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Morphogenetic and biometric comparison of four populations of *Urosomoida agiliformis* (Ciliophora, Hypotrichida)*

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Comparaison biométrique et morphogénétique de quatre populations d'*Urosomoida agiliformis* (Ciliophora, Hypotrichida).

RÉSUMÉ

Il y a une tendance accrue à utiliser des caractères biométriques et morphogénétiques pour distinguer les ciliés hypotriches, au niveau spécifique. Cependant, peu de données sont encore disponibles quant à la variabilité de tels caractères entre populations naturelles. Aussi, avons-nous comparé 4 populations d'*Urosomoida agiliformis* Foissner, 1982. Elles sont morphologiquement et biométriquement peu distinctes. Cependant, 2 populations ont 2 cirres transverses, 2 en ont normalement 4. Considérant que ce caractère est très variable dans le groupe *Urosoma-Urosomoida-Gonostonum*, il ne peut être suffisant pour distinguer ces populations au niveau spécifique. Il en est de même pour quelques différences morphogénétiques mineures. Par contre, dans les 4 populations, il y a 2 champs isolés de cinétosomes pendant les premiers stages de la morphogenèse. En conséquence, nous concluons que les 4 populations appartiennent à la même espèce et nous maintenons que *Urosomoida agiliformis* est très semblable à *Oxytricha longa*, Gelei et Szabados, 1950 et à *Oxytricha similis* Engelmann, 1862. Les seules méthodes morphologiques classiques ne peuvent trancher le statut d'espèces différentes pour les 4 populations d'*Urosomoida agiliformis* et les 2 espèces d'*Oxytricha*.

SUMMARY

There is an increasing trend to use biometric and morphogenetic characters to separate hypotrichous ciliates at species level. However, few data are available about the variability of such characters between natural populations. Thus, we compared 4 populations of *Urosomoida agiliformis* Foissner, 1982. They are morphologically and biometrically poorly distinguishable. However, two populations have 2 transverse cirri and two have normally 4. Considering the high variability of this character in the *Urosoma-Urosomoida-Gonostomum*-group it is very likely not sufficient to separate these populations at species level. The same is true of some minor morphogenetic differences. In addition, there is the remarkable similarity that all 4 populations have two isolated fields of kinetosomes during the early morphogenetic stages. From these data we conclude a conspecifity of the 4 populations investigated and maintain that *Urosomoida agiliformis* is very similar to both *Oxytricha longa* Gelei and Szabados, 1950 and *Oxytricha similis* Engelmann, 1862. Classical morphological methods do not allow a clear decision on the species status of the 4 populations of *Urosomoida agiliformis* and the two *Oxytricha*-species.

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Abstract

Morphology and morphogenesis of 4 populations of *Urosomoida agiliformis* from different regions of the world have been compared. Two populations have 2 transverse cirri and two have normally 4. Cluster analysis of 18 characters showed, however, no clear separation of these populations. The morphogenetic events are very similar in all 4 populations. Thus, they are considered as conspecific, in spite of the different number of transverse cirri.

Synopsis

La comparaison de la morphologie et de la morphogenèse de 4 populations d'*Urosomoida agiliformis* provenant de différentes parties du monde, montre que 2 populations ont 2 cirres transverses, 2 en ont 4. L'analyse de 18 caractères ne permet pas une séparation entre ces populations dont les processus morphogénétiques sont, par ailleurs, très semblables. Aussi sont-elles considérées comme représentatives d'une même espèce.

INTRODUCTION

In recent times morphogenetical criteria have been used more and more for the classification of higher taxa of ciliated protozoa (FOISSNER and ADAM, 1982, 1983; HEMBERGER, 1982; FLEURY and FRYD-VERSAVEL, 1984; WIRNSBERGER *et al.*, 1986). However, at the present state of knowledge there exists no solid basis for an application of such characters to the genus or species level. A main reason for that is the lack of information about the variability of morphogenetic features between populations (FOISSNER and ADAM, 1982).

This motivated us to compare 4 populations of *Urosomoida agiliformis* FOISSNER, 1982. A detailed description of the morphogenesis of one population of this species is already available (FOISSNER and ADAM, 1982).

MATERIAL, METHODS AND TERMINOLOGY

The following populations (P) of *Urosomoida agiliformis* were compared *in vivo* and by means of protargol silver impregnated slides (staining method of FOISSNER, 1982).

P1 : soil of a beech wood near Baumgarten (see FOISSNER, 1982). P2 : soil of an alpine meadow near Heiligenblut (description of morphogenesis see FOISSNER and ADAM, 1982). P3 : river Salzach in Salzburg upon sediments on bank in November 1984. The animals were examined *in vivo*, drawn and subsequently cultivated. As a culture medium Eau de Volvic was used, with some squashed wheat grains added to support the bacterial growth. The cultures were not cloned. To make plain the changes during the morphogenetical processes, parental cirri were depicted only by contour, whereas the new ones were filled in. The drawings were made with the help of a camera lucida. P4 : soil of a meadow in Israel in February 1985. Because of the conformity of the cirral pattern with P3, we omit to give separate drawings.

All measurements in *Table I* are based on protargol impregnated individuals and were carried out by an ocular micrometer. 1 scale mark corresponded to 1.3 µm at a magnification of 850x. The populations were compared by a nonparametric a posteriori testing procedure according to Nemenyi (SACHS, 1984). From 25 biometrically analysed individuals of each population we used only 24 for this testing procedure because we consider the single case of a highly deviating number of cirri (e.g. 1 postoral ventral cirrus) as abnormal. The results for 18 characters are illustrated in the right column of *Table I*. In order to discern the phenetic resemblance, we added the « Number of Not Significantly Different Characters » (NNSDC) for each pair of population for $\alpha = 0.05$ (BERGER *et al.*, 1985). These values were converted to percentages with 18 = 100 %, which denotes « total similarity ». The phenogram was constructed by the unweighted pair-group method with arithmetic averages (UPGMA ; SNEATH and SOKAL, 1973). The calculations were performed on a TI-66 minicomputer of Texas Instruments. The terminology is according to WALLENGREN (1900) and KAHL (1932).

RESULTS

MORPHOLOGY OF POPULATIONS 3 AND 4

P3 and P4 possess, contrary to P1 (= type population) and P2, which have mostly 2 transverse cirri, normally 4 transverse cirri in a J-shaped short row *(fig. 1, 2)*. Close to them, but clearly distinguishable, there are 2 ventral cirri, whereas P1 and P2 only have 1 ventral cirrus at this site. Both populations measure *in vivo* about 60 to 100 X 25 to 35 µm.

The posterior half of the buccal field in P3 is covered by a very hyaline pellicular projection *(fig. 1, 4)*. This « roof » commences slightly above the buccal cirrus and ends before the first cirrus of the left marginal row. Whether it also exists in P1, P2 and P4 could not be investigated because these populations are no longer being cultivated. A second peculiarity of P3 is that the undulating membranes lie partly over the adoral zone of membranelles *(fig. 1, 2, 4)*. However, this feature is not

constant, as it is shown by some individuals whose undulating membranes lie closely beneath the adoral zone of membranelles.

MORPHOGENESIS OF POPULATION 3 AND DIFFERENCES TO POPULATION 2 (FOISSNER AND ADAM, 1982)

About 300 dividing individuals have been studied. Some characteristic stages are depicted in *figures 5-8* and *10-15*.

Stomatogenesis. The formation of the new oral apparatus commences with a proliferation of kinetosomes closely to the left of the anterior postoral ventral cirrus, which remains undissolved *(fig. 5)*. Immediately afterwards a second field of kinetosomes develops apokinetally above the left transverse cirrus *(fig. 6)*. Some stages show the continuous enlargement of the anterior field of kinetosomes. It always remains more or less oval and undivided. A second primordium definitely does not appear in this region.

On the contrary, in P2 the anarchic field develops from 3 primordia. 2 originate at the site of the posterior postoral ventral cirri and the third one, as in P3, above the transverse cirri (FOISSNER and ADAM, 1982 ; *fig. 3)*. Eventually, in all 4 populations, the proliferation of kinetosomes of these initial primordia produce 2 extended fields of kinetosomes on the ventral side *(fig. 6, 16, 17* ; FOISSNER and ADAM, 1982 ; *fig. 5)*. The fields grow together by further proliferation of kinetosomes and generate the anarchic field, which is distinctly broader in P3 than in P1, P2 and P4 *(fig. 7* ; FOISSNER and ADAM, 1982 ; *fig. 7)*.

Development of the cirral primordia. In P3, the formation of the frontal-ventral-transverse (FVT)-streaks of the proter proceeds simultaneously with those of the opisthe *(fig. 8, 10, 11)*. On the contrary, the 5 FVT-streaks of the opisthe of P2 originate a little earlier than those of the proter (FOISSNER and ADAM, 1982 ; *fig. 11)*.

The FVT-streaks V and VI of the opisthe of P3 extend towards the frontal field and generate the FVT-streaks V and VI of the proter *(fig. 8, 10)*. In P2, the FVT-streaks V and VI of the proter presumably develop *de novo*.

In general, 6 FVT-streaks are developed. Occasionally, 7 FVT-streaks occur. This supernumerary streak gets resorbed during the differentiation of the cirri, because in later stages 7 FVT-streaks were never observed.

Differentiation of the new cirri. In the proter and in the opisthe each FVT-streak finally generates the following number of cirri :

FVT-streak	I	II	III	IV	V	VI
number of cirri	1	2	3	3	4	4

This mode is true of individuals with 4 transverse cirri *(fig. 13*, opisthe). In animals with 5 transverse cirri (8 %) the leftmost transverse cirrus derives from FVT-streak II *(fig. 13*, proter). Individuals with 3 transverse cirri (8 %) are probably produced by a resorption of the cirrus III/1 during the migration of the new cirri to their determined position, because FVT-streak III always differentiates 3 cirri.

The mode for the differentiation of the new cirri in P2 was changed from 1, 2, 2, 3, 3, 3 to 1, 2, 2, 2, 3, 4 (BERGER *et al.*, 1985). This alteration is based on the assumption that the uppermost cirrus in the area of the transverse cirri is a ventral cirrus.

Development of the dorsal primordia. The development of the dorsal primordia in P3 proceeds in a very similar way to P2.

Nuclear apparatus. The macronucleus pieces in P3 do not show the conspicuous changes of their shape during morphogenesis, unlike those described in P2. Contrary to P2, the micronuclei are stainable with protargol silver during the interphase (2.0 – 3.1 X 1.7 – 2.3 µm ; n = 25). Their number varies between 1 and 3 ($\bar{X}$ = 1.96). The micronuclei of P3 enlarge to 4 – 5 µm during the morphogenetical processes. The size of the micronuclei in interphase individuals of P4 is about 1.5 – 2.5 X 1.4 – 2.0 µm (n = 25). A constant number of 2 micronuclei was observed, each in close contact with a macronucleus piece.

BIOMETRICAL COMPARISON

The 4 populations of *Urosomoida agiliformis* are biometrically poorly separable. Nearly all features overlap, except for the number of transverse cirri (included the ventral cirri nearby), which is distinctly higher in P3 than in P1 and P2. On the other hand, the number of adoral membranelles is lower in P4 than in P1 and P2 *(table I)*. The number of the anterior frontal cirri and the number of the buccal cirri are constant within and among the populations. A very low variability is shown by the posterior frontal cirri, the caudal cirri, the macro- and micronuclei and the number of the dorsal kineties. Out of 100 biometrically analysed individuals, 98 have four dorsal kineties and 1 individual of P2 possesses five, 1 has three. In these characters no significant differences are demonstrable by the testing procedures of Nemenyi. The rather high coefficients of variation of the postoral ventral cirri and the posterior frontal cirri result from deviations of the number of cirri within only 1 or 2 individuals, respectively.

P3 and P4 significantly differ in body length and the length of the macronucleus pieces from P1 and P2. P4 significantly differs from all other populations by a lower number of cirri in the left and the

TABLE I. – Biometrical characterization and multiple comparison of 4 populations (P1-P4) of *Urosomoida agiliformis*

Character		$\bar{X}$	$\tilde{X}$	SD	CV	Min	Max	n	Multiple comparison* P1	P2	P3
Body, length in µm	P1	70.4	70	7.6	10.7	54	87	25			
	P2	69.6	70	7.3	10.5	55	87	25	NS		
	P3	58.9	59	7.1	12.0	47	75	25	++	++	
	P4	60.6	59	9.6	15.8	39	76	25	++	+	NS
Body, width in µm		19.9	20	2.0	10.1	16	24	25			
		21.7	21	3.2	14.9	16	28	25	NS		
		19.4	19	5.0	25.9	13	30	25	NS	NS	
		16.4	16	2.4	14.6	10	21	25	++	++	++
Number of macronucleus pieces		2.1	2	0.3	13.3	2	3	25			
		2.0	2	0.2	9.8	2	3	25	NS		
		2.0	2	0.0	0.0	2	2	25	NS	NS	
		2.0	2	0.2	9.8	2	3	25	NS	NS	NS
Macronucleus length in µm		14.8	15	2.1	14.5	9	19	25			
		14.4	14	1.9	13.5	11	20	25	NS		
		10.7	11	1.1	10.3	9	13	25	++	++	
		11.6	12	2.0	16.9	8	15	25	++	++	NS
Macronucleus width in µm		5.3	5.3	0.8	15.7	4	6.6	25			
		6.6	7	1.1	16.9	4	8.5	25	++		
		5.3	5	0.7	14.3	4	6.5	25	NS	++	
		4.9	5	0.7	15.3	3.9	6	25	NS	++	NS
Number of adoral membranelles		21.5	22	1.0	4.7	19	23	25			
		22.2	22	1.3	6.0	20	26	25	NS		
		19.9	20	1.1	5.8	18	22	25	+	++	
		16.7	17	0.9	5.5	15	18	24	++	++	++

Following of the table p. 204

Abbreviations used in the figures and tables

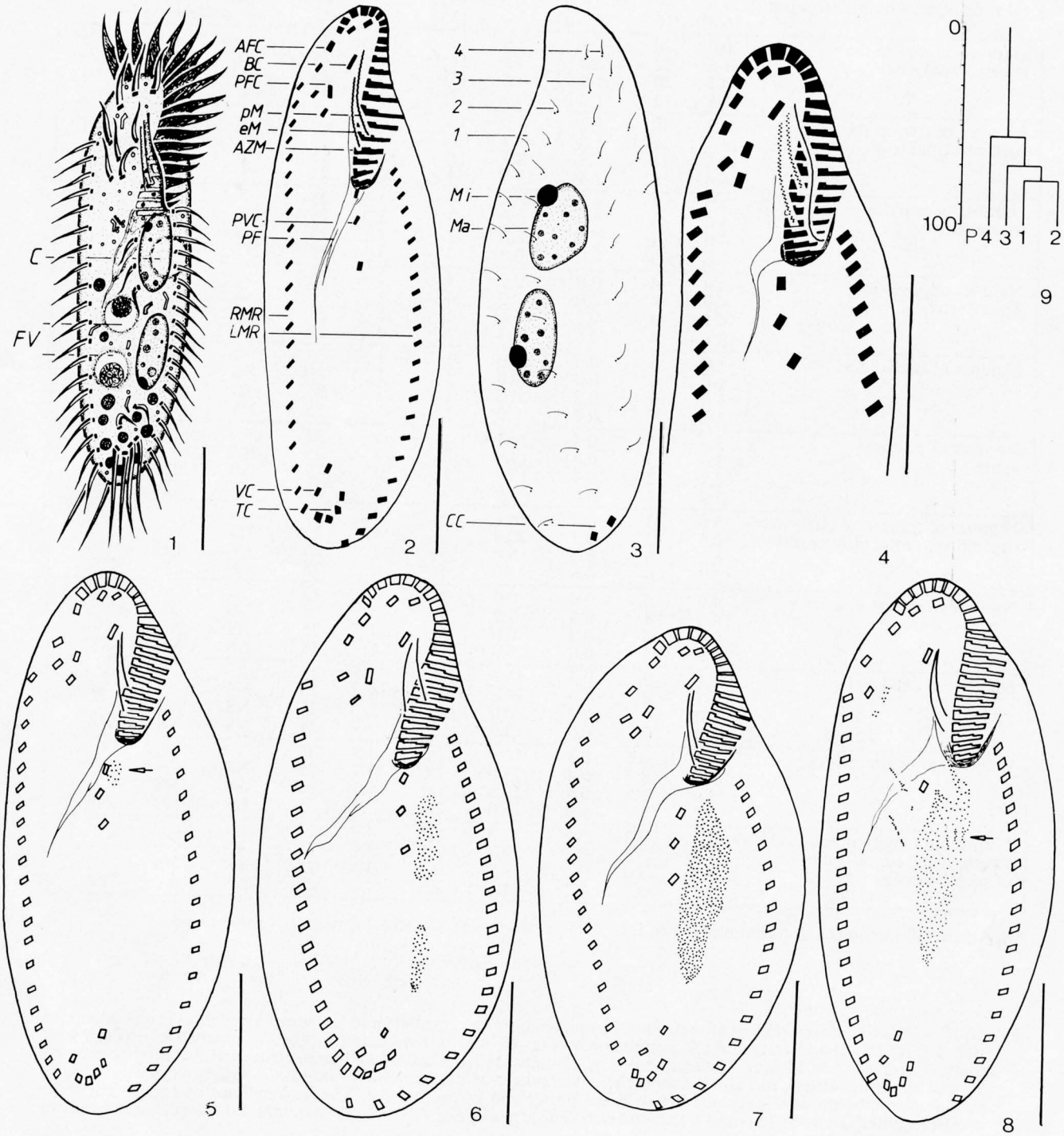
AFC, anterior frontal cirri.
AZM, adoral zone of membranelles.
BC, buccal cirrus.
C, contractile vacuole.
CC, caudal cirri.
CV, coefficient of variation in %.
eM, endorale membrane.
FV, food vacuole.
LMR, left marginal row.
Ma, macronucleus.
Max, maximum value.
Mi, micronucleus.
Min, minimum value.
n, sample size.
P, population.
PF, pharyngeal fibers.
PFC, posterior frontal cirri.
pM, paroral membrane.
PVC, postoral ventral cirri.
RMR, right marginal row.
SD, standard deviation.
TC, transverse cirri.
VC, ventral cirri.
$\bar{X}$, mean.
$\tilde{X}$, median.
1-4, number of dorsal kineties.

FIG. 1-8. – Morphology and morphogenesis of population 3 of *Urosomoida agiliformis* from life *(Fig. 1)* and after protargol impregnation *(Fig. 2-8)*. (Each scale mark is equivalent to 15 µm). *1*. Ventral view. *2, 3*. Infraciliature of the ventral and dorsal side during the interphase. *4*. Infraciliature of the oral apparatus in detail. *5-8*. Infraciliature of early morphogenetical stages. The arrow in *Fig. 5* denotes the first proliferation of kinetosomes for the oral apparatus of the opisthe. The arrow in *Fig. 8* marks the first sign of the differentiation of adoral membranelles.

FIG. 9. – Phenogram of 4 populations of *Urosomoida agiliformis*. UPGMA clustering of the number of not significantly different characters (NNSDC) in % obtained by multiple comparison procedure on 18 characters (= 100 %) presented in Table I. Significance level for multiple comparison procedure $\alpha = 0.05$.

FIG. 1-8. – Morphologie et morphogenèse de la population 3 d'*Urosomoida agiliformis* sur le vivant *(Fig. 1)* et après imprégnation au protargol *(Fig. 2-8)*. L'échelle indique 15 µm. *1*. Vues ventrales. *2, 3*. Infraciliature des faces ventrale et dorsale pendant l'interphase. *4*. Détail de l'infraciliature orale. *5-8*. Infraciliature des premiers stades de la morphogenèse. La flèche *Fig. 5* indique la première prolifération des cinétosomes de l'appareil oral de l'opisthe. La flèche *Fig. 8* marque le premier indice de différenciation des membranelles adorales.

FIG. 9. – Phénogramme des 4 populations d'*Urosomoida agiliformis* d'après analyse des 18 caractères présentés dans le tableau I.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FV
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AFC
BC
PFC
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P 4 3 1 2
9
5
6
7
8

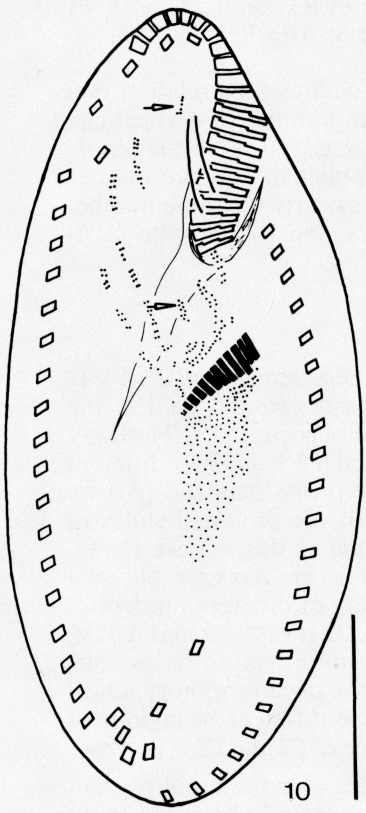
TABLE I (Following).

Distance from the anterior end of the body to the end of the adoral zone of membranelles in µm	19.0	19	1.5	8.0	17	22	25			
	21.0	21	1.6	7.6	18	24	25	++		
	19.5	19	1.6	8.5	16	22	25	NS	NS	
	16.6	16	2.2	13.2	13	20	25	+	++	++
Number of cirri in the left marginal row	20.0	20	1.5	7.6	16	23	25			
	21.6	22	2.0	9.2	18	25	25	NS		
	19.7	20	1.8	9.1	17	23	25	NS	NS	
	15.8	15	1.7	10.6	13	20	25	++	++	++
Number of cirri in the right marginal row	20.2	20	1.2	5.9	18	23	25			
	24.1	24	2.3	9.7	20	29	25	++		
	20.4	21	1.8	8.9	16	23	25	NS	++	
	16.4	16	1.8	10.7	14	20	25	++	++	++
Number of anterior frontal cirri	3.0	3	0.0	0.0	3	3	25			
	3.0	3	0.0	0.0	3	3	25	NS		
	3.0	3	0.0	0.0	3	3	25	NS	NS	
	3.0	3	0.0	0.0	3	3	25	NS	NS	NS
Number of posterior frontal cirri	4.0	4	0.0	0.0	4	4	25			
	4.0	4	0.0	0.0	4	4	25	NS		
	4.1	4	0.3	6.8	4	5	25	NS	NS	
	3.8	4	0.6	16.3	1	4	25	NS	NS	NS
Number of buccal cirri	1.0	1	0.0	0.0	1	1	25			
	1.0	1	0.0	0.0	1	1	25	NS		
	1.0	1	0.0	0.0	1	1	25	NS	NS	
	1.0	1	0.0	0.0	1	1	25	NS	NS	NS
Number of postoral ventral cirri	3.1	3	0.4	14.1	3	5	25			
	3.0	3	0.4	14.9	2	5	25	NS		
	2.9	3	0.4	13.7	1	3	25	NS	NS	
	3.0	3	0.0	0.0	3	3	25	NS	NS	NS
Number of transverse cirri (including ventral cirri nearby)	3.0	3	0.2	6.6	3	4	25			
	2.9	3	0.6	20.8	1	4	25	NS		
	6.0	6	0.4	6.8	5	7	25	++	++	
	5.7	6	0.6	11.0	4	6	25	++	++	NS
Number of dorsal kineties	4.0	4	0.0	0.0	4	4	25			
	4.0	4	0.3	7.2	3	5	25	NS		
	4.0	4	0.0	0.0	4	4	25	NS	NS	
	4.0	4	0.0	0.0	4	4	25	NS	NS	NS
Number of caudal cirri	2.1	2	0.3	15.6	2	3	25			
	2.1	2	0.5	24.8	1	4	25	NS		
	2.0	2	0.0	0.0	2	2	25	NS	NS	
	2.0	2	0.0	0.0	2	2	24	NS	NS	NS
Proportion length : width	3.5	3.6	0.4	11.3	2.7	4.3	25			
	3.2	3.3	0.4	12.0	2.6	3.9	25	NS		
	3.2	3.2	0.9	29.5	1.9	5.5	25	NS	NS	
	3.7	3.7	1.0	26.0	2.6	7.3	25	NS	NS	NS
Proportion length of body : length of the adoral zone of membranelles	3.7	3.8	0.5	12.3	2.8	4.7	25			
	3.3	3.3	0.3	9.3	2.4	3.9	25	++		
	3.0	3.0	0.2	7.8	2.7	3.4	25	++	NS	
	3.7	3.7	0.4	11.6	2.8	4.2	25	NS	++	++

* See material, methods and terminology. NS, $P > 0.05$; +, $0.05 \geq P > 0.01$; ++, $p \leq 0.01$; two tailed.

FIG. 10-17. - *Urosomoida agiliformis* after protargol impregnation. Intermediate and late morphogenetical stages of population 3 *(Fig. 10-15)* and early stage in population 1 *(Fig. 16)* and in population 4 *(Fig. 17)*, respectively. (Each scale mark is equivalent to 15 µm). The arrows in *Fig. 10* mark the dispersal of the buccal cirrus and the anterior postoral ventral cirrus the arrows in *Fig. 11* denote the development of the marginal primordia. The arrows in *Fig. 12* show the origin of the dorsal kinety number 4 in the proter and in the opisthe. The broken lines in *Fig. 13* show the displacement of the frontal-ventral-transverse cirri. The arrow in *Fig. 14* marks the parental short dorsal kinety number 4.

FIG. 10-17. - Suite des stades de la morphogenèse dans la population 3 *(Fig. 10-15)* et premiers stades morphogénétiques dans les populations 1 *(Fig. 16)* et 4 *(Fig. 17)*. (L'échelle indique 15 µm). Les flèches *Fig. 10* indiquent la dispersion du cirre buccal et du cirre antérieur postoral ventral. Les flèches *Fig. 11* indiquent le développement des primordiums marginaux ; celle *Fig. 12*, l'origine de la cinétie dorsale 4 dans le proter et dans l'opisthe ; les lignes interrompues *Fig. 13* montrent le déplacement des cirres fronto-ventro-transverses. La flèche *Fig. 14* marque la courte cinétie dorsale parentale 4.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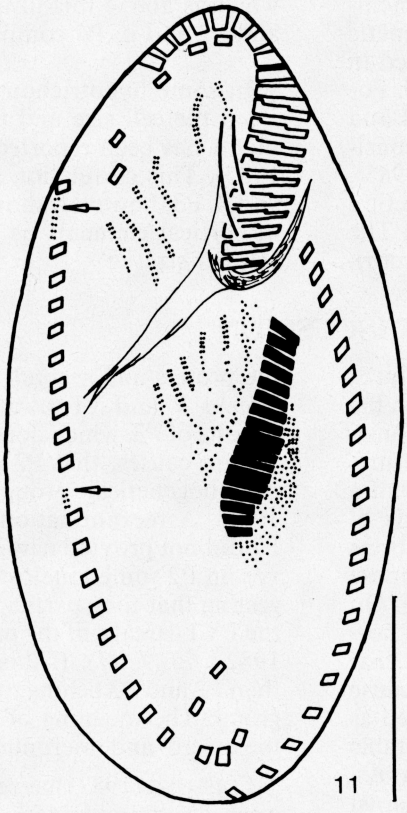
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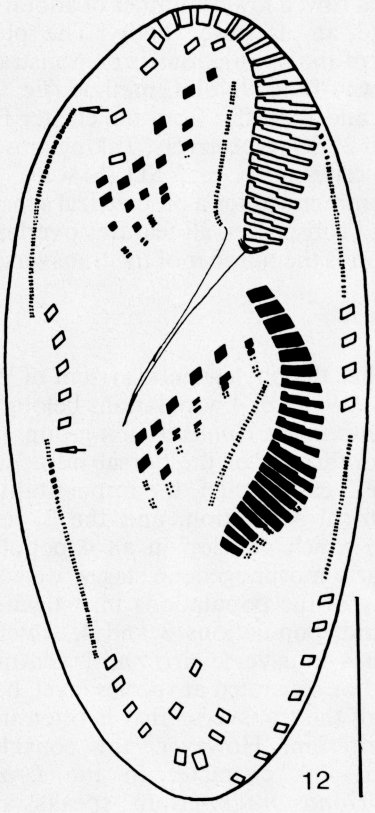
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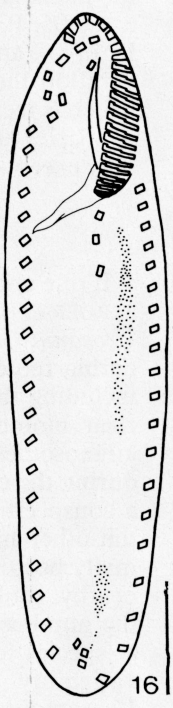
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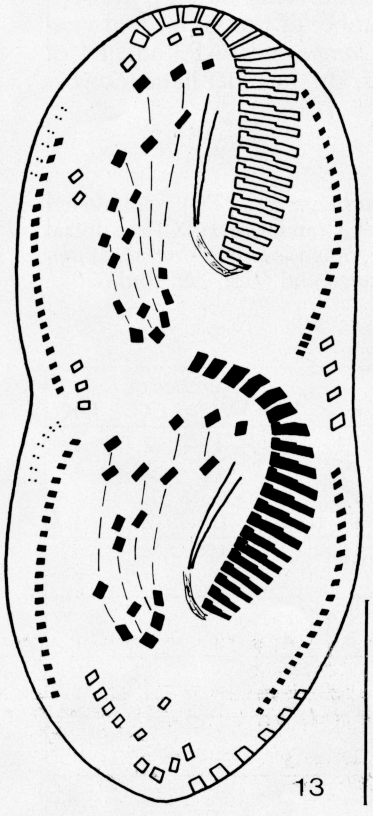
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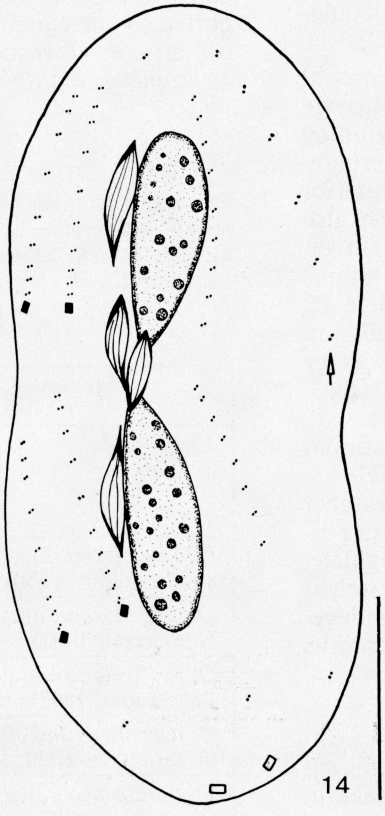
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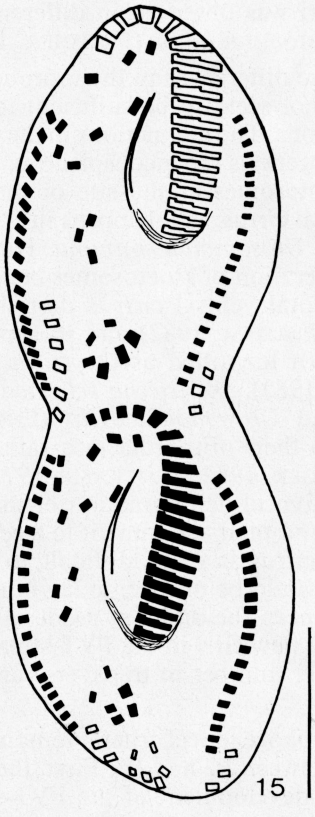
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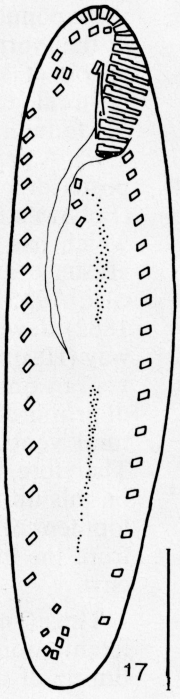
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right marginal row, a lower number of adoral membranelles and an narrower body. The phenetic resemblance of the populations is demonstrated in the phenogram of the NNSDC method *(fig. 9)*. For $\alpha = 0.05$, P3 and P4 differ from the cluster P1 and P2 in 8 % and 22 %, respectively. Taking into consideration the criterion $\bar{X} \pm 3$ SD (MACKO, 1985), which is recommended for a biometrical separation of species and subspecies, all features overlap. The only exception is the number of the transverse cirri, which is above this limit in P3 compared with P1 and P2 and in P4 compared with P1.

In some hypotrichous ciliates a correlation between the cell size and the number of cortical elements has been reported (e.g. WIRNSBERGER *et al.*, 1985). This correlation applies to populations 1, 2 and 4. P3, however, shows nearly the same number of cortical elements as P1 and P2, in spite of its smaller size.

DISCUSSION

If one applies the phylogenetic system of WIRNSBERGER *et al.* (1986) all 4 populations belong to the *Urosoma-Urosomoida-Gonostomum*-group. Considering the conformity of the dorsal infraciliature, including the 2 caudal cirri, the impossibility of a clear biometrical separation, and the 2 fields of kinetosomes, which develop in all 4 populations during the early morphogenetic stages, we suppose a conspecifity of the populations investigated. On the other hand, populations 3 and 4, which normally possess 4 transverse cirri and 2 ventral cirri nearby, could be separated at species level, because the number of the transverse cirri is often used as a species criterion. However, the considerable variability of this character in the *Urosoma-Urosomoida-Gonostomum*-group speaks against such a decision. For instance, a number of 0 - 7 transverse cirri was observed in different populations of *Gonostomum affine* (FOISSNER, 1982).

Likewise, the differences in the morphogenetical processes do not seem to be sufficient to separate these populations. The distinctions in the beginning of the morphogenesis are inconspicuous. A proliferation of kinetosomes at the site of the anterior postoral ventral cirrus, as it happens in P3, can also be found in *Urosomoida minima* HEMBERGER, 1985. A proliferation of kinetosomes beneath the 2 posterior postoral ventral cirri is described in P2 (FOISSNER and ADAM, 1982) and in a population which has been identified as *Oxytricha longa* by HEMBERGER (1982). *Oxytriccha selvatica* HEMBERGER, 1985 and *Urosomoida agilis* (ENGELMANN, 1862) develop their primordia in a rather similar way (HEMBERGER, 1982 ; BUITKAMP, 1975). However, an unequivocal determination of the number of primordia and their assignment to a certain postoral ventral cirrus is often difficult to evaluate. Therefore, it would be unwise, to lay much weight on this difference. The different mode of the development of the new cirri in the FVT-streaks results from the higher number of transverse and ventral cirri.

Thus, 2 morphogenetical criteria remain for a differentiation between P2 and P3. First, the different timing of the development of the FVT-streaks in the proters and second, the extension of the FVT-streaks V and VI towards the frontal field in the opisthe of P3, which does not occur in P2. The latter feature causes, that P2 and P3 belong to different morphogenetical groups (FOISSNER and ADAM, 1982). A reexamination of the protargol slides of P2 did not provide new data on this subject. However, in P2 some kinetosomes are recognizable, suggesting that they participate in the development of the FVT-streaks of the proter (FOISSNER and ADAM, 1982 ; *fig. 9, 11*). If this interpretation holds true, then P2 and P3 belong to the same morphogenetical group. The meaning of the different behaviour of the macro- and micronuclei of P2 and P3 is unclear.

FOISSNER (1982) has referred to the similarity between *Urosomoida agiliformis* and *Oxytricha longa* GELEI and SZABADOS, 1950. This similarity is supported by the equal number of transverse and ventral cirri in *Oxytricha longa* and in P3 and P4 of *Urosomoida agiliformis*. On the other hand, *Oxytri-*

TABLE II. - Number of transverse cirri (TC), ventral cirri near the transverse cirri (VC), caudal cirri (CC) and dorsal kineties (DK) in different populations of *Urosomoida agiliformis, Oxytricha longa* and *Oxytricha similis*

Species		Number of TC	VC	CC	DK
Urosomoida agiliformis	P1	2	1	2	4
	P2	2	1	2	4
	P3	4	2	2	4
	P4	4	2	2	4
O. longa (according to Gelei and Szabados, 1950)		4	2	2	5
O. longa (according to Hemberger, 1982)		4	2	3	4
O. similis (according to Engelmann, 1862)		5	2	2	?
O. (Opisthotricha) similis (according to Kahl, 1932)		5	2	2	?
O. similis (according to Hemberger, 1982)		5	2	3	5

cha longa is difficult to separate from *Oxytricha similis* ENGELMANN, 1862 and is indeed considered as a junior synonym by BORROR (1972). The possibility that the 4 populations of *Urosomoida agiliformis*, *Oxytricha longa* and *Oxytricha similis* are populations of one and the same species cannot be ruled out. They all have an oval body shape and deviate only by 1 dorsal kinety, 1 caudal cirrus, 1 ventral cirrus and 1 - 3 transverse cirri *(table II)*. Obviously, classical morphological methods do not allow a clear decision whether these populations belong to one or more taxa. Genetical and biochemical investigations will probably show that we are dealing with sibling species.

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