Supplemental Material to:

An integrative approach sheds new light onto the systematics and ecology of the widespread ciliate genus *Coleps* (Ciliophora, Prostomatea)

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Figure S1: SSU secondary structure of *Coleps viridis*, strain CCAP 1613/7 (MT253680). The V4 and V9 regions of the SSU are highlighted.

SSU rRNA secondary structure model
of *Coleps viridis*
(CCAP 1613/7)
Accession number: MT253680

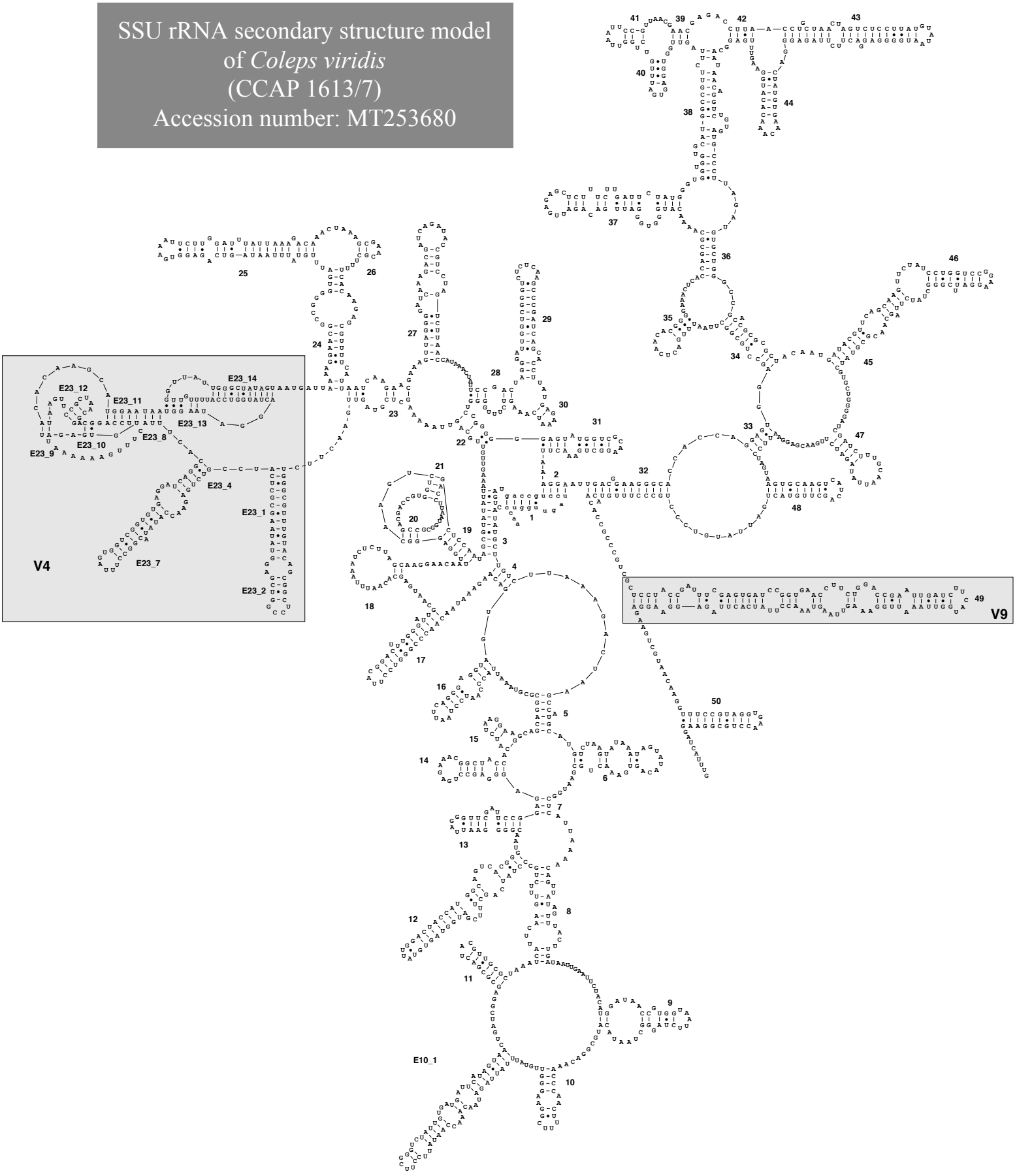
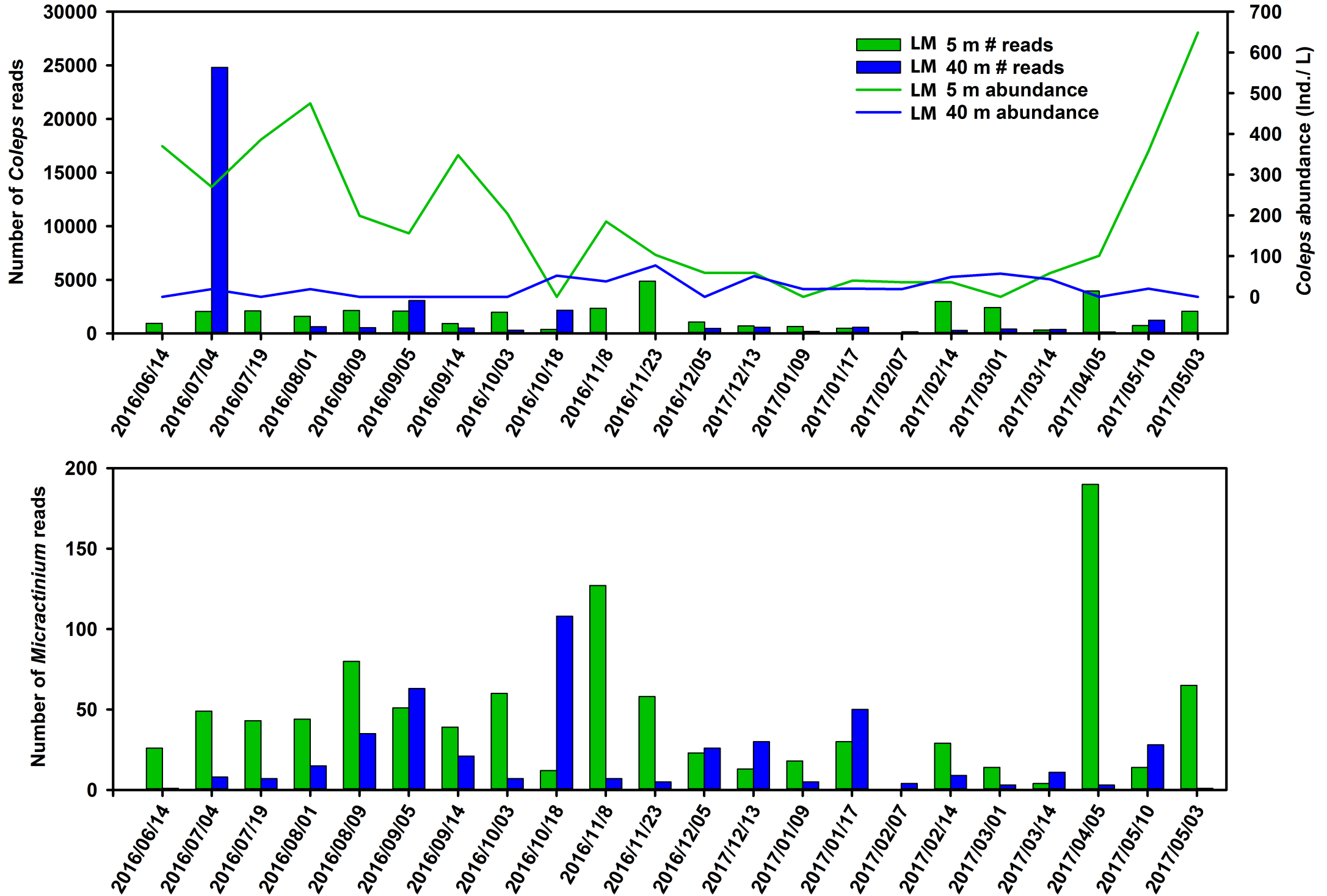


Figure S2: Comparison between abundance of *Coleps viridis* and the number of reads of this species and its endosymbiotic green algae *Micractinium conductrix* in Lake Mondsee (LM) and Lake Zurich (LZ).


LM 5 m # reads
LM 40 m # reads
LM 5 m abundance
LM 40 m abundance
Number of Coleps reads
Coleps abundance (Ind./ L)
Number of Micractinium reads
30000
25000
20000
15000
10000
5000
0
700
600
500
400
300
200
100
0
200
150
100
50
0
2016/06/14
2016/07/04
2016/07/19
2016/08/01
2016/08/09
2016/09/05
2016/09/14
2016/10/03
2016/10/18
2016/11/8
2016/11/23
2016/12/05
2017/12/13
2017/01/09
2017/01/17
2017/02/07
2017/02/14
2017/03/01
2017/03/14
2017/04/05
2017/05/10
2017/05/03

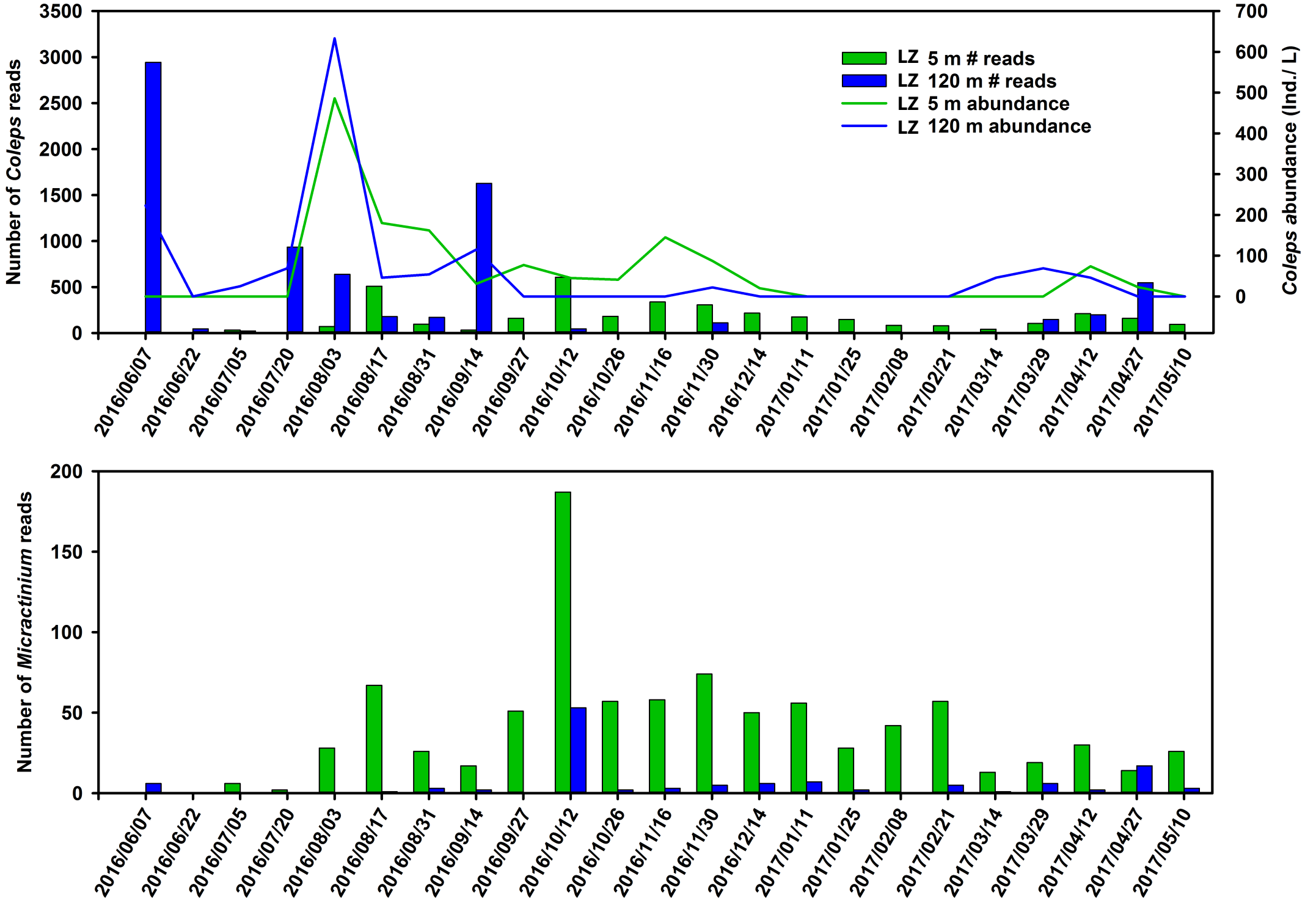

Number of Coleps reads
Coleps abundance (Ind./ L)
LZ 5 m # reads
LZ 120 m # reads
LZ 5 m abundance
LZ 120 m abundance
Number of Micractinium reads
2016/06/07
2016/06/22
2016/07/05
2016/07/20
2016/08/03
2016/08/17
2016/08/31
2016/09/14
2016/09/27
2016/10/12
2016/10/26
2016/11/16
2016/11/30
2016/12/14
2017/01/11
2017/01/25
2017/02/08
2017/02/21
2017/03/14
2017/03/29
2017/04/12
2017/04/27
2017/05/10

Table S1: Overview over described genera belonging to the Colepidae (Prostomatea). For *Coleps* and *Tiarina* symbiotic associations with photosynthetic protists are known. All other genera contain heterotrophic congeners.

Colepid genera	Colepidae with	plate type	species #	reference
Coleps Nitzsch 1827	spiny armour composed of 6 tiers	***hirtus***	5	Foissner et al. (2008), Lu et al. (2016)
Kotinia Obolkina in Aescht 2001	spiny armour composed of 8 tiers	unspecified	3	Aescht (2001)
Levicoleps Foissner, Kusuoka & Shimano 2008	smooth armour composed of 6 tiers	***hirtus***	2	Foissner et al. (2008), Chen et al. (2016)
Macrocoleps Obolkina 1995	spiny armour composed of about 12 irregular tiers	unspecified	2	Obolkina (1995)
Nolandia Small & Lynn 1985	spiny armour composed of 6 tiers	***nolandi***	2	Small & Lynn (1985), Chen et al. (2010), Chen et al. (2012)
Pinacocoleps Diesing 1865	spiny armour composed of 6 tiers	***incurvus***	7	Diesing (1865), Chen et al. (2010), Lu et al. (2013), Moon et al. (2017)
Planicoleps Dragesco & Dragesco-Kernéis 1991	smooth armour composed of 8 tiers	unspecified	1	Dragesco & Dragesco-Kernéis (1991)
Reticoleps Foissner, Kusuoka & Shimano 2008	spiny armour composed of 6 tiers	***remanei***	1	Foissner et al. (2008)
Tiarina Bergh 1881	spiny/smooth armour composed of 6 tiers	***tiarina***	1	Bergh (1881), Chen et al. (2012)
Apocoleps Chen, Warren & Song 2009	spiny armour composed of 8 tiers	***nolandi***	2	Chen et al. (2009), Chen et al. (2012)

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Table S2: Origin and morphometric characteristics and accession numbers of the investigated *Coleps* strains. All measurements in µm. (Mean = arithmetic mean; SD = standard deviation; SE = standard error; CV = coefficient of variation in %; Min. = minimum; Max. = maximum; n = number of specimens analyzed).

Species	Strain number	Origin	Country	Morphology studied	Accession #
Coleps viridis	**CIL-2017/5**	Lake Mondsee, Upper Austria, 0-20m	Austria	yes	-
	CIL-2017/6	Lake Mondsee, Upper Austria, 30-63m	Austria	yes	MT253675
	CIL-2017/7	Lake Mondsee, Upper Austria, 30-63m	Austria	yes	-
	CIL-2017/8	Lake Mondsee, Upper Austria, 0-20m	Austria	yes	MT253676
	CIL-2017/9	Lake Mondsee, Upper Austria, 30-63m	Austria	yes	MT253677
	CIL-2017/10	Lake Mondsee, Upper Austria, 0-20m	Austria	yes	MT253678
	CIL-2017/13	Lake Mondsee, Upper Austria, 0-20m	Austria	yes	MT253681
	CCAP 1613/1	Garden pool, Shelford, Cambridge	England	no	MT253670
	CCAP 1613/2	Brick pits, Madingley, Cambridge	England	no	MT253671
	CCAP 1613/3	Manchester	England	yes	MT253672
	CCAP 1613/4	Gattiker pond, Canton Zurich	Switzerland	yes	MT253673
	CCAP 1613/5	Lohbach, Tyrol	Austria	yes	MT253674
	CCAP 1613/6	Lake Mondsee, Upper Austria, 30-63m	Austria	yes	MT253679
	CCAP 1613/7	Lake Mondsee, Upper Austria, 0-20m	Austria	yes	MT253680
	CCAP 1613/8	Lake Zurich, Canton Zurich	Switzerland	yes	MT253682
	CCAP 1613/9	Lake Mondsee, Upper Austria, 30-63m	Austria	yes	MT253683
	CCAP 1613/10	Trough at the station of National Park Heiliges Meer, Nordrhein-Westfalen	Germany	yes	MT253684
	CCAP 1613/11	Lake Mondsee, Upper Austria, 30-63m	Austria	yes	MT253685
	CCAP 1613/12	Lake Mondsee, Upper Austria, 30-63m	Austria	yes	-
Coleps hirtus	**CCAP 1613/14**	Lake Piburg, Tyrol	Austria	yes	MT253687
Nolandia nolandi	**CCAP 1613/15**	Lake Wirpitsch, Salzburg	Austria	yes	MT253688

Character	Species	Strain number	Mean	Median	SD	SE	CV	Min.	Max.	n
Cell length	*Coleps viridis*	CIL-2017/5	63.29	63.42	1.01	0.22	1.59	61.35	64.9	21
		CIL-2017/6	56.13	56.32	0.90	0.19	1.60	54.48	57.4	21
		CIL-2017/7	56.46	56.38	0.88	0.19	1.56	55.07	58.61	21
		CIL-2017/8	63.37	63.34	0.50	0.11	0.80	62.44	64.5	21
		CIL-2017/9	48.02	48.2	0.61	0.13	1.27	46.64	48.98	21
		CIL-2017/10	57.90	57.89	0.46	0.10	0.81	57.17	58.75	21
		CIL-2017/13	56.63	56.61	0.41	0.09	0.73	56.1	57.6	21
		CCAP 1613/3	51.70	51.26	1.49	0.32	2.88	49.37	55.39	21
		CCAP 1613/4	51.14	51.04	0.96	0.21	1.89	49.02	52.7	21
		CCAP 1613/5	51.34	51.61	0.98	0.21	1.91	48.8	52.65	21
		CCAP 1613/6	45.03	45.11	0.64	0.14	1.42	44.01	45.96	21
		CCAP 1613/7	52.81	52.71	0.53	0.11	1.02	51.95	53.82	21
		CCAP 1613/8	55.01	55.26	0.75	0.16	1.36	53.16	56.12	21
		CCAP 1613/9	47.43	47.42	0.58	0.12	1.23	46.15	48.48	21
		CCAP 1613/10	44.99	44.95	0.52	0.11	1.17	44.21	45.9	21
		CCAP 1613/11	56.70	56.53	0.45	0.09	0.79	56.07	57.7	21
		CCAP 1613/12	47.58	47.62	0.51	0.11	1.08	46.18	48.75	21
	Coleps hirtus	CCAP 1613/14	47.31	47.07	2.59	0.56	5.48	42.28	51.91	21
	Nolandia nolandi	CCAP 1613/15	43.57	43.6	0.63	0.13	1.46	42.12	44.83	21

Character	Species	Strain number	Mean	Median	SD	SE	CV	Min.	Max.	n
Cell width	*Coleps viridis*	CIL-2017/5	34.76	34.07	2.22	0.48	6.41	31.76	40.52	21
		CIL-2017/6	31.37	31.67	1.27	0.27	4.04	28.26	33.26	21
		CIL-2017/7	34.56	34.39	0.70	0.15	2.04	33.52	35.77	21
		CIL-2017/8	33.65	33.62	0.40	0.08	1.19	33.12	34.65	21
		CIL-2017/9	27.75	27.65	0.50	0.11	1.82	27.07	28.91	21
		CIL-2017/10	27.43	27.51	0.33	0.07	1.21	26.88	27.96	21
		CIL-2017/13	29.88	29.87	0.45	0.09	1.52	29.11	30.94	21
		CCAP 1613/3	24.54	24.8	2.06	0.45	8.42	20.61	29.55	21
		CCAP 1613/4	31.79	31.4	1.69	0.37	5.34	29.16	35.07	21
		CCAP 1613/5	24.77	24.73	0.87	0.19	3.55	23.45	26.8	21
		CCAP 1613/6	21.49	21.47	0.33	0.07	1.56	21.03	22.29	21
		CCAP 1613/7	35.33	35.3	0.20	0.04	0.58	34.92	35.71	21
		CCAP 1613/8	33.44	33.56	0.87	0.19	2.60	32.07	34.82	21
		CCAP 1613/9	25.51	25.49	0.29	0.06	1.14	25.1	26.17	21
		CCAP 1613/10	24.61	24.46	0.40	0.08	1.63	24.15	25.57	21
		CCAP 1613/11	30.31	30.4	0.43	0.09	1.43	29.18	30.9	21
		CCAP 1613/12	26.49	26.47	0.54	0.11	2.05	25.06	27.66	21
	Coleps hirtus	CCAP 1613/14	24.53	24.21	1.35	0.29	5.53	22.64	27.69	21
	Nolandia nolandi	CCAP 1613/15	21.69	22.26	1.21	0.26	5.58	19.53	23.38	21

Character	Species	Strain number	Mean	Median	SD	SE	CV	Min.	Max.	n
Length:width ratio	*Coleps viridis*	CIL-2017/5	1.82	1.85	0.10	0.02	5.73	1.58	1.93	21
		CIL-2017/6	1.79	1.76	0.08	0.01	4.81	1.68	2.02	21
		CIL-2017/7	1.63	1.64	0.03	0	2.12	1.54	1.68	21
		CIL-2017/8	1.88	1.88	0.02	0	1.42	1.81	1.91	21
		CIL-2017/9	1.73	1.72	0.04	0	2.40	1.64	1.78	21
		CIL-2017/10	2.11	2.10	0.02	0	1.23	2.07	2.15	21
		CIL-2017/13	1.89	1.89	0.03	0	1.73	1.81	1.95	21
		CCAP 1613/3	2.12	2.13	0.22	0.04	10.37	1.73	2.68	21
		CCAP 1613/4	1.61	1.62	0.07	0.01	4.77	1.43	1.73	21
		CCAP 1613/5	2.07	2.07	0.09	0.01	4.40	1.86	2.22	21
		CCAP 1613/6	2.09	2.08	0.04	0	2.10	1.98	2.17	21
		CCAP 1613/7	1.49	1.49	0.01	0	1.14	1.46	1.52	21
		CCAP 1613/8	1.64	1.63	0.05	0.01	3.37	1.55	1.73	21
		CCAP 1613/9	1.85	1.84	0.02	0	1.31	1.82	1.90	21
		CCAP 1613/10	1.82	1.83	0.03	0	2.02	1.77	1.88	21
		CCAP 1613/11	1.87	1.86	0.03	0	1.80	1.82	1.95	21
		CCAP 1613/12	1.79	1.80	0.03	0	2.13	1.71	1.88	21
	Coleps hirtus	CCAP 1613/14	1.93	1.94	0.12	0.02	6.40	1.68	2.14	21
	Nolandia nolandi	CCAP 1613/15	2.01	1.97	0.11	0.02	5.90	1.80	2.24	21

Character	Species	Strain number	Number of plates	Number of windows	Anterior main plate Number of windows - (n)	Anterior secondary plate - Number of windows - (n)	Posterior main plate - Number of windows - (n)
General characteristics	*Coleps virdis*	CIL-2017/5	6	14-16	5 (21)	2 (21)	5 (21)
		CIL-2017/6	6	14-16	5 (21)	2 (21)	4 (21)
		CIL-2017/7	6	14-16	5 (18) 5-6 (3)	2 (21)	4-5 (5) 5 (16)
		CIL-2017/8	6	14-16	5 (21)	2 (21)	4-5 (1) 5 (20)
		CIL-2017/9	6	14-16	4 (21)	2 (21)	4 (21)
		CIL-2017/10	6	14-16	4-5 (1) 5 (20)	2 (21)	5 (21)
		CIL-2017/13	6	14-16	4-5 (5) 5 (15) 5-6 (1)	2 (17) 2-3 (4)	4 (1) 4-5 (8) 5 (12)
		CCAP 1613/3	6	12-13	4 (19) 4-5 (2)	2 (21)	4 (21)
		CCAP 1613/4	6	12	4 (18) 4-5 (3)	2 (21)	4 (21)
		CCAP 1613/5	6	12	4 (21)	2 (21)	4 (21)
		CCAP 1613/6	6	12	4 (21)	2 (21)	4 (21)
		CCAP 1613/7	6	14-16	4-5 (1) 5 (18) 5-6 (2)	2 (21)	4-5 (4) 5 (17)
		CCAP 1613/8	6	12-14	4 (3) 4-5 (16) 5 (2)	2 (7) 2-3 (12) 3 (2)	4 (2) 4-5 (15) 5 (4)
		CCAP 1613/9	6	12	4 (21)	2 (21)	4 (21)
		CCAP 1613/10	6	12-14	3-4 (1) 4 (20)	2 (21)	4 (21)
		CCAP 1613/11	6	14-16	4-5 (1) 5 (20)	2 (21)	4 (3) 4-5 (10) 5 (8)
		CCAP 1613/12	6	12-14	4 (21)	2 (21)	4 (21)
	Coleps hirtus	CCAP 1613/14	6	12-13	3-4-5 (1) 4 (17) 4-5 (2) 5 (1)	2 (21)	4 (11) 4-5 (6) 5 (4)
	Nolandia nolandi	CCAP 1613/15	6	12-14	3-4 (1) 4 (2) 4-5 (16) 5 (1) 5-6 (1)	2 (21)	4 (3) 4-5 (12) 5 (3) 6 (2)

Character	Species	Strain number	Posterior secondary plate - Number of windows - (n)	Number of caudal cilia	Number of anterior spines - (n)	Number of posterior spines - (n)	Window type
General characteristics	*Coleps virdis*	CIL-2017/5	2 (21)	1 (21)	0 (7) 1 (14)	3 (4) 4(17)	*hirtus*-type
		CIL-2017/6	2 (21)	1 (21)	0 (7) 1 (14)	3 (5) 4(16)	*hirtus*-type
		CIL-2017/7	2 (21)	1 (21)	0 (8) 1 (13)	3 (4) 4(17)	*hirtus*-type
		CIL-2017/8	2 (21)	1 (21)	1 (21)	2 (2) 3 (3) 4 (12) 5 (1)	*hirtus*-type
		CIL-2017/9	2 (21)	1 (21)	0 (1) 1 (20)	3 (6) 4(15)	*hirtus*-type
		CIL-2017/10	2 (21)	1 (21)	0 (4) 1 (16) 2 (1)	3 (2) 4(19)	*hirtus*-type
		CIL-2017/13	2 (21)	1 (21)	0 (13) 1 (7) 2 (1)	0 (1) 1 (1) 2 (4) 3 (6) 4 (9)	*hirtus*-type
		CCAP 1613/3	2 (21)	1 (21)	0 (21)	0 (21)	*hirtus*-type
		CCAP 1613/4	2 (21)	1 (21)	0 (21)	0 (20) 1 (1)	*hirtus*-type
		CCAP 1613/5	2 (21)	1 (21)	0 (21)	1 (5) 2 (6) 3 (6) 4 (4)	*hirtus*-type
		CCAP 1613/6	2 (21)	1 (21)	1 (21)	2 (1) 3 (13) 4 (7)	*hirtus*-type
		CCAP 1613/7	2 (20) 3 (1)	1 (21)	0 (8) 1 (13)	1 (2) 2 (5) 3 (5) 4 (9)	*hirtus*-type
		CCAP 1613/8	2 (20) 2-3 (1)	1 (21)	0 (2) 1 (18) 2 (1)	2 (7) 3 (13) 5 (1)	*hirtus*-type
		CCAP 1613/9	2 (21)	1 (21)	0 (13) 1 (8)	0 (1) 1 (2) 2 (8) 3 (10)	*hirtus*-type
		CCAP 1613/10	2 (21)	1 (21)	0 (20) 1 (1)	0 (8) 1 (9) 2 (4)	*hirtus*-type
		CCAP 1613/11	2 (21)	1 (21)	0 (19) 1 (2)	2 (3) 3 (9) 4 (9)	*hirtus*-type
		CCAP 1613/12	2 (21)	1 (21)	0 (18) 1 (3)	1 (2) 2 (7) 3 (7) 4 (5)	*hirtus*-type
	Coleps hirtus	CCAP 1613/14	2 (21)	1 (21)	0 (21)	1 (5) 2 (6) 3 (6) 4 (4)	*hirtus*-type
	Nolandia nolandi	CCAP 1613/15	2 (15) 2-3 (1) 3 (5)	1 (21)	0 (21)	0 (1) 1 (6) 2 (10) 3 (4)	*nolandi*-type

Character	Species	Strain number	Shape of ridge	Body shape	Presence of green algal endosymbionts - (n)
General characteristics	*Coleps virdis*	CIL-2017/5	Wing-like	Barrel-shaped	Yes (21)
		CIL-2017/6	Wing-like	Barrel-shaped	Yes (18) No (3)
		CIL-2017/7	Wing-like	Barrel-shaped	Yes (21)
		CIL-2017/8	Wing-like	Barrel-shaped	Yes (16) No (5)
		CIL-2017/9	Wing-like	Barrel-shaped	No (21)
		CIL-2017/10	Wing-like	Barrel-shaped	Yes (4) No (17)
		CIL-2017/13	Wing-like	Barrel-shaped	Yes (21)
		CCAP 1613/3	Not wing-like	Barrel-shaped	No (21)
		CCAP 1613/4	Not wing-like	Barrel-shaped	Yes (21)
		CCAP 1613/5	Not wing-like	Barrel-shaped	Yes (11) No (10)
		CCAP 1613/6	Wing-like	Barrel-shaped	No (21)
		CCAP 1613/7	Wing-like	Barrel-shaped	Yes (21)
		CCAP 1613/8	Wing-like	Barrel-shaped	No (21)
		CCAP 1613/9	Wing-like	Barrel-shaped	No (21)
		CCAP 1613/10	Wing-like	Barrel-shaped	No (21)
		CCAP 1613/11	Wing-like	Pyriform	Yes (21)
		CCAP 1613/12	Wing-like	Barrel-shaped	No (21)
	Coleps hirtus	CCAP 1613/14	Not wing-like	Barrel-shaped	No (21)
	Nolandia nolandi	CCAP 1613/15	Wing-like	Cylindrical	No (21)

Table S3: List of GenBank entries found with the BLASTn search algorithm (100% coverage, >97% identity) using the V4 region (SSU) and the respective haplotype. Accession numbers marked in green are the strains investigated in this study.

Accession #	Haplotype	Origin	Habitat	Reference
MT253670	1a	UK	freshwater	this study
MT253671	1a	UK	freshwater	this study
MT253672	1a	UK	freshwater	this study
MT253673	1a	Switzerland	freshwater	this study
MT253674	1a	Austria	freshwater	this study
MT253675	1a	Austria	freshwater	this study
MT253676	1a	Austria	freshwater	this study
MT253677	1a	Austria	freshwater	this study
MT253678	1a	Austria	freshwater	this study
MT253679	1a	Austria	freshwater	this study
MT253680	1a	Austria	freshwater	this study
MT253681	1a	Austria	freshwater	this study
MT253682	1a	Switzerland	freshwater	this study
MT253683	1a	Austria	freshwater	this study
MT253684	1a	Germany	freshwater	this study
MT253686	1a	Switzerland	freshwater	this study
AM292312	1a	Germany	freshwater	Barth et al. (2008)
LS999899	1a	Switzerland	freshwater	Pitsch et al. (2019)
JN090894	1a	Greece	freshwater	Oikonomou et al. (2012)
EU446361	1a	Mediterranean Sea	marine	Alexander et al. (2009)
EU024974	1a	Austria	freshwater	Auinger et al. (2008)
FJ765380	1a	South Korea	freshwater	Joo et al. (2010)
LN870142	1b	Italy	freshwater	Rossi et al. (2016)
LN870060	1b	Italy	freshwater	Rossi et al. (2016)
LN869945	1b	Italy	freshwater	Rossi et al. (2016)
LN870149	1b	Italy	freshwater	Rossi et al. (2016)
LN870054	1b	Italy	freshwater	Rossi et al. (2016)
EU446396	1c	Mediterranean Sea	marine	Alexander et al. (2009)
U97109	1d	unknown	unknown	unpublished
MT253685	1e	Austria	freshwater	this study
MT253687	2a	Austria	freshwater	this study
LN870048	2a	Italy	freshwater	Rossi et al. (2016)
LN870110	2a	Italy	freshwater	Rossi et al. (2016)
LN870063	2a	Italy	freshwater	Rossi et al. (2016)
LN870036	2a	Italy	freshwater	Rossi et al. (2016)
LN870025	2a	Italy	freshwater	Rossi et al. (2016)
LN870011	2a	Italy	freshwater	Rossi et al. (2016)
AM292311	2a	Germany	freshwater	Barth et al. (2008)
DQ487194	2a	USA	freshwater	Duff et al. (2008)
HM140399	2b	South Korea	freshwater	unpublished
LN870155	2c	Italy	freshwater	Rossi et al. (2016)
KF639909	2c	USA	freshwater	Dunthorn et al. (2014)
X76646	2d	USA	freshwater	Stechmann et al. (1998)

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Table S4: Geography and hydrological parameters of both lakes (Lake Mondsee, Austria and Lake Zurich, Switzerland).

Lake	Mondsee (LM)	Zurich (LZ)
Country	Austria	Switzerland
Coordinates sampling site	47°50′N, 13°23′E	47°19.3′N, 8°33.9′E
Elevation (m a.s.l.)	481	406
Surface area (km²)	14.2	66.2
Average depth (m)	36	50
Maximum depth (m)	68	136