A new freshwater ciliate from northeastern Azerbaijan: 
Gymnocyclidium nabranicum n. gen., n. sp and 
Gymnocyclidiidae n. fam. (Scuticociliatida, Ciliophora)

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Abstract: From 2003 to 2006, the freshwater ciliates of northeastern Azerbaijan were studied. The present paper describes a new ciliate – Gymnocyclidium nabranicum n. gen., n. sp. (Gymnocyclidiidae n. fam.) that clearly differs from other representatives of Scuticociliatida by reduction of bipolar somatic kinetics to 2 or 3 short longitudinal crowns. Gymnocyclidiidae n. fam. includes 3 genera – Gymnocyclidium n. gen. (type genus), Paurotricha Dragesco and Dragesco-Kerneis, 1991 and Paracyclidium Grolière, de Puytorac, Grain, 1980.

Key words: Scuticociliatida, freshwater, ciliates, Azerbaijan

Introduction
The free-living ciliates of Azerbaijan have been insufficiently studied. This unicellular group of protists shows much diversity in the different geographic regions of Azerbaijan. Numerous clean, small rivers and spring waters characterize the northeastern area. There has not been an investigation on freshwater ciliates of this region, except for a general research on hydrobiological, in which other groups hydrobionts 9 ciliates species were mentioned (Veysig, 1940).

This study was carried out from 2003 to 2006, where we researched the free-living ciliates fauna of northeastern Azerbaijan. The present paper describes new scuticociliatid ciliates from the freshwaters of this region of Azerbaijan.

Materials and methods
Freshwater ciliates have been discovered in several small rivers and spring waters of northeastern Azerbaijan, mainly near the Russian border. We collected and processed 140 samples of plankton, periphyton, and benthos. The ciliates were collected by microcapillars and studied under both in vivo and postmortem conditions. For postmortem surveying, we used the silver nitrate (Chatton and Lwoff, 1930) and protargol (Alekperov, 1992) impregnation methods. Impregnated cells were drawn using a camera lucida. The measurements on length and width of cells were made both on living specimens and after impregnation. All measurements were taken based on 10 specimens. The type material has been deposited in the collection of the Protistology
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laboratory in the Institute of Zoology of NAS of Azerbaijan, Baku.

Morphometric data are based on randomly selected, protargol impregnated and mounted non-dividers; statistics were analyzed using the SigmaStat 2.0 program; abbreviations in the tables are as follows: \( \bar{X} \) – arithmetic mean, \( M \) – median, \( SD \) – standard deviation, \( SE \) – standard error, \( CV \) – coefficient of variance (in %), \( Max \) – maximum, \( Min \) – minimum, \( n \) – number of specimens.

Results

Family *Gymnocyclidiidae* n. fam. (Figure 1, A-F)


Somatic ciliature reduces to a longer apical crown bearing double kinetosomes, and a posterior shorter one – 1 of *Parurotricha* and *Paracyclidium* genera and 2 posterior crowns of the *Gymnocyclidium* n. gen, bearing simple kinetosomes. Unciliated wide equatorial area separates anterior crown from posterior ones.

There are 2 caudal cilia and 2 post-oral scutica.

*Gymnocyclidiidae* n.fam. includes 3 monotypic genera - *Gymnocyclidium* n. gen. (type genus), *Parurotricha* Dragesco and Dragesco-Kerneis, 1991, described from Lake Tanganyika (Dragesco and Dragesco-Kerneis, 1991) and *Paracyclidium* Grolière, de Puytorac, Grain, 1980. The first two genera (*Gymnocyclidium* n. gen. and *Parurotricha*) are free-living, but the third, *Paracyclidium*, is an endocommensal of sea urchins (Grolière et al., 1980). The new family *Gymnocyclidiidae* n. fam. clearly differs from other representatives of Scuticociliatida Small, 1967 by its strong reduction of somatic ciliature.

**Genus Gymnocyclidium n. gen.**

**Diagnosis.** Freshwater. Medium size (in vivo 55-70 μm × 35-40 μm) ciliates with typical Scuticociliatida buccal ciliature included undulating membrane and 3 (M₁, M₂, M₃) oral membranelles. Outline oval with truncated anterior and posterior poles. Somatic ciliature reduced to 3 different width

Figure 1. Three monotypic genera including in *Gymnocyclidiidae* m. fam. A-B – *Gymnocyclidium nabranicum* n. gen., n. sp.; C-D – *Parurotricha cyclidiformis* Dragesco et Dragesco-Kerneis, 1991 (according to Dragesco et Dragesco-Kerneis, 1991); E-F – *Paracyclidium rhabdotectum* (Powers, 1935) Grolière, de Puytorac, Grain, 1980 (according Grolière, de Puytorac, Grain, 1980) UM – undulating membrane; M₁, M₂, M₃ – oral membranelles; Ct – cytostome; S – scutica; CC – caudal cilia; AR – anterior somatic crown; PR – posterior somatic crown; CR – caudal somatic crown; Lcs – lateral ciliary scarf; Ma – macronucleus; Mi – micronucleus Scale line: 20 μm (A-B); 10 μm (C-F)
short ciliary crowns – longer anterior, consists of dikinetids shorter – posterior, consists of simple kinetosomes and third caudal, consists of only 1 kinetosome.

There are 2 caudal cilia and 2 postoral scutica.

Type species *Gymnocyclidium nabranicum* n. gen., n. sp.

**Comparison with related genera.** *Gymnocyclidium* n. gen. resembles the genus *Parurotricha* in its outline, with truncated anterior and posterior poles and owing to the fact that its kinetosomes are double in the anterior crown and single in the posterior one, but it is quite different by the lack of the typical oblique ciliary scarf of *Parurotricha*. *Gymnocyclidium* n. gen. and it also clearly differs from *Parurotricha* by the presence of 3 crowns (*Parurotricha* has only 2) of somatic ciliature.

The new genus differs from the marine genus *Paracyclidium* from endocommensal sea urchins in its arrangement and structure of oral membrandelles, especially more long cone-shaped membrandelles $M_3$, more wide unciliated equatorial area and also the presence of 3 somatic ciliature crowns (*Paracyclidium*, like *Parurotricha* has only 2). There are certainly ecological differences between the free-living freshwater *Gymnocyclidium* n. gen. and the endocommensal of marine sea urchins, *Paracyclidium*.

*Gymnocyclidium nabranicum* n. gen., n. sp.

(Figure 1, A-B; Figure 2, A-B)

**Diagnosis.** Outline oval with truncated anterior and posterior poles. Somatic ciliature reduced to 3 different width ciliary crowns. First anterior consists of 17-20 rows of dikinetids with 16-18 in each row. Second posterior consists of 17-18 rows situated on the caudal quarter cell and consists 7-8 simple kinetosomes in each row. Third caudal crown consists of only 1 kinetosome. There are 2 caudal cilia and 2 postoral scutica. Morphometric characteristics of *G. nabranicum* n. gen., n. sp. are given in the Table.

**Type location.** Sandy bottom of the shallow spring water near Nabran village.

**Type specimens.** 1 holotype as a slide (N-2) of protargol impregnated cells.

**Description.** The living cells 55-70 μm × 35-40 μm, after fixation 45-55 μm × 22-30 μm. The body shape was oval with truncated anterior and posterior ends. Buccal infraciliature typical of the Scuticociliatida: large buccal area including on the left, 3 adoral membrandelles: $M_1$ – double row of 10-11 dikinetids, $M_2$ more voluminous cone-like of 21-24 kinetosomes and $M_3$ – double row of 5-6 dikinetids. On the right, an enclosing paroral undulating membrane, with double kinetosomes joined in zig-zag pattern. The fine cytostome located in the upper left margin of undulating membrane. Below the undulating membrane, there were 2 or 3 postoral scutica. Somatic ciliature was composed of 3 different width ciliary crowns. First, anterior crown consists of 17-20 rows of dikinetids with 16-18 in each row. Second, posterior crown of 17-18 rows situated on the caudal quarter cell and consists 7-8 simple kinetosomes in each row. Third, caudal crown consists of only one ring of kinetosomes. On the caudal end 2 caudal cilia and between anterior and posterior crowns there is a wide unciliated zone.

The endoplasm transparent had spherical dark inclusion in the anterior part and usually 3-7 food vacuoles with bacteria. Macronucleus was oval to spherical (13 μm) with single micronucleus (2-3.5 μm) located usually in the mid body or anterior part. Contractile vacuole was located posteriorly. Cytoproct was unknown, as not shown by protargol impregnation.
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Table 1. Morphometric characteristics of *Gymnocyclidium nabranicum* n. gen., n. sp.

<table>
<thead>
<tr>
<th>Character</th>
<th>$\bar{X}$</th>
<th>M</th>
<th>SD</th>
<th>SE</th>
<th>CV</th>
<th>Min</th>
<th>Max</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body length</td>
<td>48.7</td>
<td>48.0</td>
<td>3.401</td>
<td>1.075</td>
<td>6.984</td>
<td>45.0</td>
<td>55.0</td>
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<tr>
<td>Body width</td>
<td>26.6</td>
<td>26.5</td>
<td>2.951</td>
<td>0.933</td>
<td>11.094</td>
<td>22.0</td>
<td>30.0</td>
<td>10</td>
</tr>
<tr>
<td>Length of adoral membranelle $M_1$</td>
<td>4.3</td>
<td>4.50</td>
<td>0.823</td>
<td>0.260</td>
<td>1.914</td>
<td>3.0</td>
<td>5.0</td>
<td>10</td>
</tr>
<tr>
<td>Length of adoral membranelle $M_2$</td>
<td>7.791</td>
<td>7.90</td>
<td>0.336</td>
<td>0.101</td>
<td>4.313</td>
<td>7.0</td>
<td>8.10</td>
<td>11</td>
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<tr>
<td>Length of adoral membranelle $M_3$</td>
<td>3.460</td>
<td>3.50</td>
<td>0.259</td>
<td>0.0819</td>
<td>7.486</td>
<td>3.10</td>
<td>4.0</td>
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<tr>
<td>Undulating membrane length</td>
<td>31.6</td>
<td>33.0</td>
<td>3.658</td>
<td>1.157</td>
<td>11.576</td>
<td>27.0</td>
<td>35.0</td>
<td>10</td>
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<tr>
<td>Somatic kineties number in the anterior crown</td>
<td>18.5</td>
<td>18.0</td>
<td>1.179</td>
<td>0.373</td>
<td>6.373</td>
<td>17.0</td>
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<td>Somatic kineties number in the posterior crown</td>
<td>17.5</td>
<td>17.5</td>
<td>0.527</td>
<td>0.167</td>
<td>3.400</td>
<td>17.0</td>
<td>18.0</td>
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<td>Somatic kineties number in the caudal crown</td>
<td>17.750</td>
<td>18.0</td>
<td>0.463</td>
<td>0.164</td>
<td>2.608</td>
<td>17.0</td>
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<td>10</td>
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<tr>
<td>Caudal cilia number</td>
<td>2.0</td>
<td>2.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2.0</td>
<td>2.0</td>
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<tr>
<td>Postoral scutica number</td>
<td>2.4</td>
<td>2.0</td>
<td>0.516</td>
<td>0.163</td>
<td>21.5</td>
<td>2.0</td>
<td>3.0</td>
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<tr>
<td>Kinetosomes number in each row of anterior crown (dikinetids)</td>
<td>16.9</td>
<td>17.0</td>
<td>0.738</td>
<td>0.233</td>
<td>4.367</td>
<td>16.0</td>
<td>18.0</td>
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<tr>
<td>Kinetosomes number in each row of posterior crown</td>
<td>7.5</td>
<td>7.5</td>
<td>0.527</td>
<td>0.167</td>
<td>7.027</td>
<td>7.0</td>
<td>8.0</td>
<td>10</td>
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<tr>
<td>Kinetosomes number in caudal crown</td>
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<td>1.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.0</td>
<td>1.0</td>
<td>10</td>
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<tr>
<td>Macronucleus length</td>
<td>12.420</td>
<td>12.5</td>
<td>0.377</td>
<td>0.119</td>
<td>3.035</td>
<td>12.0</td>
<td>13.0</td>
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<tr>
<td>Macronucleus width</td>
<td>7.540</td>
<td>7.5</td>
<td>0.331</td>
<td>0.105</td>
<td>4.390</td>
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<td>10</td>
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<tr>
<td>Micronucleus diameter</td>
<td>2.850</td>
<td>3.0</td>
<td>0.435</td>
<td>0.138</td>
<td>15.263</td>
<td>2.0</td>
<td>3.5</td>
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References


