

Two Newly Recorded Ciliates, *Oxytricha balladyna* and *O. longa* (Ciliophora: Spirotrichea: Sporadotrichida) from Korea

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ABSTRACT

Two oxytrichid ciliates collected from the two habitats (soil under pine forest near beach and sewage treatment plant) in Korea were identified as *Oxytricha balladyna* Song and Wilbert, 1989 and *O. longa* Gelei and Szabados, 1950. These species are reported in this paper for the first time from Korea. The description was based on the observation of living specimens and protargol impregnated specimens. Diagnostic characteristics for each species are as follows. *O. balladyna*: one micronucleus located between two macronuclei, five transverse cirri, three caudal cirri, five rows of dorsal kinety, no granule in cytoplasm. *O. longa*: each micronucleus closely located near two macronuclei, three postoral ventral cirri lying in a straight line and positioned far away from transverse cirri, four transverse cirri, two caudal cirri, four rows of dorsal kinety, yellow-green granules scattered on cytoplasm.

Key words: *Oxytricha*, redescription, sewage treatment plant, soil, morphology

INTRODUCTION

Eigner (2001) estimated that the species diversity belong to the genus *Oxytricha* amounts to at least 58 species, but three species have been recorded in Korea upto now: *O. haematoplasma* Blatterer and Foissner, 1990, *O. hymenostoma* Stokes, 1887 and *O. rubripuncta* Berger and Foissner, 1987

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(Shin and Kim, 1993). Recently, *O. haematoplasma* has moved into different genus *Rubrioxytricha*, as a type species, by the characteristics of the color of cytoplasm and cortical granules (Berger, 1999). Most *Oxytricha* species have been reported from aquatic habitats, like various freshwater and marine environments. In this study, we redescribed two *Oxytricha* species (*O. balladyna*, and *O. longa*) have not been recorded in Korea. The former species was collected from soil and the latter from the waters of sewage treatment plant.

MATERIALS AND METHODS

The specimens of *O. balladyna* were collected from the soil under the pinetree in the Mulgeonbangjoeoburim Forest, Samdong-myeon, Namhae-gun, Gyeongsangnam-do, Korea, on 15 May 2003. The specimens of *O. longa* were collected from the waters of Yongyoen sewage treatment plant in Ulsan, Korea, from April to July 2004. The collected samples were moved to the laboratory, and the ciliates were isolated and cultured in commercial mineral water with dried wheat grains. Specimens were observed *in vivo* and protargol impregnated specimens, and analyzed biometrically (Wilbert, 1975; Shin and Kim, 1993). The shapes and movements of the living specimens were captured by digital video camera recorder. We adopted the classification schemes established by Small and Lynn (1985) and Lynn and Corliss (1991).

RESULTS AND DISCUSSION

Phylum Ciliophora Doflein, 1901
Class Polyhymenophora Jankowski, 1967
Order Hypotrichida Stein, 1859
Family Oxytrichidae Ehrenberg, 1838
Genus *Oxytricha* Ehrenberg, 1830

1. *Oxytricha balladyna* Song and Wilbert, 1989 (Fig. 1, Table 1)

Oxytricha balladyna Song and Wilbert, 1989, p. 166; Foissner et al., 1991, p. 299; Berger, 1999, p. 126.

Balladyna similis Kahl, 1932, p. 592.

Description. Size *in vivo* 50–87.5 × 25–37.5 μm. Length/width ratio about 2.5/1 (Table 1). Body soft and flexible. One micronucleus (Mi) located between two macronuclei (Ma) (Fig. 1a and 1c). Contractile vacuole (CV) slightly above mid-body at left margin of cell, without distinct collecting canals. Cortex colourless. Cytoplasm without special granules, packed with 2–5 μm fat globules and scattered crystals (Fig. 1a). Movements rapid and rotated itself, and it goes straight quickly, sometimes anchored at posterior end and circled around. Posterior frontoventral cirrus close underneath buccal vertex (Fig. 1c). Transverse cirri in narrowly V-shaped pattern and 25–30 μm long (Fig. 1e). All cirri in ventral side very long and prominent. Adoral zone of membranelles (AZM) wide with long membranelles up to 25 μm. 8–10 right and 10 left marginal cirri. Five rows of dorsal kinety with prominent dorsal cilia 7–8 μm long, 4th and 5th rows broken. Three caudal cirri 30 μm

long.

Distribution. Germany, Yugoslavia, USA and Korea.

Remarks. This species resembles *O. setigera*, *O. opisthomuscorum* and *O. elegans* as concerns body size and nuclear apparatus, cirral pattern, and number of adoral membranelles. *O. setigera* has the buccal cirrus near the posterior end of the undulating membrane, while the present species has it near the anterior end of undulating membrane (Foissner, 1982; Song and Wilbert, 1989). This species is different from *O. elegans* by following two characteristics: the former has long dorsal bristles (7–8 μm) and short distance from pretransverse cirri to transverse cirri and the latter short

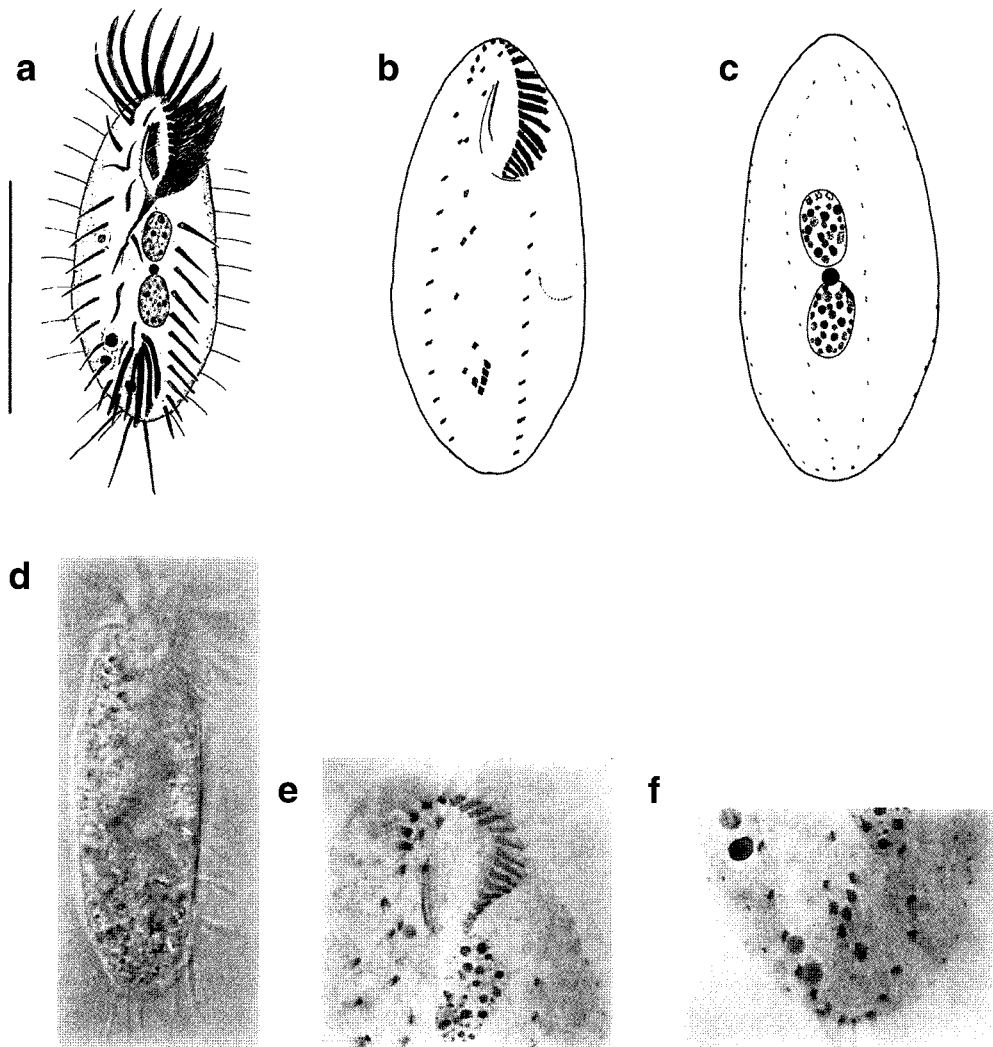


Fig. 1. *Oxytricha balladyna*. a, living specimen, ventral view (scale bar = 50 μm); b, infraciliature after protargol impregnation, ventral view; c, dorsal kineties and nuclear state, dorsal view; d, cytoplasm packed with 2–5 μm fat globules and scattered crystals, and three caudal cirri; e, ventral infraciliature of anterior half of cell; f, transverse cirri in narrowly V-shaped pattern in ventral infraciliature of posterior half of cell.

dorsal bristles (3-5 μm) and long distance from pretransverse cirri to transverse cirri (Song and Wilbert, 1989; Foissner, 1999). *O. opisthomuscorum* has invariably six dorsal kineties while the present species has five. However more specimens of these closely related species by the same investigator are needed to elucidate the exact relationship of them. Berger (1999) reviewed that this species was confined to freshwater, however present specimens were discovered in the soil under pine tree nearby beach. Previous authors did not mentioned about fringed state of transverse cirri, however present specimens have the fringed transverse cirri like that of *O. crassistilata*. (Kahl, 1932; Berger, 1999).

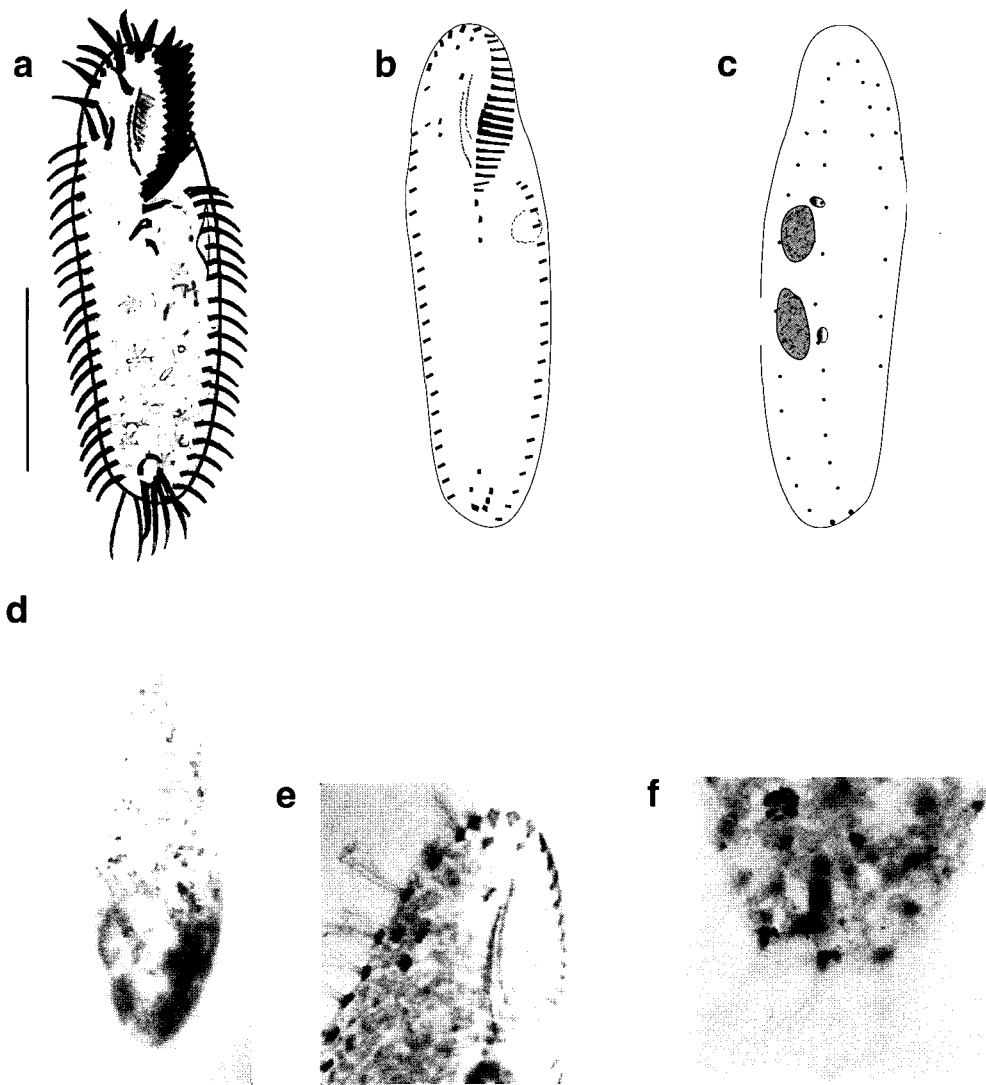


Fig. 2. *Oxytricha longa*. a, living specimen, ventral view (scale bar = 50 μm); b, infraciliature after protargol impregnation, ventral view; c, dorsal kineties and nuclear state, dorsal view; d, cytoplasm packed with fat globules and scattered crystals; e, ventral infraciliature of anterior half of cell; f, two caudal cirri.

2. *Oxytricha longa* Gelei and Szabados, 1950 (Fig. 2, Table 1)

O. longa Gelei and Szabados, 1950, p. 266; Berger, 1999, p. 158.

Urosomoida agiliformis: Ganner et al., 1987, p. 199 (in part fig. 44b-n).

Description. Size *in vivo* 60-90 × 20-30 μm. Length/width ratio about 3.6/1. Each micronucleus closely located near two macronuclei. Contractile vacuole slightly above mid-body at left margin of cell, with distinct collecting canals (Fig. 2a). Cortex colourless. Cytoplasm packed with fat globules and scattered crystals, and 1-1.5 μm yellow green granules (Fig. 2a and 2d). Three postoral ventral cirri

Table 1. Morphometric data of *Oxytricha balladyna* (upper line) and *O. longa* (lower line). All data are based on protargol-impregnated specimens except length and width. The abbreviations in the table are as follows: AZM = adoral zone of membranelles; AM = adoral membrane; Ma = macronucleus; Mi = micronucleus; RMR = right marginal row; LMR = left marginal row; TC = transverse cirri; CC = caudal cirri; DK = dorsal kineties; Max = maximum; Med = median; Min = minimum; SD = standard deviation; SE = standard error; CV = coefficient of variation in %; n = population size.

CHARACTERS	Mean	Med.	Min.	Max.	SD	SE	CV(%)	n
Body length (μm)	74.4	80.0	50.0	87.5	11.8	3.9	15.9	9
	103.4	105.0	90.0	115.0	7.6	2.3	7.4	11
Body width (μm)	30.0	30.0	25.0	37.5	3.3	1.1	11.0	9
	28.5	28.0	20.0	38.0	6.0	2.1	20.9	8
Length/width	2.5	2.5	2.0	2.8	0.3	0.1	10.3	9
	3.6	3.7	2.6	5.5	0.9	0.3	24.8	8
AZM length (μm)	30.1	30.0	19.0	36.0	4.3	1.0	14.3	19
	35.7	35.0	30.0	44.0	4.1	1.1	11.4	14
Body length/AZM	3.3	3.2	2.6	5.1	0.5	0.1	15.9	19
	2.9	3.0	2.4	3.4	0.3	0.1	9.7	11
AM number	20.6	20.5	19.0	22.0	0.8	0.2	4.0	16
	24.0	25.0	20.0	27.0	2.1	0.6	8.7	11
UM size (μm)	14.3	14.5	12.0	17.0	1.4	0.4	10.0	12
	16.5	16.0	14.0	20.0	1.9	0.5	11.3	13
Anterior Ma length (μm)	19.1	17.5	15.0	30.0	4.9	1.1	25.6	20
	16.4	15.5	10.0	28.0	4.6	1.2	27.9	14
Mi diameter (μm)	3.8	4.0	3.0	5.0	0.6	0.1	16.3	20
	4.2	4.0	3.0	6.0	1.0	0.3	23.1	14
RMR number	10.2	10.0	8.0	12.0	0.9	0.2	8.8	20
	22.0	19.0	24.0	1.6	0.4	7.1	13.0	14
LMR number	11.0	11.0	10.0	12.0	0.8	0.2	6.9	20
	21.9	22.0	19.0	24.0	1.6	0.4	7.1	13
TC number	5.0	5.0	5.0	5.0	0.0	0.0	0.0	20
	4.1	4.0	4.0	5.0	0.3	0.1	6.8	13
CC number	3.0	3.0	3.0	3.0	0.0	0.0	0.0	20
	2.0	2.0	2.0	2.0	0.0	0.0	0.0	12
DK number	5.0	5.0	5.0	5.0	0.0	0.0	0.0	17
	4.0	4.0	4.0	4.0	0.0	0.0	0.0	12

lying in a straight line and positioned far away from transverse cirri (Fig. 2b). Four Transverse cirri. Four rows of dorsal kinety, dorsal bristles 2-3 μm long. All cirri in ventral side conspicuously short (Fig. 2a). Adoral zone of membranelles thin and short. One buccal cirrus near the anterior of undulating membrane (Fig. 2a, 2b and 2e). 19-22 right and 18-21 left marginal cirri. Two caudal cirri 15 μm long (Fig. 2f).

Distribution. Hungary, Austria, Israel. Germany, Spain, South Australia and Korea.

Remarks. This species resembles *O. similis* as concerns body size, nuclear apparatus, caudal cirri number, dorsal bristle length. This species has four transverse cirri and granules, but *O. similis* five transverse cirri and no granules (Wang and Nie, 1935). This species also very similar to *Urosomoida agiliformis* Foissner, 1982 and *U. agiliformis* sensu Ganner et al., 1987 (in part) with respect to the nuclear features, cytoplasmic granules and crystals, position of buccal cirrus, two caudal cirri, three postoral ventral cirri. However, this species is different from *U. agiliformis* by the following characteristics: the former has six transverse cirri including pretransverse cirri while the latter three. The present specimens have three postoral ventral cirri lying in straight line longitudinally but those of previous European were not in straight line longitudinally (Gelei and Szabados, 1950; Foissner, 1982; Ganner et al., 1987; Begeer, 1999).

The present species seems to be the very same as *O. longa* by Ganner et al. (1987) in many aspects. The present specimens have the yellow-green granules (1-1.5 μm in diameter) in cytoplasm, however it was not mentioned in the previous descriptions on *O. longa*. This species has been collected from freshwater, soil and polluted waters while the present specimens were collected from the waters of sewage treatment plant.

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한국산 2미기록종 *Oxytricha balladyna*와 *O. longa* (유모문: 다막강: 하모목)

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요 약

해안의 소나무 아래 토양과 하수처리장 폭기조에서 채집된 섬모충이 각각 *Oxytricha balladyna*와 *O. longa*으로 동정되었다. 이 종들은 한국에서 처음 보고 되는 것으로 생체표본과 protargol로 염색한 표본에 근거하여 재기재하였다. 유사 종들과 비교한 결과 *Oxytricha balladyna*는 한 개의 소핵이 두 개의 대핵 사이에 위치하고, 5개의 후방극모, 3개의 미극모, 5열의 등쪽섬모열이 있으며 세포질에 granule이 없다. *O. longa*는 소핵이 각각 대핵 부근에 한 개씩 위치하며, 3개의 postoral ventral cirri가 직선상으로 배열하며 후방극모 (transverse cirri)와 멀다. 4개의 후방극모, 2개의 미극모와 4열의 등쪽섬모열이 있으며 특히 세포질에 yellow-green granules이 관찰되어 특이하였다.