Supplementary Table 1: List of strains, associated sequences and metadata used in this study. For the molecular markers (nSSU, nmSSU and ITS2) GenBank accession numbers (#) are listed (sequences in bold were obtained in this work). Phycobiliprotein (PBP) type, PC for phycocyanin and PE for phycoerythrin. Temperature, country, habitat and locality.

Name	Strain	nSSU #	nmSSU #	ITS2 #	PBP	Temp.	Country	Habitat	Locality
Hemiselmis amylosa[4]	Cowl- CSU	AF143944			PC 615[5]		USA	freshwater	North America, Cowdry Lake/ Colorado
*Hemiselmis andersenii**	CCMP1180	AM901353	AM901022		PE 545/ 555[2]	20°C	MEX	marine	Gulf of Mexico
*Hemiselmis andersenii**	CCMP441	AM901350	AM901019		PE 555[2]	20°C	MEX	marine	Gulf of Mexico, Gulf Stream
*Hemiselmis andersenii**	CCMP644	AM901351	DQ519365		PE 555[2]	20°C	USA	marine	Gulf of Mexico, Gulf Stream
*Hemiselmis andersenii**	CCMP439	AJ007283	AJ420690		PE 555[2]	24°C	USA	marine	Gulf of Mexico, Cape San Blas
Hemiselmis* cf. *andersenii	**RCC4116**	**MT628036**	**MT628035**	**MT628029**	**PE 551/ 553**	**20°C**	**JPN**	**marine**	**North Pacific Ocean**
Hemiselmis* cf. *andersenii	**RCC2614**	**MF179473**	**MF179479**	**MT628034**		**15°C**	**GBR**	**marine**	**North Atlantic Ocean, North Sea**
Hemiselmis aquamarina	**RCC4102**	**MF179476**	**MT605191-MT605193**	**MT628026-MT628028**	**PC 564**	**20°C**	**JPN**	**marine**	**North Pacific Ocean**
Hemiselmis aquamarina	**BMAK265 (RCC5634)**	**MT605165 MT605166**	**MT605187-MT605190**	**MT628030-MT628033**	**PC 564**	**20°C**	**BRA**	**marine**	**South Atlantic Ocean, Ubatuba, SP**
Hemiselmis cf. *aquamarina*	UTEX2000[6]	AM901367	AM901034				USA	marine	North Atlantic Ocean, Virginia, York River
*Hemiselmis cryptochromatica**	CCMP1181	AM901354	AM901023		PC 659[4]	14°C	USA	marine	North Atlantic Ocean, Boothbay Harbor, Maine
*Hemiselmis pacifica**	CCMP706	AM901352	AM901020		PC 576[1]	14°C	USA	marine	North Atlantic Ocean, Washington, San Juan Island

Hemiselmis rufescens	**RCC659**	**MF179475**	**MF179481**	**MT628025**	**PE 554/ 555**	**15°C**	**NOR**	**marine**	**North Atlantic Ocean, North Sea**
Hemiselmis rufescens	**RCC4216**	**MF179474**	**MF179480**		**PE 554/ 555**	**15°C**	**FRA**	**marine**	**North Atlantic Ocean, English Channel**
*Hemiselmis rufescens**	CCAP 984/2	AJ007282	AM901016		PE 554[(2)]		GBR	marine	North Atlantic Ocean, English Channel
*Hemiselmis rufescens**	CCMP440	AM901349	AM901018		PE 555[(3)]	20°C	USA	marine	North Atlantic Ocean, Maine, West Boothbay Harbor
*Hemiselmis tepida**	CCMP443	AJ007284	AJ420691		PC 612[(3)]	20°C	USA	marine	North Atlantic Ocean, Galveston Channel, Texas
*Hemiselmis tepida**	CCMP442	HM126533	EF594307		PC 612[(3)]	20°C	USA	marine	North Atlantic Ocean, Galveston Channel, Texas
Hemiselmis* cf. *virescens	**RCC3575, (M1635, CACC1635 B)**	**MF179477**	**MF179484**	**MT628024**	**PC 612[(3)]**	**17°C**	**SWE**	**marine**	**Kristineborg, Baltic Sea**
*Hemiselmis virescens**	UTEX 2002	AM901368	AM901035		PC 614[(3)]		USA	marine	North Atlantic Ocean, Virginia, York River
Chroomonas africana		HG328376	HG328384		PC 645[(3)]		ZAF	marine	South Atlantic Ocean, Cape Province, Yzerfontein region
Chroomonas coerulea	NIES-0714	HG328381	HG328389				JPN	freshwater	Asia, Honshu, Nagano, Sugadaira
*Chroomonas debatzensis**	CCAC 5074 B	MG387973	MG387972				FRA	**marine**	North Atlantic Ocean, English Channel, Roscoff
*Chroomonas debatzensis**	CCAC 0173 B (M1318)	AJ007279	AJ420679				FRA	**marine**	North Atlantic Ocean, English Channel, Île de Batz

*Chroomonas debatzensis**	M1703	AJ420699	AJ420681		PC 630[3]		DNK		Jutland, Hjerting
Chroomonas* cf. *debatzensis	**RCC3436**	**MF589232**		**MT628020, MT628021**		**17°C**	Unknown	**marine**	**Unknown**
Chroomonas* cf. *debatzensis	**RCC1504**	**MT628016**		**MT628022, MT628023**		**17°C**	**FRA**	**marine**	**North Atlantic Ocean, English Channel, Roscoff**
*Chroomonas gentoftensis**	CCAC 1627 B (M1627)	AM901360	AM901029		PC 630[3]		DNK	marine	Baltic Sea, Sjaelland, Bellevue Strandbad
Chroomonas mesostigmatica	CCMP1168	AF508268	AM901021		PC 645[3]		Unknown	marine	Unknown
Chroomonas mesostigmatica	CCMP0269	AM901347	AM901017		PC 645[3]		USA	Marine	North Atlantic Ocean, Maryland, Assateague Island
*Chroomonas nordstedtii**	NIES-0708	HG328378	HG328386				JPN	freshwater	Asia, Hokkaido, Sapporo, Hokkaido University
*Chroomonas nordstedtii**	UTEX 2779	AM901369	AM901036		PC 630[3]		USA	freshwater	North America, Colorado, Wellington Reservoir
Chroomonas pauciplastida	CCMP0268	AM901346	DQ519363		PC 645[3]		USA	marine	North Atlantic, Nantucket Sound
Chroomonas placoidea	CCAP 978/08	AM901345	AM901015		PC 645[3]		GBR	marine	North Atlantic, Irish Sea, Yorkshire
Chroomonas sp.	CCAC 0060 (M0874)	AM901357	AM901026		PC 630[3]		DEU	freshwater	Europe, Griether Ort
Chroomonas sp.	SAG 980-1	AJ420698	AJ420677		PC 645[3]		GBR		Europe, Wales
Chroomonas sp.	CCAC 2291 (M2291/1)	AM901366	AM901033		PC 645[3]		DEU	freshwater	Europe, Cologne, Wahner Heide
Chroomonas sp.	CCAC 1481 B (M1481)	AJ007278	AJ420680		PC 645[3]		DEU	freshwater	Europe, Spessart, Biebergemuend

Komma caudata	MUCC Cr#10	U53122	U53121	PC 645[3]	AUS	freshwater	Oceania, Wimmera river
Cryptomonas curvata	CCAC 0080	AM051189	AJ715462		DEU	freshwater	Europe, Muenster
Cryptomonas marssonii	CCAC 0086	AM051191	AJ566173		DEU	freshwater	Muenster
Cryptomonas pyrenoidifera	CCAC 0179 B (M1077)	AM051197	AJ566180		DEU	freshwater	Europe, Cologne
Falcomonas daucoides	Fada ShP-CSUCC	AF143943	AJ420689	PC 569[3]	USA	marine	North Pacific Ocean, Shannon Point, Washington
Geminigera cryophila	CCMP2564	DQ452091	DQ452092		ATA	marine	Southern Ocean, McMurdo Sound
Guillardia theta	CCMP327	X57162	AJ010592	PE 545[3]	USA	marine	North Atlantic, Long Island Sound
Hanusia phi	CCMP325	U53126	U53125		USA	marine	North Atlantic, Milford, Connecticut USA, Long Island Sound
Plagioselmis nannoplanctica	HB2011-4pn	KC928320	KC928321		Unknown		Unknown
Proteomonas sulcata	CCMP704	AJ007285	AJ420692		Unknown		Unknown
Rhinomonas pauca	MUCC Cr#47	U53132	U53131	PE546[3]	AUS	marine	Bass Strait, Hobsons Bay
Rhinomonas reticulata var. *reticulata*	CCAP 979/15	HF952562	HF952608		GBR	marine	English Channel, Plymouth Sound
Rhodomonas duplex	NIES-765	HF952604	HF952620		JPN	marine	East China Sea, Okinawa, Yaga
Rhodomonas lens	CCMP739	HF952574	HF952611			marine	Gulf of Mexico
Storeatula major	CCMP320	U53130	U53129		Unknown		Unknown
Teleaulax amphioxeia	SCCAP K-0434	AJ007287	AJ421146		Unknown		Unknown

Names in bold represents the strains sequenced in this study.

* Names revised in the study of Lane and Archibald (2008) and Hoef-Emden (2018).

(1) Value of pigments according to Lane and Archibald (2008).

(2) Value of biliprotein maximum absorption according to Hill and Rowan (1989) and references therein.

(3) Value of biliprotein maximum absorption according to Hoef-Emden (2008) and references therein.

(4) Value of biliprotein maximum absorption according to Cunningham et al. 2019.

(5) Species name and phycobiliprotein characterization are according to Clay and Kugrens (1999).

(6) Strain is deposited in UTEX culture collection as *Chroomonas* sp. (see https://utex.org/products/utex-lb-2000)

Supplementary Table 2: Description of *Hemiselmis* species from the literature.

***Hemiselmis* species**	**Cell shape**			**Cell measurements**						
	lateral view	**dorsal/ ventral view**	**cell end**	**length (µ)**	**width (µ)**	**Chromatophore description**	**Biliprotein**	**Authentic strain**	**Habitat**	**Type locality**
H. amylosa Clay & Kugrens, 1999	bean-shaped	cylindrical	rounded	5.-6	3-3.5	parietal	Cr-PC 615	CowL CSU	freshwater	Cowdry Lake, Colorado (USA)
H. aquamarina Magalhães & Oliveira, 2020	bean-shaped	ovoid	rounded	4.5-7.5	2.7-4.4	parietal, lobate, light green	Cr-PC 564	BMAK265 (syn. RCC5634)	marine, coastal	Ubatuba, SP (BRA)
H. andersenii Lane & Archibald, 2008	reniform	ovoid	acute	5.5-8.5	3.-5	parietal, orange to dark red	Cr-PE 555	CCMP644	marine, oceanic	Gulf Stream
H. cryptochromatica Lane & Archibald, 2008	reniform	obovoid to pyriform	rounded	4.5-6.5	3-4.5	faint gray	Cr PC 630	CCMP1181	marine, coastal	Boothbay Harbor, Maine (USA)
H. pacifica Lane & Archibald, 2008	reniform	ovate	acute	7-8.5	4-6.0	parietal, grass-green to grey-green	Cr PC 615	CCMP706	marine, coastal	Friday Harbor, San Juan Island, Washington (USA)
H. rufescens Parke, 1949	bean-shaped		acute	4-8.5	3.5-5	parietal, lobated, French Rose	Cr-PE 555	PCC563	marine, coastal	Port Erin, Isle of Man, (GBR)
H. tepida Lane & Archibald, 2008	reniform	ovate	rounded	5.5-7	3.5-4.5	parietal, absinthe-green to emerald	Cr-PC 612	CCMP443	marine, coastal	Galveston Channel, Texas (USA)
H. virescens Droop, 1955	bean-shaped/ falcate	cylindrical		5-7	2.5-3	brilliant green, turquoise to bottle-green	Cr-PC 612	no. 64	marine, coastal	Cumbrae, Scotland (GBR)
H. amylifera Butcher nom. inval. 1967	oblong, ovoid	slightly compressed	rounded	7.5	2.5-3	single, olive-yellow (CC 235)	unknown	unavailable	marine	Lowestoft, Suffolk (GBR)
H. anomala Butcher nom. inval. 1967	bean-shaped	ovoid	rounded	5-6.5	3-3.5	parietal, Paris green or Neptune green	unknown	unavailable	marine	Carmathenshire, Caernarvonshire (GBR)

H. brunnescens Butcher, nom. inval. 1967	ovate, bean-shaped	slightly compressed/ elliptical	obtuse-rounded	5- 5.5	3	salmon-pink/ tangerine- orange	Cr-PE 555	PCC14 (syn. CCAP984/2)	marine	English Channel
H. cyclopea Butcher nom. inval. 1967	ovate, bean-shaped	slightly compressed/ elliptical	obtuse	4.5-5.5	4.5- 5	poppy red, parietal	unknown	unavailable	marine	Fishguard, Lowestoft and Conway (GBR)
H. oculata Butcher nom. inval. 1967	ovate, bean-shaped	elliptical, uncompressed	rounded	5-8	4-4.5	two, poppy red parietal	unknown	unavailable	marine	Knap Buoy, English Channel
H. simplex Butcher, nom. inval. 1967	bean-shaped	ovate, lanceolate or cylindrical	rounded	5-6.5	3.5-4	Paris green	unknown	unavailable	marine, coastal	Yorkshire, Lowestoft, Southend, and Conway (GBR)
H. rotunda Butcher nom. inval. 1967	ovate	uncompressed	very rounded	4.-5	2.5-3	parietal, lobated, Nepture green, absinthe	unknown	unavailable	brackish, marine	Bembridge, Isle of Wight (GBR)

Supplementary Table 3

PCRs cycles for nmSSU of initial denaturation at 94°C during 5min. Followed by 35 cycles of: (i) 94°C for 30sec; (ii) 60°C for 1min and (iii) 72°C for 2min. Final extension step at 72°C for 7 minutes. PCRs for nSSU were performed as indicated in (Majaneva et al. 2014) and ITS2 as described in Hoef-Emden & Melkonian 2003.

Primers used for PCRs and sequencing reactions

Primers for nmSSU PCRs		
	Sequences of oligonucleotides (5'- 3')	
CrNM1F	CAG TAG TCA TAT GCT TGT CTT AAG	(Hoef-Emden and Melkonian 2003)
SSUBR	TTG ATC CTT CTG CAG GTT CAC CTA C	(Hoef-Emden and Melkonian 2003)
18S 5'	CCA CCT GGT TGA TCC TGC CAG T	(Sogin 1990)
18S 3'	GAT CCT TCT GCA GGT TCA CCT ACG GAA	(Sogin 1990)
Primers for nSSU PCRs		
18SNF2	TGA TGG TCC CTT ACT ACA	(Majaneva et al. 2014)
SSUR	CTT GTT ACG ACT TCT CCT	(Majaneva et al. 2012)
Primers for nSSU and nmSSU sequencing reactions		
18S 5'	CCA CCT GGT TGA TCC TGC CAG T	(Sogin 1990)
CrNM1F	CAG TAG TCA TAT GCT TGT CTT AAG	(Hoef-Emden and Melkonian 2003)
528F	CGG TAA TTC CAG CTC C	(Sogin 1990)
1055F	GGT GGT GCA TGG CCG	(Bellorin et al. 2002)
18S 3'	GAT CCT TCT GCA GGT TCA CCT ACG GAA	(Sogin 1990)
536R	GAA TTA CCG CGG CTG CTG	(Bird et al. 1992)
1055R	CGG CCA TGC ACC ACC	(Bird et al. 1992)
18SNF2	TGATGGTCCCTTACTACA	(Majaneva et al. 2014)
SSUBR	TTG ATC CTT CTG CAG GTT CAC CTA C	(Hoef-Emden and Melkonian 2003)
SSUR	CTTGTTACGACTTCTCCT	(Majaneva et al. 2012)
Primers for ITS PCR and sequencing reaction		
ITS03F-800	CGA TGA AGA ACG YAG CGA	(Hoef-Emden and Melkonian 2003)
ITS05R-700	TAC TTG TTC GCT ATC GGT CTC T	(Hoef-Emden and Melkonian 2003)

References

Bellorin, A.M., Oliveira, M.C. & Oliveira, E.C. 2002. Phylogeny and systematics of the marine algal family Gracilariaceae (Gracilariales, Rhodophyta) based on small subunit rDNA and its sequences of Atlantic and Pacific species. *J Phycol*. 38:551–63.

Bird, C.J., Rice, E.L., Murphy, C. a. & Ragan, M. a. 1992. Phylogenetic relationships in the Gracilariales (Rhodophyta) as determined by 18S rDNA sequences*. *Phycologia*. 31:510–22.

Hoef-Emden, K. & Melkonian, M. 2003. Revision of the Genus Cryptomonas (Cryptophyceae): a Combination of Molecular Phylogeny and Morphology Provides Insights into a Long-Hidden Dimorphism. *Protist*. 154:371–409.

Majaneva, M., Remonen, I., Rintala, J.-M., Belevich, I., Kremp, A., Setälä, O., Jokitalo, E. et

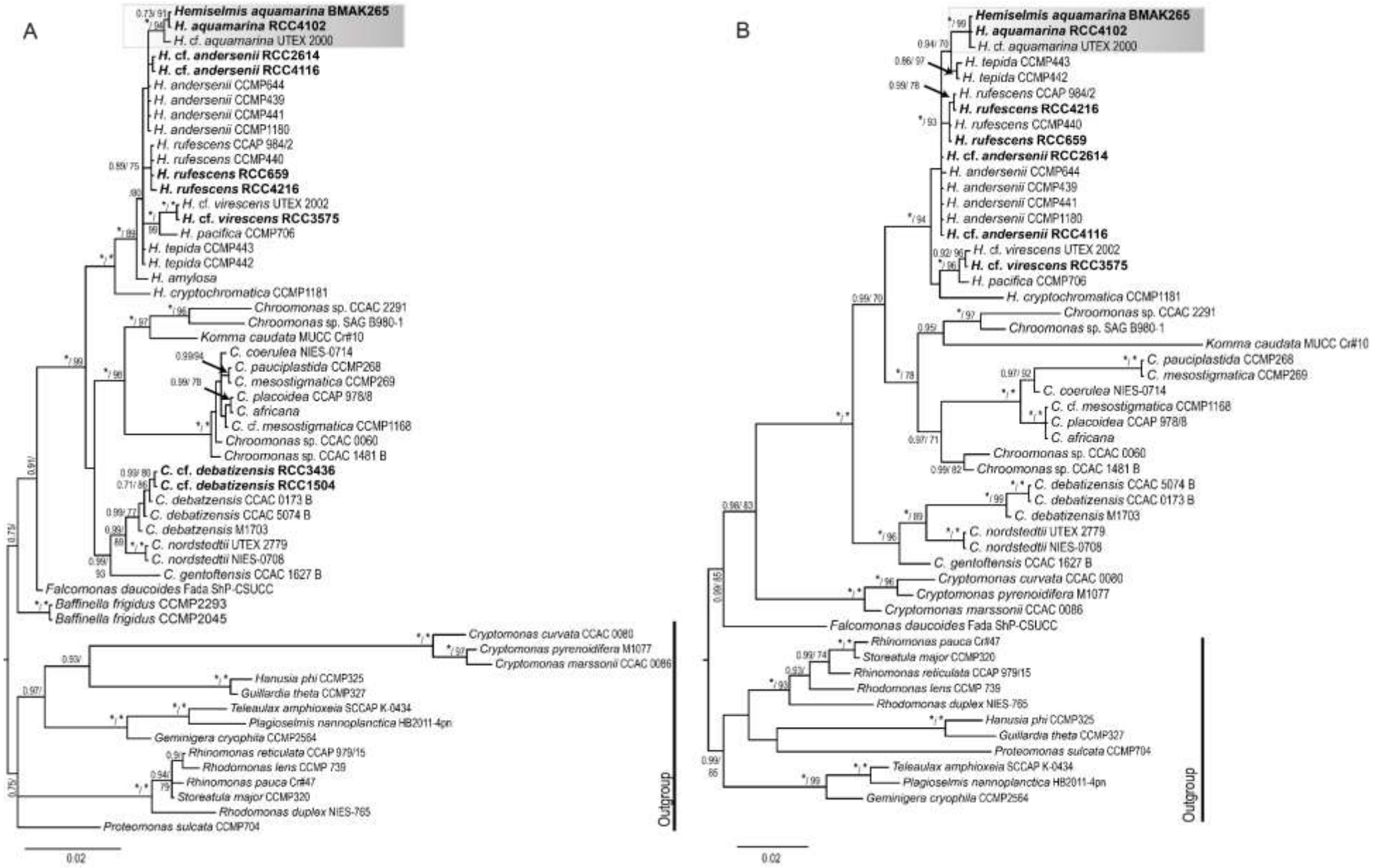
Supplementary Table 3

al. 2014. Rhinomonas nottbecki n. sp. (Cryptomonadales) and Molecular Phylogeny of the Family Pyrenomonadaceae. *J Eukaryot Microbiol*.

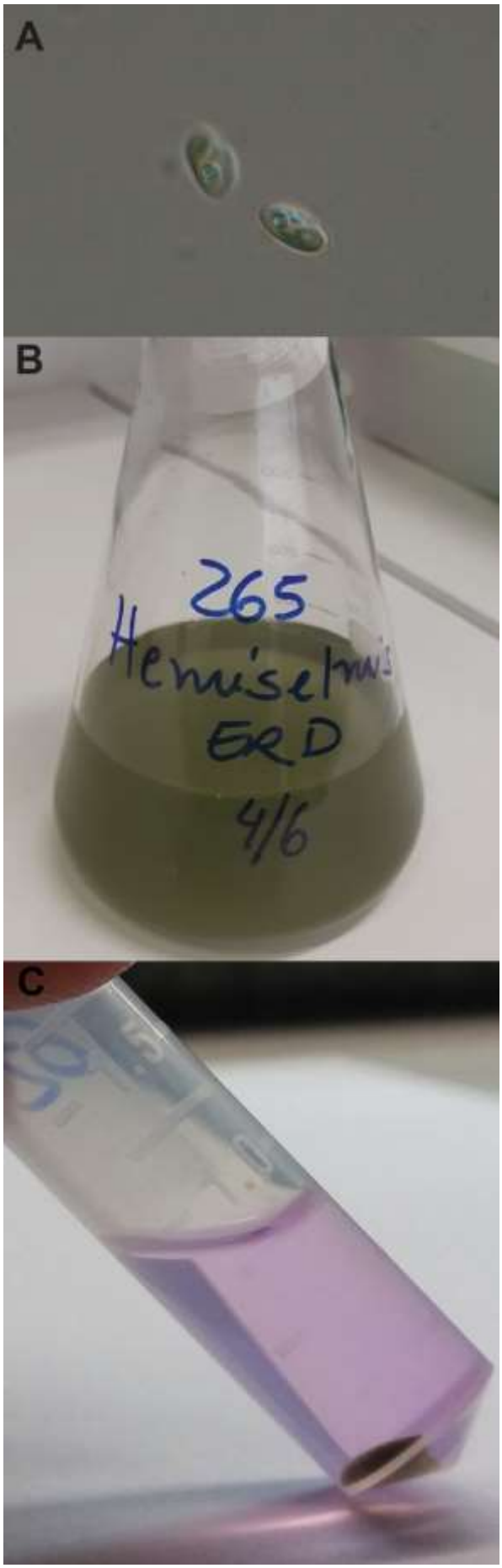
Majaneva, M., Rintala, J.-M., Piisilä, M., Fewer, D.P. & Blomster, J. 2012. Comparison of wintertime eukaryotic community from sea ice and open water in the Baltic Sea, based on sequencing of the 18S rRNA gene. *Polar Biol*. 35:875–89.

Sogin, M.L. 1990. Amplification of ribosomal RNA genes for molecular evolution studies. *In* Innes, M. A., Gelfand, D. H., Snisnky, J. J. & White, T. J. [Eds.] *PCR Protocols. A Guide to Methods and Applications*. M.A. Innes. Academic Press, San Diego, pp. 307–14.

Supplementary Figure 1: Molecular phylogeny trees of *Hemiselmis* estimated by BA supported by PP and BS. Strains in bold were sequenced in the present study. (A) Phylogeny inference of nSSU rRNA gene using HKY+G+I as nucleotide substitution model. (B) Phylogeny inference based on sequences of nmSSU rRNA gene, using the nucleotide substitution model GTR+G+I. Nodes with * are fully supported by PP or BS. Supports below 0.75 PP or 70% of BS are omitted. Scale bar indicates the rate of nucleotide substitution per site.



Supplementary Figure 2: *Hemiselmis aquamarina* colour images. A) Color picture of ells in light microscopy. B) Dense cultures aspect. C) Cr-PC 564 pigment after extraction.



Supplementary Figure 3: *Hemiselmis aquamarina* consensus secondary structure of nuclear ITS2.