Korean J. Zool. 37:113-119, 1994

Morphology and Biometry of Two Oxytrichid Species of Genus *Histriculus* Corliss, 1960 (Ciliophora, Hypotrichida, Oxytrichidae) from Seoul, Korea

Mann Kyoon Shin and Won Kim

Department of Molecular Biology, College of Natural Sciences, Seoul National University, Seoul 151-742, Korea

The oxytrichid hypotrichs collected from the cultivated field in Yonchon-gun, Misan-myon Kyonggi-do near Seoul, Korea and the moss-covered soils on the old castle walls in Namhansansong, Kwangju-gun, Kyonggi-do near Seoul, Korea were identified as *Histriculus cavicola* (Kahl, 1935) and *H. muscorum* Kahl, 1932. These two species were redescribed with illustrations. The description was based on the observation of living specimens, protargol impregnated specimens and biometric analysis. These are reported for the first time from Korea and distinguished from the other congeneric species by the following characteristics: the former has 4 macronuclei, 4 micronuclei, 5 transverse cirri and rather inconspicuous marginal cirri, while the latter, 2 macronuclei, 2 micronuclei, 4 transverse cirri and conspicuous marginal cirri, respecitvely.

KEY WORDS: Systematics, Hypotrichida, *Histriculus cavicola*, *H. muscorum*, Redescription, Infraciliature, Biometry, Korea

Recently, many new genera and species of soil hypotrichs have been discovered, and their ecological significance has been affirmed (Berger & Foissner, 1987; Foissner, 1982, 1987). In the present paper we redescribe two species of *Histriculus* which had not known from Korea, and compare them with other related species and characterized them biometrically.

Materials and Methods

The specimens were collected from the cultivated field in Yonchon-gun, Misan-myon Kyonggi-do near Seoul, Korea on April 10, 1993 and the moss-covered soils on the old castle walls of Namhansansong, Kwangju-gun, Kyonggi-do near Seoul, as well on April 4, 1993. Laboratory cultures were maintained in a commercial mineral water provided with boiled wheat grains and shrimp meats supplying for fungal and bacterial nutrients for hypotrichs.

The shapes of the living specimens on slides were drawn without cover slips. The infraciliature was observed by using the modified protargol method (Wilbert, 1975; Shin & Kim, 1993). The drawings of the impregnated specimens were made with the aid of a drawing tube. All counts and measurements were undertaken at the magnifications of X400-X1600. Biometrical analysis was performed using the methods described in Sokal and Rohlf (1973). We adopted the classification schemes established by Borror (1972) and Corliss (1979).

This study was supported by the grant from S.N.U. Daewoo Research Fund (93-062080).

Results

Phylum Ciliophora Doflein, 1901 有毛 門
Class Polyhymenophora Jankowski, 1967 多膜 綱
Order Hypotrichida Stein, 1859 下毛 目
Family Oxytrichidae Fauré-Fremiet, 1961 尖毛下毛 科(신칭)
Genus *Histriculus* Corliss, 1960 組織下毛蟲 屬(신칭)

1. *Histriculus cavicola* (Kahl, 1935) 四核組織下毛蟲(신칭) **(Fig. 1, Table 1)**

Oxytricha cavicola Kahl, 1935 [p. 841, fig. 155(16)]

Histriculus cavicola: Berger & Foissner, 1987 (pp. 212-215, figs. 49-55, table 8)

Material examined: 20 living specimens collected from the cultivated field in Yonchon-gun, Misan-myon Kyonggi-do near Seoul, Korea on April 10, 1993 and 16 protargol impregnated specimens cultured at the laboratory were observed and analyzed biometrically and their data were summarized in Table 1.

Description: General morphology and behavior: Body stiff and inflexible, oval or ellipsoidal, flattened dorso-ventrally, ranging from 150-220 μm long and 70-100 μm wide *in vivo*; anterior and posterior ends slightly narrow and broadly round; ventral surface flattened and slightly concave; dorsal surface convex; anterior and posterior part thin. Movement rapid, sometimes sliding and rotating around long axis of body.

Frontal and buccal fields: Three frontal cirri (FC) enlarged and prominent, located at ventral surface of right anterior part; four frontoventral cirri (FVC) located at right ventral surface of undulating membrane; one buccal cirrus (BC) slightly prominent, located at mid point of paroral membrane. Adoral zone of membranelles (AZM) with prominent 35-43 adoral membranelles (AM) 60-80 μm long, covering approximately 42% of body length. Buccal field large, comprising undulating membrane (UM) 36-56 μm long.

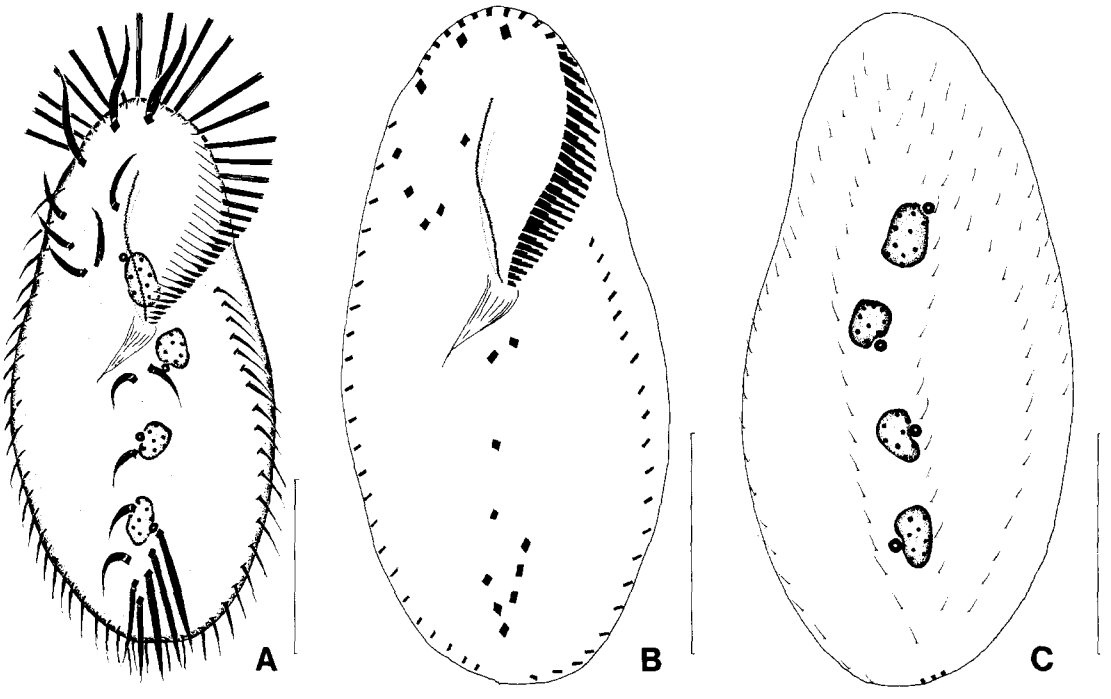

Fig. 1. *Histriculus cavicola* (Kahl, 1935): A, living specimen, ventral view. B, infraciliature after protargol impregnation, ventral view. C, dorsal kineties and nuclear state, dorsal view (scale bars = 50 μm).

Pharyngeal fibers (PF) at base of buccal field slanted to right posterior of body and 22-30 μm long. Four ventral cirri of postoral region (poVC) located between posterior end of buccal field and anterior transverse cirri; one ventral cirri near transverse cirri (VCnTC) located near last TC; posterior region of ventral surface bearing J-form like five TC and each TC prominent and extending beyond posterior end of body.

Somatic infraciliature: Rows of left marginal cirri (LMC) and right marginal cirri (RMC) extending almost to near posterior end; both rows of marginal cirri not confluent posteriorly; LMC beginning at region beneath approximately 12th AM, extending posterior end and bearing 15-24 cirri; RMC beginning near anterior most frontoventral cirri and bearing 17-26 cirri; anterior most cirrus of RMC slightly detached from rest of cirri; number of LMC more than RMC by three; both marginal cirri rather inconspicuous. Three Caudal cirri (CC) located on dorsal surface of right posterior end between RMC and LMC; CC rather inconspicuous *in vivo*. Dorsal surface bearing six dorsal kineties (DK); mid-dorsal kinety with 20-30 cilia; cilia on dorsal surface bristle-like, approximately 5 μm long, some of them more or less shortened.

Nuclear organelles with 4 ellipsoidal macronuclei (Ma), 15-17 μm long and 9-10 μm wide, lying along median line of body; anterior macronucleus usually larger than posterior ones; 4 micronuclei (Mi) spherical, approximately 4 μm in diameter. Pellicle and cytoplasm colorless, subpellicular granules absent. Food vacuoles with ciliates and testate amoebas. Contractile vacuole spindle-like, positioning near center of left margin of body, during diastole with 2 dilated channels.

2. *Histriculus muscorum* Kahl, 1932 蘚苔組織下毛蟲(신칭) (Fig. 2, Table 1)

Histriculus muscorum Kahl, 1932 [p. 616, fig. 116(3)]; Foissner, 1982 (pp. 80-83, figs. 19a-f, table 18); Dragesco, 1970 (pp. 116-118, fig. 83); Dragesco & Dragesco-Kernéis, 1986 (pp. 483-485, figs. 143E-G); Berger *et al.*, 1985 (p. 303, figs. 13-34, tables 2,3)

Material examined: 15 living specimens collected from the moss-covered soils on the old castle walls of Namhansansong, Kwangju-gun, Kyonggi-do near Seoul, Korea on April 4, 1993 and 10 protargol impregnated specimens cultured at the laboratory were observed and analyzed biometrically and their data were summarized in Table 1.

Description: General morphology and behavior: Body stiff and inflexible, oval or ellipsoidal, flattened dorso-ventrally, ranging from 100-140 μm long and 50-70 μm wide *in vivo*; anterior and posterior ends slightly narrow and broadly round; ventral surface flattened and slightly concave; dorsal surface convex; anterior and posterior part thin. Movement rapid, sometimes sliding and rotating around long axis of body.

Frontal and buccal fields: Three frontal cirri (FC) enlarged and prominent, located at ventral surface of anterior part; four frontoventral cirri (FTC) located at right ventral surface of undulating membrane; one buccal cirrus (BC) slightly prominent, located at mid point of paroral membrane. Adoral zone of membranelles (AZM) with prominent 27-31 adoral membranelles (AM) 41-47 μm long, covering approximately 41% of body length. Buccal field large, comprising undulating membrane (UM) 24-34 μm long. Pharyngeal fibers (PF) at base of buccal field slanted to right posterior of body and 12-24 μm long. Four ventral cirri of postoral region (poVC) located between posterior end of buccal field and anterior transverse cirri; one ventral cirri near transverse cirri (VCnTC) located near last TC; posterior region of ventral surface bearing J-form like four TC and each TC prominent and extending beyond posterior end of body.

Somatic infraciliature: Rows of left marginal cirri (LMC) and right marginal cirri (RMC) extending almost to near posterior end; both rows of marginal cirri not confluent posteriorly; both marginal cirri rather conspicuous; LMC beginning at region beneath approximately 10th AM, extending posterior end and bearing 15-20 cirri; RMC beginning near anterior most frontoventral cirri and bearing 20-23 cirri; anterior most cirrus of RMC slightly detached from rest of cirri; number of LMC more than RMC by three; both marginal cirri rather conspicuous. Three caudal cirri (CC) located on dorsal surface of posterior

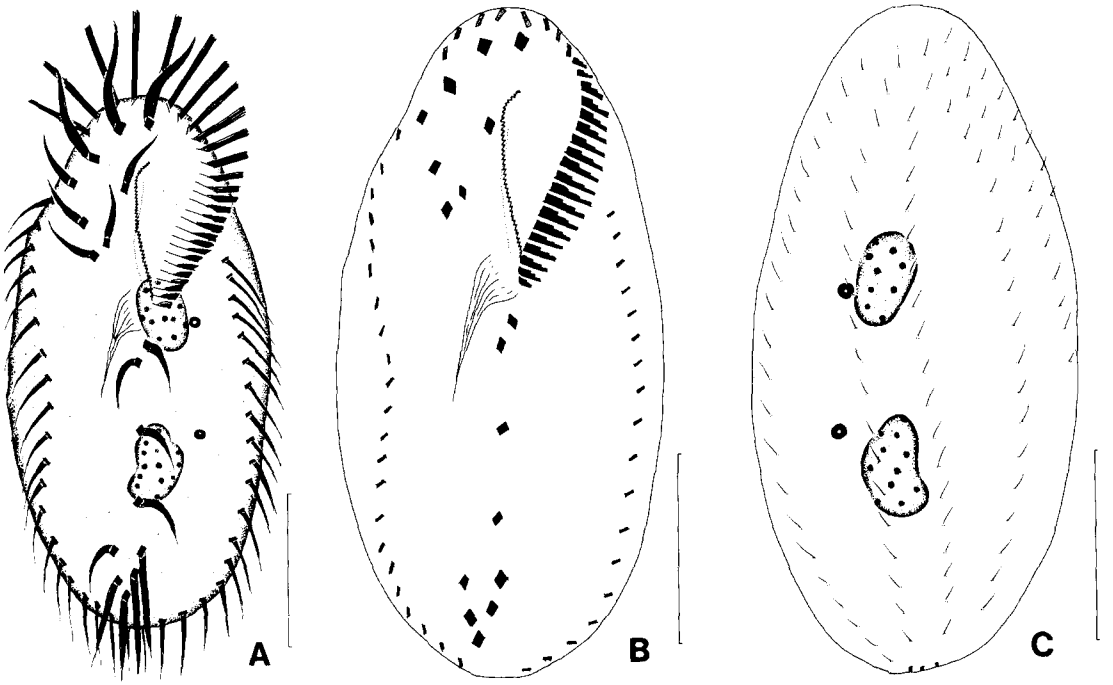

Fig. 2. *Histriculus muscorum* Kahl, 1932: A, living specimen, ventral view. B, infraciliature after protargol impregnation, ventral view. C, dorsal kineties and nuclear state, dorsal view (scale bars = 30 μm).

end between RMC and LMC; CC rather inconspicuous *in vivo*. Dorsal surface bearing six dorsal kineties (DK); mid-dorsal kinety with 18-25 cilia; cilia on dorsal surface bristle-like, approximately 5 μm long, some of them more or less shortened.

Nuclear organelles with two ellipsoidal macronuclei (Ma), 13-22 μm long and 9-12 μm wide, lying along median line of body; two micronuclei (Mi) spherical, approximately 2.25 μm in diameter. Pellicle and cytoplasm colorless, subpellicular granules absent. Food vacuoles with ciliates and testate amoebas. Contractile vacuole spherical, positioning nearly at level of cytostome.

Discussion

Histriculus cavicola (Kahl, 1935) is very similar to *H. muscorum* Kahl, 1932 with respect to the shapes of body and adoral zone of membranelles, and patterns of frontal cirri, buccal cirri and frontoventral cirri. *H. cavicola* is, however, distinguished from *H. muscorum* by the following characteristics. (1) *H. cavicola* has four macronuclei, while *H. muscorum* two. (2) *H. cavicola* has four micronuclei, while *H. muscorum* two. (3) *H. cavicola* has approximately five transverse cirri, while *H. muscorum* four. (4) The body size of *H. cavicola* is lager than that of *H. muscorum*. (5) *H. cavicola* has approximately 38 adoral membranelles, while *H. muscorum* 28. (6) *H. cavicola* has approximately 21 left marginal cirri and 24 right marginal cirri, while *H. muscorum* 18 and 21, respectively. (7) Both marginal cirri of *H. cavicola* are less conspicuous than those of *H. muscorum* (Kahl, 1932, 1935; Dragesco, 1970; Foissner, 1982; Berger *et al.*, 1985; Dragesco & Dragesco-Kernéis, 1986; Berger & Foissner, 1987).

The body size of Korean population of *Histriculus cavicola* is slightly larger than that of European population (Berger & Foissner, 1987). As a part of the biometrical data (Table 1) of this species, we calculated the coefficients of variation (CV). The following characters showed the CV of 0.00: the numbers of frontal cirri, buccal cirri, frontoventral cirri, ventral cirri, transverse cirri and

Table 1. Biometrical characterization of *Histriculus cavicola* (upper line) and *H. muscorum* (lower line). All data were based on protargol impregnated specimens. The abbreviations in the table are the same as in the description except statistical terms (Max.: maximum; Min.: minimum; SD: standard deviation; SE: standard error; CV: coefficient of variation in %; n: population size).

CHARACTERS	Mean	Median	Max.	Min.	SD	SE	CV(%)	n
Body length	155.56	159	180	123	13.93	3.48	8.95	16
	105.80	103.5	114	100	4.85	1.53	4.58	10
Body width	74.38	77	82	61	5.67	1.42	7.62	16
	53.00	54	59	47	3.62	1.15	6.83	10
Body length/width	2.09	2.07	2.39	1.86	0.14	0.03	6.46	16
	2.00	1.98	2.26	1.85	0.15	0.05	7.30	10
AZM length	66.63	65	80	60	5.25	1.31	7.88	16
	43.40	43	47	41	2.01	0.64	4.63	10
Body length/AZM length	2.34	2.36	2.67	1.91	0.20	0.05	8.36	16
	2.44	2.42	2.56	2.36	0.06	0.02	2.63	10
UM length	44.81	44	56	36	4.96	1.24	11.06	16
	30.70	32	34	24	3.23	1.02	10.53	10
UM/AZM length	0.67	0.68	0.71	0.60	0.03	0.01	5.14	16
	0.71	0.72	0.79	0.57	0.07	0.02	9.48	10
Ma length (1st)	17.88	18	23	13	2.50	0.63	13.99	16
	15.95	15.5	22	13	2.50	0.79	15.67	10
Ma width (1st)	10.13	11	12	7	1.59	0.40	15.67	16
	10.00	10	12	9	0.82	0.26	8.16	10
Ma length (4th)	15.81	16	20	12	2.43	0.61	15.36	16
	—	—	—	—	—	—	—	—
Ma width (4th)	9.19	9	12	7	1.33	0.33	14.45	16
	—	—	—	—	—	—	—	—
Distance between Ma pairs	14.50	15	22	5	4.13	1.03	28.49	16
	—	—	—	—	—	—	—	—
Mi diameter	2.79	3	3	2.5	0.25	0.06	8.81	16
	2.25	2.25	2.5	2	0.26	0.08	11.71	10
Ma number	4.19	4	6	4	0.54	0.14	12.99	16
	2.00	2	2	2	0.00	0.00	0.00	10
Mi number	4.06	4	6	2	1.12	0.28	27.66	16
	2.10	2	3	1	0.57	0.18	27.03	10
DK number	6.19	6	7	6	0.40	0.10	6.51	16
	6.00	6	6	6	0.00	0.00	0.00	8
AM number	37.81	38	43	35	1.94	0.48	5.13	16
	28.40	29	31	27	1.26	0.40	4.45	10
BC number	1.00	1	1	1	0.00	0.00	0.00	16
	1.00	1	1	1	0.00	0.00	0.00	10
FC numbe	3.00	3	3	3	0.00	0.00	0.00	16
	3.00	3	3	3	0.00	0.00	0.00	10
FVC number	4.00	4	4	4	0.00	0.00	0.00	16
	3.90	4	4	3	0.32	0.10	8.11	10
poVC number	4.00	4	4	4	0.00	0.00	0.00	16
	4.00	4	4	4	0.00	0.00	0.00	10
VCnTC number	1.00	1	1	1	0.00	0.00	0.00	16
	1.00	1	1	1	0.00	0.00	0.00	10
TC number	5.00	5	5	5	0.00	0.00	0.00	16
	4.00	4	4	4	0.00	0.00	0.00	10

CHARACTERS	Mean	Median	Max.	Min.	SD	SE	CV(%)	n
CC number	3.00	3	3	3	0.00	0.00	0.00	16
	3.10	3	4	2	0.57	0.18	18.31	10
LMC number	21.44	23	24	15	2.48	0.62	11.55	16
	18.20	19	20	15	1.55	0.49	8.51	10
RMC number	24.19	25	26	17	2.29	0.57	9.45	16
	21.60	21.5	23	20	1.17	0.37	5.43	10
Pharyngeal fiber	25.81	26	30	22	2.12	0.53	8.21	16
	19.00	20	24	12	3.59	1.14	18.90	10

caudal cirri. Thus these characters are found to be very constant and considered as the important diagnostic features of this genus. Comparatively low CVs ranging from 5.13 to 11.55 were shown in the following characters: lengths or widths of body, adoral zones of membranelles, undulating membrane, micronucleus and pharyngeal fiber, ratio of body-length/width, UM/AZM and body-length/AZM-length, numbers of dorsal kinety, adoral membranelles and both marginal cirri. These characters are very important for the identification of the species of this genus because of their low variability. Other characters showed fairly high value of CV ranging from 12.99 to 28. 49.

The characteristics of Korean population of *H. muscorum* are slightly different from those of European and African populations. Especially, the Korean population has different body size from the European and African populations: Body length (μm) of Korean population 100-114; European population 60-80; African population 67-92; numbers of adoral membranelles: 27-31; 28-35; 30-37; right marginal cirri: 20-23; 17-25; 20-31; and left marginal cirri: 15-20; 17-24; 15-25 (Berger & Foissner, 1987; Berger *et al.*, 1985; Dragesco & Dragesco-Kernéis, 1986). As a part of the biometrical data (Table 1) of this species, we calculated the coefficients of variation (CV). The following characters showed the CV of 0.00 : the numbers of dorsal kinety, buccal cirri, frontal cirri and ventral cirri. Thus these characters are found to be very constant and considered as the important diagnostic features of this genus. Comparatively low CVs ranging from 2.63 to 10. 53 were shown in the following characters: lengths or widths of body, adoral zones of membranelles, undulating membrane and macronucleus, ratio of body-length/width, UM/AZM and body-length/AZM-length, numbers of adoral membranelles, frontoventral cirri and both marginal cirri. These characters are very important for the identification of the species of this genus because of their low variability. Other characters showed fairly high value of CV ranging from 11.71 to 27.03.

References

Berger, H. and W. Foissner, 1987. Morphology and biometry of some soil hypotrichs (Protozoa, Ciliophora). *Zool. Jb. Syst.*, **55:** 19-46.

Berger, H., W. Foissner and H. Adam, 1985. Morphological variation and comparative analysis of morphogenesis in *Parakahliella macrostoma* (Foissner, 1982) nov. gen. and *Histriculus muscorum* (Kahl, 1932), (Ciliophora, Hypotrichida). *Protistologica*, **21:** 295-311.

Borror, A.C., 1972. Revision of the order Hypotrichida (Ciliophora, Protozoa). *J. Protozool.*, **19:** 1-23.

Corliss, J.O., 1979. The ciliated protozoa. 2nd ed. Pergamon Press, New York, 455pp.

Dragesco, J., 1970. Ciliés libres du Cameroun. Ann. Fac. Sci. Univ. féd. Cameroun (Numero hors-série), Yaoundé, 141pp.

Dragesco, J. and A. Dragesco-Kernéis, 1986. Cilié libres de l'Afrique intertropicale. Introduction à la connaissance et à l'étude des cilié. *Faune tropicale*, **26:** 1-559.

Foissner, W., 1982. Ökologie und Taxonomie der Hypotrichida (Protozoa: Ciliophora) einiger sterreichischer Böden. *Arch. Protistenkd.*, **123:** 19-143.

Foissner, W., 1987. Soil protozoa: fundamental problems, ecological significance, adaptations in

ciliates and testaceans, bioindicators, and guide to the literature. *Progress in Protozoology*, **2:** 69-212.

Kahl, A., 1932. Urtiere oder Protozoa I: Wimpertiere oder Ciliata (Infusoria) 3. Spirotricha. *Tierwelt Dtl.*, **25:** 1-650.

Kahl, A., 1935. Urtiere oder Protozoa I: Wimpertiere oder Ciliata (Infusoria) 4. Peritricha und Chonotricha. *Tierwelt Dtl.*, **25:** 651-886.

Shin, M.K. and W. Kim, 1993. New records of three oxtrichid hypotrichs (Ciliophora: Hypotrichida: Oxytrichidae) from the the Han river in Seoul, Korea. *Korean J. Zool.*, **36:** 223-230.

Sokal, R. R. and F. J. Rohlf, 1973. Introduction to biostatistics. Freeman & Co., San Francisco, 368pp.

Wilbert, N., 1975. Eine Vertesserte Technik der Protargoimpragnation für Ciliaten. *Mikrokosmos*, **64:** 171-179.

(Accepted December 5, 1993)

한국산 조직하모충 속 하모류 2종(유모 문, 하모 목, 첨모하모 과)의 형태 및 통계

신만균 · 김 원(서울대학교 자연과학대학 분자생물학과)

서울인근 지역인 경기도 연천군 미산면에 위치한 밭과 경기도 광주군 남한산성 성벽의 이끼로 덮힌 토양에서 채집된 하모류가 각각 *Histriculus cavicola*(Kahl, 1935) (四核組織下毛蟲)와 *H. muscorum* Kahl, 1932(蘚苔組織下毛蟲)으로 밝혀져서 재기재하였다. 기재는 서식처에서 채집된 표본과 배양된 것을 생체로 관찰하고 protargol로 염색하여 섬모하부구조를 관찰한 자료를 통계처리하여 실시하였다. 이 두 종은 한국에서 처음으로 기록되는 종으로 아래의 식별형질로 구분된다. 사핵조직하모충은 4개씩의 대핵과 소핵, 5개의 후방극모와 뚜렷하지 않은 측극모를 가지는 반면 선태조직하모충은 2개씩의 대핵과 소핵, 4개의 후방극모와 뚜렷한 측극모를 가진다.