеристики *D. paradoxus* с разных видов хозяев

Host species	Body diameter, μm	Macronucleus diameter, μm	Length of the tentacles, μm
<i>G. lacustris</i>	25–100.0 (mean 68.9 ± 8.7)	7.0–39.0 (mean 25.7 ± 3.9)	20.0–91.1 (mean 12.9 ± 0.8)
<i>G. balcanicus</i>	26.3–76.3 (mean 50.5 ± 4.5)	7.9–42.1 (mean 19.9 ± 2.2)	23.67–68.38 (mean 48.4 ± 3.0)
<i>G. kischineffensis</i>	43.8–57.9 (mean 51.4 ± 4.1)	11.2–13.8 (mean 12.9 ± 0.8)	36.8–92.1 (mean 66.8 ± 16.0)
<i>H. azteca</i>	40–81.2 (mean 63.2 ± 1.3)	10–16.8 (mean 14.2 ± 0.7)	34.8–59.2 (mean 51.6 ± 3.7)

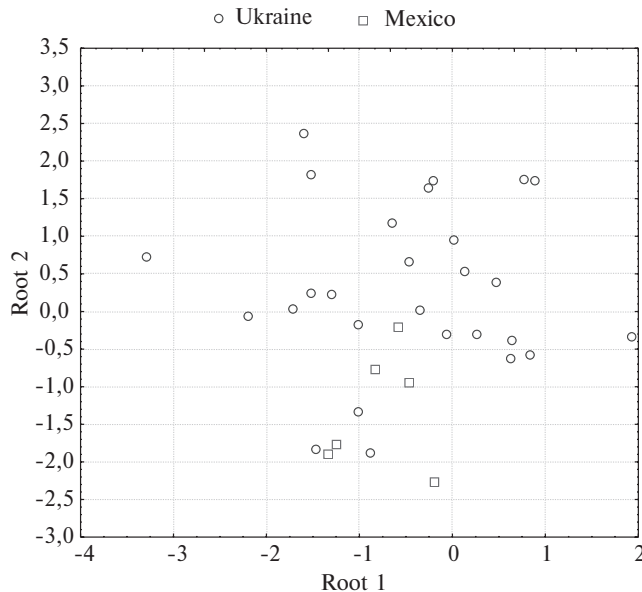


Fig. 5. Scatterplot of canonical scores computed for dimensions of individuals of *Dendrocometes paradoxus* from Ukraine and Mexico.

Рис. 5. Распределение особей *Dendrocometes paradoxus* из Украины и Мексики в пространстве двух первых канонических переменных.

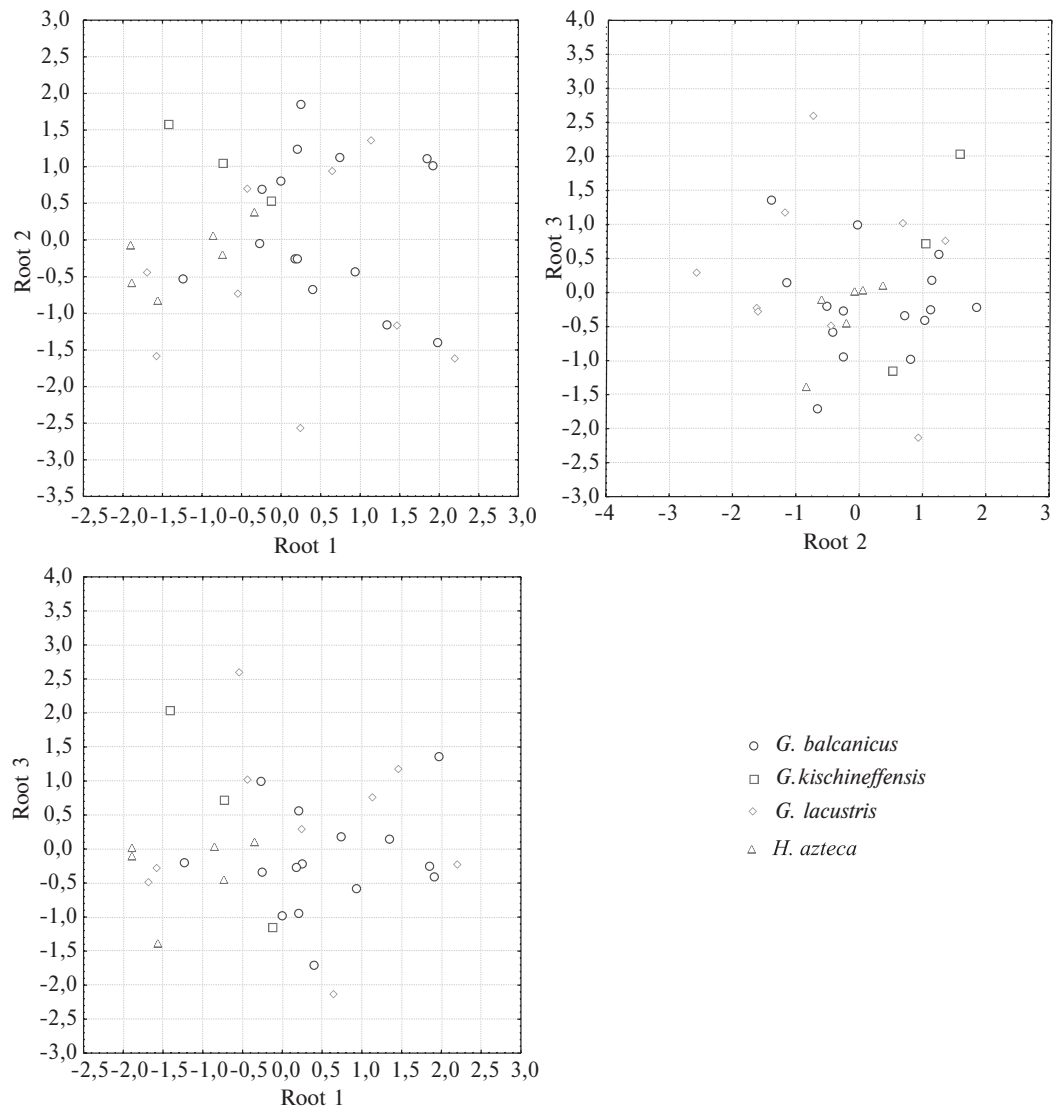


Fig. 6. Scatterplots of canonical scores computed for dimensions of individuals of *Dendrocometes paradoxus* from different host species: 1 — Root 1 versus Root 2; 2 — Root 2 versus Root 3; 3 — Root 1 versus Root 3.

Рис. 6. Распределение особей *Dendrocometes paradoxus* с разных видов хозяев: 1 — в пространстве двух первых канонических переменных; 2 — в пространстве второй и третьей канонических переменных; 3 — в пространстве первой и третьей канонических переменных.

We found differences in the means of macronucleus diameter between specimens from *G. balcanicus* and *G. lacustris* ($t = 2.42$ under $p = 0.04$), and *G. lacustris* and *H. azteca* ($t = 2.65$ under $p = 0.03$). However no differences by this parameter were found between *G. kischineffensis*, *G. balcanicus* and *H. azteca*.

Also, we did not find any difference for the length of tentacles in ciliates from all host species.

Processing the data with a discriminant analysis, the overlaps in the three first canonical variables between the dimensional parameters in *D. paradoxus* specimens from different hosts were displayed (fig. 6), which means that despite of that this dendrocometid sucktorian is a commensal of a non-gammarid amphipode in an unusual hosts localization in the case of Mexico specimens, we have not obtained any statistical difference between Mexican and Ukrainian dendrocometids.

Mariño-Pérez with co-authors (2011) documented the variability of the suctorian *Discophrya elongata* (Claparede et Lachmann, 1859) on different host species with some ciliate adaptations to certain conditions on the host body, in particular to hydrodynamic properties.

However, *D. elongata* is a stalked species rising above substrate, whereas *D. paradoxus* is a representative of unstalked flattened forms (Dovgal, 2002). It is known that stalked protists are exposed to two main hydrodynamic loads — shear stress which maximally acts at the attachment point, and the integrated force which maximally incidences at its distal (apical) end (Dovgal, Kochin, 1997; Dovgal, 2000). All the flattened sessile protists like *D. paradoxus* are subjected to shear stress only due to be located in the limits of the displacement thickness. Only both increasing of the cell body basal area along with increasing of the body size were reported as sessile protists adaptations for shear stress (Dovgal, Kochin, 1997; Dovgal, 2000).

As the result, amphipod crustaceans from Ukraine and Mexico share a suctorian common species, *Dendrocometes paradoxus*, attached to different host species, and with a different host corporal distribution.

We conclude that hydrodynamic conditions are not different for *D. paradoxus* to attach to various regions of the host body and, in contrast to other species of commensal suctorians, its morphological variability is not associated both with habitation at different host species and with various localizations at the host body.

We would like to express our thanks to DGAPA–PAPIIT–UNAM IN229811 for the funds to obtain samples from Mexico. Secretaría de Intercambio Académico and DGECI, UNAM, provided to RME support for a short stay at Schmalhausen Institute of Zoology, NAS of Ukraine. From Facultad de Ciencias, UNAM, to M. Vicencio and M. Reyes for their technical support for Mexican samples, and to R. Aguilar for Cuitzeo sample collection. To M. Hermoso, ICMyL, UNAM for the Mexican amphipod identification.

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Received 11 February 2013

Accepted 20 May 2013