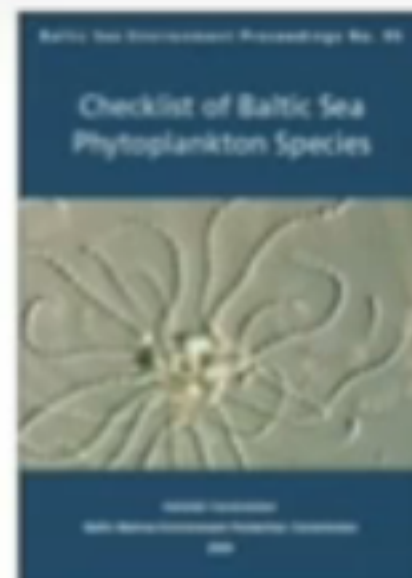


Baltic Sea phytoplankton

Nomenclature

The nomenclature is based on Hällfors, G. (2004). Checklist of Baltic Sea phytoplankton species (including some heterotrophic protistan groups). Baltic Sea Environmental Proceedings 95:1-208.

<http://www.helcom.fi/stc/files/Publications/Proceedings/bsep95.pdf>



Cell sizes of Baltic Sea phytoplankton

Olenina, I., Hajdu, S., Edler, L., Andersson, A., Wasmund, N., Busch, S., Göbel, J., Gromisz, S., Huseby, S., Huttunen, M., Jaanus, A., Kokkonen, P., Ledaine, I., Niemkiewicz, E. (2006). Biovolumes and size-classes of phytoplankton in the Baltic Sea. Baltic Sea Environment Proceeding 166: 1-144.

<http://www.helcom.fi/stc/files/Publications/Proceedings/bsep106.pdf>

Updated excel file on ICES-website: http://www.ices.dk/marine-data/vocabularies/Documents/PEG_BVOL.zip



Scale presented in this summary in every photo is only an indication of the cell size/colony size.

Classification for phytoplankton

Division

Class

Order

(Family)

Genus

Species

Example:

Division **CYANOPHYTA**

Class **Nostocophyceae** (Cyanophyceae)

Order **NOSTOCALES**

(Family **Nostocaceae**)

Genus *Nodularia*

Species *Nodularia spumigena*



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Phytoplankton size classes:

- Picoplankton $< 2 \mu\text{m}$
- Nanoplankton $2\text{-}20 \mu\text{m}$
- Microplankton $20\text{-}200 \mu\text{m}$
- Mesoplankton $200\text{-}2000 \mu\text{m}$

Trophy of phytoplankton:

- **Autotroph** (AU) – an organism that can synthesize organic compounds from inorganic molecules using energy from light (photosynthesis) or inorganic chemical reactions.
- **Heterotroph** (HT) – an organism deriving its nutritional requirements from complex organic substances
- **Mixotroph** (MX) – a phototrophic organism that complements its diet by the uptake of organic compounds (both autotroph and heterotroph).



Overview of Baltic Sea phytoplankton groups and some heterotrophic protistan groups

The nomenclature is based on Hällfors, G. (2004). Checklist of Baltic Sea phytoplankton species (including some heterotrophic protistan groups). *Baltic Sea Environmental Proceedings* 95:1-208.

Division CYANOPHYTA – Cyanobacteria (SE: cyanobakterier, blågrönalger)

Division CRYPTOPHYTA – Recoiling algae (SE: *cryptofycéer*, *rekylalger*)

Division DINOPHYTA – Dinoflagellates (SE: *dinoflagellater*)

Division HAPTOPHYTA - Haptophyte algae

Division CHRYSOPHYTA (HETEROCONTOPHYTA)

Division EUGLENOPHYTA – Euglenoids (SE: euglenider)

Division CHLOROPHYTA

Photosynthetic ciliates, Ciliophora

Phylum Zoomastigophora - Zooflagellates

Class Bicosoecidea

Class Choanoflagellidea - Collar flagellates

Class Eбриidea

Insertae sedis



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Overview of Baltic Sea phytoplankton groups (part 1)

Division CYANOPHYTA (CYANOBACTERIA)

Class Nostocophyceae (Cyanophyceae)

Order CHROOCOCCALES

Order OSCILLATORIALES

Order NOSTOCALES

Division CRYPTOPHYTA

Class Cryptophyceae – Recoiling algae

Order CRYPTOMONADALES

Division DINOPHYTA (PYRRHOPHYTA)

Class Dinophyceae – Dinoflagellates

Order PROROCENTRALES

Order DINOPHYSALES

Order GYMNODINIALES

(Order OXYRRHINALES)

(Order NOCTILUCALES)

(Order ACTINISCALES)

(Order PHYTODINIALES)

Order PERIDINIALES

Order GONYAULACALES

Division HAPTOPHYTA - Haptophyte algae

Class Prymnesiophyceae- Haptophyceae

Order PRYMNESIALES

(Order PAVLOVALES)

Division CHRYSOPHYTA (HETEROCONTOPHYTA)

Class Chrysophyceae - Golden brown algae

Order OCHROMONADALES

(Order PARMALES)

(Order STICHOGLOEALES)

Order PEDINELLALES

Class Dictyochophyceae

Order DICTYOCHALES

(**Class Synurophyceae**)

(Order SYNURALES)

Class Diatomophyceae (Bacillariophyceae) – Diatoms

Order EUPODISCALES (BIDDOULPHIALES) – CENTRALES

Order BACILLARIALES – PENNALES

(**Class Tribophyceae (Xanthophyceae)- Yellow-green algae**)

(Order RHIZOCHLORIDALES)

(Order MISCHOCOCCALES)

(Order TRIBONEMATALES)

(**Class Raphidophyceae**)

(Order CHATTONELLALES)

(Order RAPHIDOMONADALES)

Division EUGLENOPHYTA

Class Euglenophyceae – Euglenoids

Order EUGLENALES

(Order SPENOMONADALES)

(Classes and orders in brackets not included here)



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Overview of Baltic Sea phytoplankton groups including some heterotrophic protistan groups (part 2)

Division CHLOROPHYTA
(Class Pedinophyceae)
(Order PEDINOMONADALE S)
Class Prasinophyceae (Micromonadophyceae)
(Order SMARTELIALES)
Order CHLORODENDRINALES
(Class Charophyceae)
(Order KLEBSORMONALE S)
(Order ZYGARMALES)
Class Chlorophyceae - Green algae
(Order VOLVOCALES)
Order CHLOROCOCCALES
(Order LEPTOCALLES)
Order MICROSPORALES
(Order OEDOGONALES)

Phylum Zoosporophora - Zooflagellates
Class Bicosoecidae
(Order BICOSOECIDA)
Class Choanoflagellata - Collar flagellates
(Order CHOANOFAGELLATA)
Class Eutreptiidae
(Order EUTREPTIIDA)
Class Kinetoplastida
(Order KINETOPLASTIDA)

Insertae sedis

Photosynthetic ciliates, Ciliophora

(Classes and orders in brackets not included here)



Division CYANOPHYTA (CYANOBACTERIA)

Class Nostocophyceae (Cyanophyceae),

Cyanobacteria = Blue-green algae (SE: cyanobakterier, blågrönalger)

Cyanobacteria are procaryotes (like bacteria) and are autotrophs (photosynthetic). They contain several specific pigments (like algae), which color them blue-green to red. Some species are diazotrophic (fix nitrogen), able to produce toxins and forms blooms. Many contain gasvacuols to regulate their position in the water column and to prevent them from sinking. In the Baltic Sea they mainly occur during summer.



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Division CYANOPHYTA (CYANOBACTERIA)

Class Nostocophyceae (Cyanophyceae),

Cyanobacteria = Blue-green algae (SE: cyanobakterier, blågrönalger)

Order Chroococcales

Aphanocapsa

Aphanothece

(*Chroococcus*)

Cyanodictyon

Cyanonephron

Lemmermanniella

Merismopedia

Microcystis

Snowella

Woronichinia

Order Oscillatoriales

(*Leptolyngbya*)

(*Limnothrix*)

Planktolyngbya

Planktothrix

Pseudanabaena

(*Romeria*)

(*Tychonema*)

Order Nostocales

Dolichospermum

(*Anabaena*)

Aphanizomenon

Anabaenopsis

Cronbergia

(*Cuspidothrix*)

Gloeotrichia

Nodularia

Genus in brackets = not presented here.

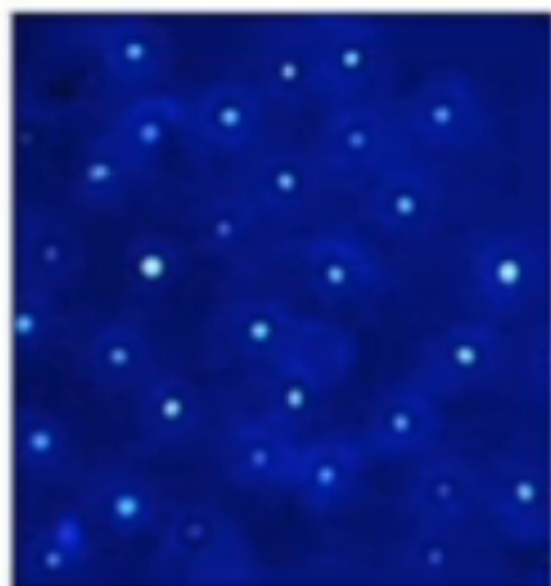


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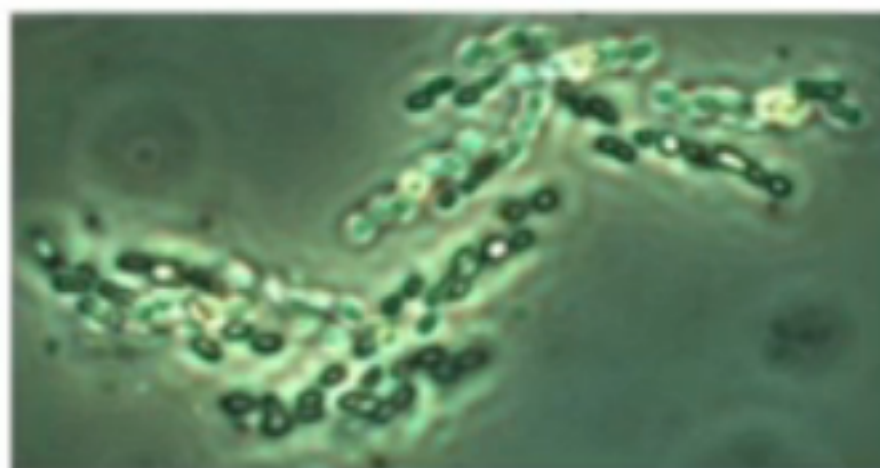
Class Nostocophyceae

Order Chroococcales

Unicellular, small cells with high surface to volume ratio, giving them effective nutrient uptake. Cells are often embedded in sheaths of mucilage and form colonies (defence against grazing). Do not form true filaments but some form pseudofilamentous structures. Several species are common during summer. Cell size from less than 1 μm to above 30 μm . Colony size variable, depending on species (can even be visible as "grains" in the water).



Synecoccus sp. (culture),
Unicellular, not colony-forming



Aphanothece paralleliformis
Example of colony-forming species

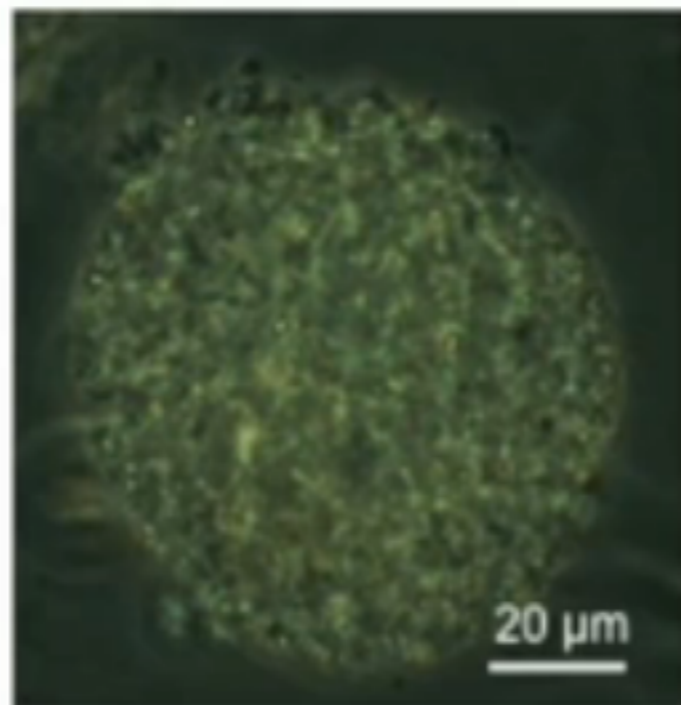


Class Nostocophyceae

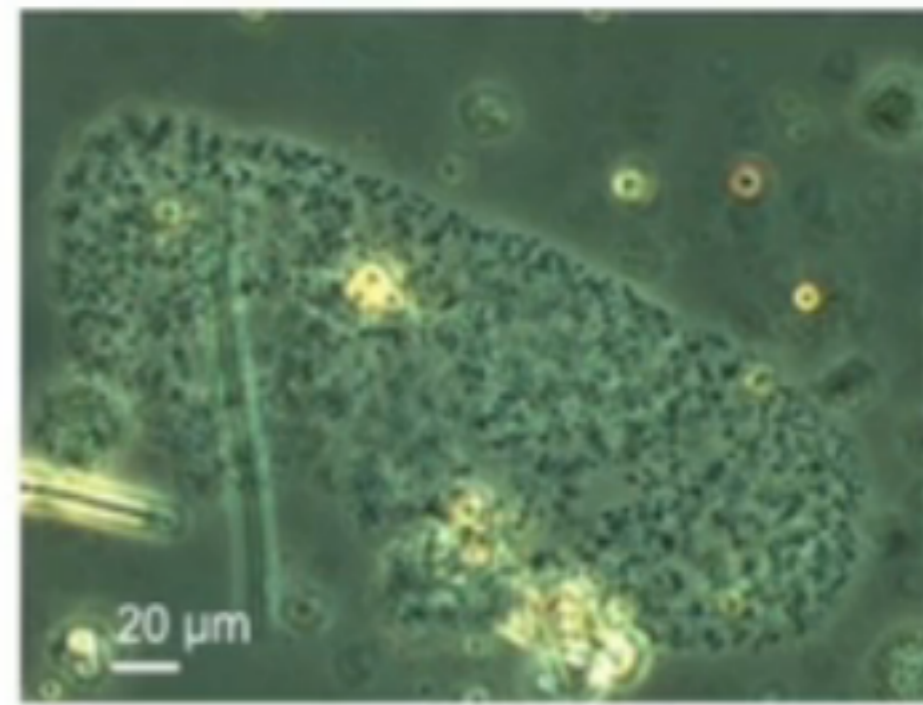
Order Chroococcales

Aphanocapsa

9 species in Hällfors 2004



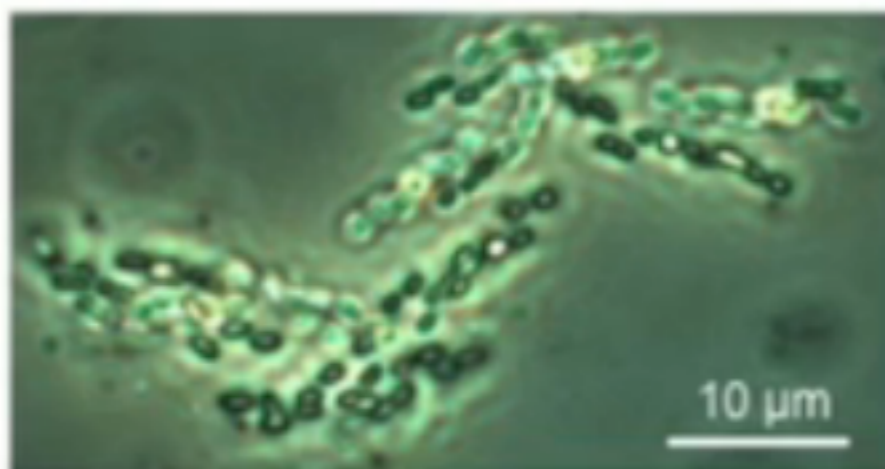
Aphanocapsa delicatissima



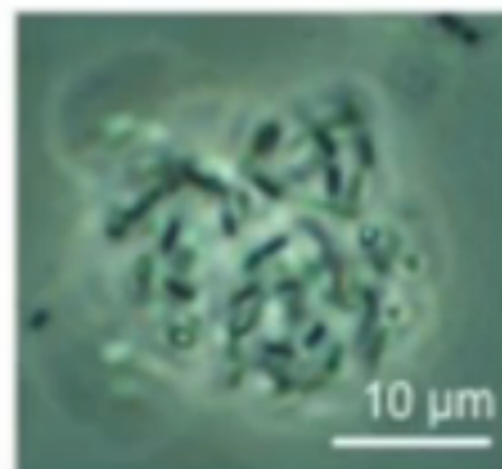
Aphanocapsa sp.

Aphanothece

8 species in Hällfors 2004



Aphanothece paralleiformis



Aphanothece sp.

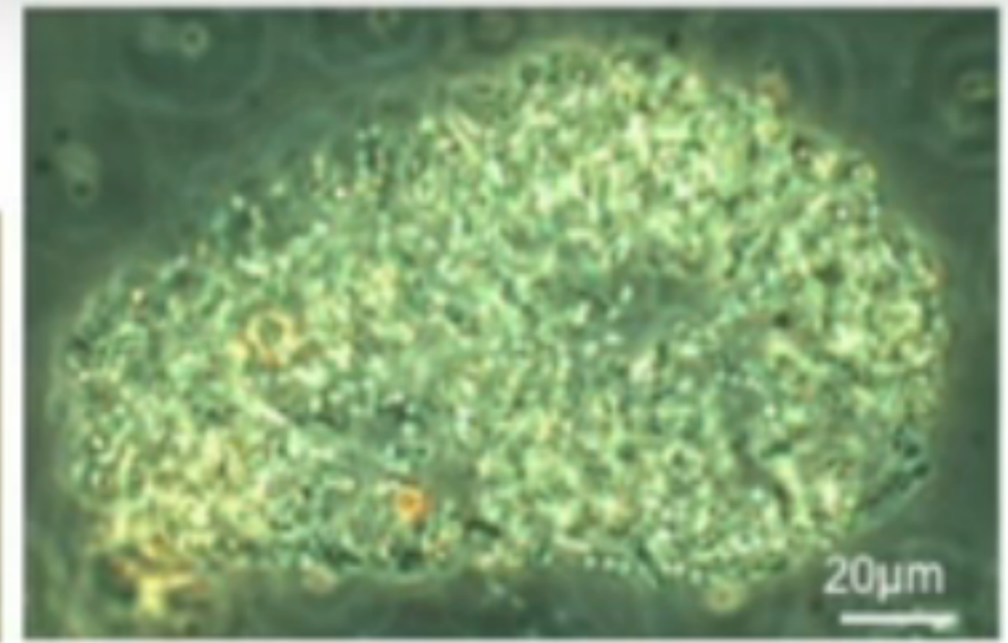
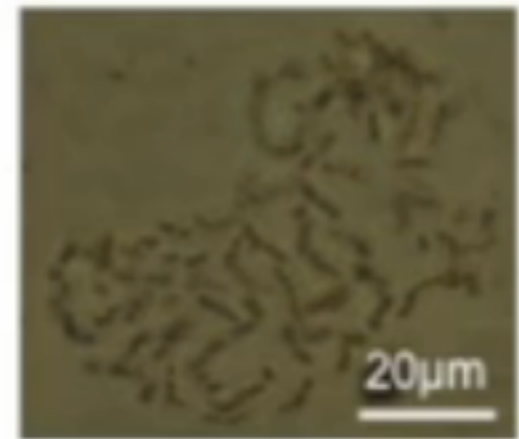


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Order Chroococcales

Cyanodictyon

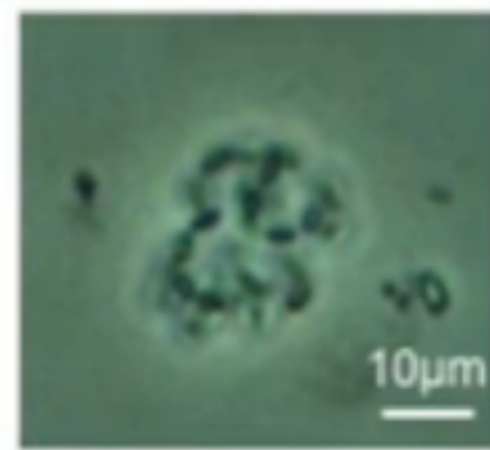
3 species in Hällfors 2004



Cyanodictyon sp.

Cyanonephron

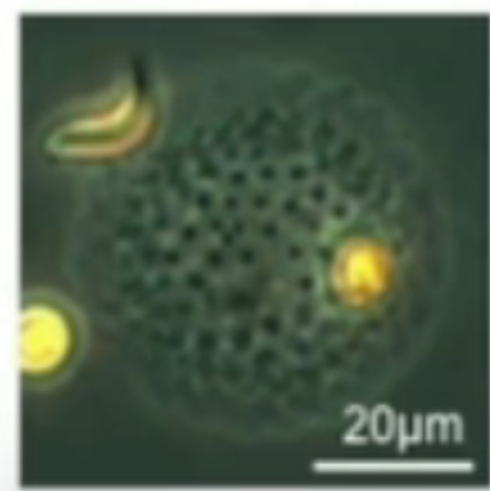
1 species in Hällfors 2004



Cyanonephron styloides

Lemmermanniella

2 species in Hällfors 2004

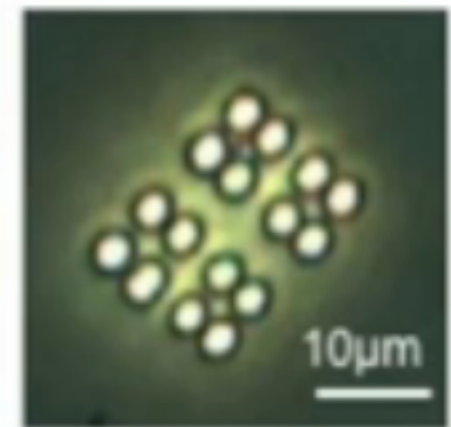
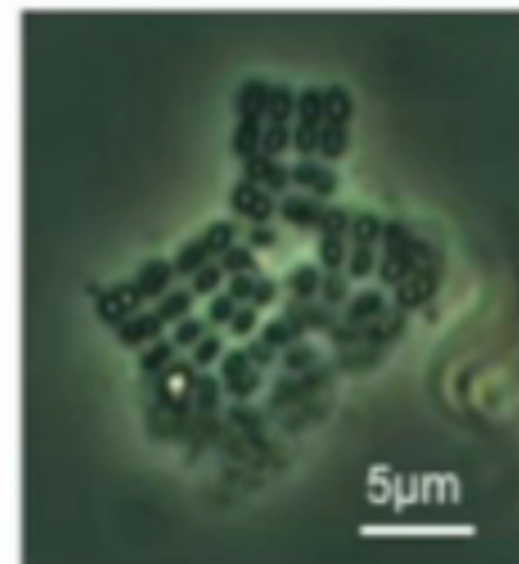
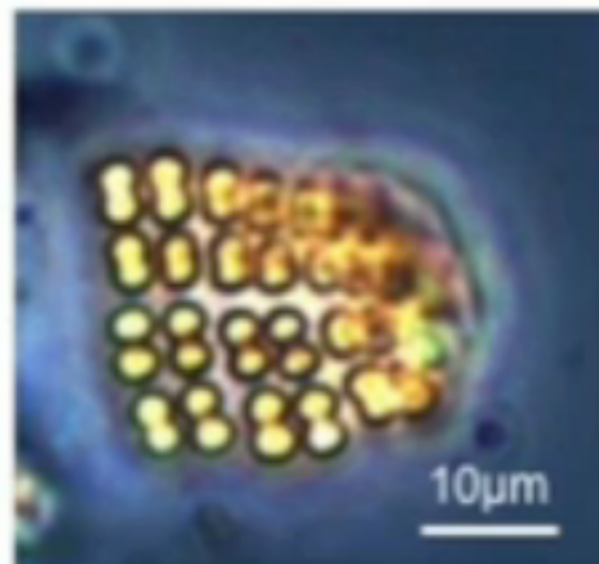


Lemmermanniella sp.

Order Chroococcales

Merismopedia

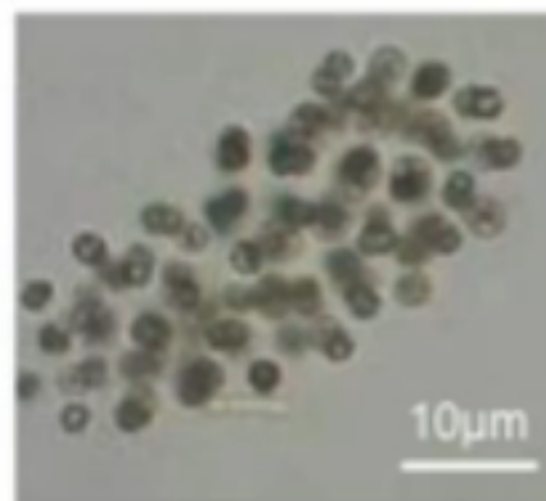
5 species in Hällfors 2004



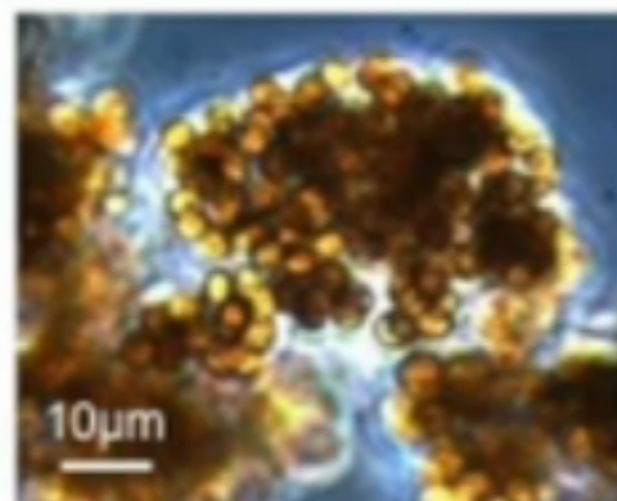
Merismopedia sp.

Microcystis

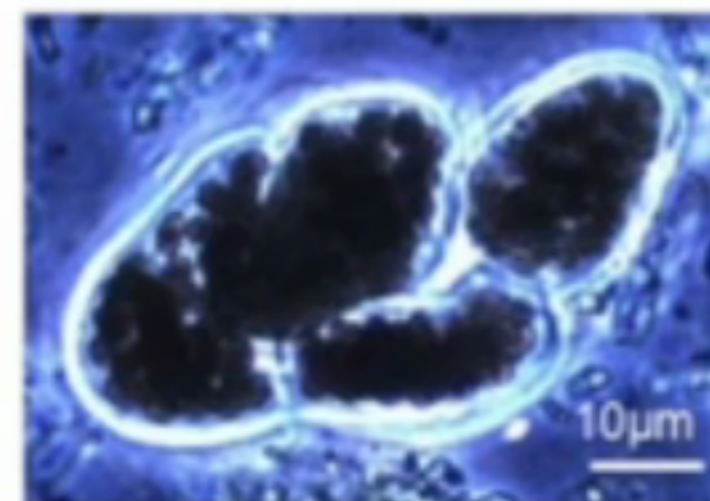
11 species in Hällfors 2004



Microcystis aeruginosa



Microcystis viridis



Microcystis wesenbergii



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Order Chroococcales

Snowella

6 species in Hällfors 2004

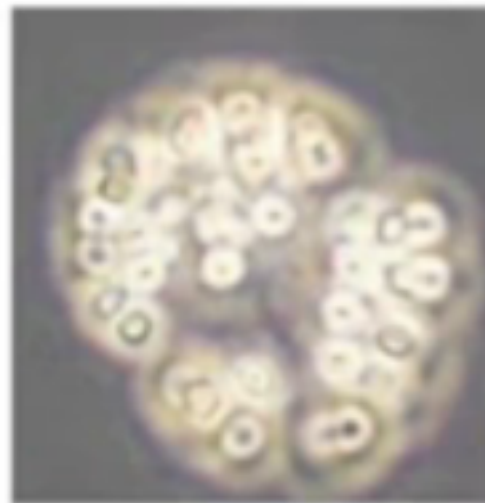
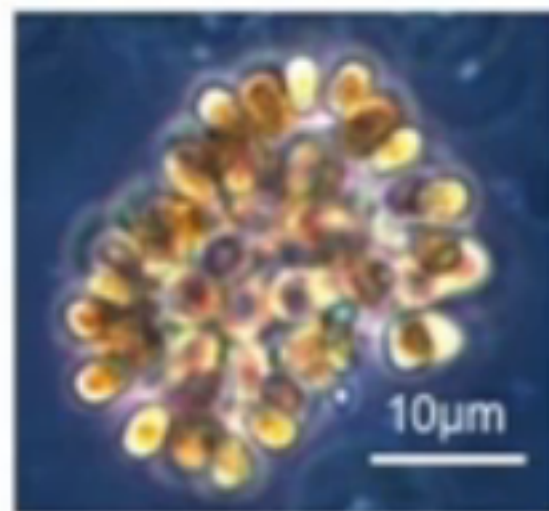


Photo: IOW-Warmemünde

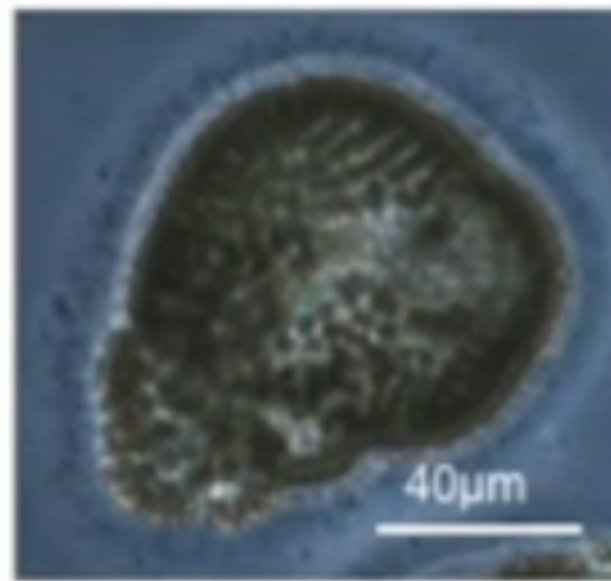
Snowella sp.

Woronichinia

5 species in Hällfors 2004



Woronichinia sp.



Woronichinia naegliana

Order Oscillatoriales

Filamentous species without heterocytes (N-fixing cells) or akinetes (resting spores). With unbranched filaments. The genus *Pseudanabaena* is common in the Baltic Sea during summer. Some species, like *Planktothrix agardhii* thrives in eutrophic waters and cause toxic blooms.

(Leptolyngbya)

(Limnothrix)

Planktolyngbya

Planktothrix

Pseudanabaena

(Romeria)

(Tychonema)



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Order Oscillatoriales

Planktolyngbya

4 species in Hällfors 2004



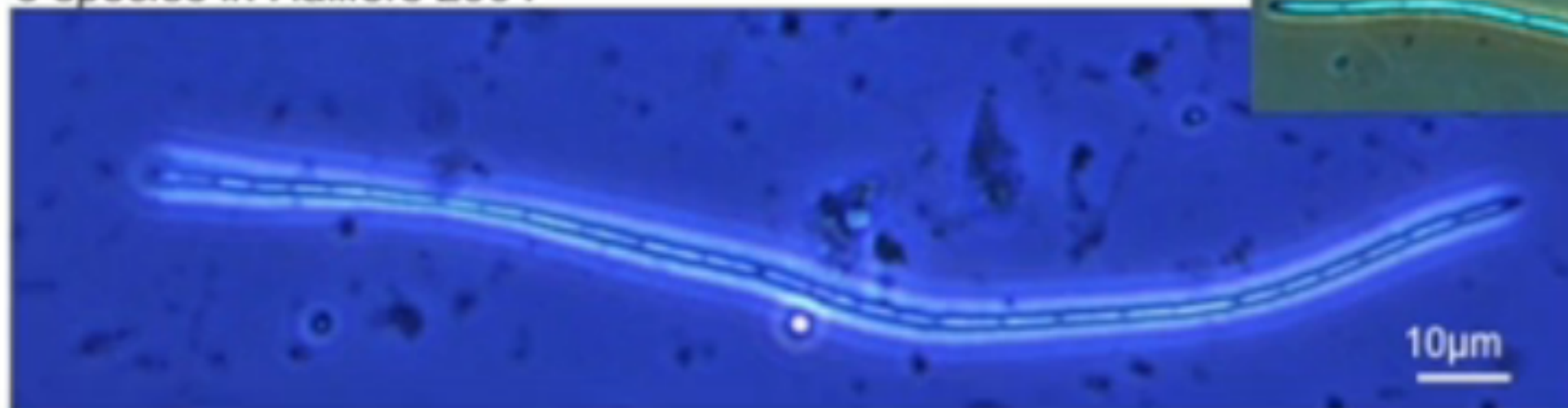
Planktolyngbya sp.



Planktolyngbya contorta

Pseudanabaena

3 species in Hällfors 2004



Pseudanabaena limnetica

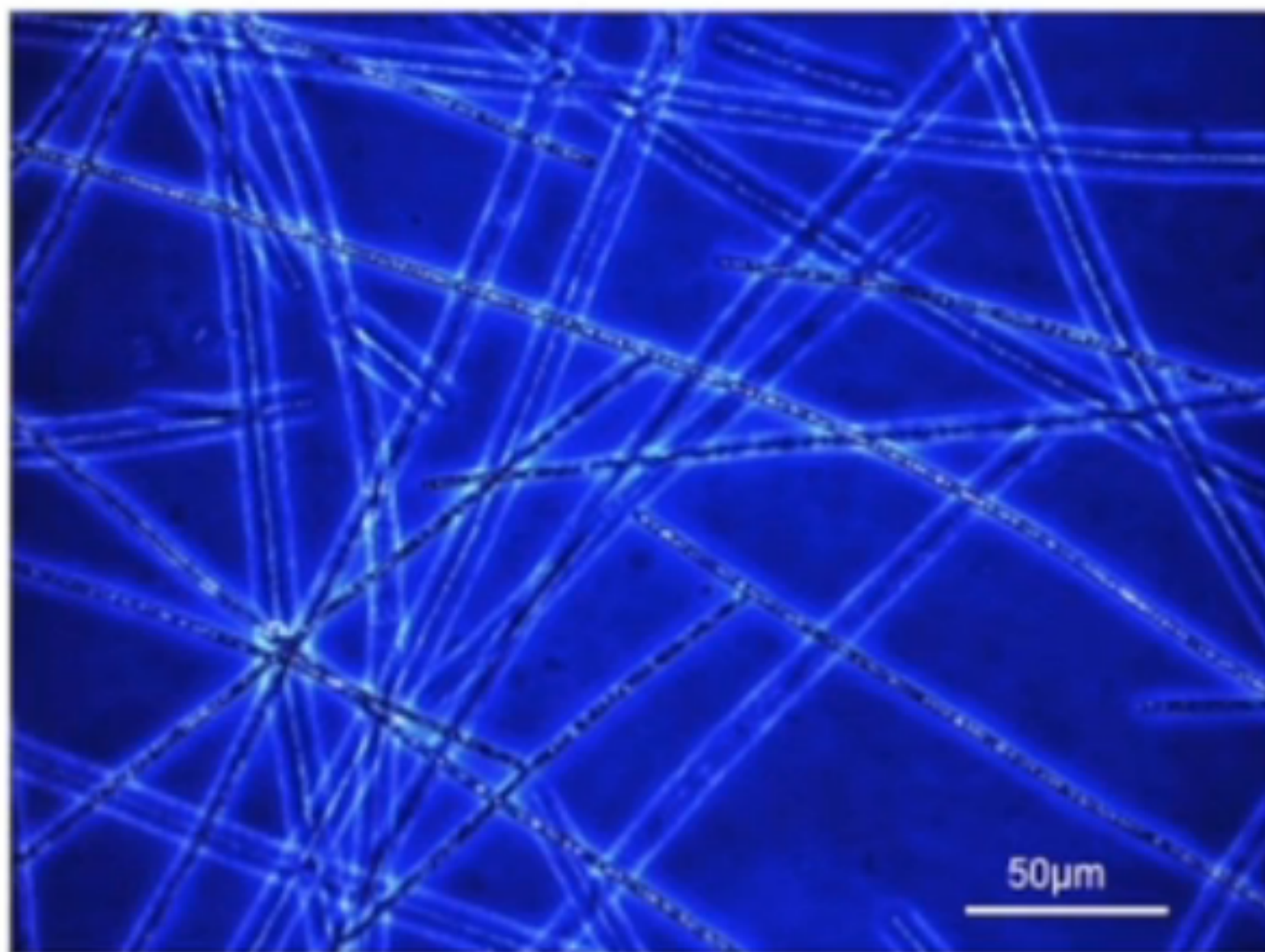


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Order Oscillatoriales

Planktothrix

3 species in Hällfors 2004



Planktothrix agardhii



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Order Nostocales

Filamentous species with both heterocytes and akinetes. Unbranched filaments, no true branching exist. Some species even form colonies (*Aphanizomenon*, *Gloeotrichia*). They are able to fix nitrogen (diazotrophic) and occur mainly during summer when the trophogenic layer is depleted in nitrogen, but phosphorus still exist in the surface water. Most important genus in the Baltic Sea are *Aphanizomenon*, *Nodularia* and *Dolichospermum*.

Dolichospermum (*Anabaena*)

Aphanizomenon

Anabaenopsis

Cronbergia

(*Cuspidothrix*)

Gloeotrichia

Nodularia



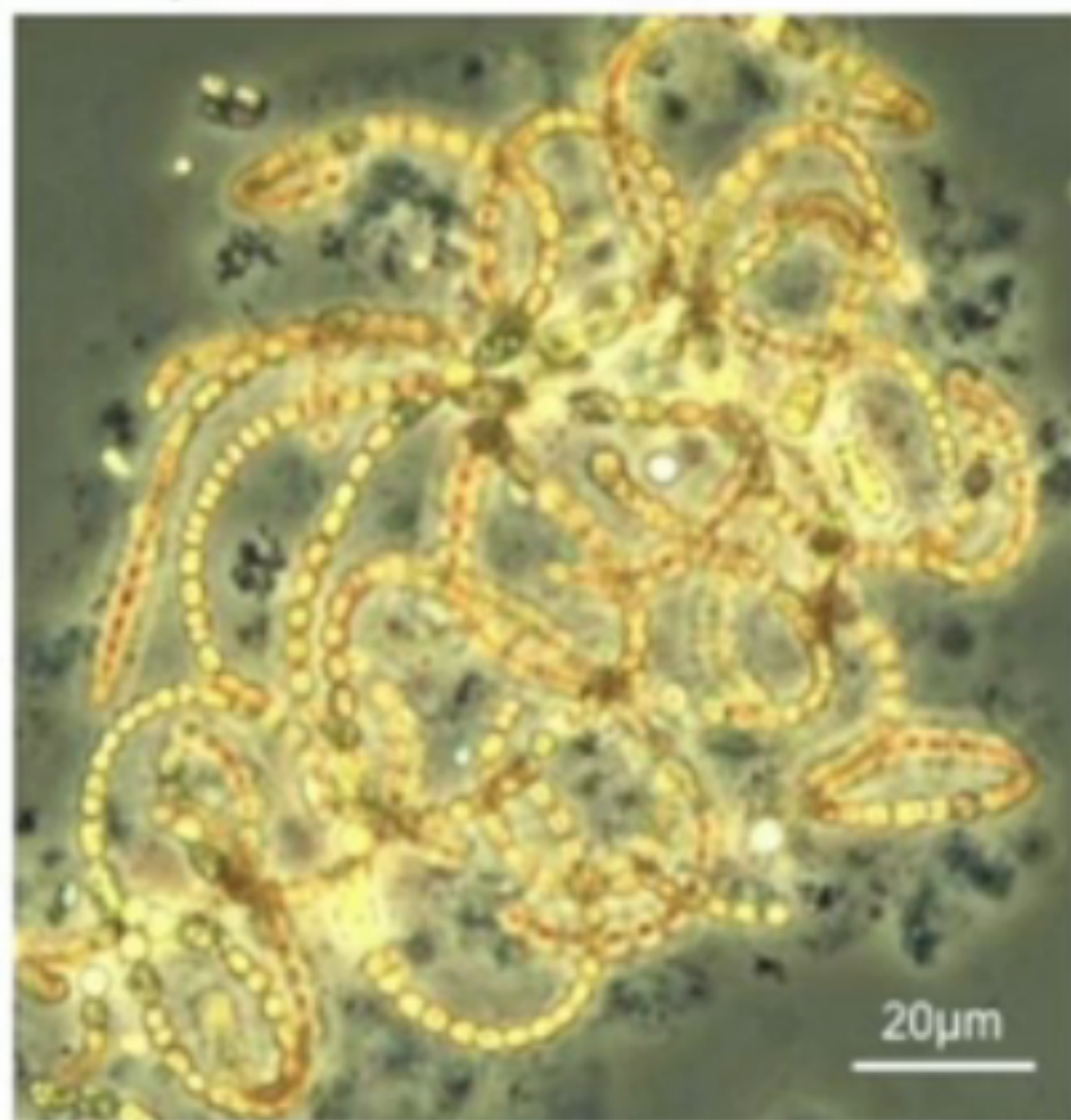
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Order Nostocales

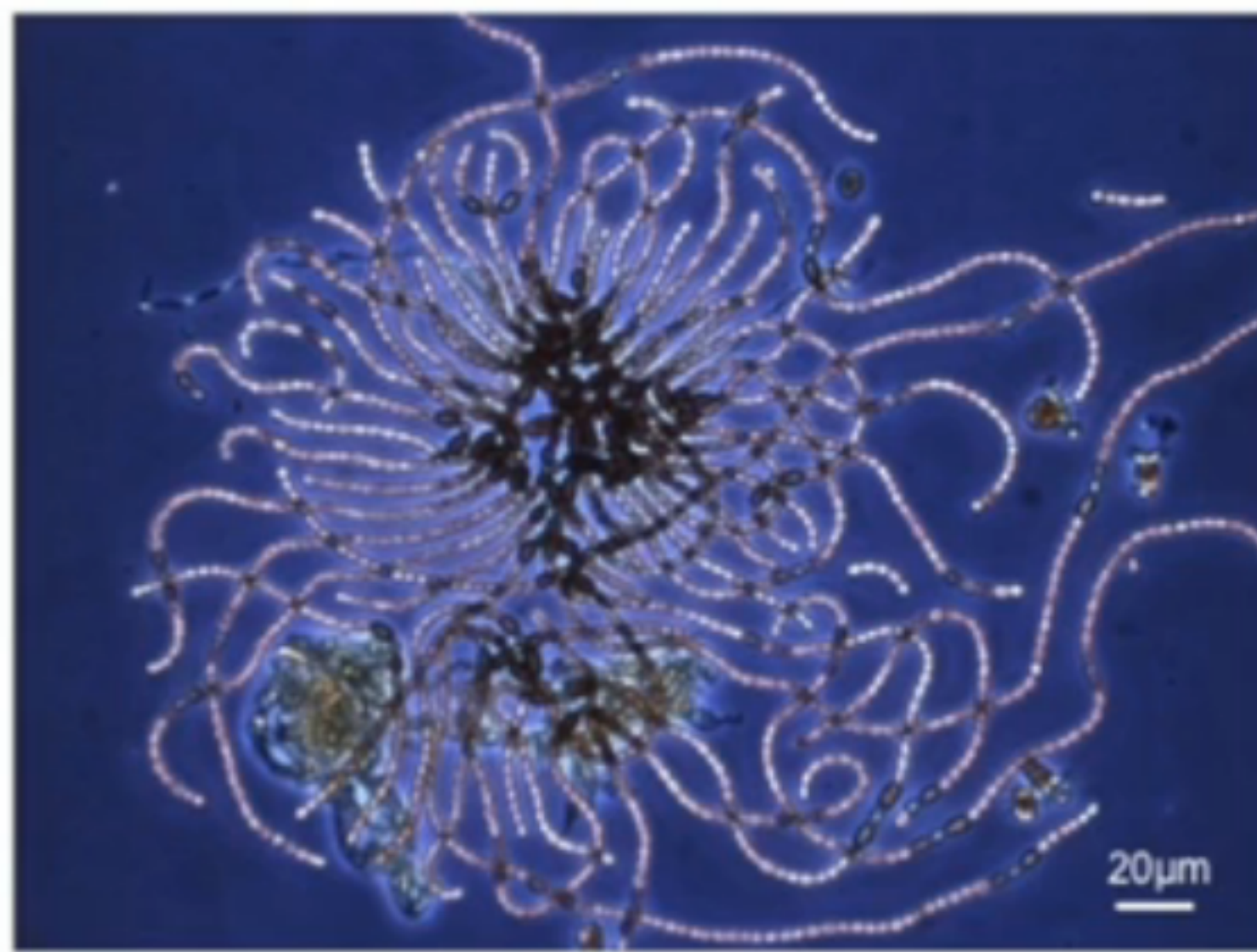
Dolichospermum

(Before called *Anabaena*)

18 species in Hällfors 2004



Dolichospermum sp.



Dolichospermum lemmermannii

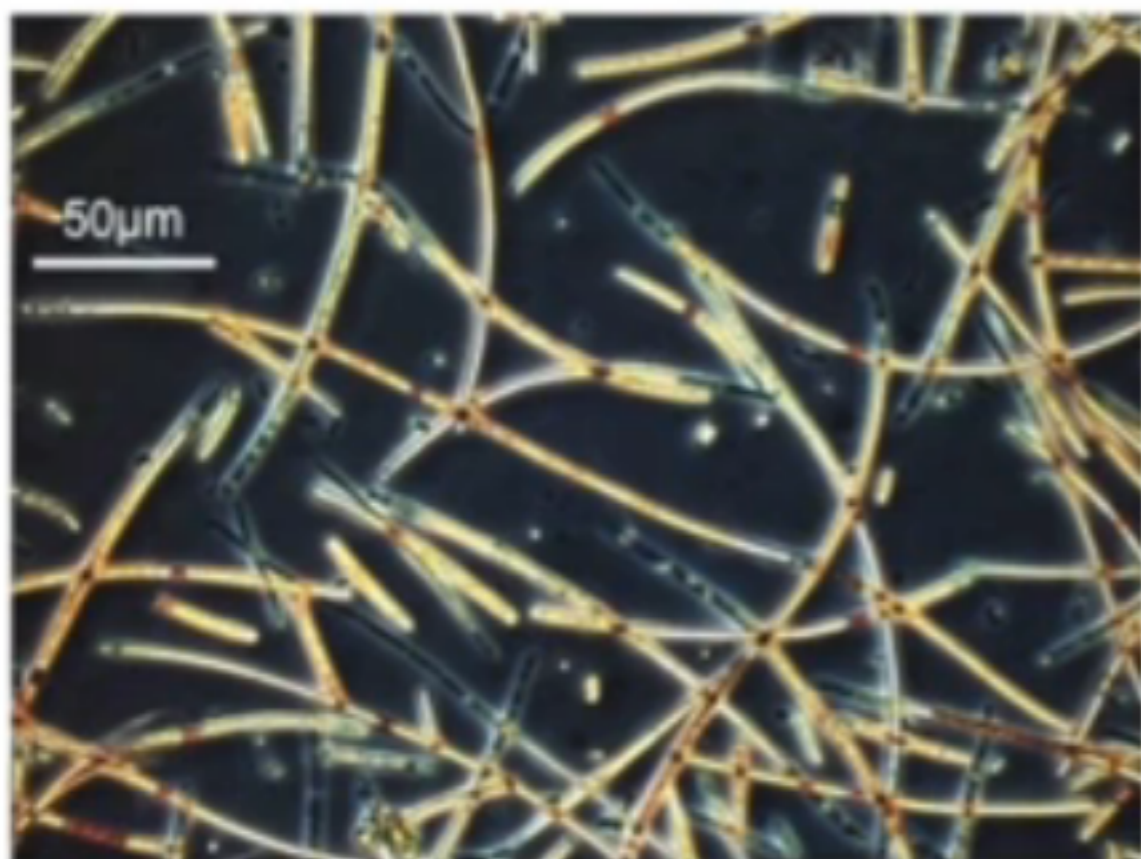
All pelagic species are transferred to *Dolichospermum*, benthic species are still called *Anabaena* (Wacklin et al 2009, Fottea 9(1) 59-64).



Order Nostocales

Aphanizomenon

6 species in Hällfors 2004



Aphanizomenon sp.

akinetete (resting spore)

heterocyt



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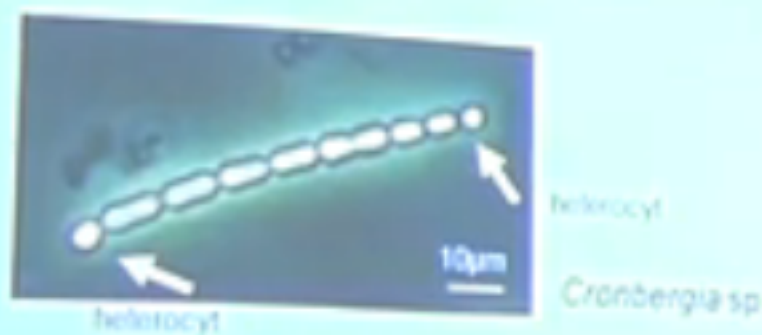
Order Nostocales

Anabaenopsis

3 species in Hallfors 2004



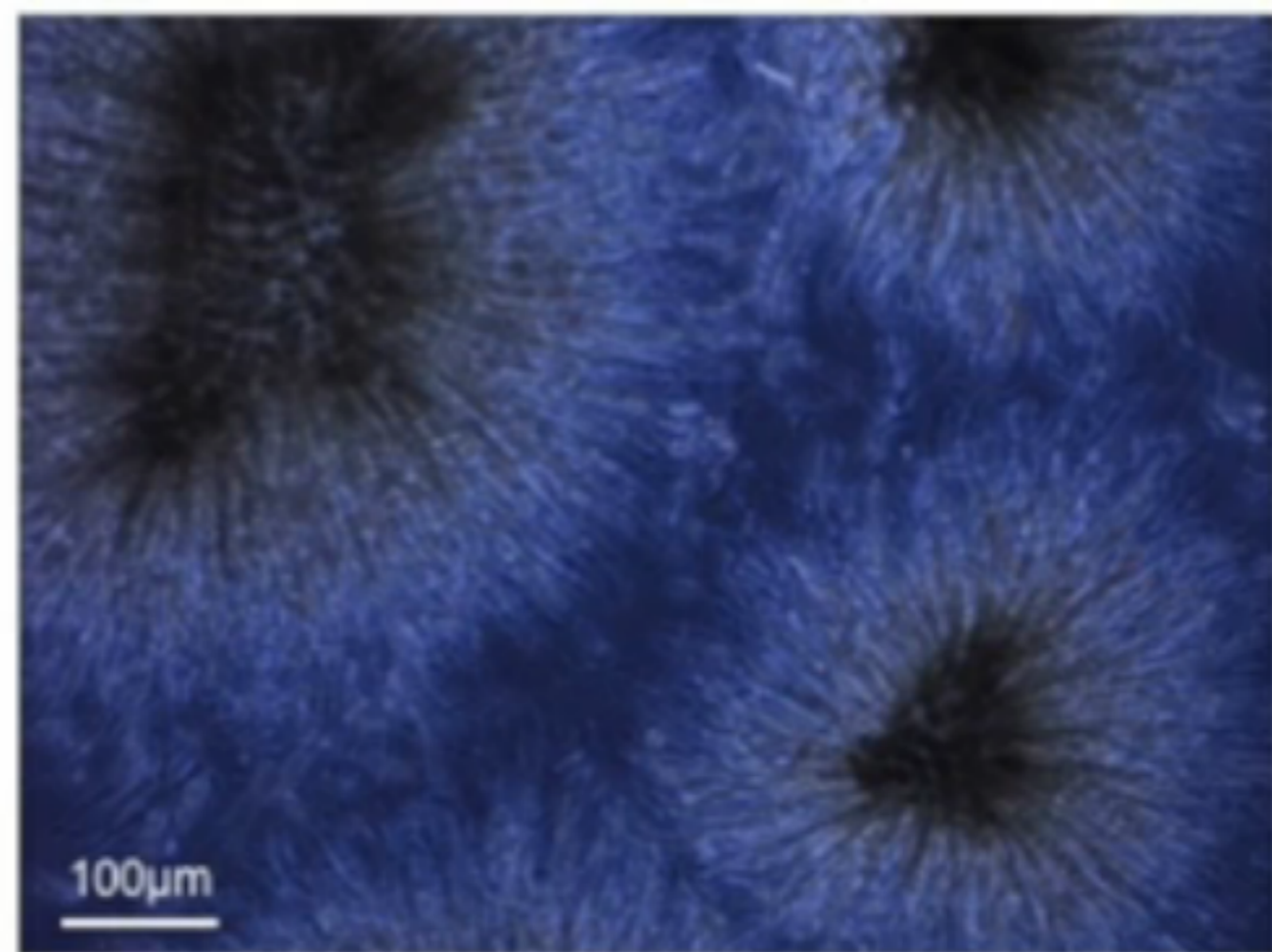
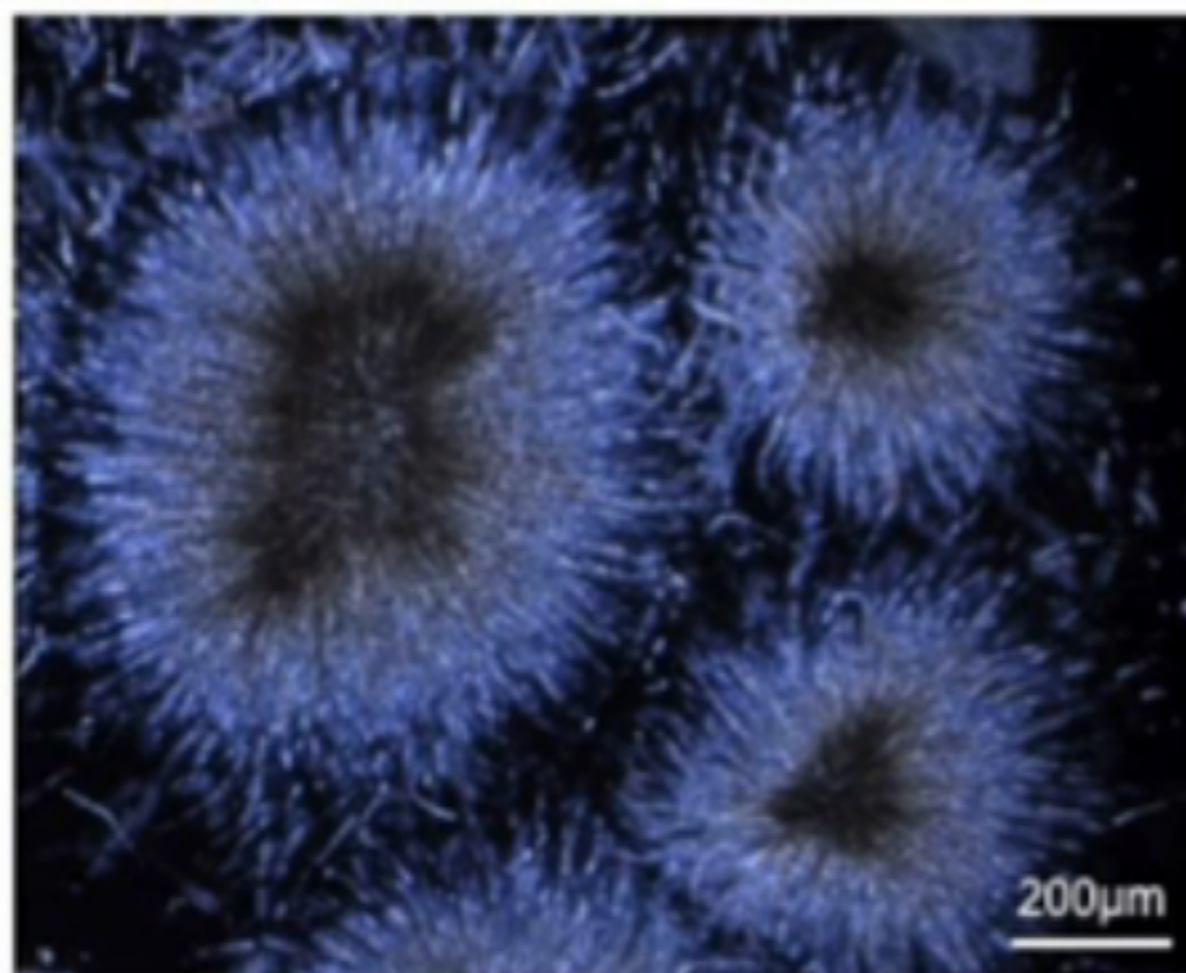
Cronbergia



Order Nostocales

Gloeotrichia

1 species in Hällfors 2004



Gloeotrichia sp.

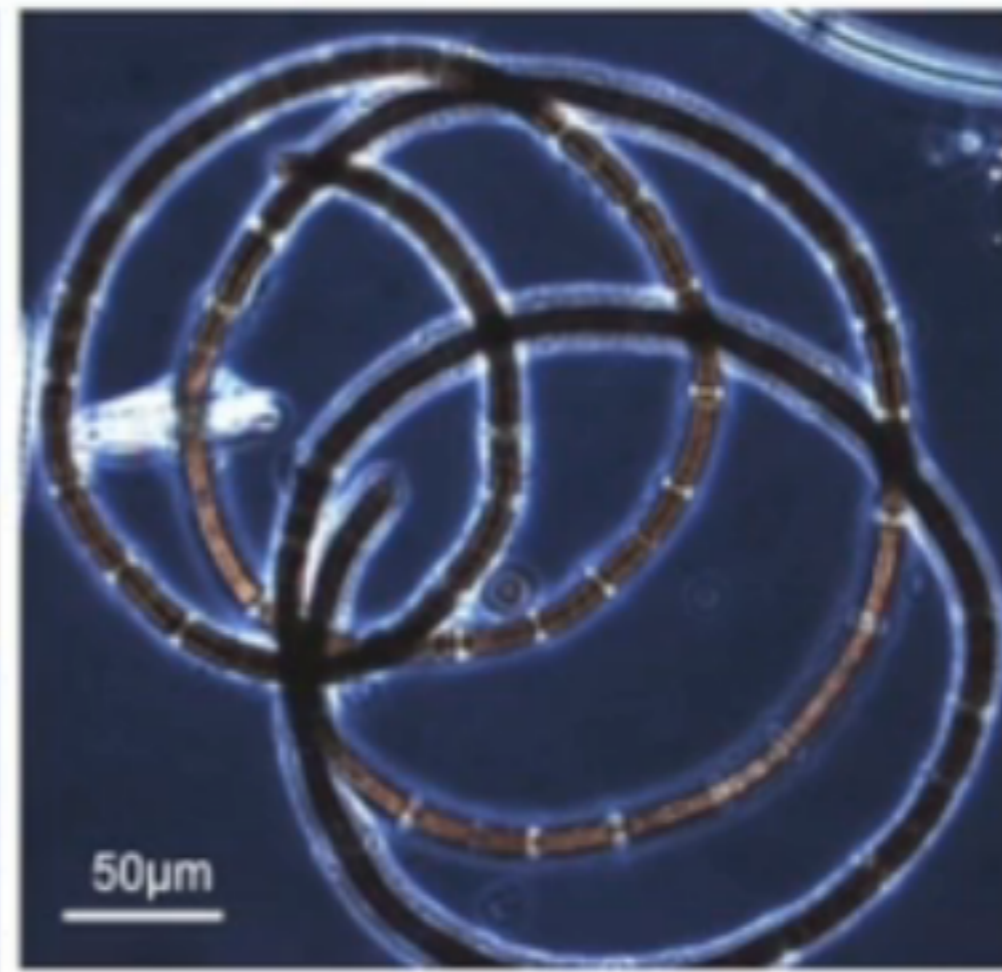
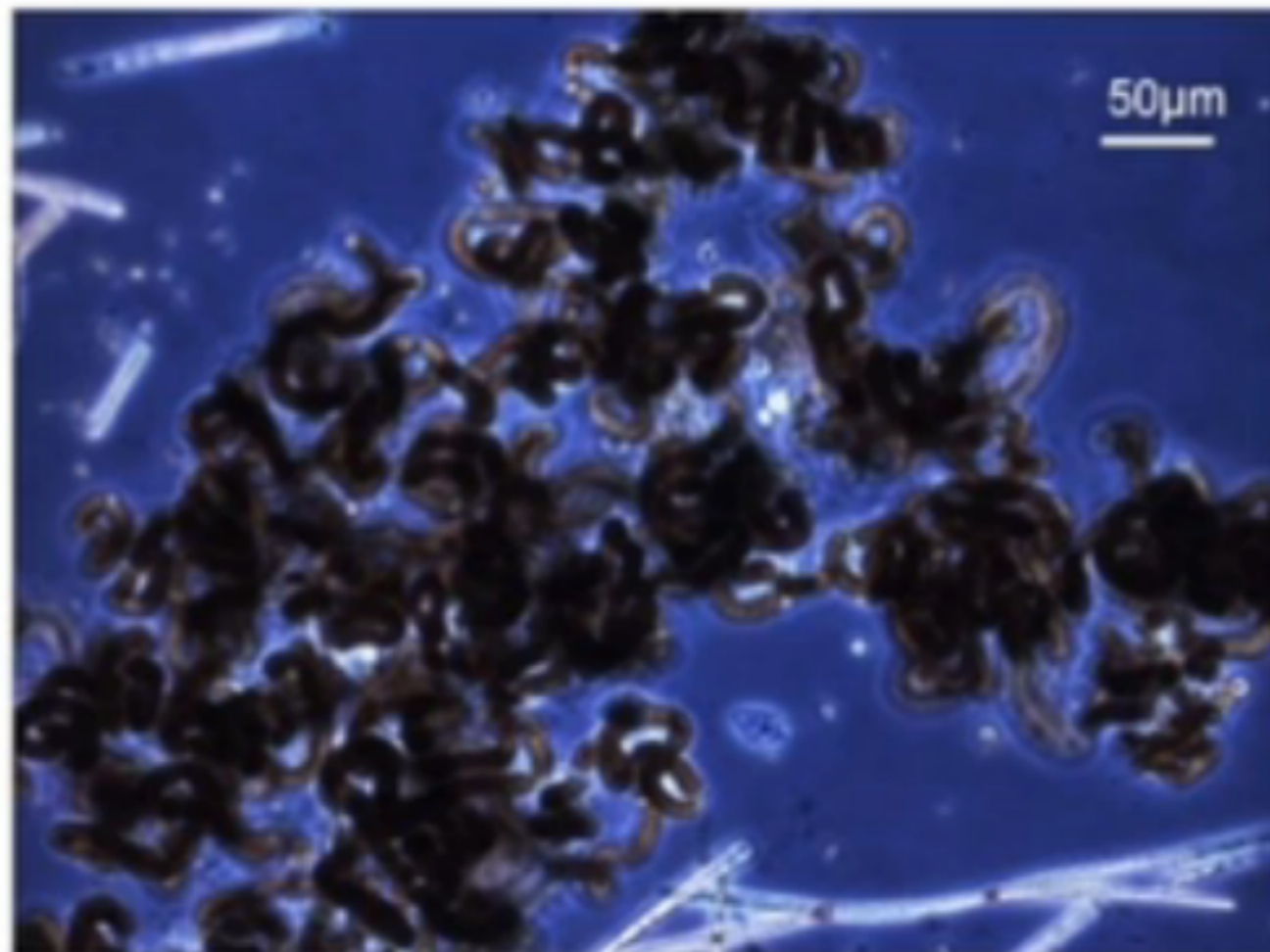
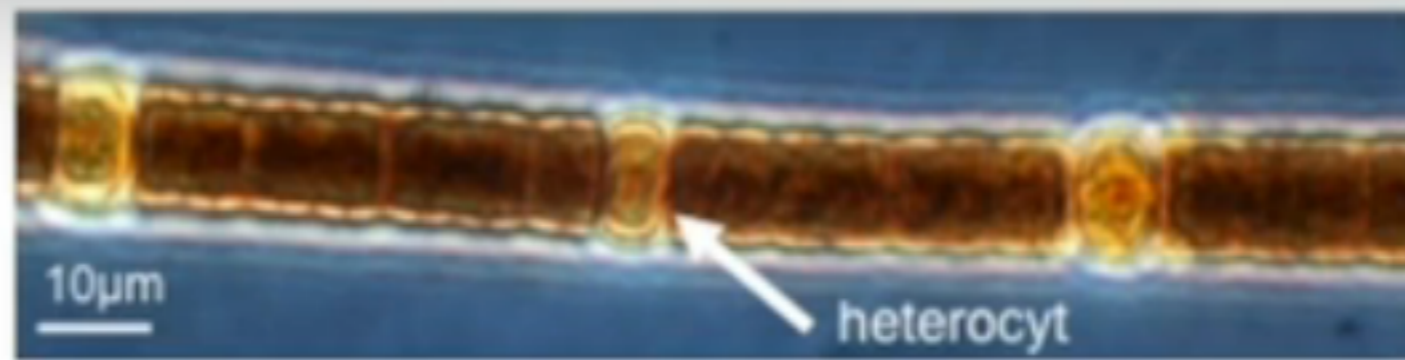


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Order Nostocales

Nodularia

5 species in Hällfors 2004



Nodularia spumigena (all pictures)

Division CRYPTOPHYTA

Class Cryptophyceae – (SE:Cryptofycéer)

Cryptophytes (recoiling algae) are unicellular flagellates with two flagella which differ in length. The cell is dorsoventrally constructed (dorsal side convex, ventral side flat) and covered by periplast (small proteinaceous plates). They have a gullet at the ventral side (never on the top) and trichocysts around that. Include both autotrophic and heterotrophic species.

Autotrophs have 1-2 chloroplasts and different accessory pigments that make them blue, reddish or yellow-brown. They migrate vertically and thrive at low light, because of their pigments.

Cryptophytes constitute significant fraction of the nanoplankton, especially late summer and autumn, but they occur year around.



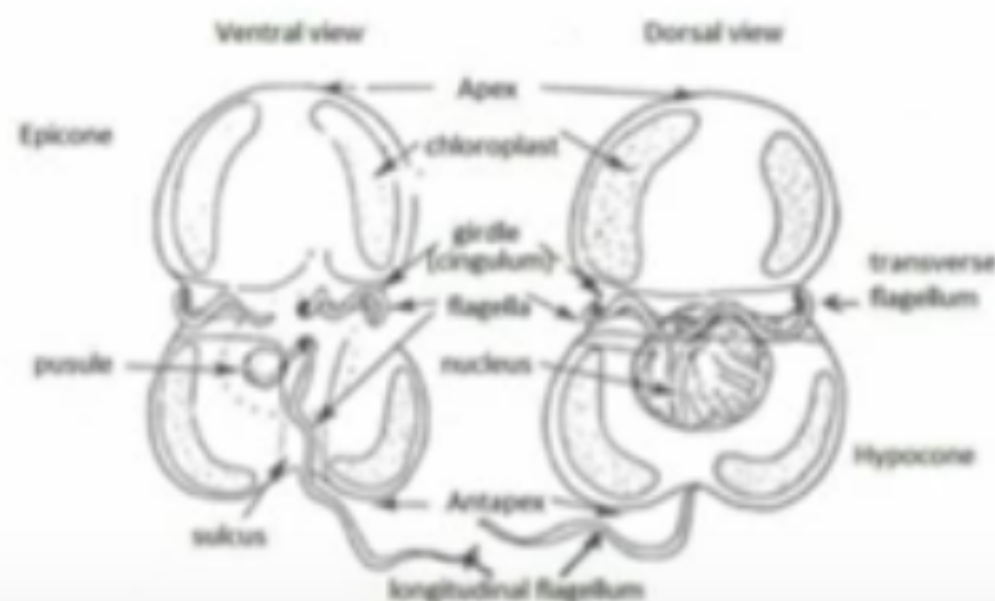
Division DINOPHYTA (PYRRHOPHYTA)

Class Dinophyceae – Dinoflagellates

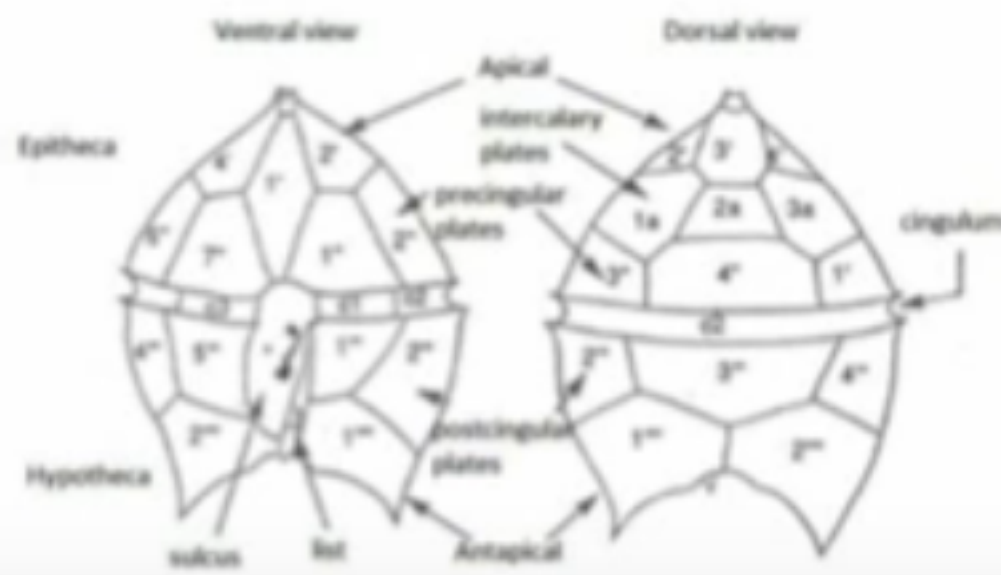
Mostly unicellular species with two dissimilar flagella and a big characteristic nucleus (dinocaryon). The cell is divided by a transverse furrow (called girdle or cingulum) and they have a longitudinal groove (sulcus) on the ventral side. These two structures house the dinoflagellate's flagella.

Dinoflagellates are divided into two large groups: armoured (thecate) dinoflagellates which have an outer covering (theca) consisting of cellulose plates and the naked dinoflagellates (athecate), which do not have any plates.

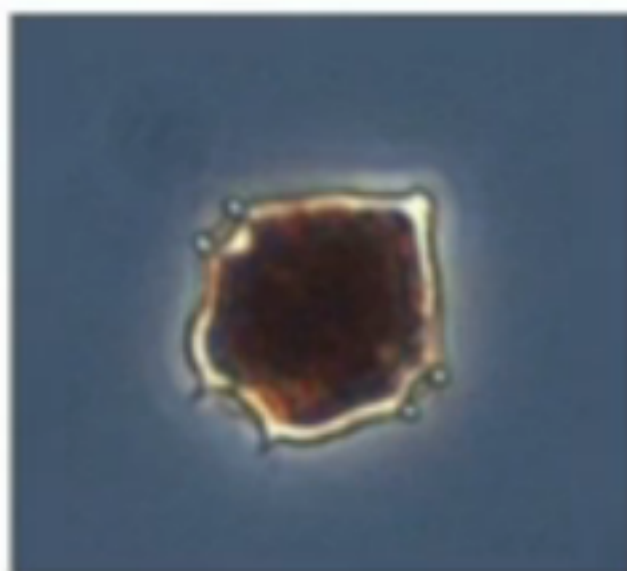
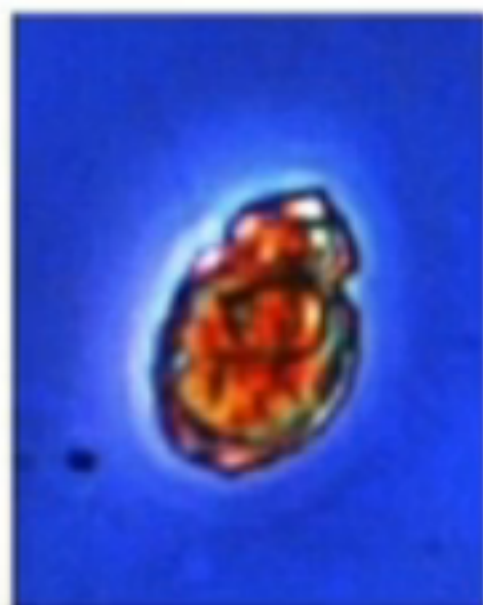
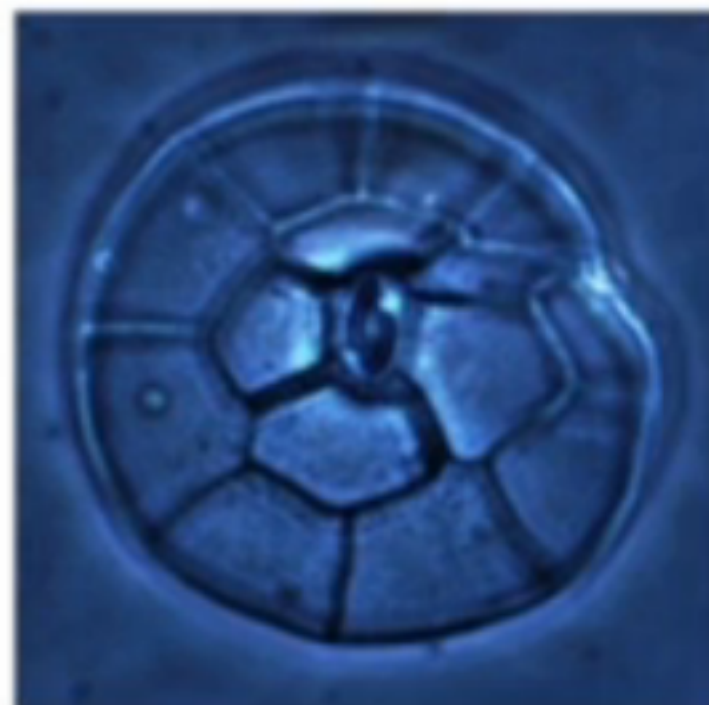
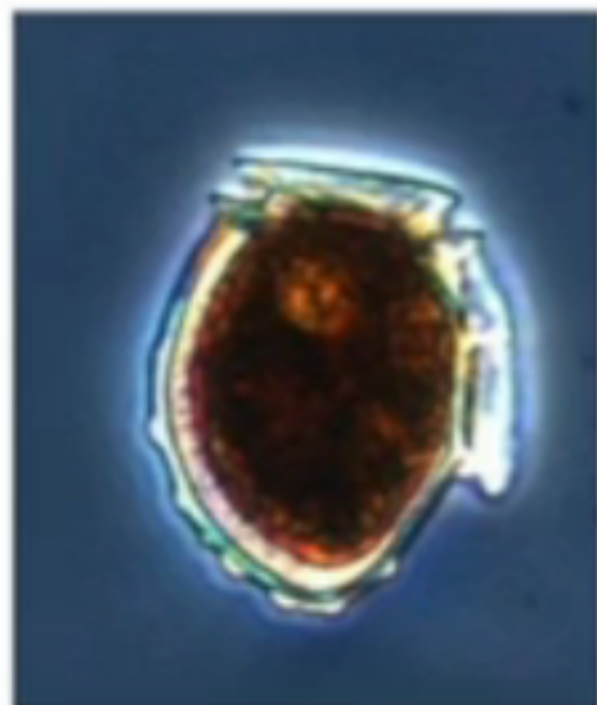
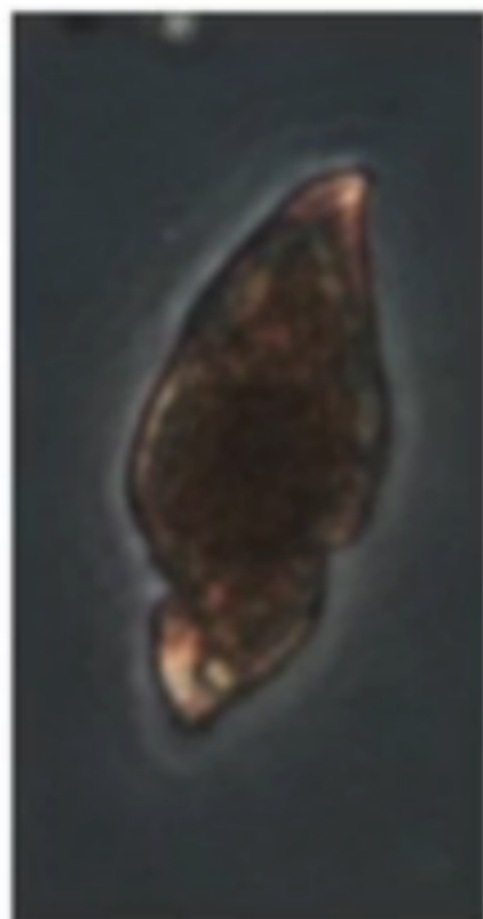
Schematic picture of naked Gymnodinoid cell



Schematic picture of a thecal (armoured) Peridinoid cell



Important for identification: shape, position of the girdle, number and arrangement of thecal plates:



Dinoflagellates are, autotrophic, mixotrophic or obligately heterotrophic (~50%). Mixotrophs ingest bacteria and other algae. Heterotrophs have different method of feeding: ingestion into food vacuoles (naked species) or with a special organelle called peduncle. Prey can be large diatoms and ciliates, but even nematodes and polychaete larvae.

Their chloroplasts contain several accessory pigments (carotenoids, peridinin) that make them red-brownish. Dinoflagellate blooms are often called **red tide**. Several species produce toxins. *Dinophysis* species are known to cause PSP or DSP (Paralytic or diarrhetic shellfish poisoning)

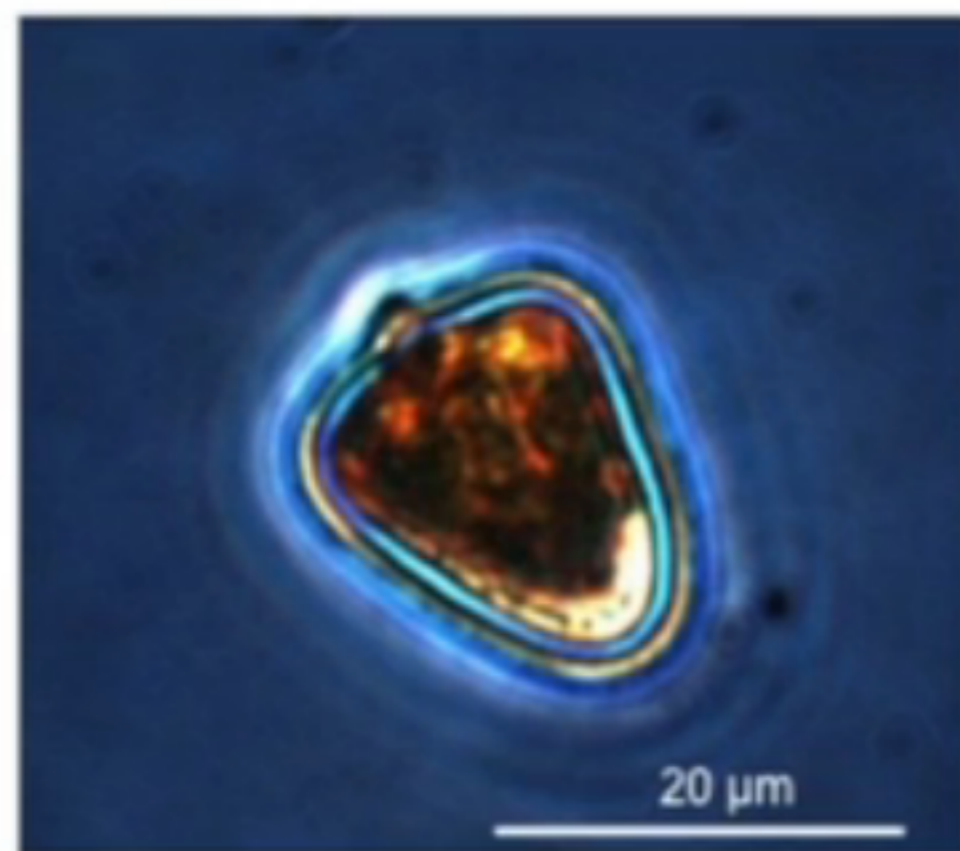
Most of them are marine species (90%) and ~ 200 have been reported from the Baltic. They are common during spring and summer. Heterotrophs most common at the end of the spring bloom (~5-7% of the total biomass). Dinoflagellates migrate vertically, daytime towards to the surface, nighttime down to the pycnocline.

Sexual reproduction and life cycle stages has been observed in several dinoflagellates and many of them produce cysts.

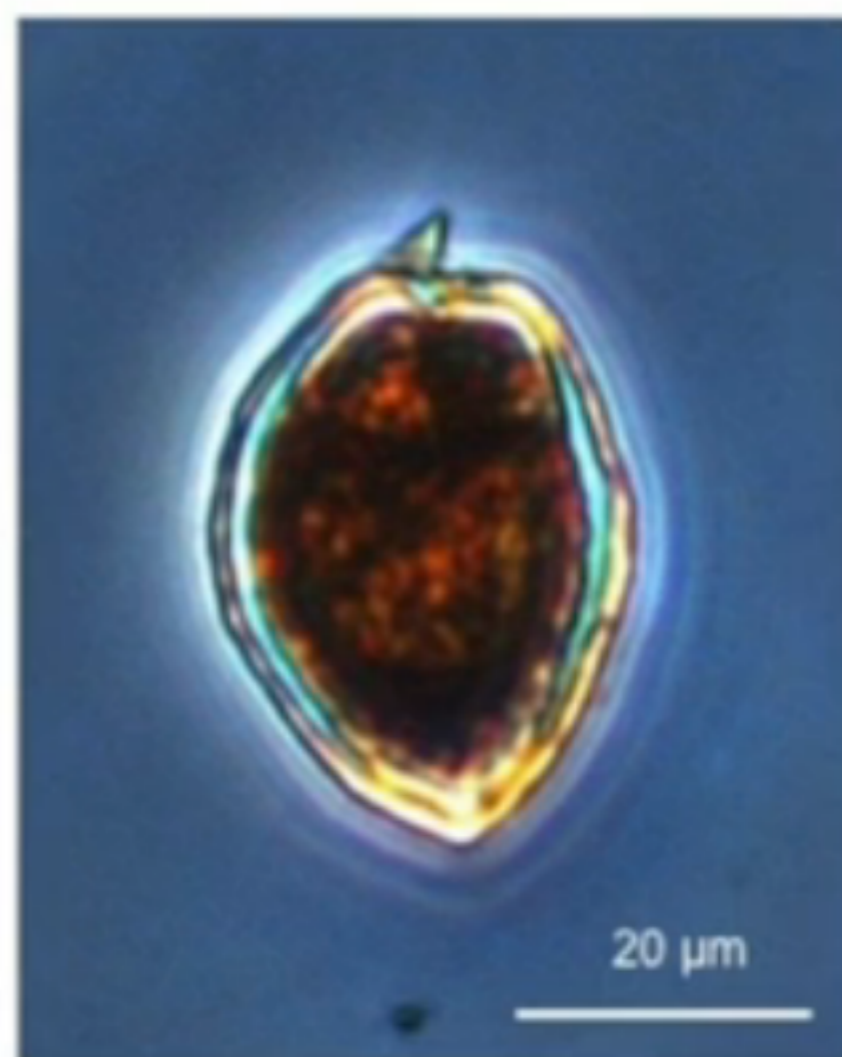
Order PROCENTRALES

Prorocentrum

7 species in Hällfors 2004



Prorocentrum minimum (AU)



Prorocentrum micans (AU)



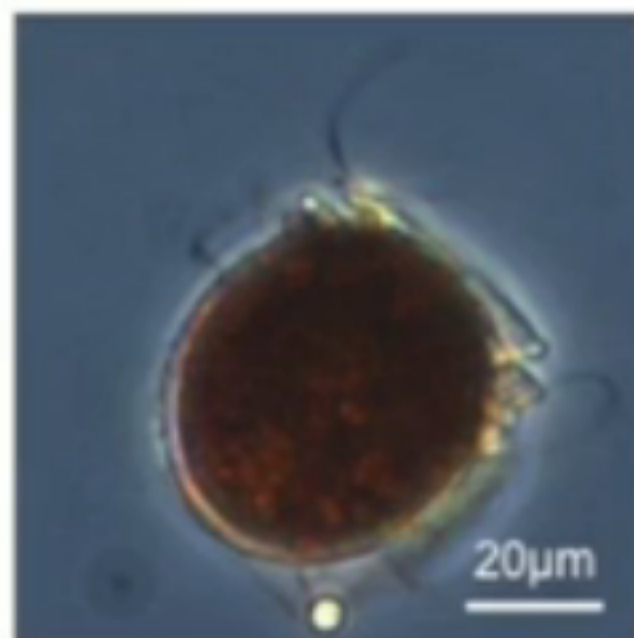
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Order DINOPHYSALES

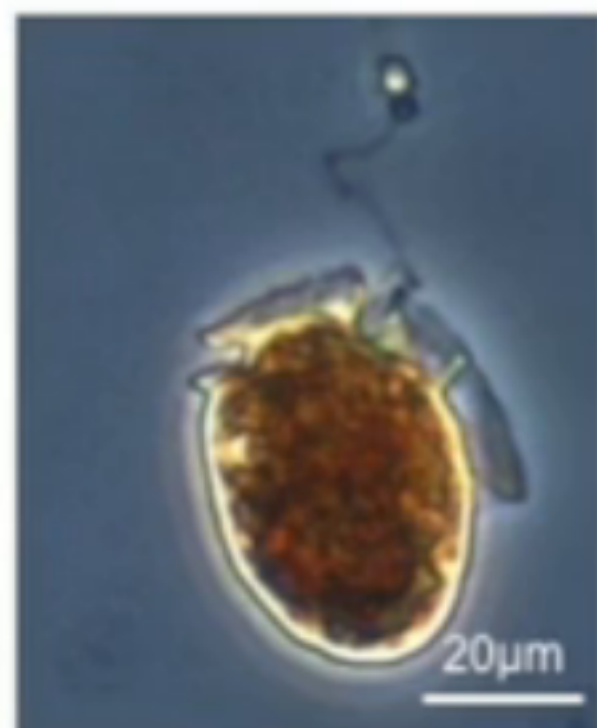
Dinophysis

10 species in Hällfors 2004

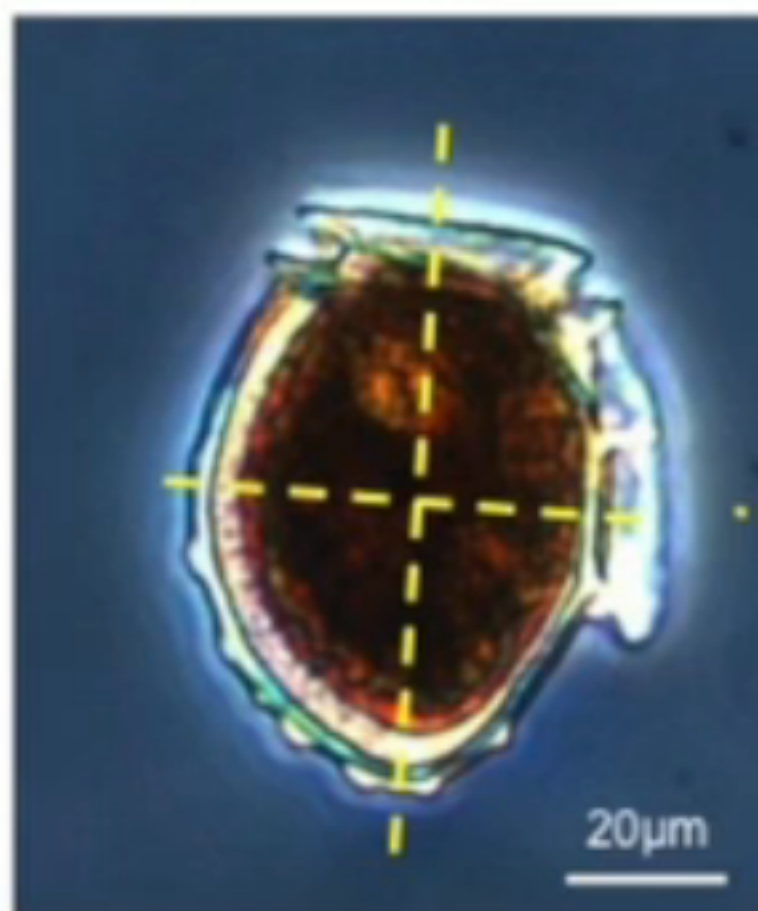
Mixotrophic (MX) and heterotrophic species (HT). Cells are laterally more or less compressed. The cingulum divides the cell into a small epitheca and a large hypotheca. Both cingulum and sulcus have lists that can be large. Can produce toxins that may be accumulated in mussels that cause diarrhetic shellfish poisoning (DSP) in humans that eat them.



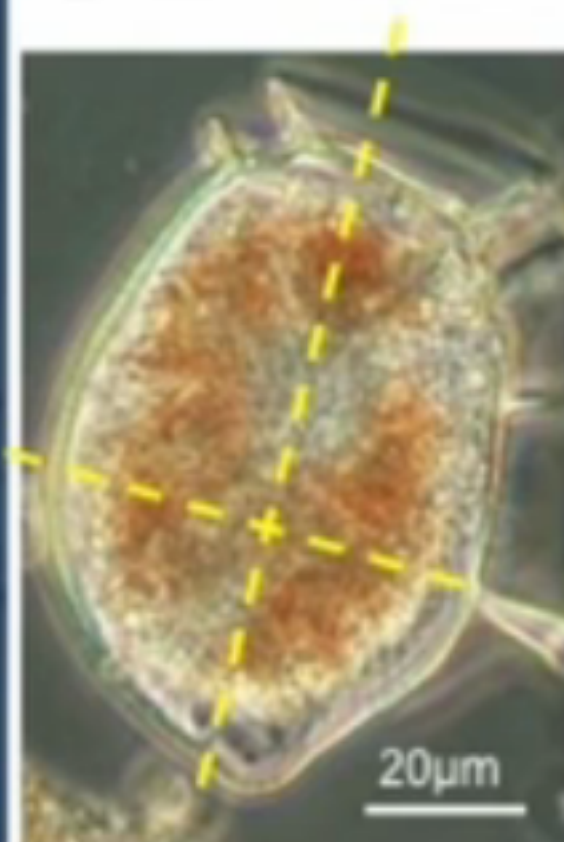
Dinophysis rotundata
(*Phalacroma rotundata*)
(HT)



Dinophysis acuminata
(MX)



Dinophysis norvegica
(MX)



Dinophysis acuta
(MX)

Photo: IOW-Warnemuende (*D. acuta*)



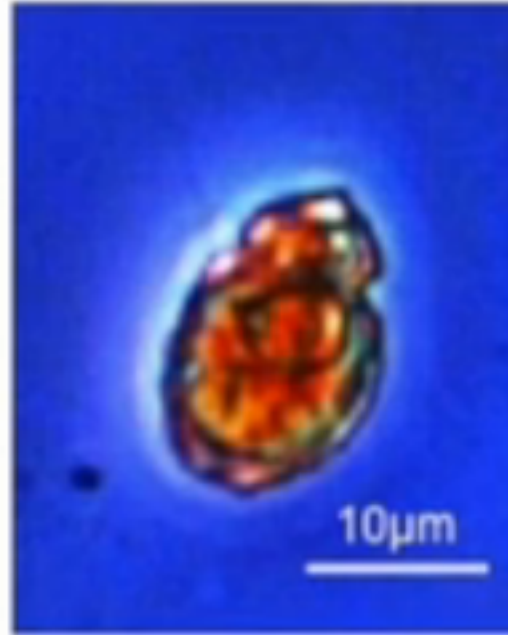
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Order GYMNODINIALES

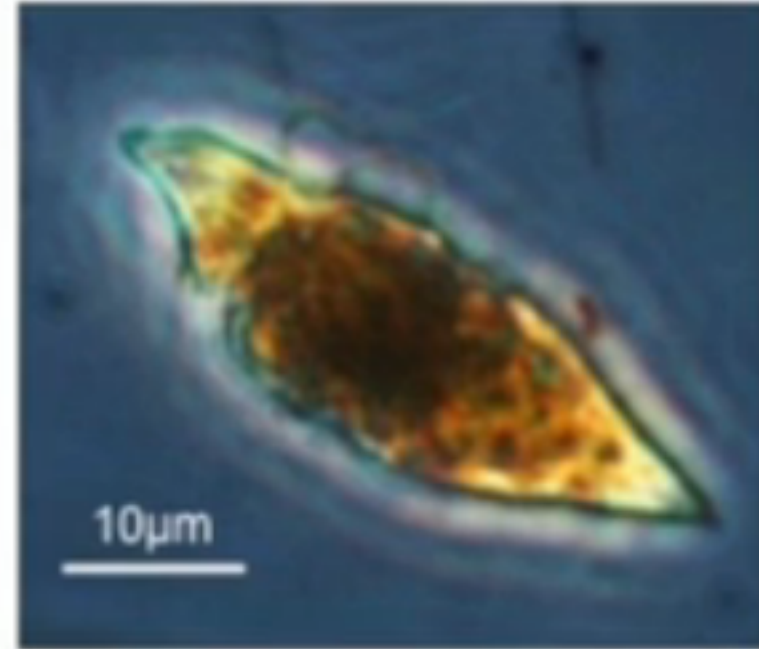
Amphidinium

12 species in Hällfors 2004

Gymnodinoid cells (naked) with a small episome and large hyposome.



Amphidinium crassum
(HT)



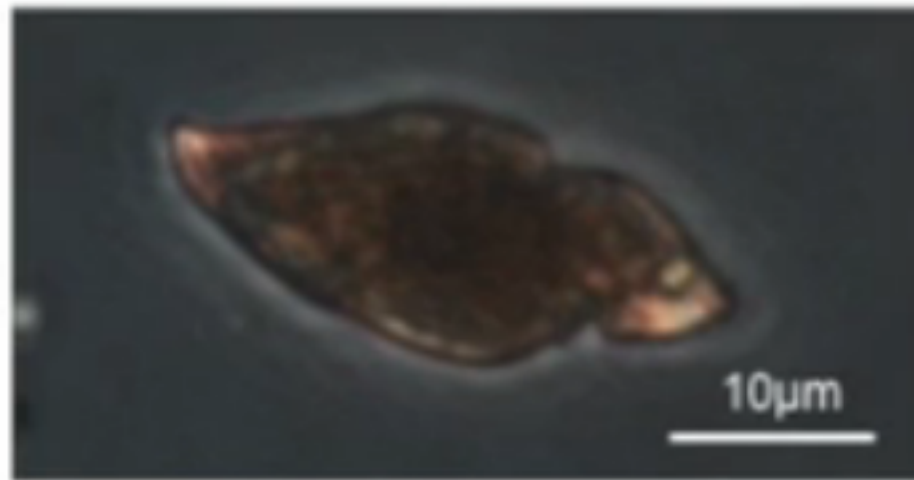
Amphidinium sphenoides
(HT)

Katodinium

4 species in Hällfors 2004

Gymnodinoid cells (naked) with a large episome and small hyposome.

Differentiated from *Amphidinium* in how they swim (both swims with episome first).

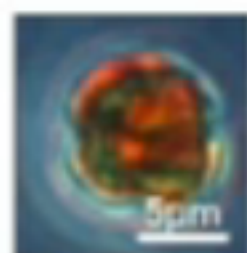


Katodinium glaucum (HT)

Order GYMNODINIALES

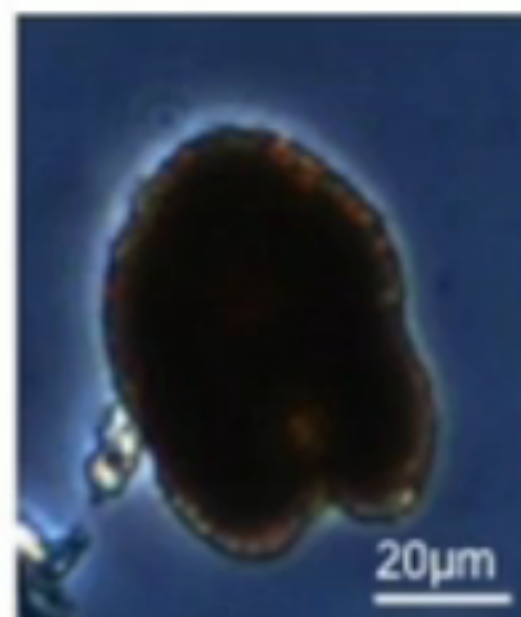
Gymnodinium

33 species in Hällfors 2004



Gymnodinium sp.

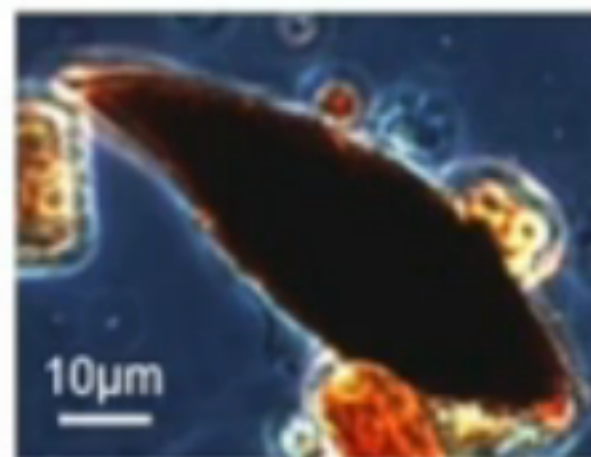
Akashiwo



Akashiwo sanguinea (AU)
(Before *Gymnodinium sanguineum*)

Gyrodinium

16 species in Hällfors 2004



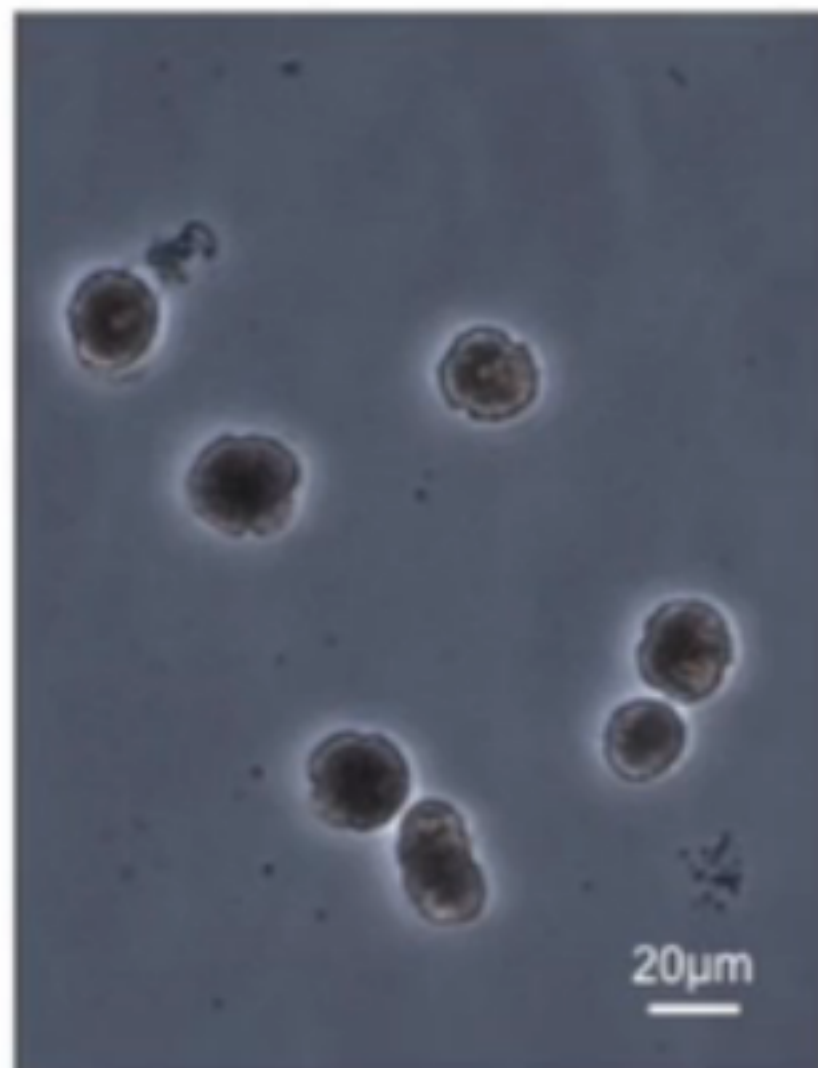
Gyrodinium spirale (HT)



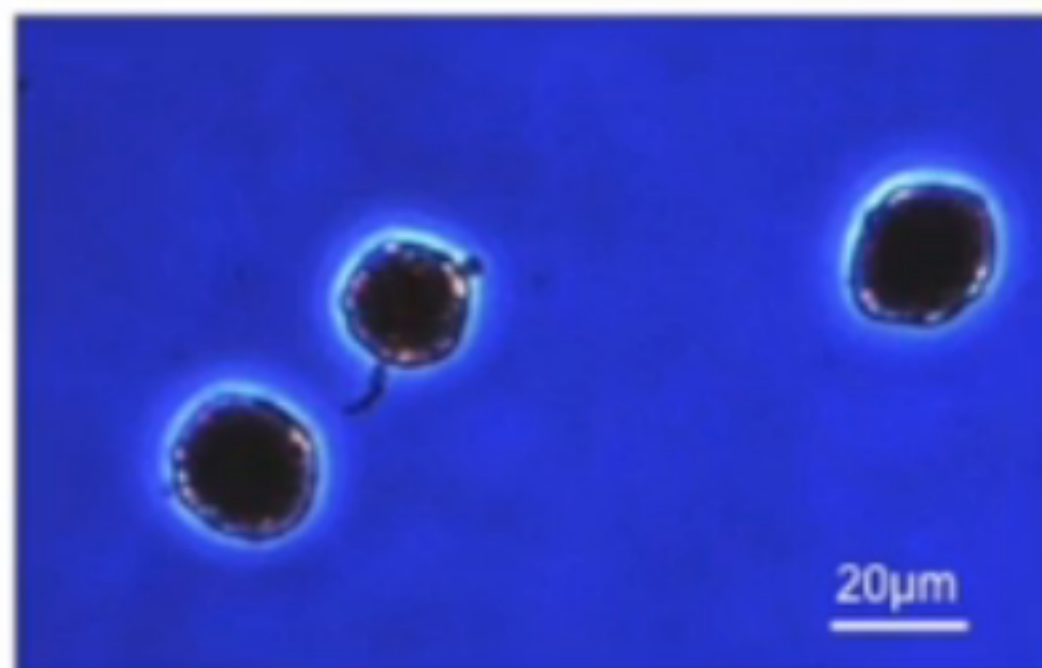
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Complex: *Biecheleria baltica*/ *Gymnodinium corollarium*/ *Scrippsiella hangoei*

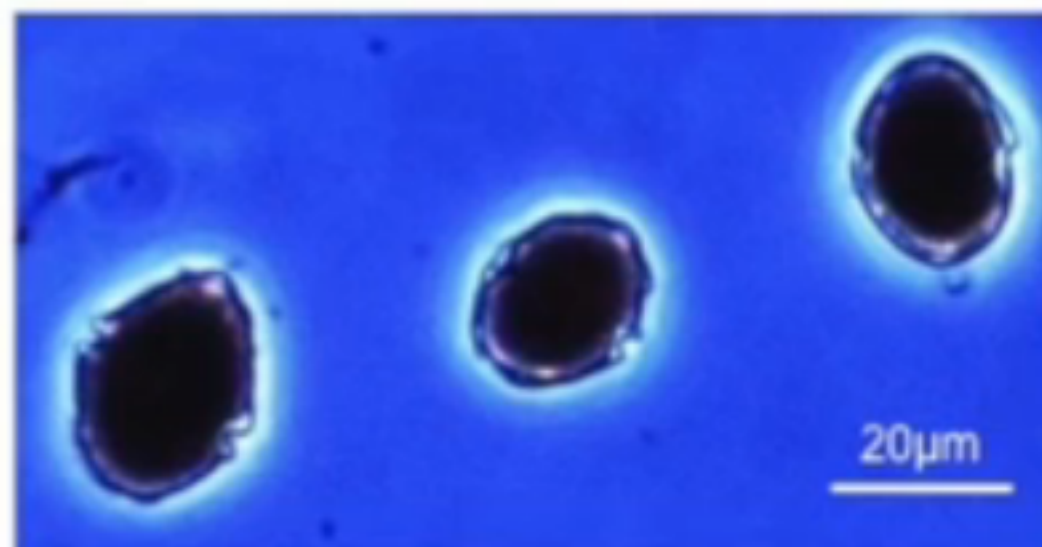
Complex with similar species belonging to different Genera and Orders. Common spring species. Difficult to differentiate in light microscope.



Biecheleria baltica (AU)
(Before *Woloszynskia halophila*)
Order: Suessiaceae



Gymnodinium corollarium (AU)
Order: Gymnodiniales



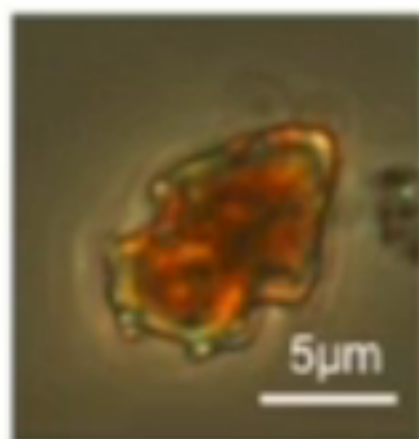
Scrippsiella hangoei (AU)
Order: Peridiniales

(All photos from cell cultures provided by Anke Kremp).

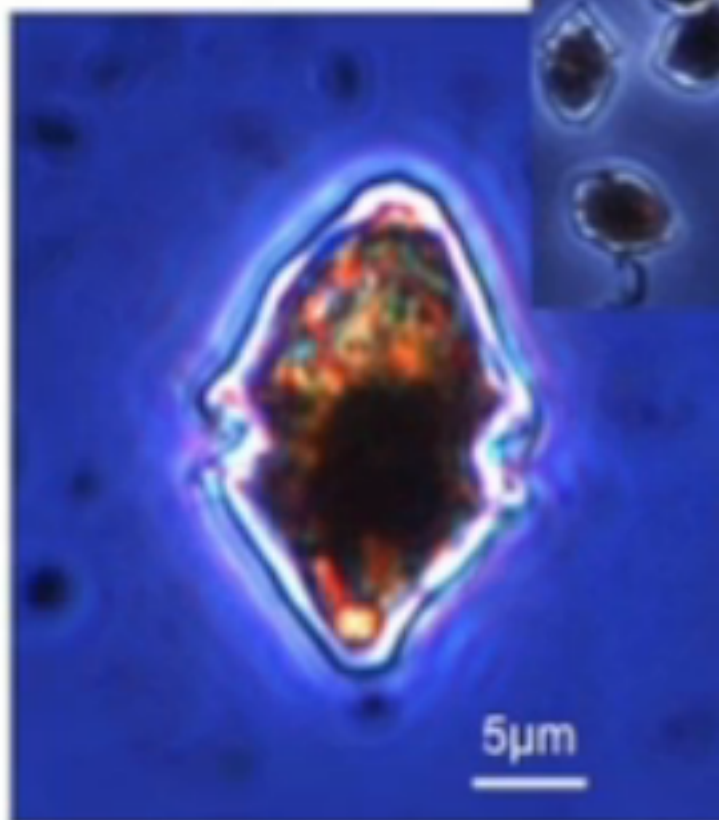
Order PERIDINIALES

Heterocapsa

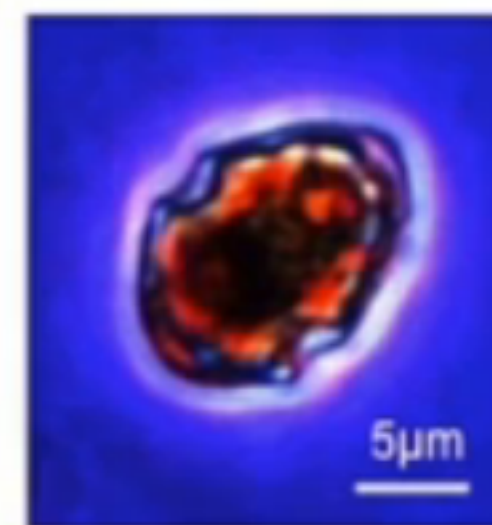
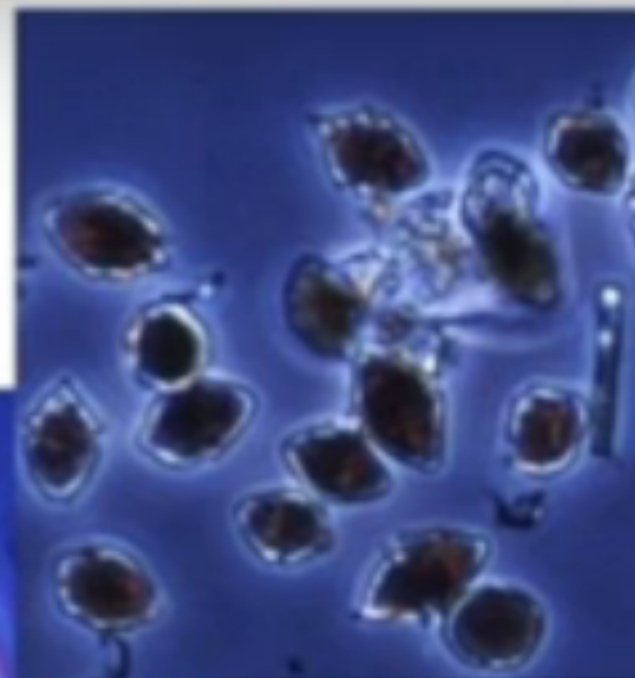
5 species in Hällfors 2004



Heterocapsa rotundata
(AU)



Heterocapsa triquetra (MX)



Heterocapsa arctica
sp. frigida (AU)
(not in Hällfors 2004)

Glenodinium

6 species in Hällfors 2004

Hällfors (2004), p 141: "The genus *Glenodinium* is a "wastebasket" for species with thin theca and unknown or imperfectly known plate arrangement. When studied properly, most species probably should be transferred to other genera".



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Order PERIDINIALES

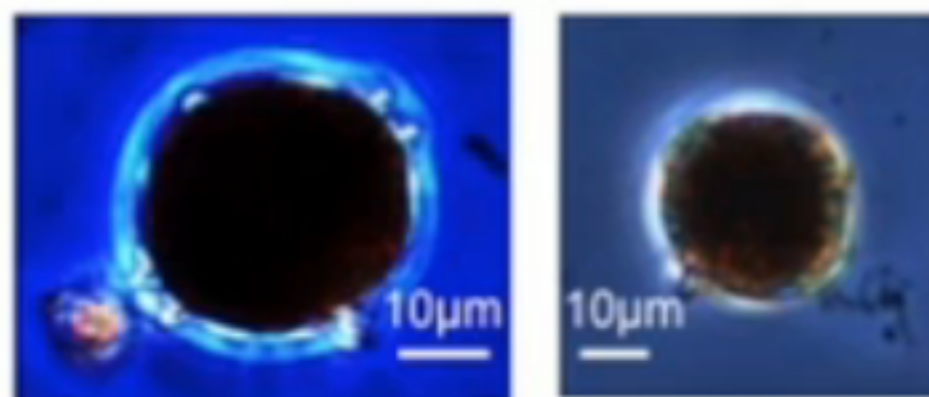
(Kryptoperidinium)

1 species in Hällfors 2004

Kryptoperidinium foliaceum

Oblea rotunda – complex

Several species?



Oblea sp. (HT)

(Preperidinium)

1 species in Hällfors

Preperidinium meunieri

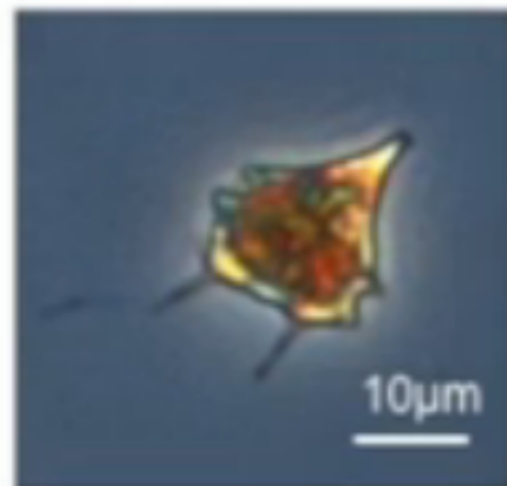


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Order PERIDINIALES

Protoperidinium

37 species in Hällfors 2004



Protoperidinium bipes
(HT)

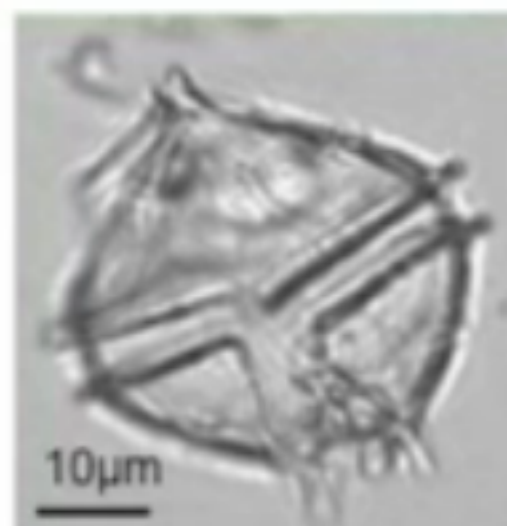
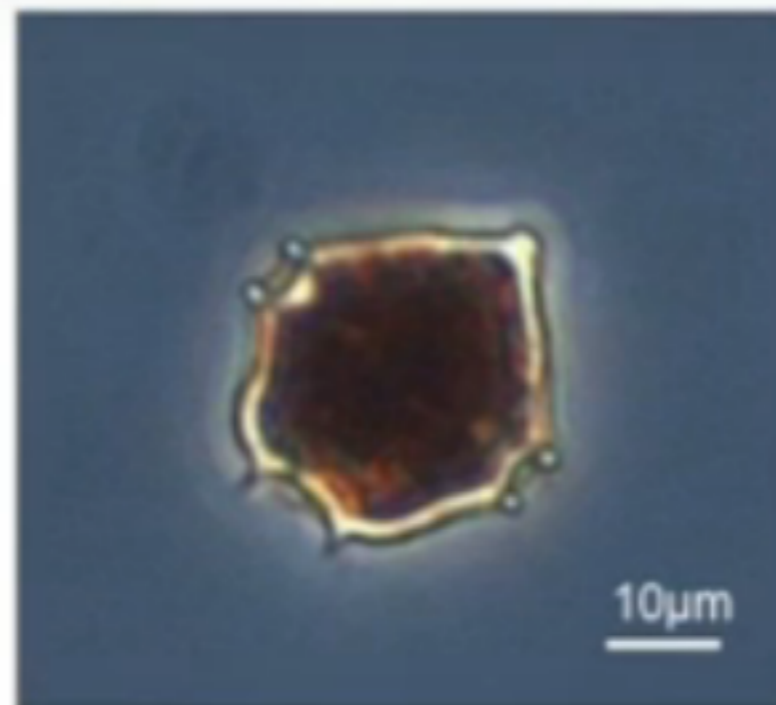
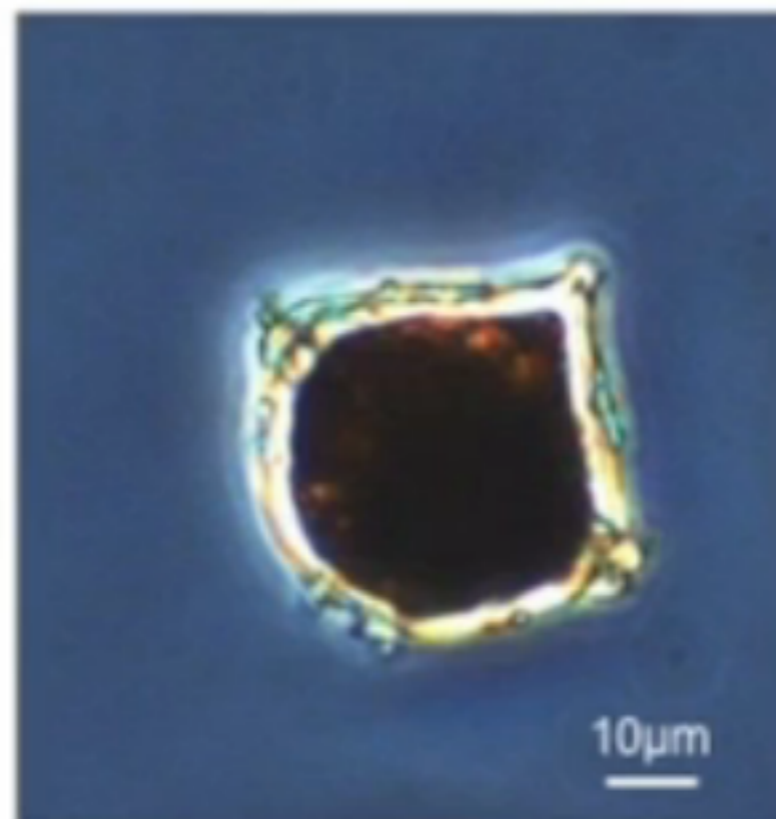


Photo: IOW-Warmemuende

Protoperidinium pellucidum (HT)



Protoperidinium brevipes (HT)



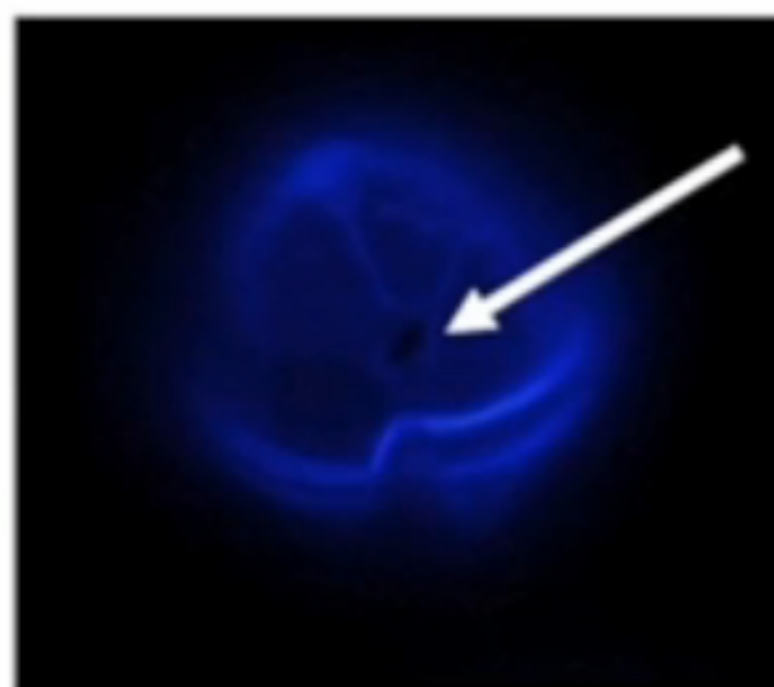
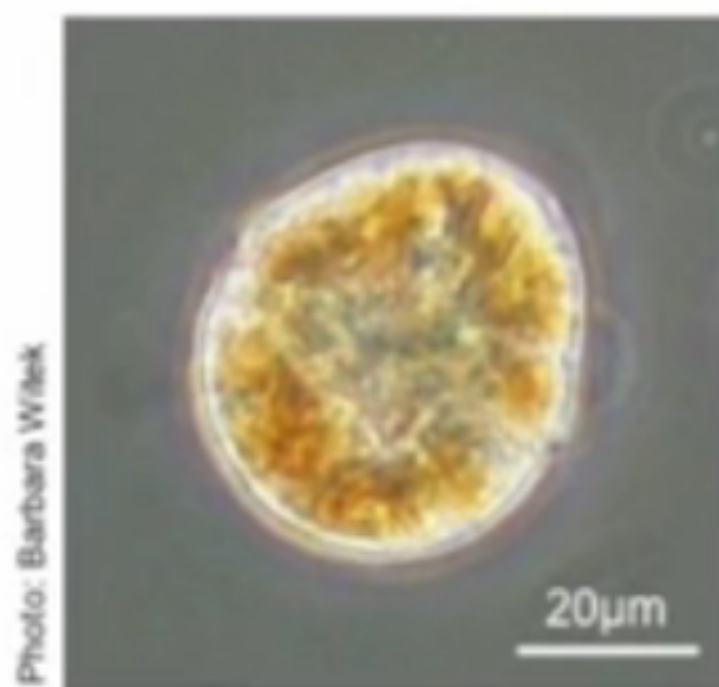
Protoperidinium granii (HT)

Order GONYAULACALES

Alexandrium

4 species in Hällfors 2004

Species can be toxic and cause bioluminescence.



Alexandrium ostenfeldii (AU)

Amylax

1 species in Hällfors 2004



Amylax triacantha (AU)

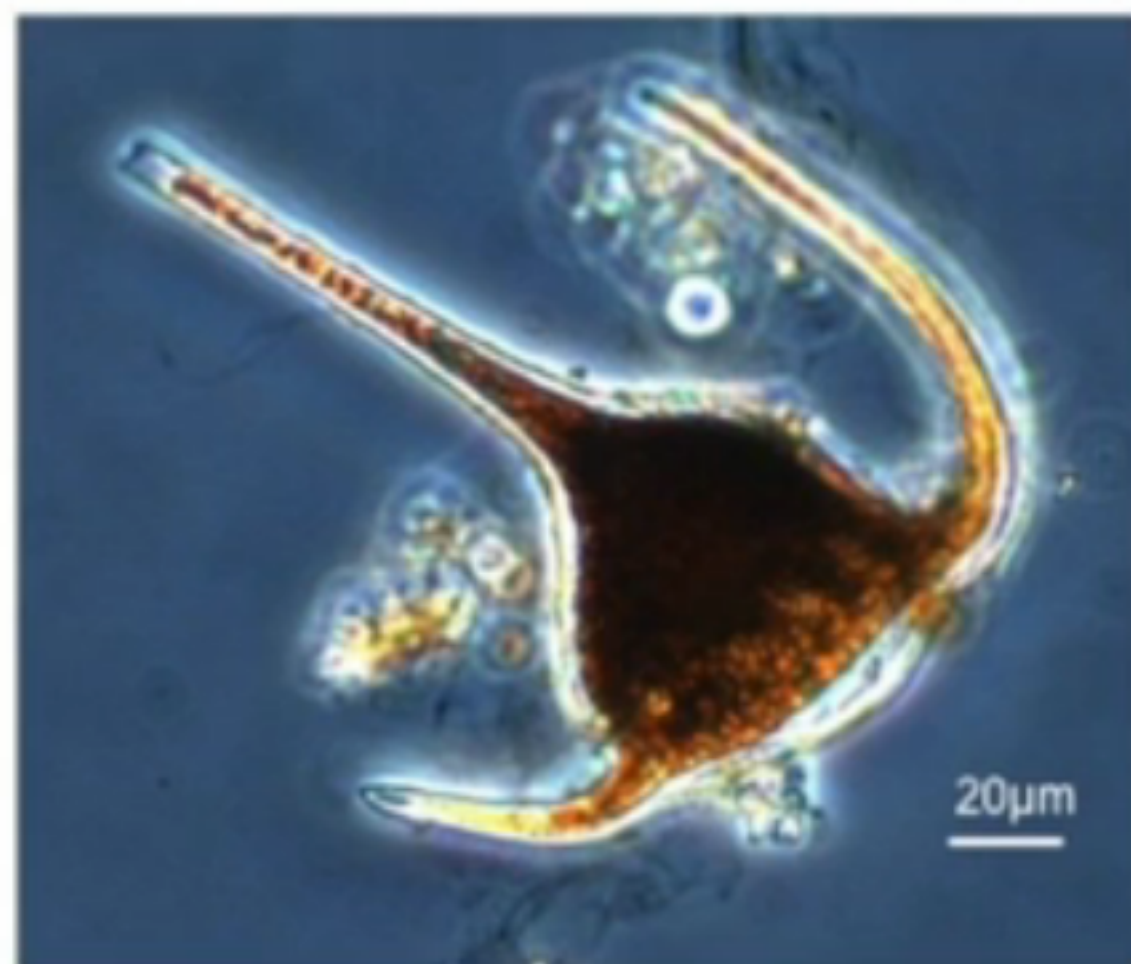


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Order GONYAULACALES

Ceratium

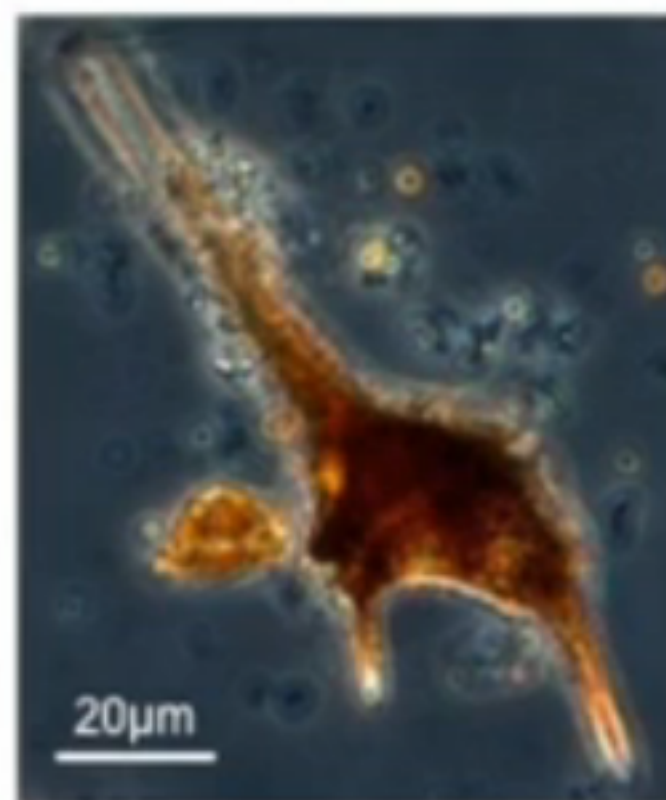
12 species in Hällfors 2004



Ceratium tripos (AU),
marine species



Ceratium lineatum
(AU), marine species



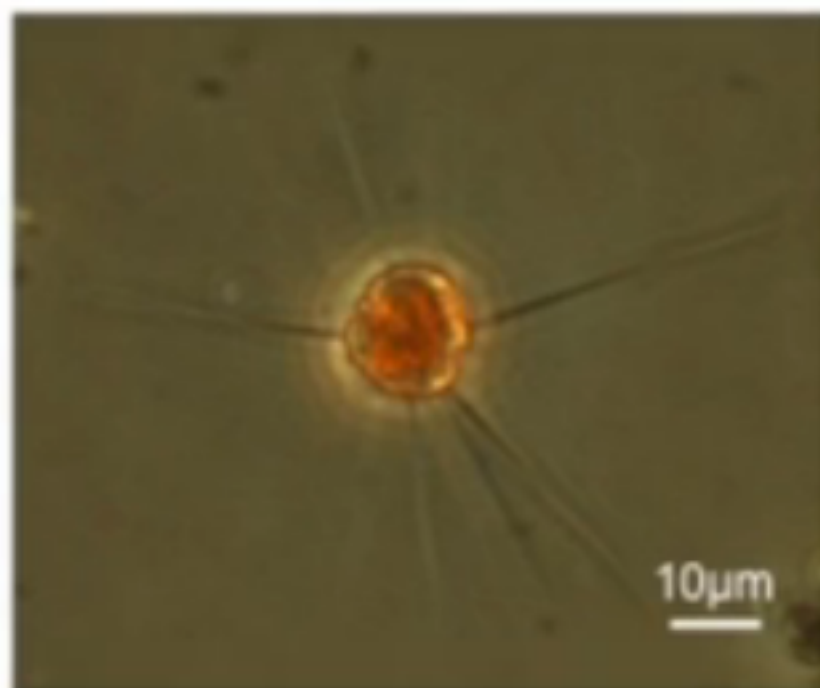
Ceratium hirundinella
(AU), example of freshwater
species

Mainly marine species, found in the southern Baltic Sea.

Order GONYAULACALES

Cladopyxis

2 species in Hällfors 2004



Cladopyxis setifera (AU)

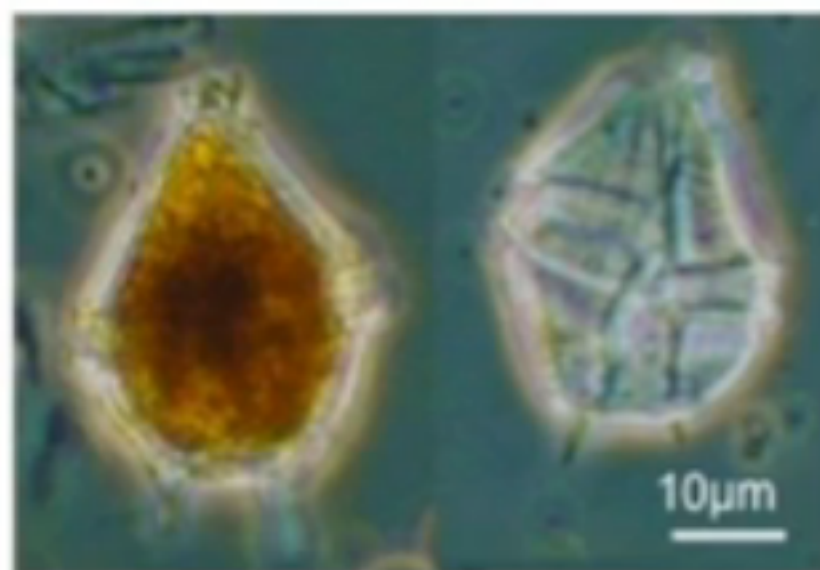


Cladopyxis claytonii (AU)

Photo: IOW-Warremuende

Gonyaulax

6 species in Hällfors 2004



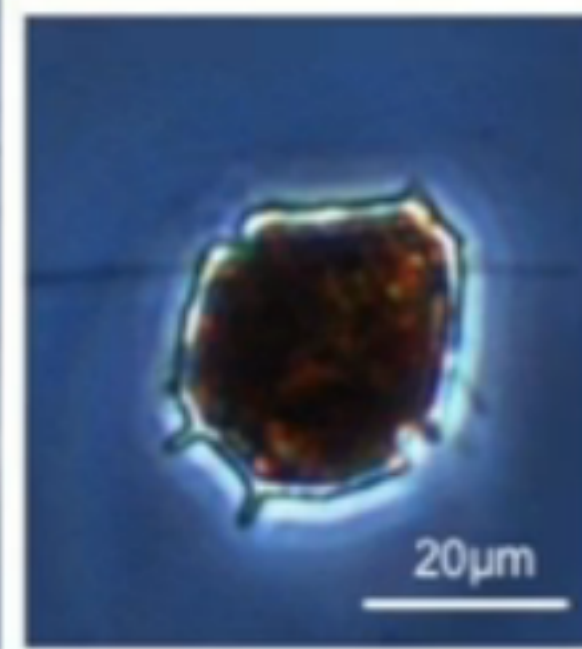
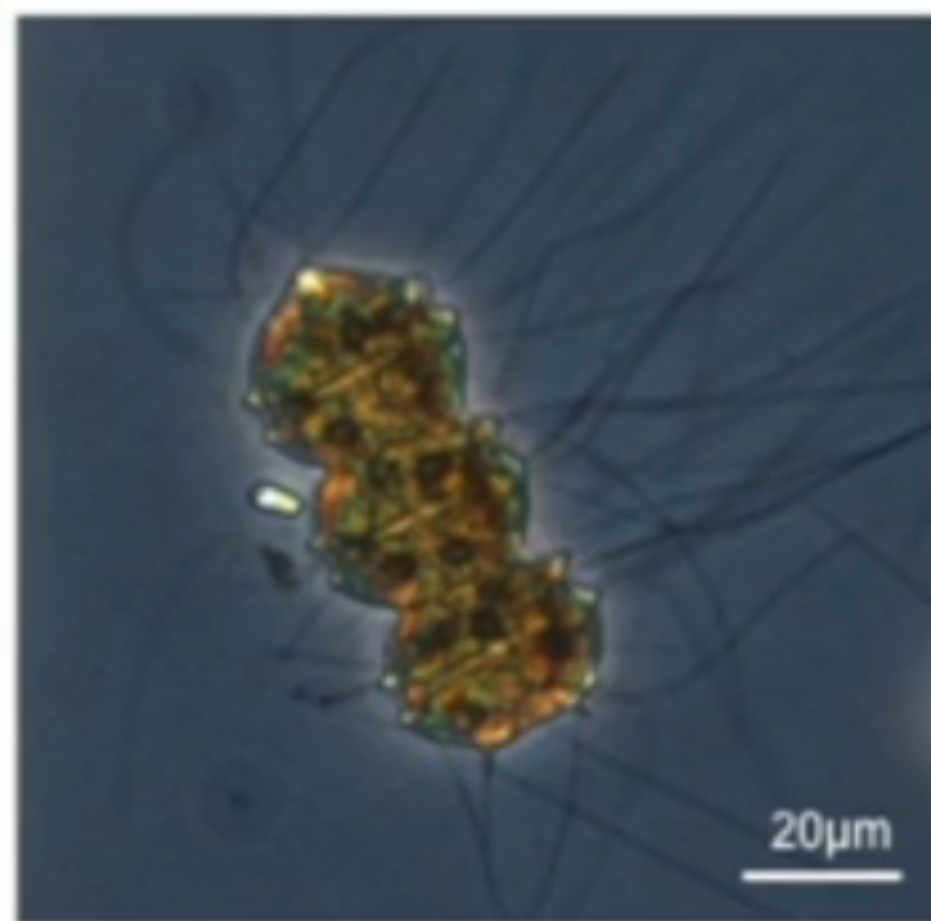
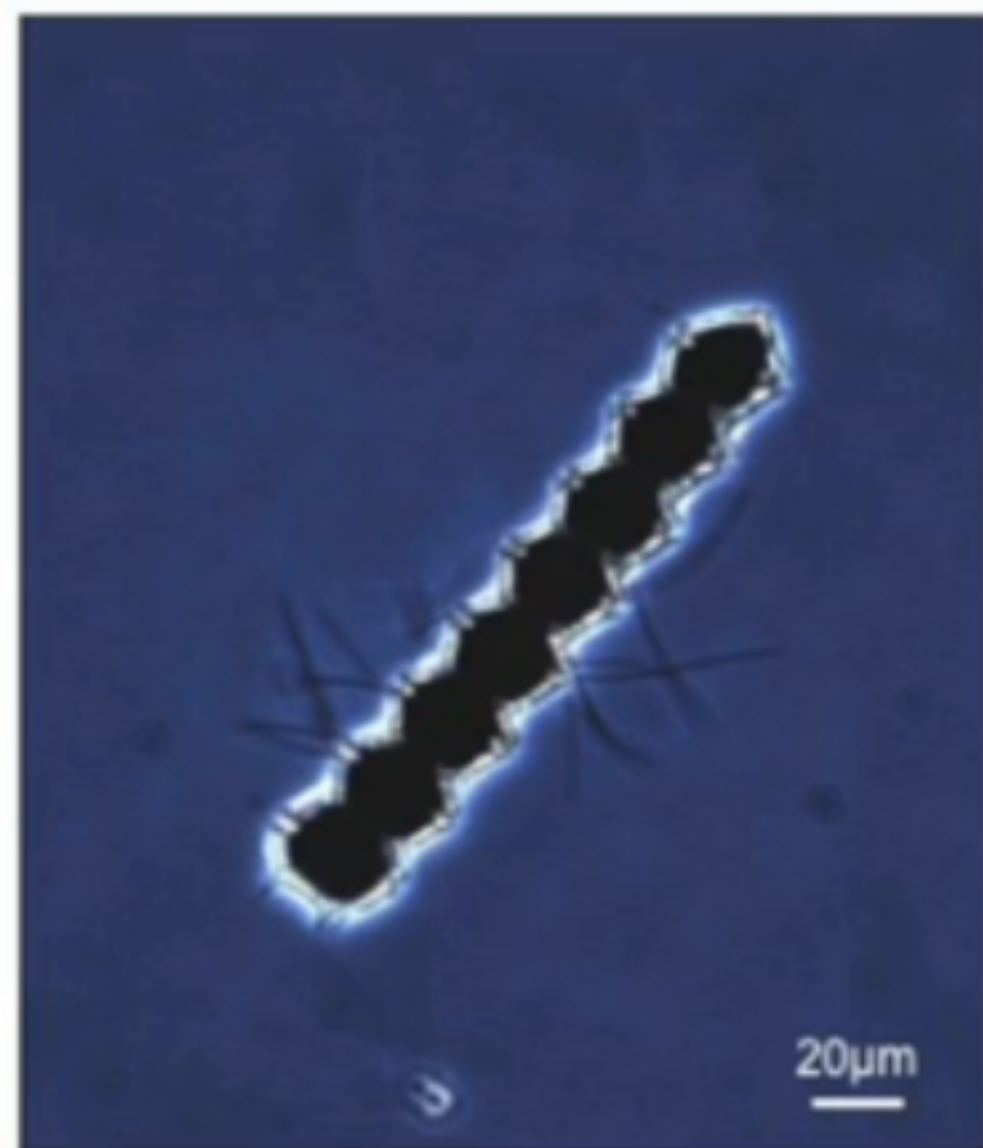
Gonyaulax verior (AU)

Photo: IOW-Warremuende

Order GONYAULACALES

Peridiniella

1 species in Hällfors 2004



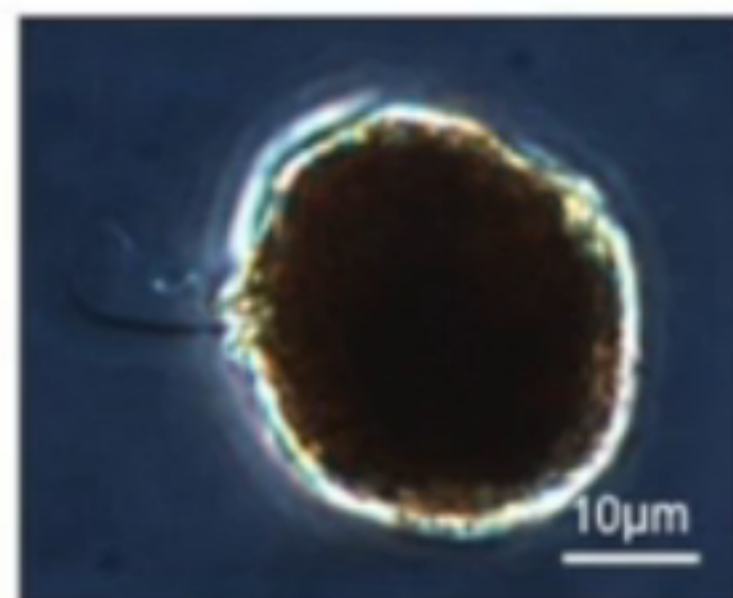
Peridiniella catenata (AU)

Common spring species in the Baltic Sea. Often in chain-like colonies with 4-8-16- cells/colony.

Order GONYAULACALES

Protoceratium

1 species in Hällfors 2004



Protoceratium reticulatum (AU)

Pyrophacus

1 species in Hällfors 2004

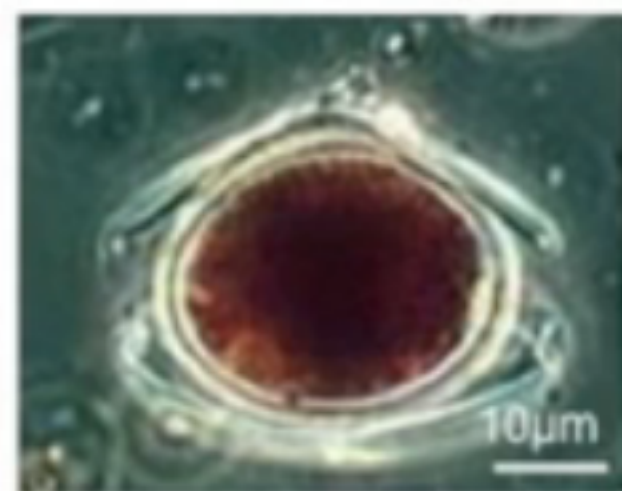
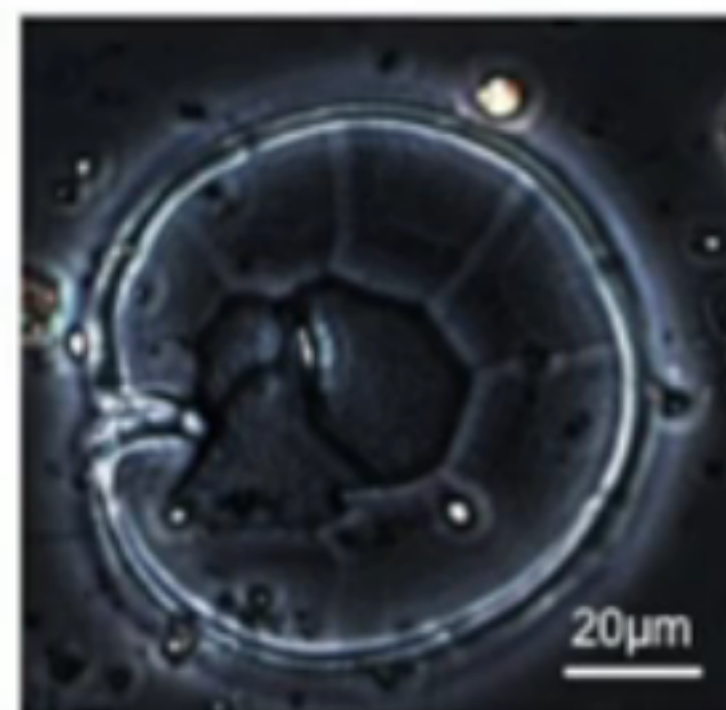
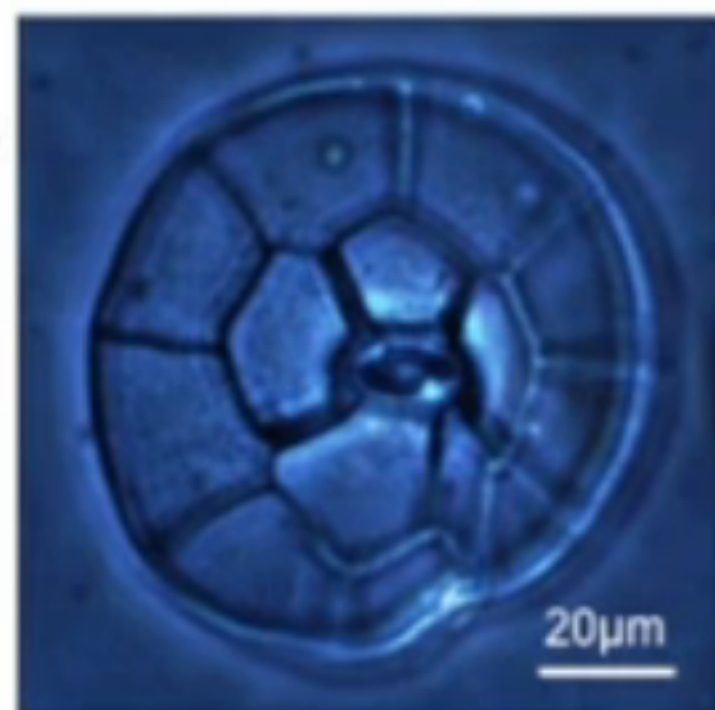


Photo: Seija Hällfors
Östersjöportalen



Pyrophacus horologicum (AU)

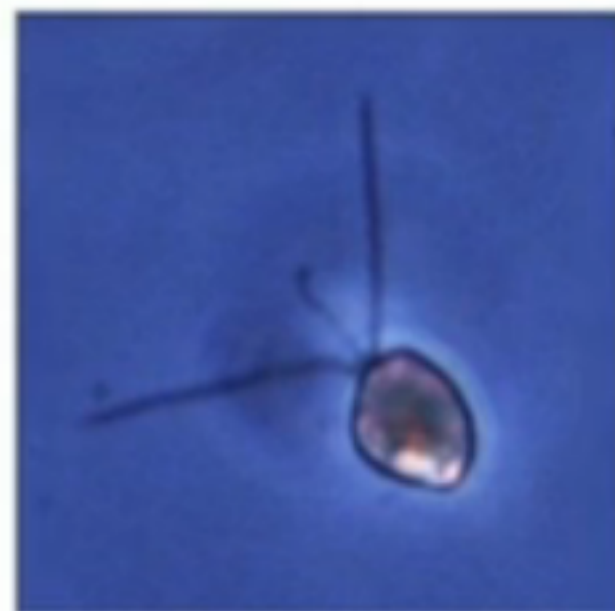


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Division HAPTOPHYTA

Class Prymnesiophyceae (Haptophyceae)

Unicellular nanoflagellates, with two flagella (equal or unequal) and a haptonema (flagella like organell) between them. Their surface are covered with tiny cellulose scales with different pattern which are important for the identification (but require electron microscope). Their two chloroplasts are golden or yellow-brown. Cell form: round, oblong or saddle shaped. Cell size: ~2-25 μm .



Most of them are marine species, some produce toxins. Most of them are mixotrophs and able to ingest bacteria and small algae. In the Baltic they are most common during late spring and summer.

Chrysochromulina polylepis caused a serious toxic bloom in the Kattegat in spring 1988. It killed a lot of fish and other organisms causing both economical and ecological damages.

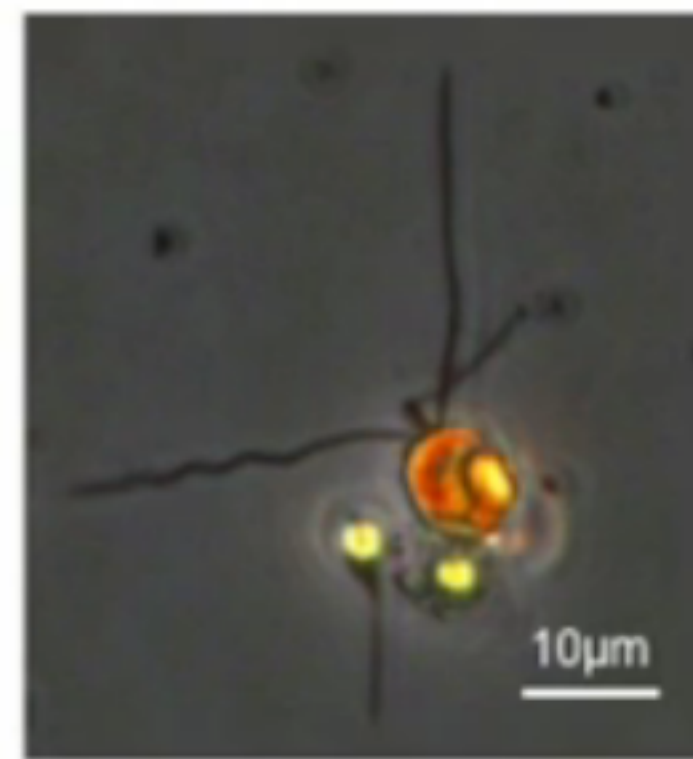
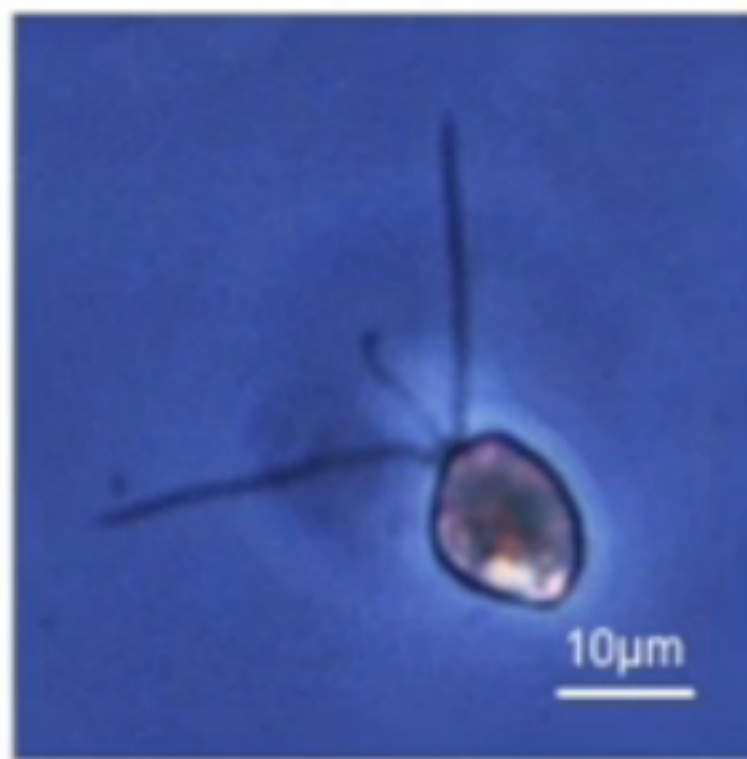
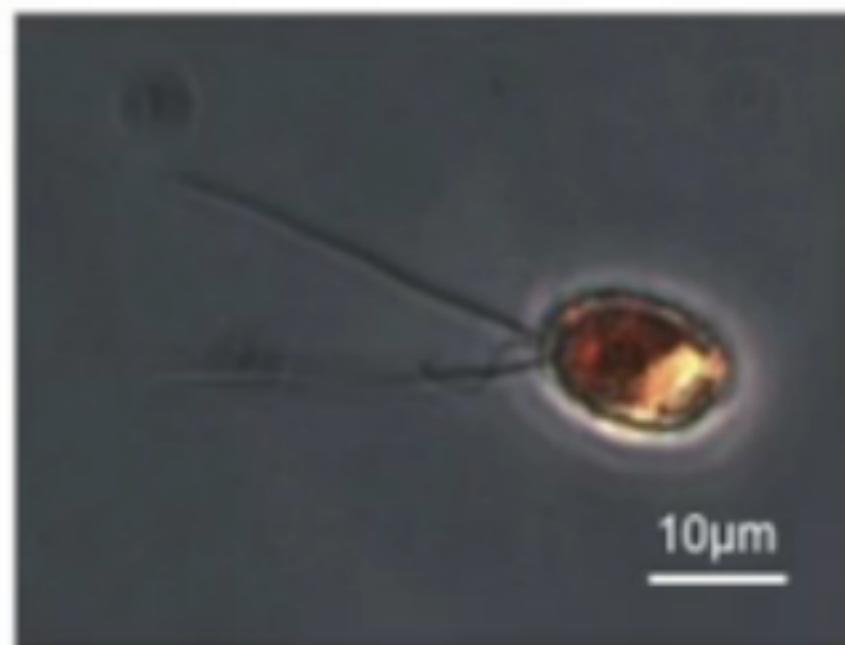


Division HAPTOPHYTA

Class Prymnesiophyceae (Haptophyceae)

*Chrysochromulina**

39 species in Hällfors 2004



Chrysochromulina spp.

* **Class is under revision.** See for example Edvardsen, et al. (2011). Ribosomal DNA phylogenies and a morphological revision provide the basis for a revised taxonomy of the Prymnesiales (Haptophyta), *European Journal of Phycology*, 46:3, 202-228.



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Division CHRYSOPHYTA (HETEROKONTOPHYTA)

They are brown, brown-green or yellow-green (never clear green), because of their dominating accessory pigments, fucoxanthin and vaucheriaxanthin. This division include very different organisms divided in several classes and orders:

Class Chrysophyceae – Golden-brown algae (SE: guldalger)

Order OCROMONADALES
(Order STICHOGLOEALES)
Order PEDINELLALES

Class Dictyochophyceae

Order DICTYOCHALES

(Class Synurophyceae)

(Order SYNURALES)

Class Diatomophyceae (Bacillariophyceae) – Diatoms

Order EUPODISCALES (CENTRALES)
Order BACILLARIALES (PENNALES)



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Division CHRYSOPHYTA (HETEROKONTOPHYTA)

Class Chrysophyceae – Golden-brown algae

Mainly small cells with two different long flagella. Cells are solitary or in colonies. Cellulose or chitin lorica ("house") present in some species. Cysts are common and characteristic (made of silica, with spines or protuberances, are produced endogenously (in the cells). Form of the cysts can be important for species identification.

Important orders:

Order OCROMONADALES

Order PEDINELLALES



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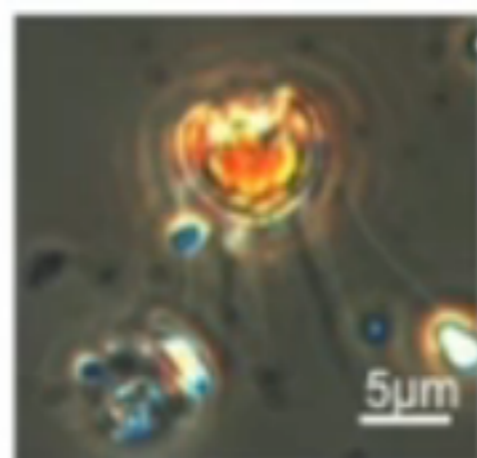
Division CHRYSOPHYTA (HETEROKONTOPHYTA)

Class Chrysophyceae

Order PEDINELLALES

Apedinella

1 species in Hällfors 2004

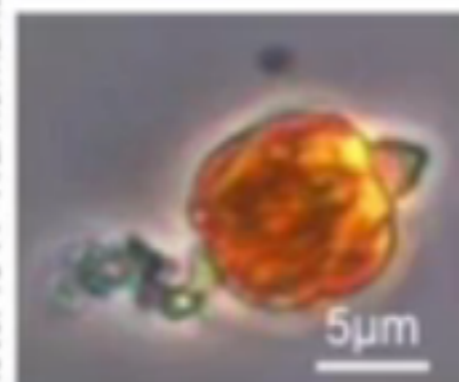


Apedinella radians (AU)

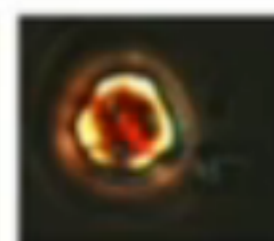
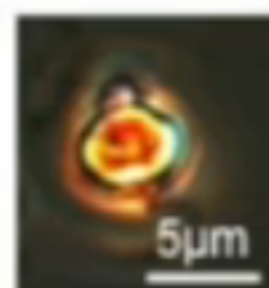
Pseudopedinella

3 species in Hällfors 2004

Photo: IOW-Warnemünde



Pseudopedinella sp.
(AU)



Pseudopedinella
tricostata (AU)

Division CHRYSOPHYTA (HETEROKONTOPHYTA)

Class Dictyochophyceae

Order DICTYOCHALES

Dictyocha

2 species in Hällfors

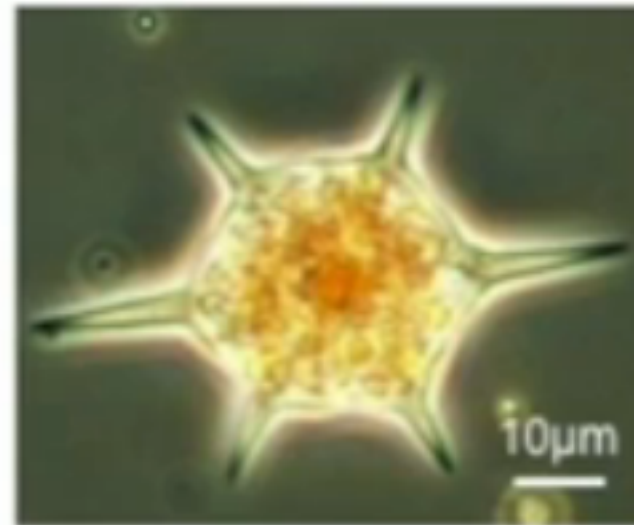


Photo: ICW-Warmemunde

Dictyocha speculum

(Class Synurophyceae)

(Order SYNURALES)

(*Mallomonas*)

27 species in Hällfors 2004. Freshwater species. Sometimes found in coastal areas.

(*Synura*)

5 species in Hällfors 2004. Freshwater species. Sometimes found in coastal areas.



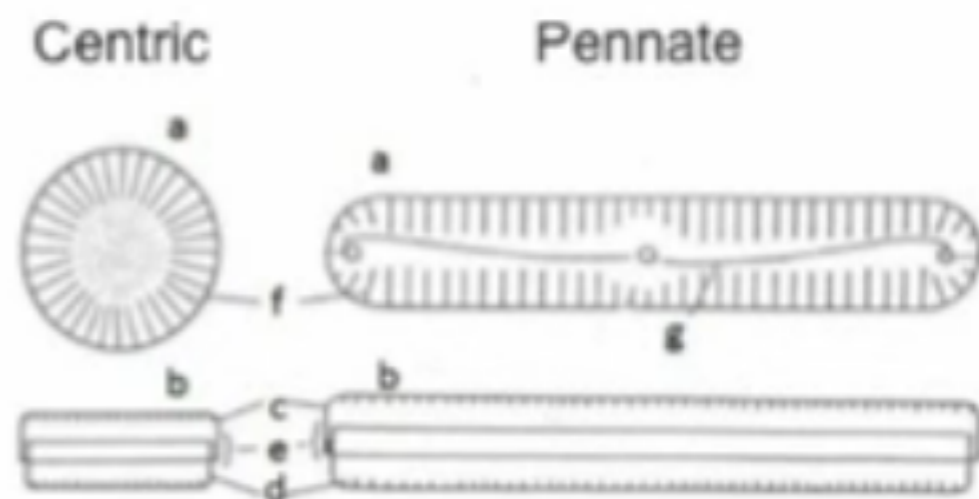
Division CHRYSOPHYTA (HETEROKONTOPHYTA)

Class Diatomophyceae (Bascillariophyceae)

Diatoms (SE: diatoméer, kiselalger)

Unicellular or colonial algae. Each cell is encased by a siliceous cell wall that looks like a box with an overlapping frustule (shell). The frustule has characteristic patterns used for identification.

Diatoms are a very diverse group with lot of species both in freshwater and the sea. They are important in the Baltic, especially during spring when there are plenty of nutrients and light intensity is increasing. They are obligatory autotrophs with golden-brown chloroplasts (fucoxanthin). They can regulate their position somewhat by active buoyancy control, big vacuoles and long spines, but they sink out when the water have become stratified and nutrients depleted in the surface layer. They are the main food source for bottom fauna.



- a = cell from above
- b = cell from side
- c = epitheca
- d = hypotheca
- e = girdle band
- f = striae (rows of dots)
- g = raphe

Class Diatomophyceae (Bacillariophyceae)

There are two major groups (orders): Centric and Pennate diatoms:

Order EUPODISCALES (BIDDULPHIALES, CENTRALES)

Centric diatoms
(SE: *centriska kiselalger*)

Actinocyclus
Attheya
(*Aulacoseira*)
Chaetoceros
Coscinodiscus
Cyclotella
Melosira
(*Rhizosolenia*)
Skeletonema
Thalassiosira

Genus in brackets = not presented here

Order BACILLARIALES (PENNALES)

Pennate diatoms (SE: *pennata kiselalger*)

Achnanthes
(*Amphora*)
Asterionella
Cylindrotheca
Diatoma
Fragilaria
(*Fragilariopsis*)
(*Grammatophora*)
Navicula
Nitzschia
(*Phaeodactylum*)
(*Tabellaria*)



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Class Diatomophyceae (Bacillariophyceae)

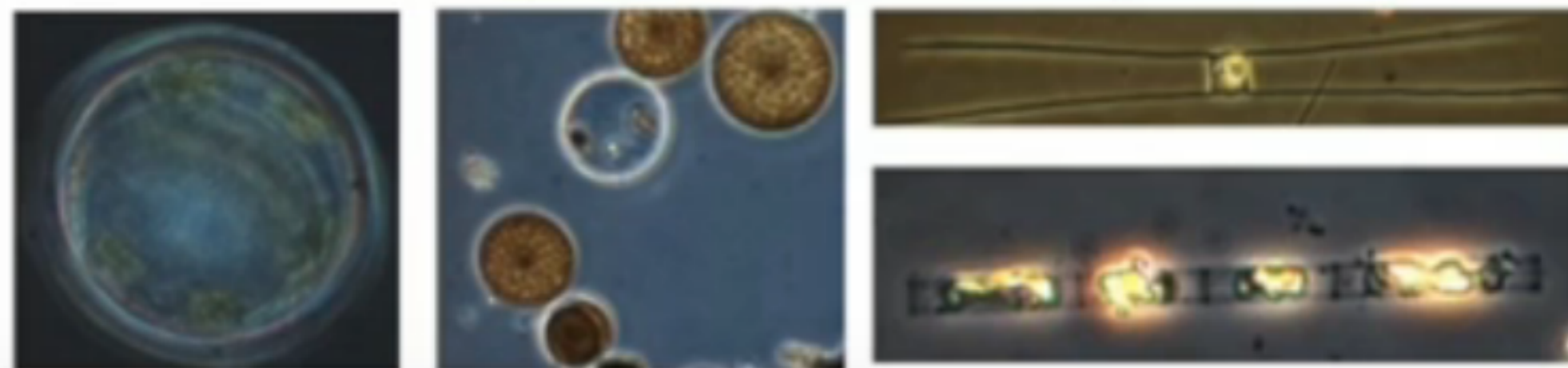
Order EUPODISCALES (BIDDULPHIALES, CENTRALES)

-Centric diatoms (*SE: centriska kiselalger*)

Cell valves are circular, elliptical or polygonal. The valve structure is radiating from a centre that is not always identical with the morphological centre. They do not have a raphe (longitudinal slit in the valve).

Morphological diverse group, unicellular or cells aggregated in colonies or filaments. Many species are able to produce resting spores. Species are mostly marine or brackish.

In the Baltic they are especially common in the spring, sometimes also in the autumn. Some species also occur during summer.



Class Diatomophyceae (Bascillariophyceae)

Order EUPODISCALES (BIDDULPHIALES, CENTRALES)

Centric diatoms (*SE: centriska kiselalger*)

Actinocyclus

Attheya

(*Aulacoseira*)

Chaetoceros

Coscinodiscus

Cyclotella

Melosira

(*Rhizosolenia*)

Skeletonema

Thalassiosira

Genus in brackets = not presented here



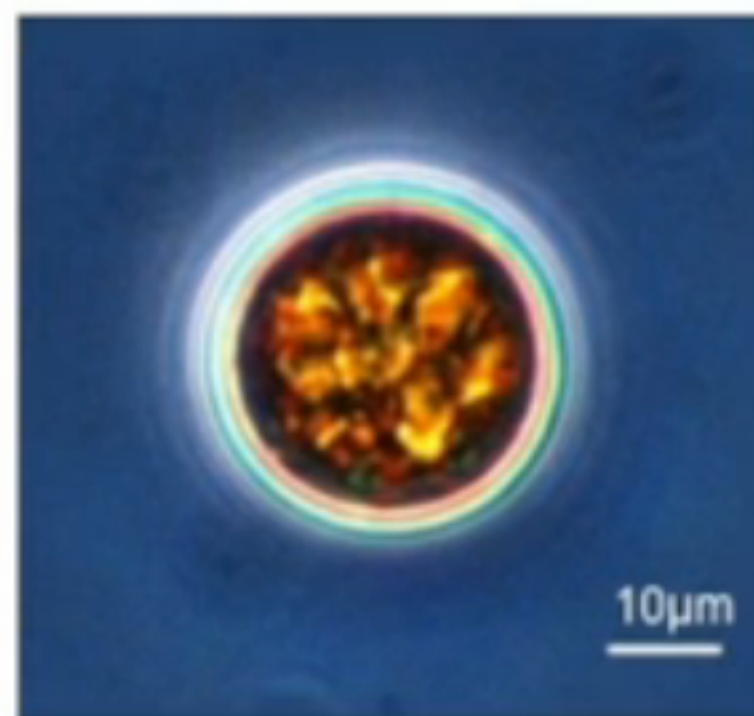
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Order EUPODISCALES (BIDDULPHIALES, CENTRALES)

-Centric diatoms

Actinocyclus

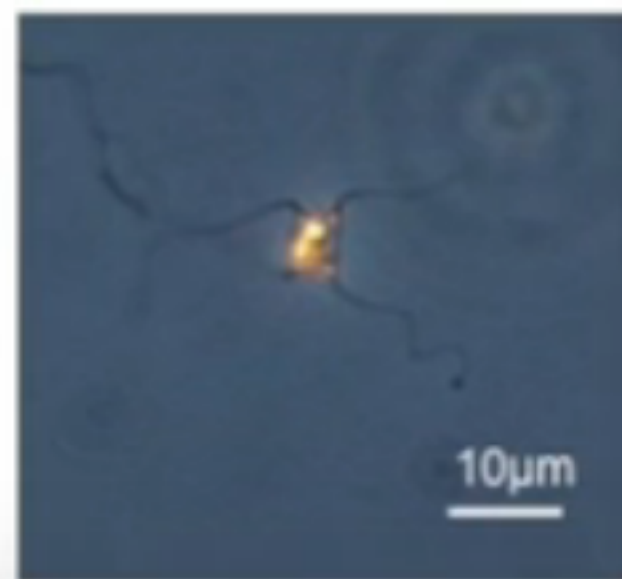
3 species in Hällfors 2004



Actinocyclus sp.

Attheya

2 species in Hällfors 2004



Attheya septentrionalis



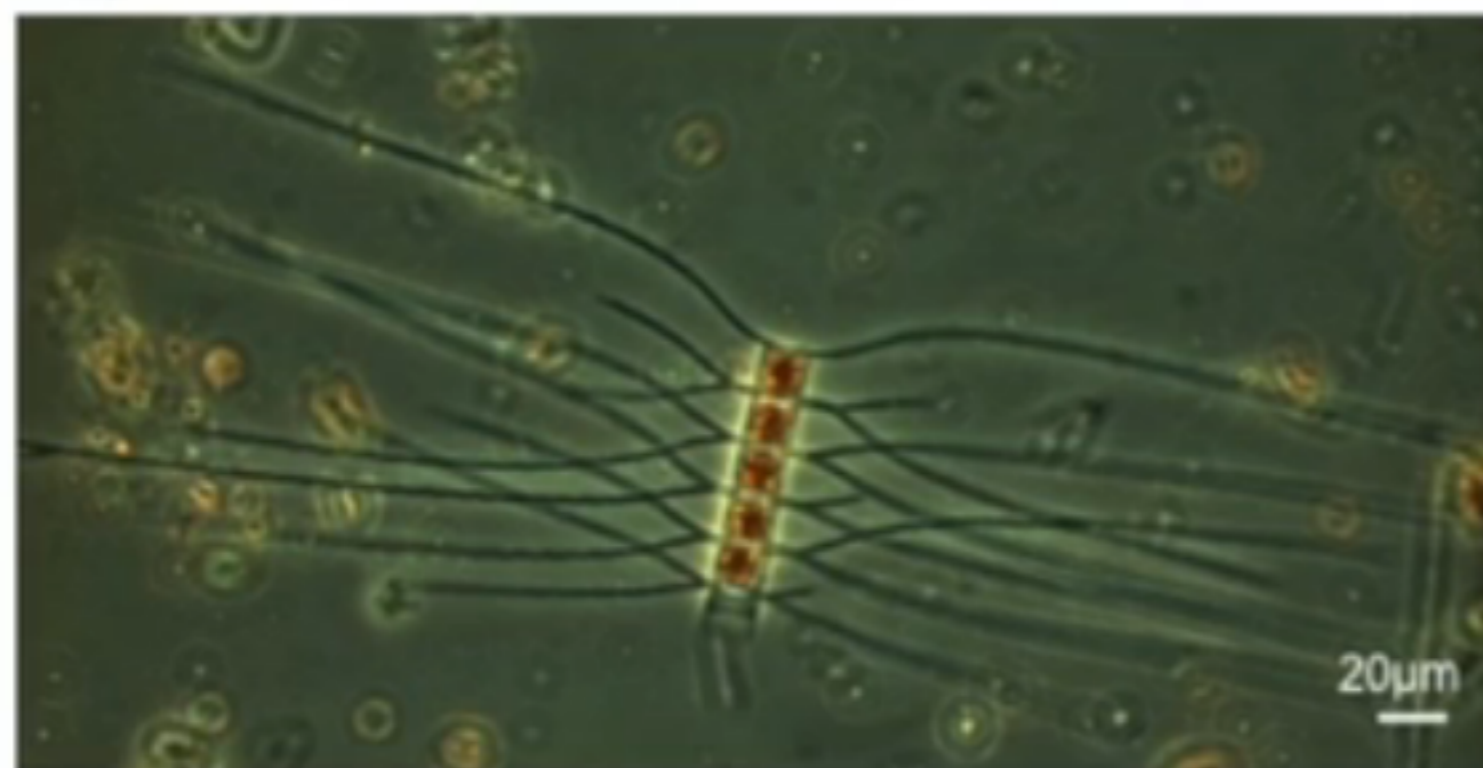
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Order EUPODISCALES (BIDDULPHIALES, CENTRALES)

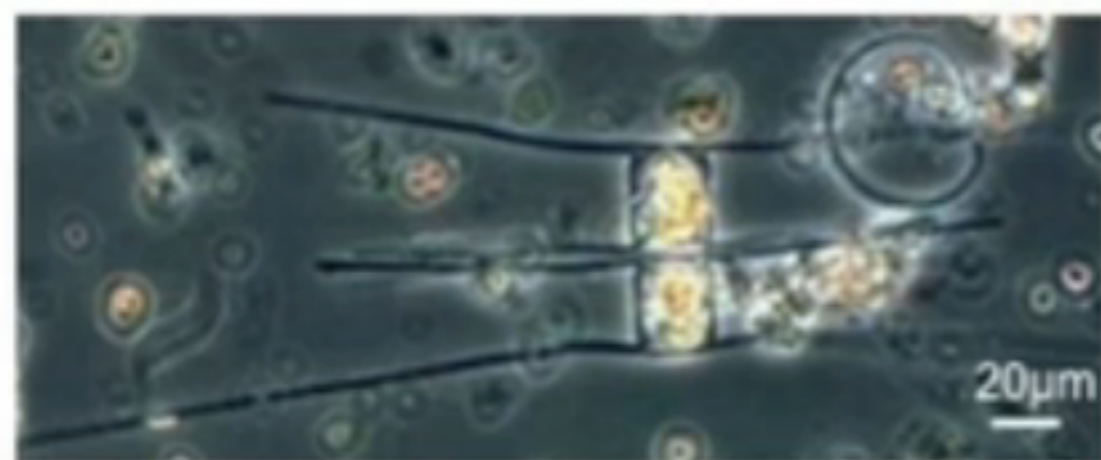
-Centric diatoms

Chaetoceros

55 species in Hällfors 2004



Chaetoceros impressus



Chaetoceros danicus

Photo: Seija Hällfors
Östersjöportalen

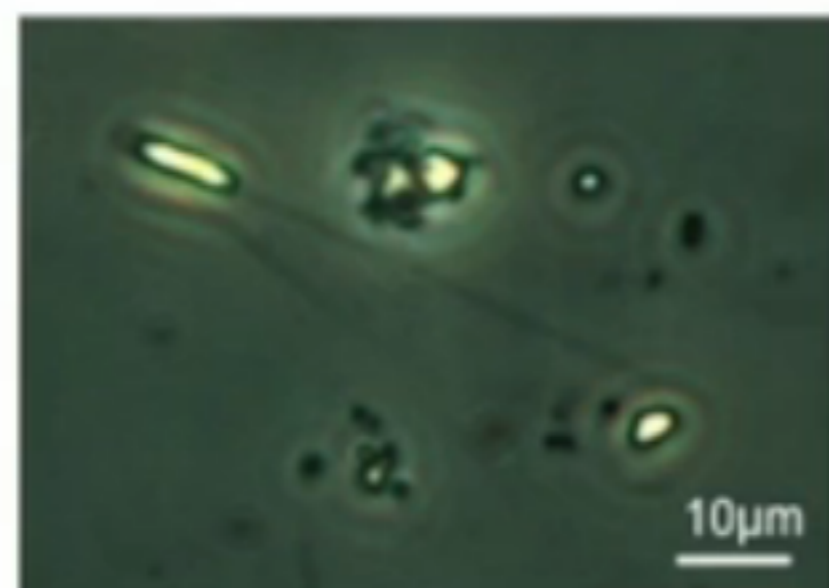


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Order EUPODISCALES (BIDDULPHIALES, CENTRALES)

-Centric diatoms

Chaetoceros



Chaetoceros thronsdenii
(small centric diatom, mostly
occurring during summer)



Chaetoceros subtilis

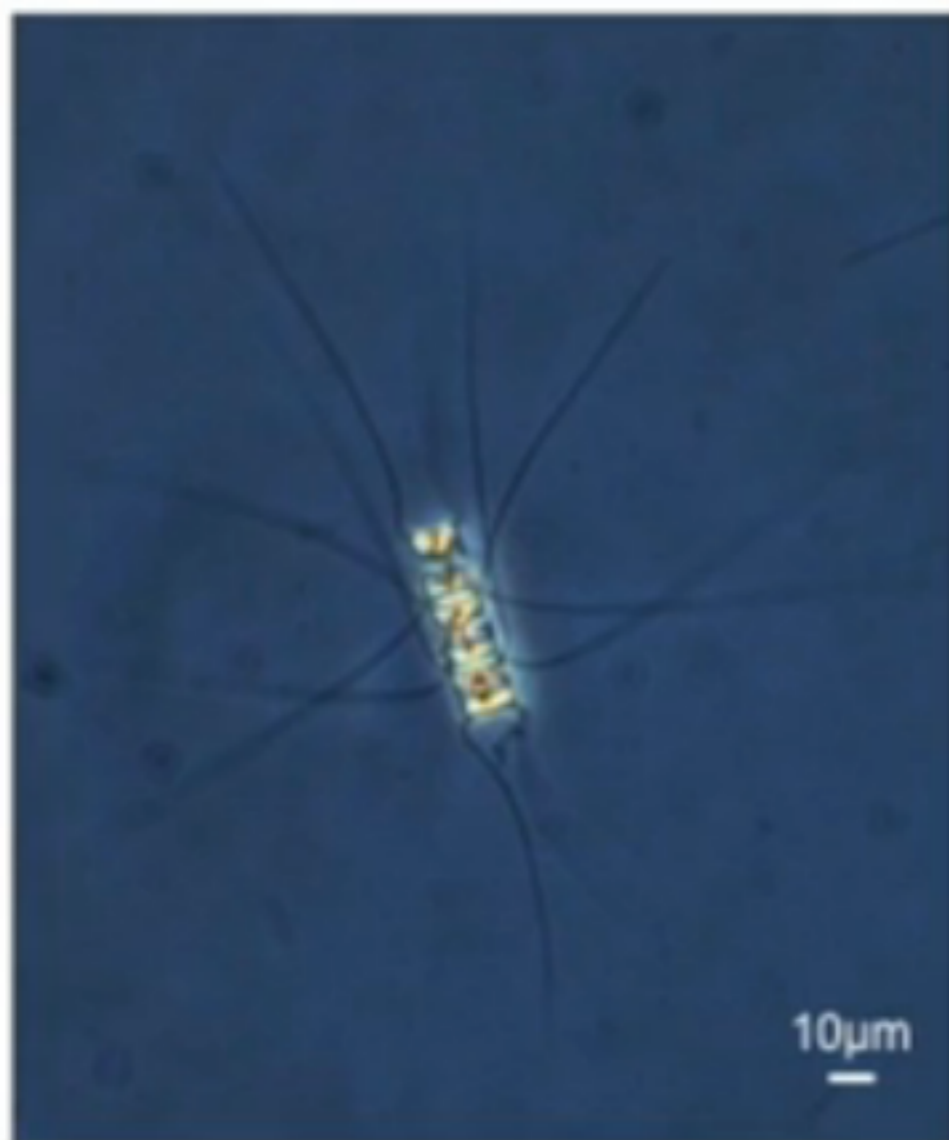


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Order EUPODISCALES (BIDDULPHIALES, CENTRALES)

-Centric diatoms

Chaetoceros



Chaetoceros wighamii



Chaetoceros holcaticus



Chaetoceros similis



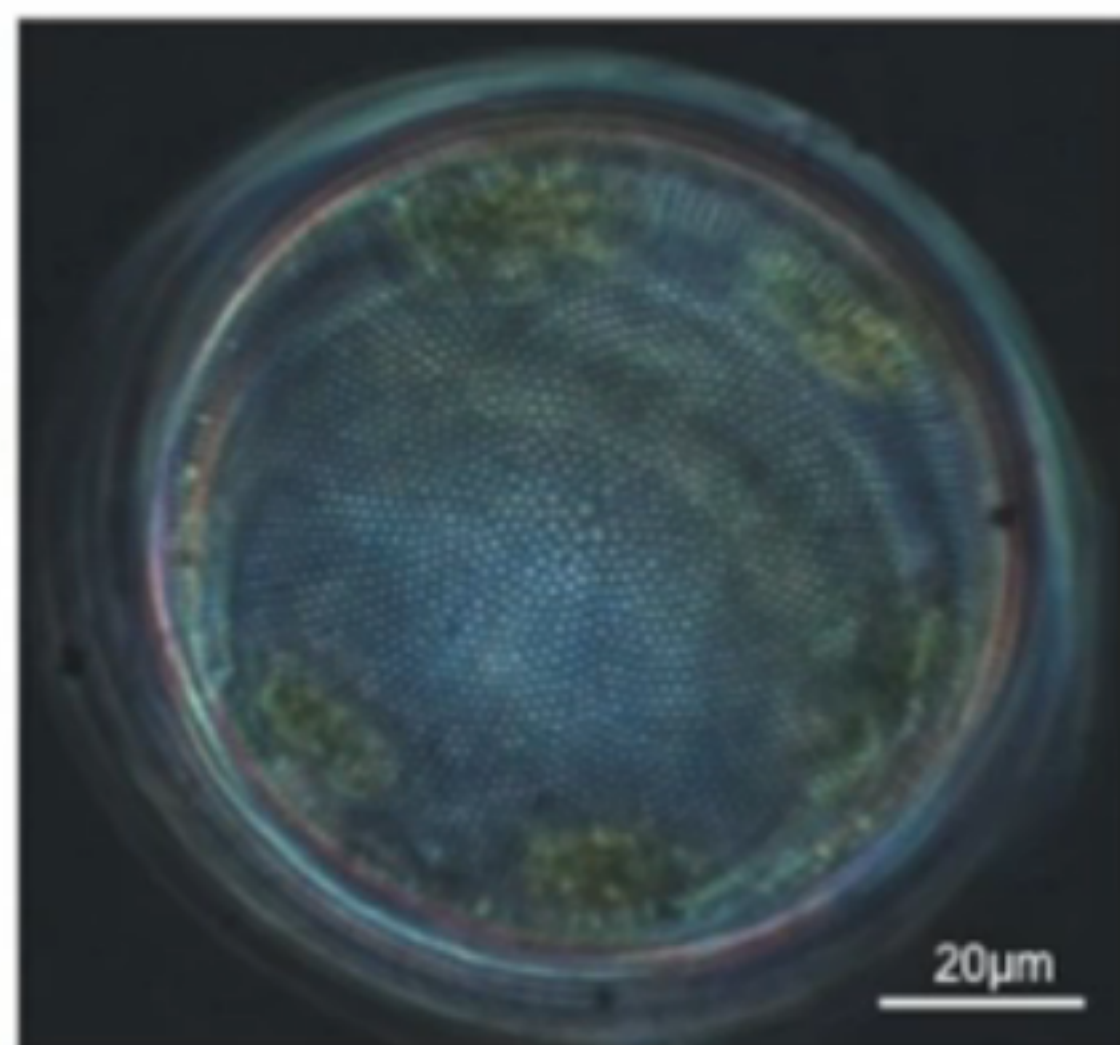
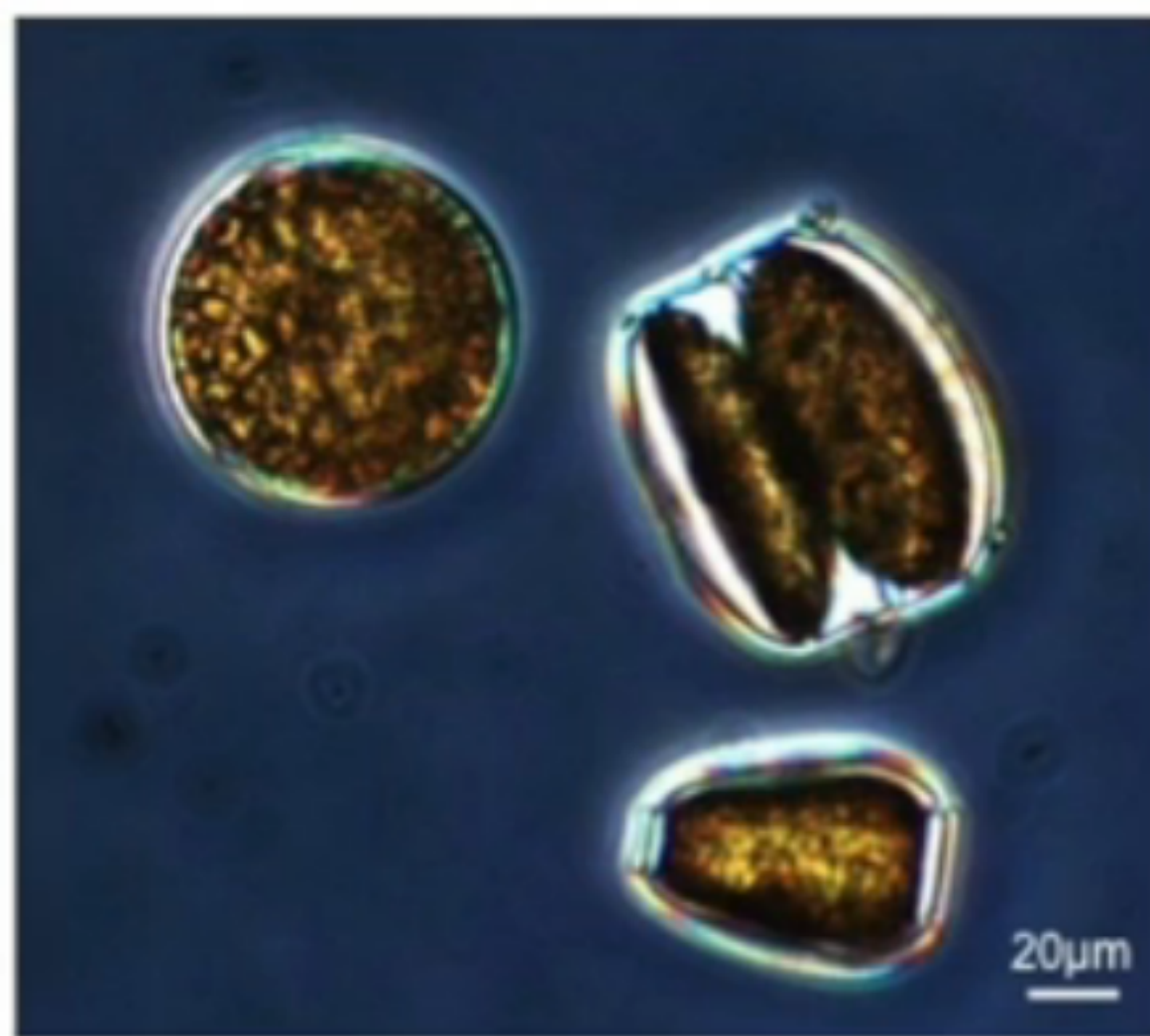
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Order EUPODISCALES (BIDDULPHIALES, CENTRALES)

-Centric diatoms

Coscinodiscus

18 species | Hällfors 2004



Coscinodiscus granii



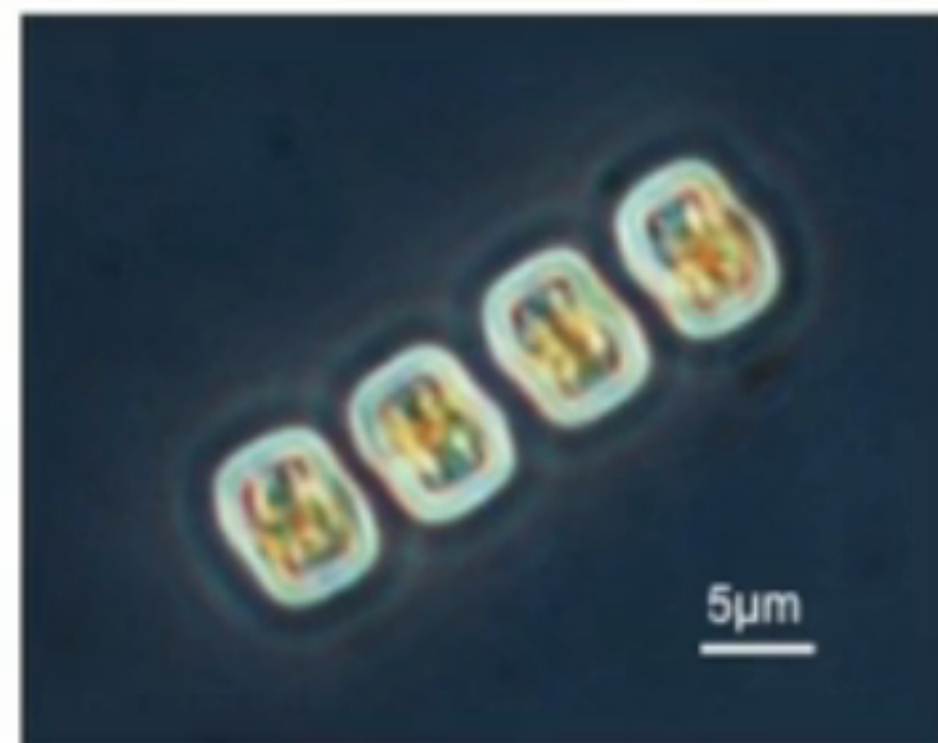
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Order EUPODISCALES (BIDDULPHIALES, CENTRALES)

-Centric diatoms

Cyclotella

16 species in Hällfors 2004



Cyclotella choctawhatcheeana



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Order EUPODISCALES (BIDDULPHIALES, CENTRALES)

-Centric diatoms

Melosira

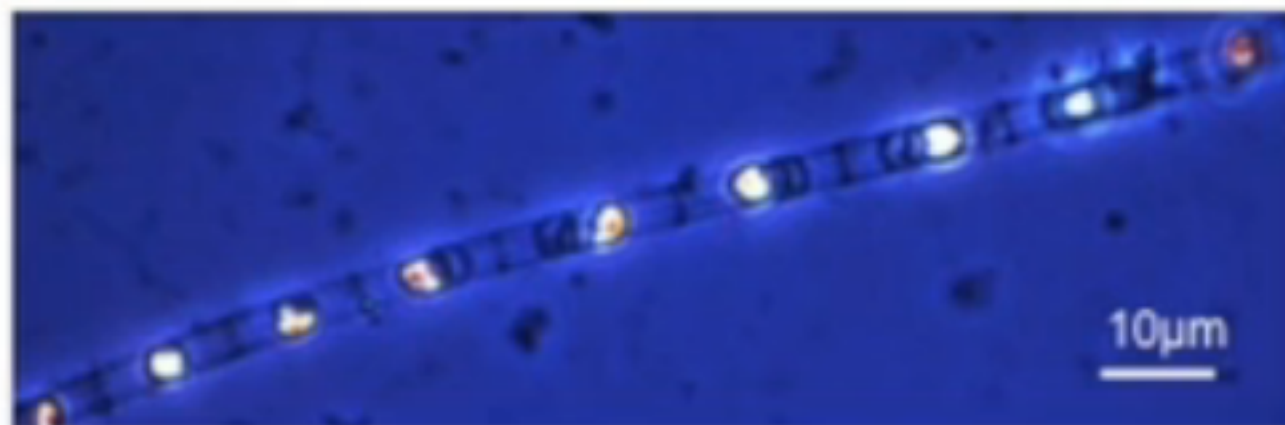
7 species in Hällfors 2004



Melosira arctica

Skeletonema

3 species in Hällfors 2004



Skeletonema marinoi
(Before *Skeletonema costatum*)



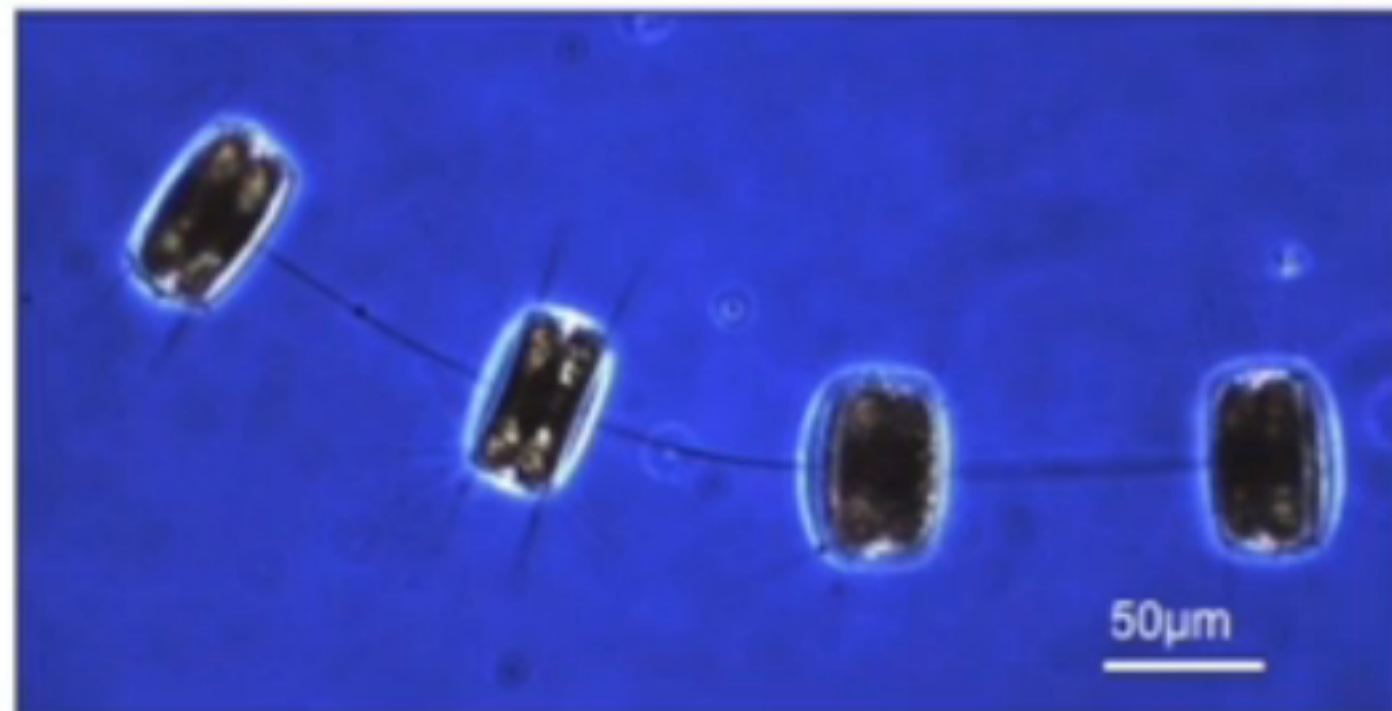
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Order EUPODISCALES (BIDDULPHIALES, CENTRALES)

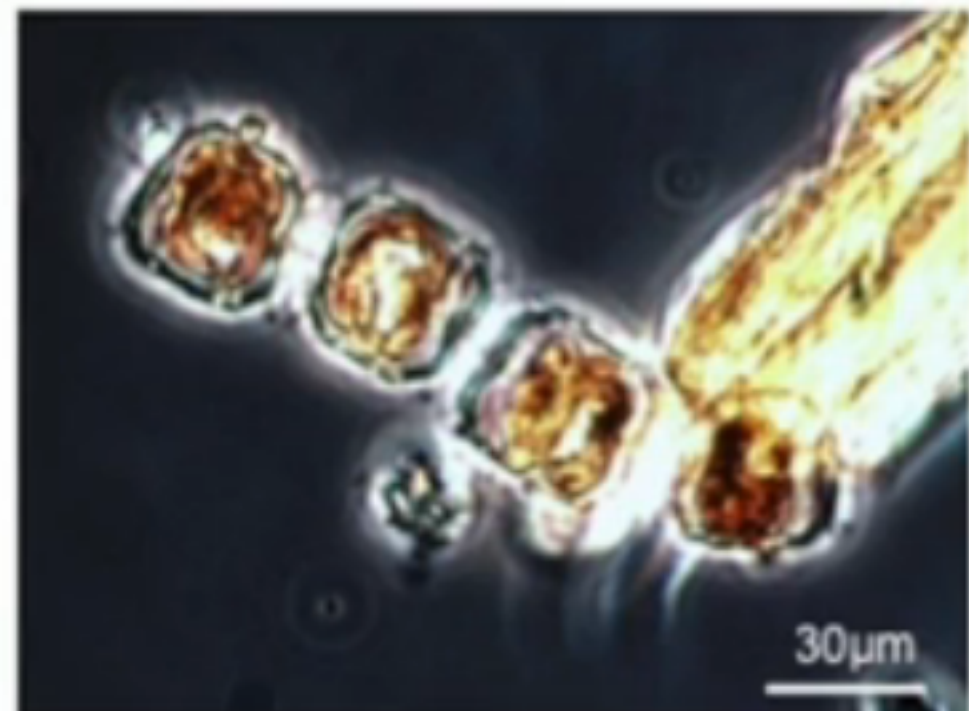
-Centric diatoms

Thalassiosira

17 species in Hällfors 2004



Thalassiosira baltica



Thalassiosira nordenskiöldii



Thalassiosira levanderi



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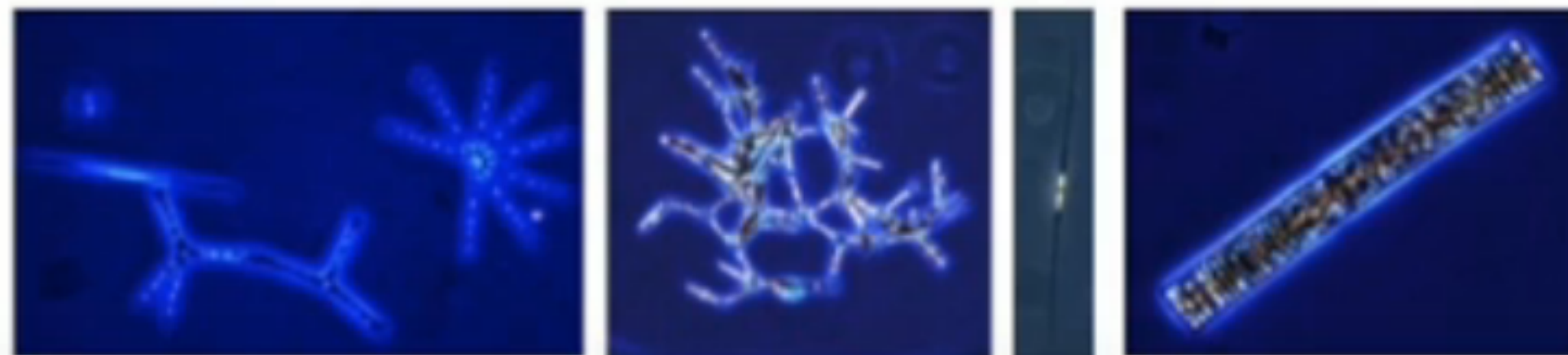
Class Diatomophyceae (Bacillariophyceae)

Order BACILLARIALES (PENNALES)

-Pennate diatoms (*SE: pennata kiselalger*)

Cells are elongate in valve view, usually with bilaterally patterns consisting of rows of dots (striae) that are important for identification. Some species have a raphe (a longitudinal slit). Single cells or cells in colonies. Diverse group.

Pennate diatoms are found mainly in freshwater and many species are benthic. Few species can be properly identified in light microscope. (Frustula need to be cleansed from organic material before ornamentation on the frustula can be used for species identification).



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Class Diatomophyceae (Bascillariophyceae)

Order BACILLARIALES (PENNALES)

-Pennate diatoms (*SE: pennata kiselalger*)

Achnanthes
(*Amphora*)
Asterionella
Cylindrotheca
Diatoma
Fragilaria
(*Fragilariopsis*)
(*Grammatophora*)
*Lennoxia**
Navicula
Nitzschia
(*Phaeodactylum*)
Pseudo-nitzschia
(*Tabellaria*)



* New genus, not in Hållfors 2004

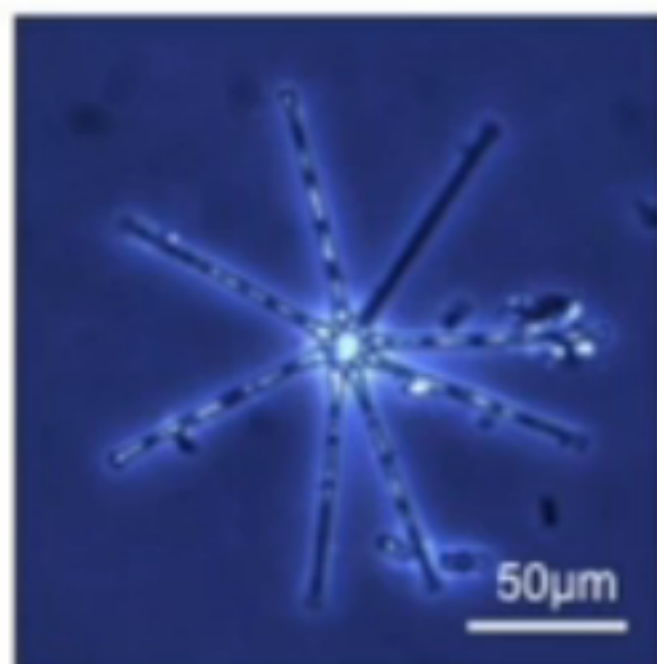


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Order BACILLARIALES (PENNALES)

Asterionella

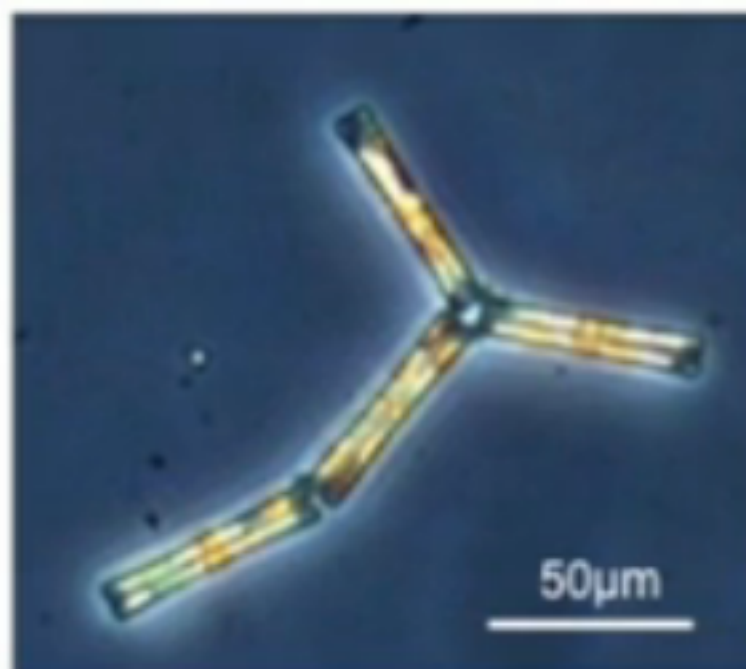
1 species in Hällfors 2004



Asterionella formosa

Diatoma

7 species in Hällfors 2004



Diatoma sp.

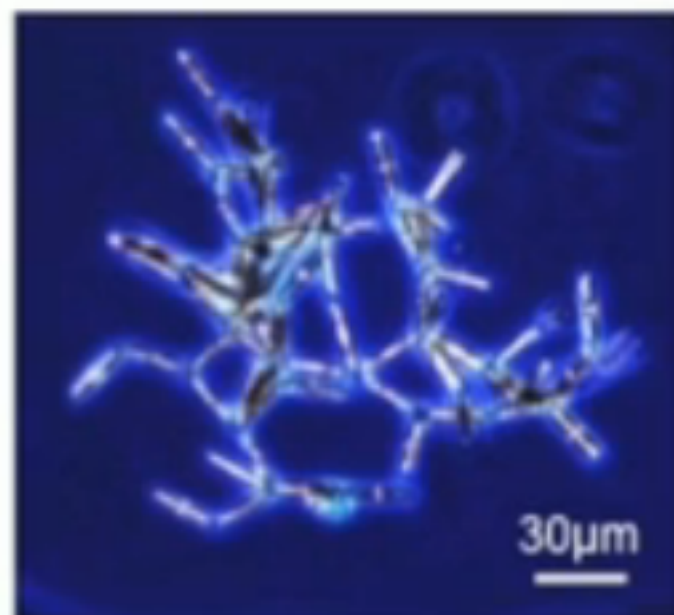


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Order BACILLARIALES (PENNALES)

Nitzschia

48 species in Hällfors 2004



Nitzschia frigida



Photo: Seija Hällfors
Östersjöportalen

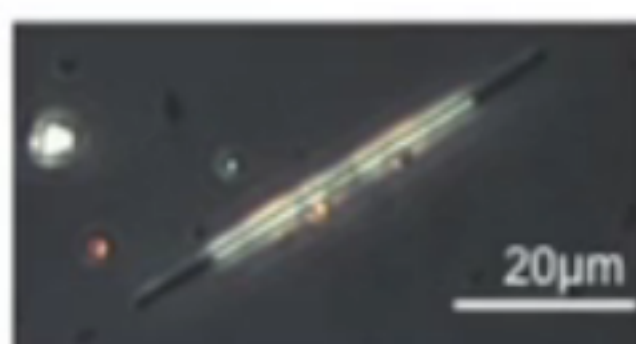
Nitzschia paleacea

Pseudo-nitzschia

6 species in Hällfors 2004



Pseudo-nitzschia seritata group



Pseudo-nitzschia delicatissima group

Marine species, found in southern Baltic Sea, Kattegat and Skagerrak. Some produce toxins.



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Order BACILLARIALES (PENNALES)

Cylindrotheca

2 species in Hällfors 2004



Cylindrotheca closterium

*Lennoxia**

(New genus, not
in Hällfors 2004)



Lennoxia faveolata



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Division EUGLENOPHYTA

Class Euglenophyceae - Euglenoids

Mainly unicellular flagellates with two flagella (one can be too short to see in LM) arising from an invagination (ampulla) located at the anterior end of the cell. They have an orange-red eyespot and are surrounded by a skin-like protein layer called pellicle (periplast). It is thin in some species, which allowed them to change their form.

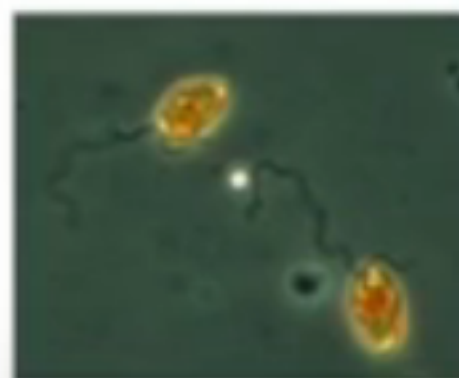
Both autotroph and heterotroph species occur. Chloroplasts are green (pigment composition resemble the green algae) and different in shape. Mostly freshwater species, only a few occur in the Baltic. However, they form blooms, especially during summer after upwelling. Most species prefer nutrient rich waters. Heterotrophs occur mainly in waste waters.

Eutreptiella

3 species in Hällfors 2004



Eutreptiella sp. (AU)



(*Euglena*)

10 species in Hällfors 2004

Freshwater



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Division CHLOROPHYTA

Class Prasinophyceae

Order CHLORODENDRALES

Order MAMIELLALES

Class Chlorophyceae – Green algae (SE: grönalger)

Order VOLVOCALES

Order CHLOROCOCCALES

(Order ULOTRICALES)

Order MICROSPORALES

(Order OEDOGONIALES)

Class Charophyceae

Order KLEBSORMIDALES

(Order ZYGNEMATALES)



Division CHLOROPHYTA

Includes many unicellular, colonial or filamentous algae, some with flagella and eyespot. They have rigid cell wall and green chloroplasts. Their main pigments are chlorophyll a and b, but some accessory pigments also occur (carotenoids, xanthophylls).

The division include very different organisms divided into several classes and orders. Two classes are important in the Baltic Sea:

Class Prasinophyceae

Order CHLORODENDRALES

Order MAMIELLALES

Class Chlorophyceae – Green algae (SE: grönalger)

Order VOLVOCALES

Order CHLOROCOCCALES

(Order ULOTRICALES)

Order MICROSPORALES

(Order OEDOGONIALES)



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Division CHLOROPHYTA

Class Prasinophyceae (Micromonadophyceae)

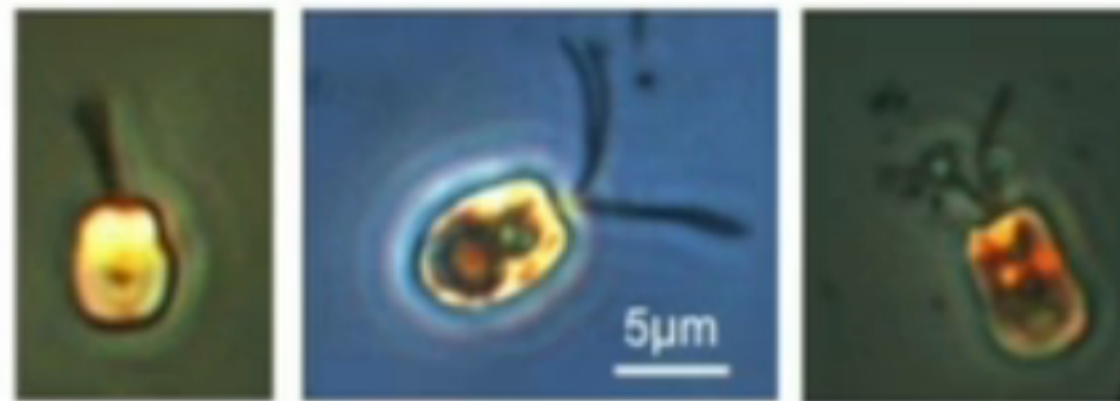
Mainly solitary species. They are free-living small flagellates with 2 or 4 flagella (seldom 1 or 8). Cell and flagella are covered by organic plates (therefore they look thick). Patterns of the plates are used for identification. They have one chloroplast with pyrenoid and eyespot.

Order CHLORODENDRALES

Pyramimonas

14 species in Hällfors 2004

Pyraminomas has four flagella. It is the most common genus of the class Prasinophyceae in the Baltic and occur almost year around. Some species are common during spring bloom others during summer and autumn.



Pyramimonas spp. (AU)



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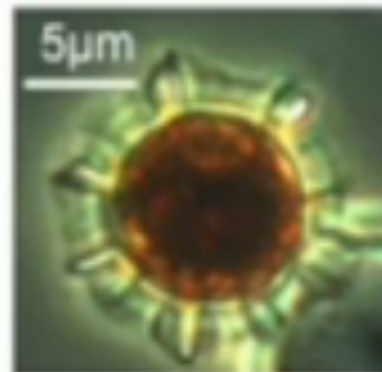
Division CHLOROPHYTA

Class Prasinophyceae (Micromonadophyceae)

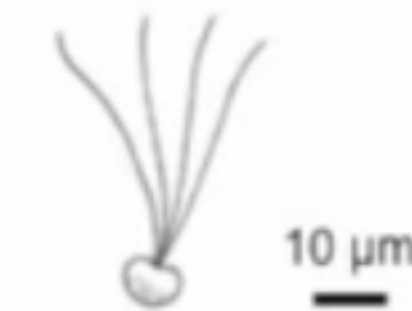
Order CHLORODENDRALES

Pachysphaera/Pterosperma

2 species *Pterosperma*,
1 species *Pachysphaera*
in Hällfors 2004



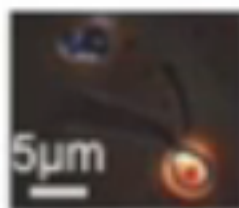
Pterosperma sp. (AU)
(phycoma stage)



(flagellate stage)

Pseudoscourfieldia

1 species in Hällfors 2004



Pseudoscourfieldia marina (AU)



Order MAMIELLALES

Micromonas

1 species in Hällfors 2004



Micromonas pusilla (AU)



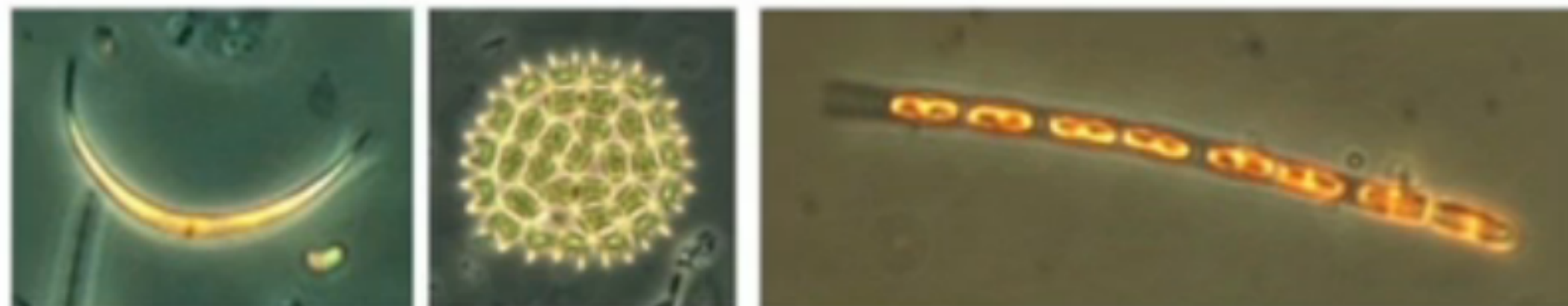
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Division CHLOROPHYTA

Class Chlorophyceae - Green algae

Includes several orders and a great variety of algae, from free-living flagellates, colonial motile and non motile forms to filamentous species. They are most similar to higher plants having similar cell wall structure, nucleus, chloroplasts and pigments (chlorophylls *a* and *b* and some carotenoids). Both vegetative and sexual reproduction occur.

The great majority of the species are autotrophic and are living in freshwater. In the open Baltic Sea only a few species occur, but in low saline coastal areas many different species can be found.



Class Chlorophyceae - Green algae

Order VOLVOCALES (incl. TETRASPORALES)

(Chlamydomonas)

(Eudorina)

(Gonium)

(Pandorina)

(Volvox)

Order CHLOROCOCCALES

Acutodesmus

(Botryococcus)

(Coelastrum)

Desmodesmus

(Dichtyosphaerium)

Monoraphidium

Oocystis

Pediastrum

Scenedesmus

Sphaerocystis

Order MICROSPORALES

Planctonema

Genus in brackets = not presented here. Mostly freshwater genera.



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Order CHLOROCOCCALES

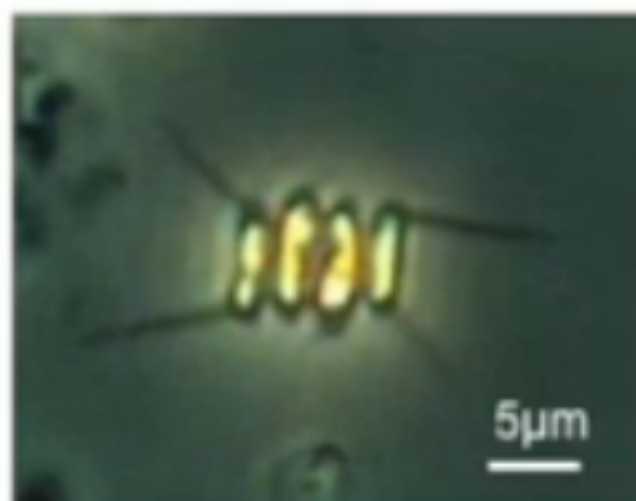
Acutodesmus



Acutodesmus sp.

Desmodesmus

17 species in Hällfors 2004



Desmodesmus sp.

Scenedesmus

16 species in Hällfors 2004



Scenedesmus sp.

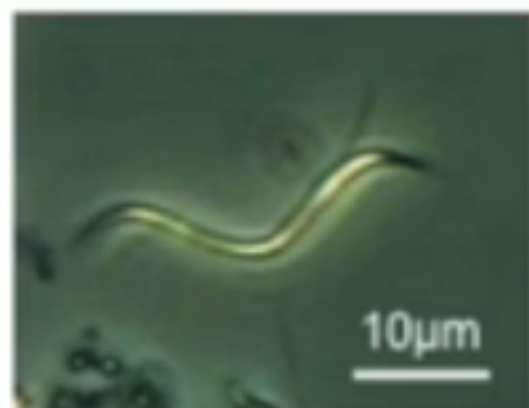


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Order CHLOROCOCCALES

Monoraphidium

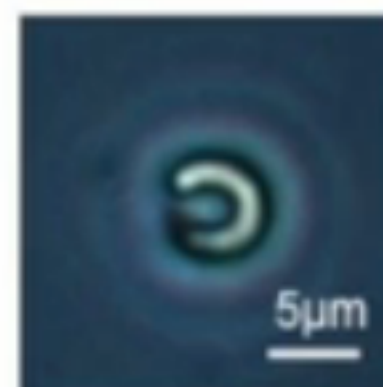
9 species in Hällfors 2004



Monoraphidium contortum



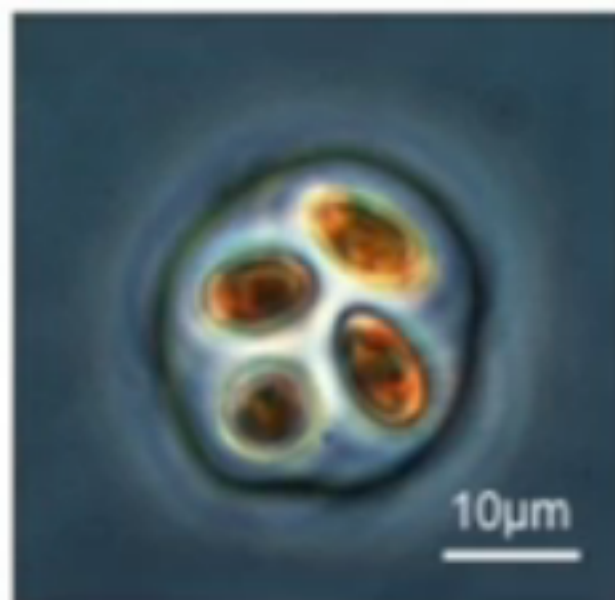
Monoraphidium sp.



Monoraphidium minutum

Oocystis

11 species in Hällfors 2004



Oocystis sp.

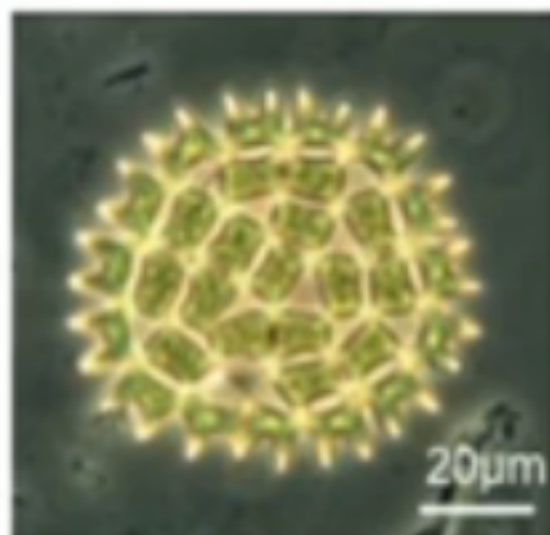


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Order CHLOROCOCCALES

Pediastrum

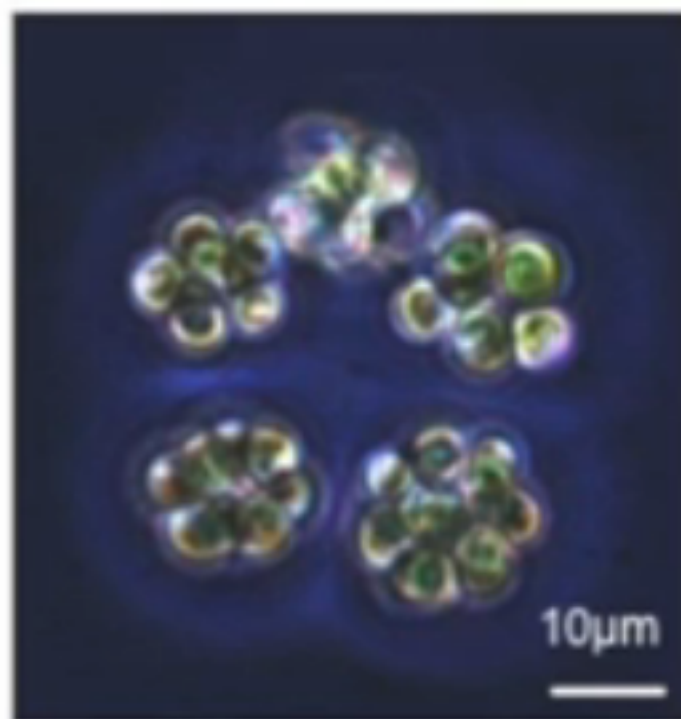
9 species in Hällfors 2004



Pediastrum sp.

Sphaerocystis

2 species in Hällfors 2004



*Sphaerocystis
schroeteri*

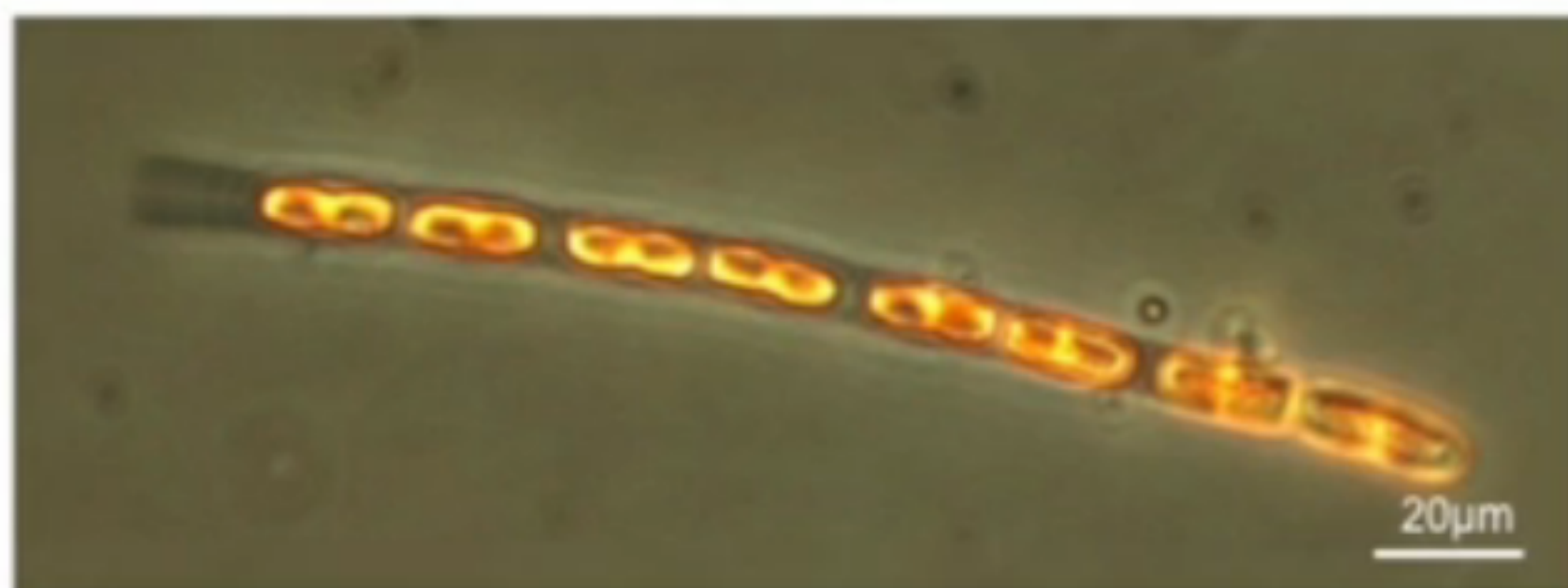


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Order MICROSPORALES

Planctonema

1 species in Hällfors 2004



Planctonema lauterbornii



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Division CHLOROPHYTA

Class Charophyceae

Order KLEBSORMIDALES

(Elakatothrix)

3 species in Hällfors 2004

Benthic species that sometimes occur in the pelagic.

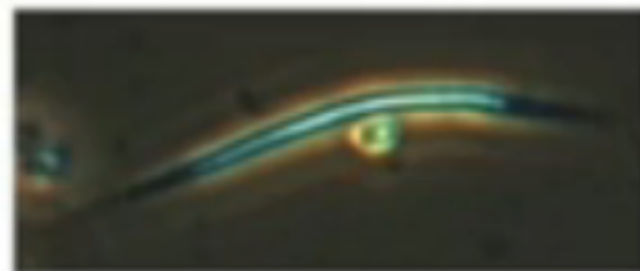


Elakatothrix genevensis (AU)

Koliella

5 species in Hällfors 2004

Species similar in form as *Monoraphidium* species. Cell division across the cell (in *Monoraphidium* along the long axis).



In recent taxonomy this genus has been moved to the class Trebouxiophyceae.



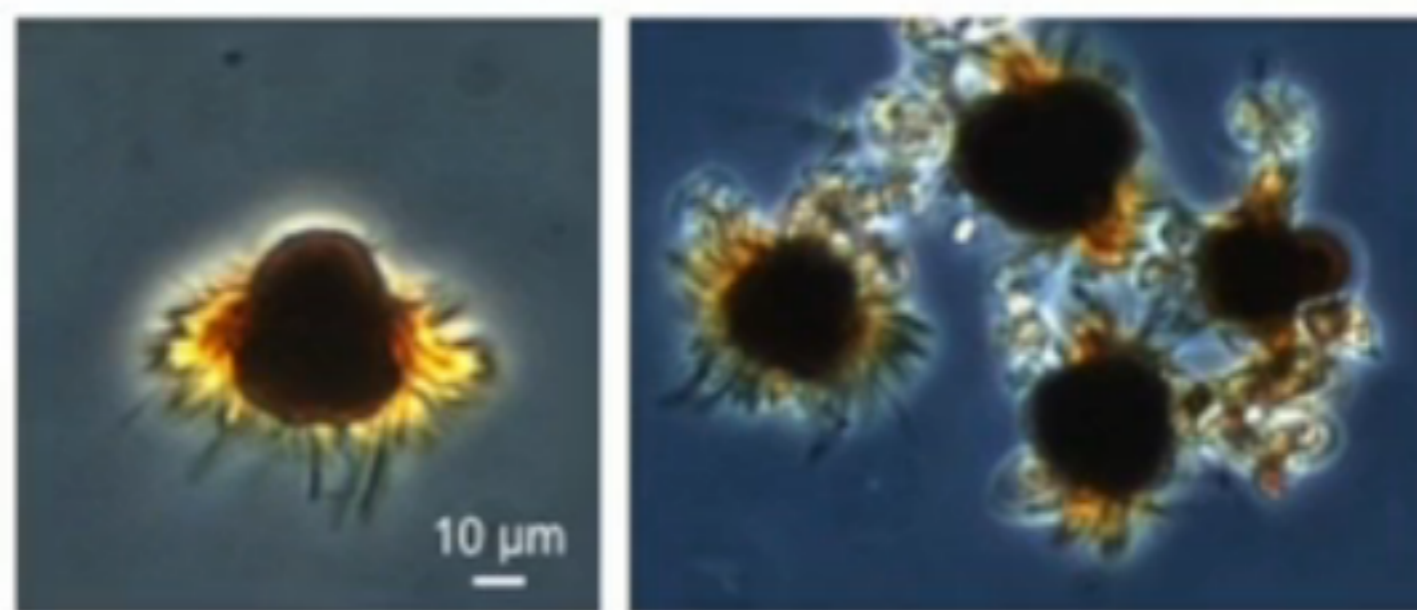
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Photosynthetic ciliates - Ciliophora

Mesodinium

Mesodinium rubrum is the most typical and important member of this group. It has several chloroplasts of cryptophycean origin and are able to perform photosynthesis. The accessory pigments in their chloroplast colour them red. When occurring in high numbers they colour the water reddish.

M. rubrum occur regularly in almost all samples year around and are common at the end of the spring bloom. They are able to migrate vertically and explore nutrients below the pycnocline.



Mesodinium rubrum



Non-photosynthetic protists:

Phylum ZOOMASTIGOPHORA – Zooflagellates

This group contain colorless, heterotrophic flagellates, mainly nanoplanktonic ones. Based on their microanatomy they are not included in the algal system, but in the zoological system.

Three classes are important in the Baltic Sea:

Class Bicosoidea

Class Eбриidea

Class Choanoflagellida – Collar flagellates
(Craspedophyceae) (SE: kragflagellater)



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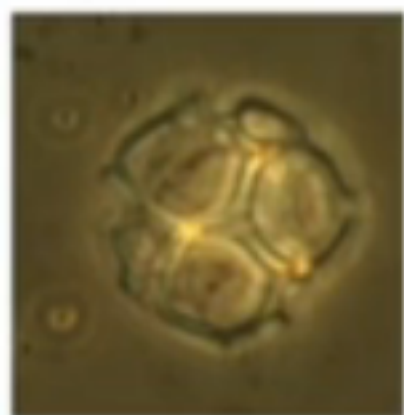
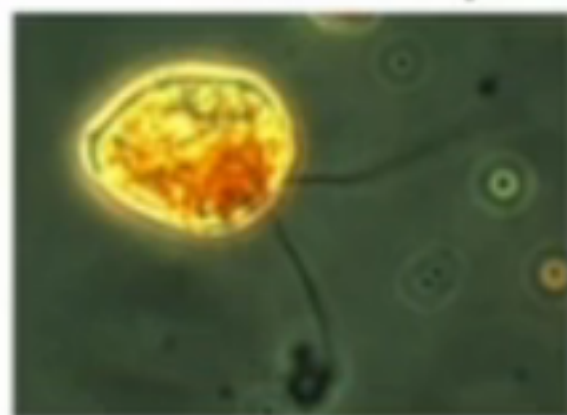
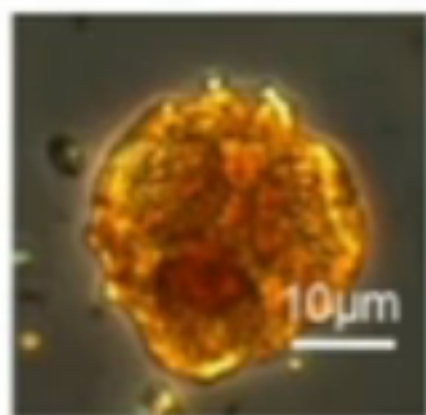
Phylum ZOOMASTIGOPHORA – Zooflagellates

Class Eбриidea

Heterotrophic naked cells with two flagella and an internal siliceous skeleton.

Ebria

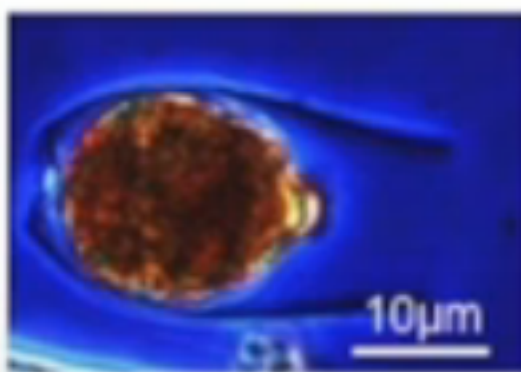
Ebria tripartita is common in the Baltic, especially after the spring bloom. This species (25-40 μm in diam.) attach to other algae, even bigger than itself, and sucks out their plasma.



Ebria tripartita (HT)

Class Bicosoecidea

Bicosoeca



Bicosoeca sp. (HT)

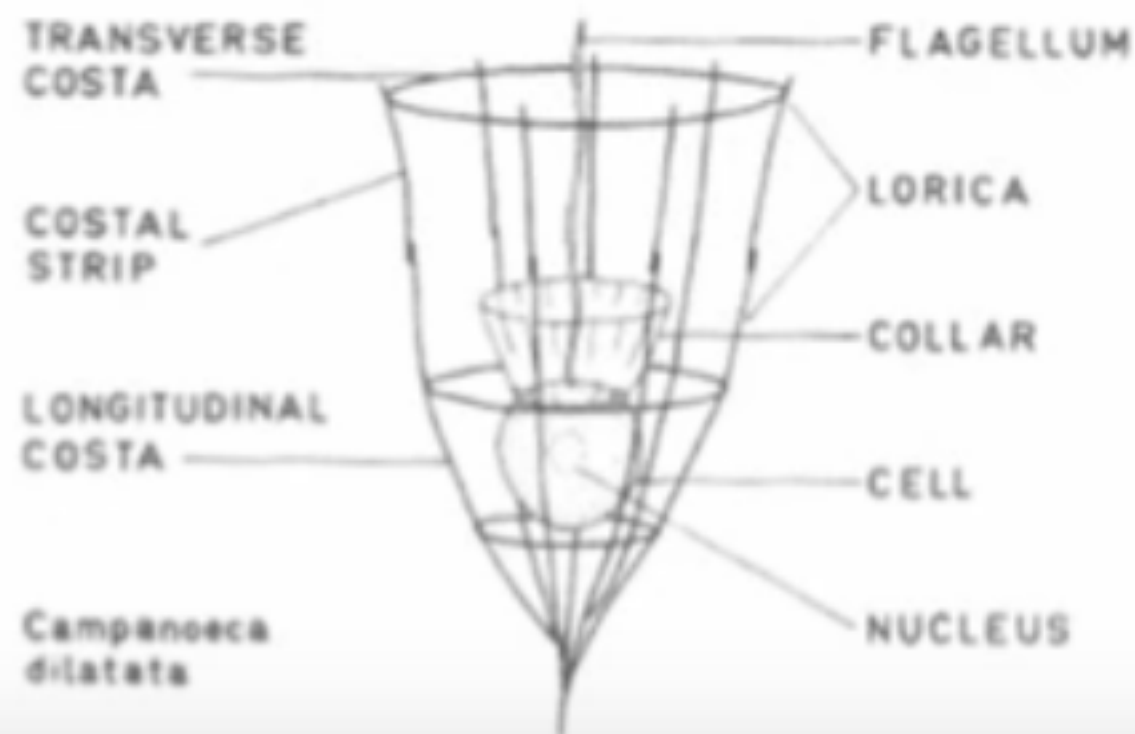


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Phylum ZOOMASTIGOPHORA – Zooflagellates

Class Choanoflagellida – Collar flagellates (Craspedophyceae) (SE: kragflagellater)

Oval cells with single flagellum encircled by a collar. Many species enveloped in a lorica composed of silica rods and costal strips. Their taxonomy is based on the morphology of the lorica. They can be numerous at the end of the spring bloom and after, mostly because they ingest bacteria and organic particles.



Schematic picture of a choanoflagellate (from Thronsdén, 1974, Sarsia 56: 95-122)



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Phylum ZOOMASTIGOPHORA – Zooflagellates

Class Choanoflagellida – Collar flagellates (Craspedophyceae)

Calliacantha

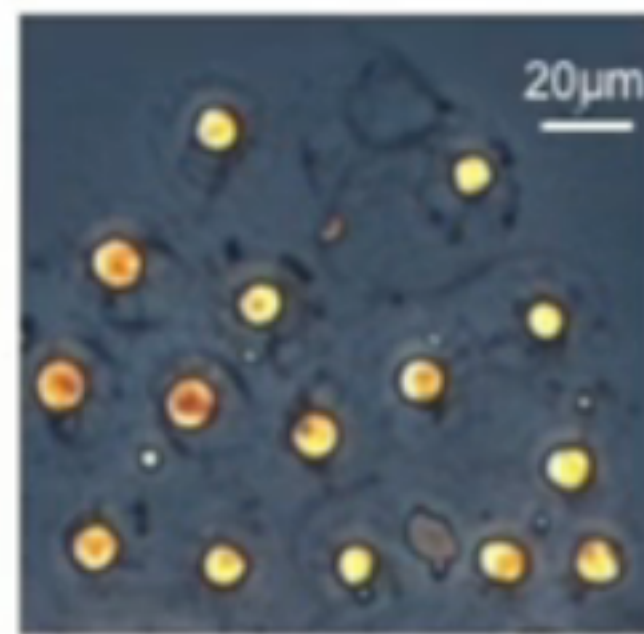
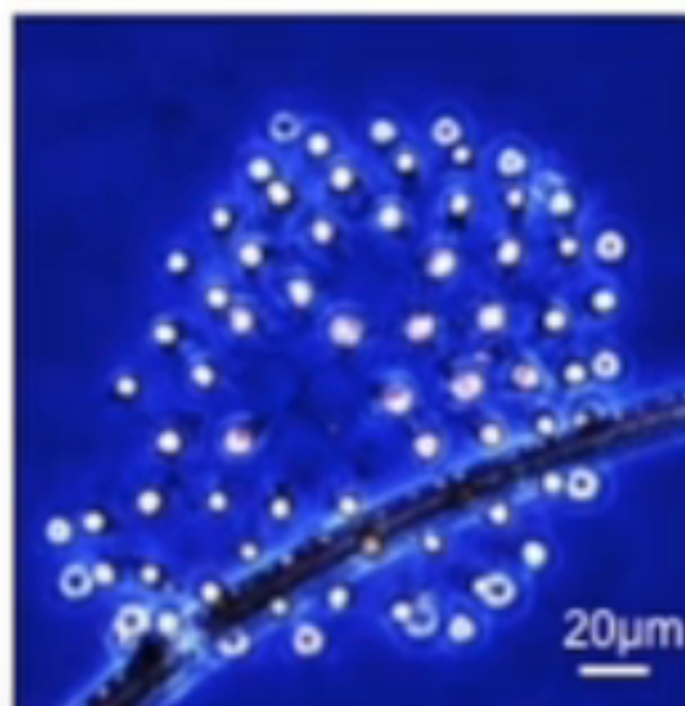
2 species in Hällfors 2004



Calliacantha sp. (HT)

Diaphanoeca

3 species in Hällfors 2004



Diaphanoeca sp. (HT)



Phylum ZOOMASTIGOPHORA – Zooflagellates

Incertae sedis

The taxonomical position of these species are not yet clear. They are mostly colorless, heterotrophic nanoflagellates that ingest bacteria and small algae.

Katablepharis

2 species in Hällfors 2004



Katablepharis sp. (HT)

Leucocryptos

1 species in Hällfors 2004



Leucocryptos marina (HT)

Telonema

2 species in Hällfors 2004

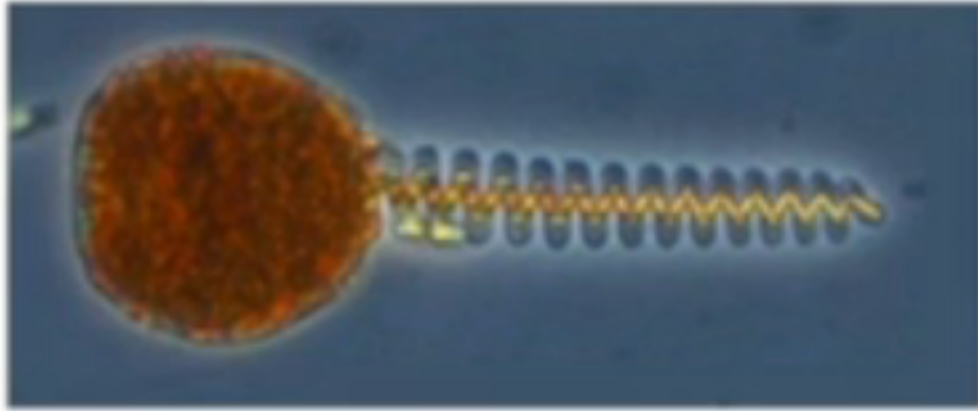


Telonema sp. (HT)



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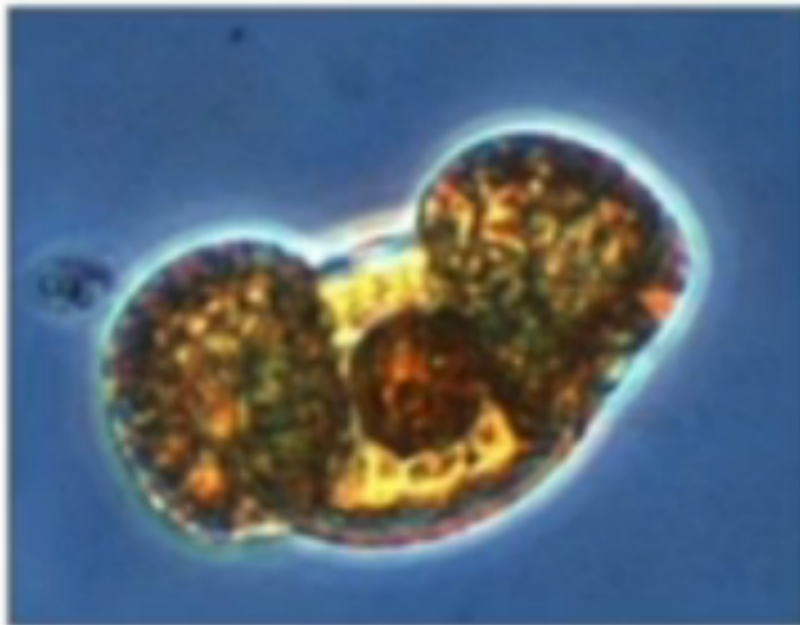
Other things that can appear in the plankton samples...



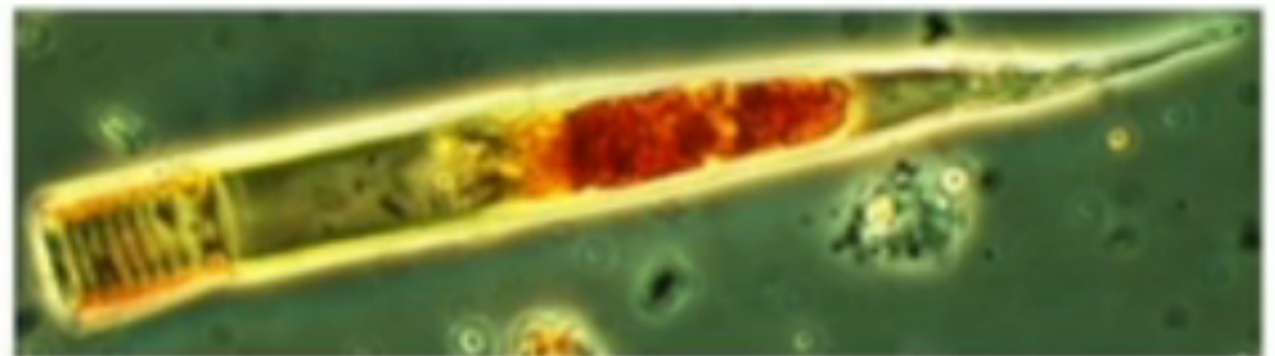
The ciliate *Vorticella* sp.



Benthic ciliate *Euplotes* sp.
(Common in *Nodularia spumigena* aggregates).



Pollen grain from pine



The ciliate *Helicostomella* sp.

