Identification of Flagellates in the Raritan Bay

The Monmouth County Department of Health

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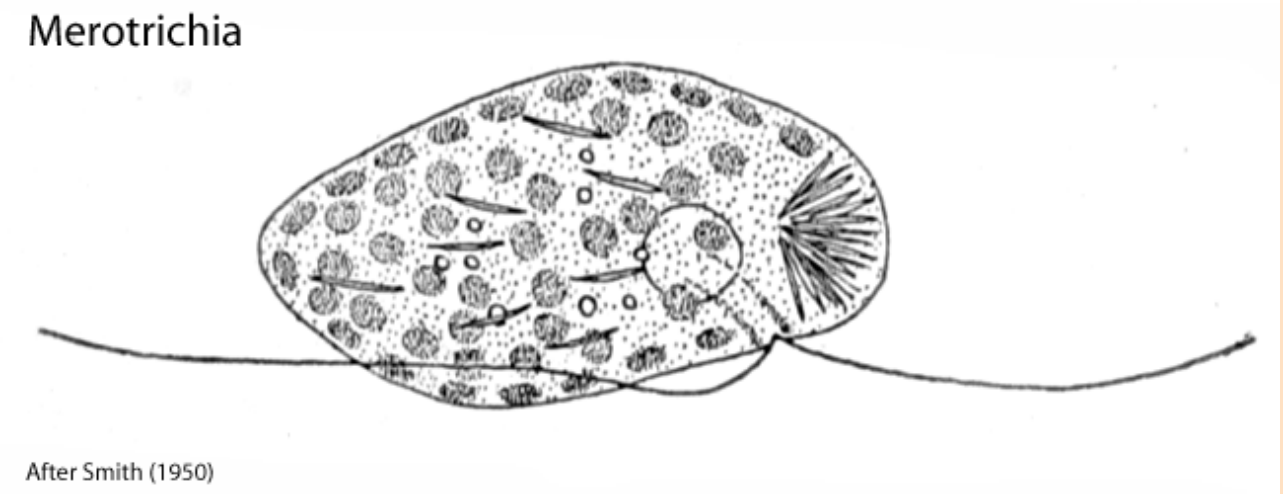
Photographs and slideshow by Becky Cosgrove, Environmental Lab Director

Dinoflagellates or Armoured flagellates

- unicellular eukaryotic microorganisms
- free-swimming protists with a forward spiraling motion propelled by two dimorphic flagella



What is a bloom?

- The term “bloom” sometimes refers to a single species which has exploited conditions far more successfully than others, leading to the almost exclusive presence of that species.
- the environmental conditions are such that one single organism type has a rapid population increase.
- Sometimes there is a co-dominant species. Groups of phytoplankton are commonly seen together, such as “red-tide organisms”.

Low Bloom of 2 or more species

- a low bloom in the Raritan Bay, Atlantic Highlands Municipal Marina was observed on June 5, 2006 in the morning of a gloomy day.
  - Cloudy water reported
  - The cell count for the most prevalent species in the sample was *Heterocapsa triquetra (*5,740 cells/ml), *Prorocentrum minimum* (5,420 cells/ml), *Heterocapsa rotundata* (1,620 cells/ml) and *Polykrikos* sp (280 cells/ml).

Strategies for success

competition among phytoplankton for limiting resources

- flagellated phytoplankton may have increased growth rates over non-migrating phytoplankton
- diel vertical migration
  - access to light and nutrient resources in stratified water bodies where light and nutrients are vertically separated.
- release of chemicals that inhibit other species, a process known as allelopathy.
  - allelopathic species also induced the formation of temporary cysts in *S. trochoidea (G.O Fistarol* et al 2004)
  - By forming temporary cysts, *S. trochoidea* may be able to overcome the effect of allelochemicals, and thereby have an adaptive advantage over other organisms unable to do so.

Giovana O. Fistarol, Catherine Legrand, Karin Rengefors, Edna Granéli (2004)
Temporary cyst formation in phytoplankton: a response to allelopathic competitors?
Environmental Microbiology 6 (8), 791–798.

Polykrikos kofoldi

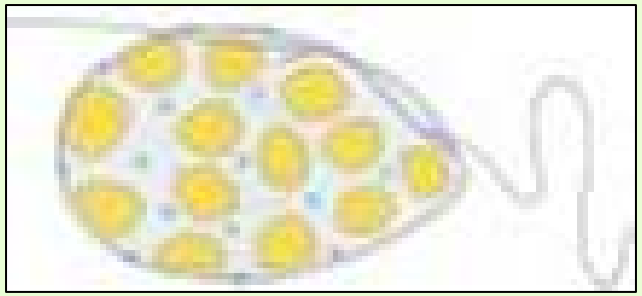
- A naked (not armoured) dinoflagellate
- A permanent colony, usually of 4 or 8, sometimes 2 or 16 zooids
- each zooid with a girdle which may or may not be displaced
- The sulcus is continuous on ventral side of the colony
- each zooid with a transverse and a longitudinal flagellum
- Nematocysts usually present.

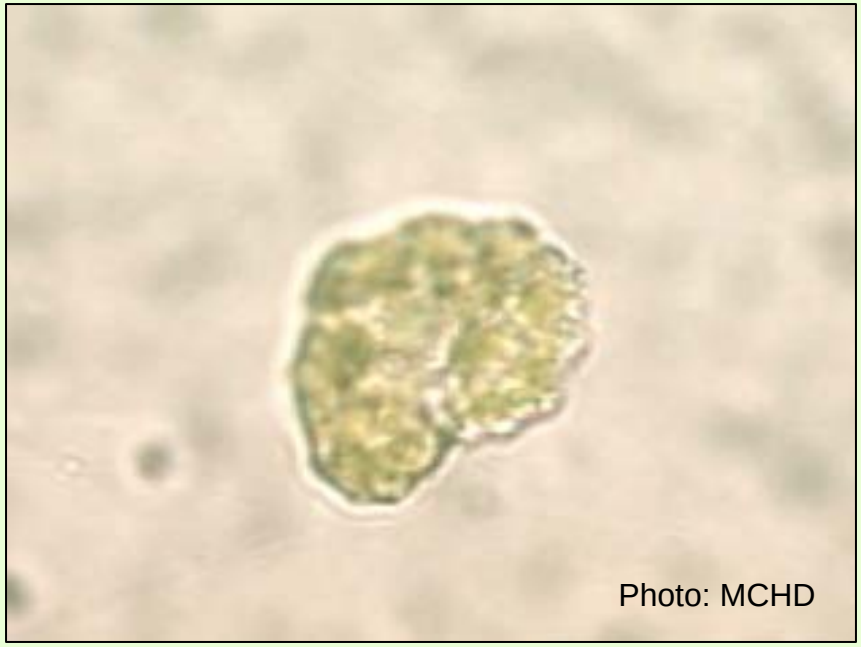
Photo: MCHD

Heterosigma akashiwo

Synonym *Olisthodiscus luteus*

- Major Taxonomic Group: Raphidophytes
- Potato-shaped cells
- 11-25 X 8-13 µm cell is only slightly compressed
- 2 sub-apically inserted flagella, one motile, one trailing
- Plastids are truly parietal
- recurrent flagellum lies in a ventral groove
- Worldwide in brackish waters.





Heterocapsa rotundatum

Synonym(s): *Amphidinium rotundatum* Lohmann 1908 , *Katodinium rotundatum* (Lohmann) Loeblich III 1965

- cell readily rounds up (thus the name)
- dinoflagellate is 7.5-11 X 6-7.5 um
- resembles an arrowhead or mushroom
- The epicone longer and broader compared to the hypocone
- Sometimes known as a mahogany tide
- *H. rotundata* can cause large nuisance blooms

Photo: MCHD

Heterocapsa triquetra

- a phototrophic marine dinoflagellate
- wide coastal distribution.
- often in high concentrations in low salinity areas.
- cell is elongated, variable, and spindle shaped.
- the posterior hypotheca ends in a blunted oblique point
- no apical spine
- girdle is equatorial, descending, displaced ½ girdle width with a short sulcus.
- 19-30 um long, 13-19 um wide.

Photo: MCHD

Gyrodinium grossestriatum

•The genus *Gyrodinium* is a group of naked, heterotrophic dinoflagellates

• girdle or cingulum displacement from one to more cingulum widths

• apical groove elliptical

• The characteristic feature of Gyrodinium is not so much the cingulum displacement as the morphology of the apical groove system

• The apical groove is an elliptical structure situated around the apical end, perpendicular to the longitudinal axis of the cell.

Photo: MCHD

Flagellates of the Raritan Bay

A variety of flagellates were collected and identified, and photographed from a sample taken from Ideal Beach in Keansburg, early in August 2006. The following slides are those images.

Chlorella marina

- A member of the Chlorophyta (green algae)
- Cells ovoid, 4-6 x 7-10 um
- cell walls thin and smooth
- Chloroplast fills most of cell
- reproduction takes place by internal cell division, in this instance forming non-motile autospores (Pictures show cells with autospores)

PHOTO:MCHD

Grass green. Frequently noted within estuaries and bay systems along the east coast and over the shelf.

PHOTO:MCHD

Prorocentrum redfieldi

Implicated in mild discomfort to bathers (NJDEP Annual Phytoplankton Reports) The production of DSP toxins has been confirmed in dinoflagellate *Prorocentrum redfieldi* (Viviani, 1992).

Chroomonas sp.

Cells ellipsoid or oval, or slipper shaped, usually bilobed anteriorly. 2 flagella attached immediately below cell apex. 2 parietal, blue or bluish-brown chloroplasts.


PHOTO:MCHD

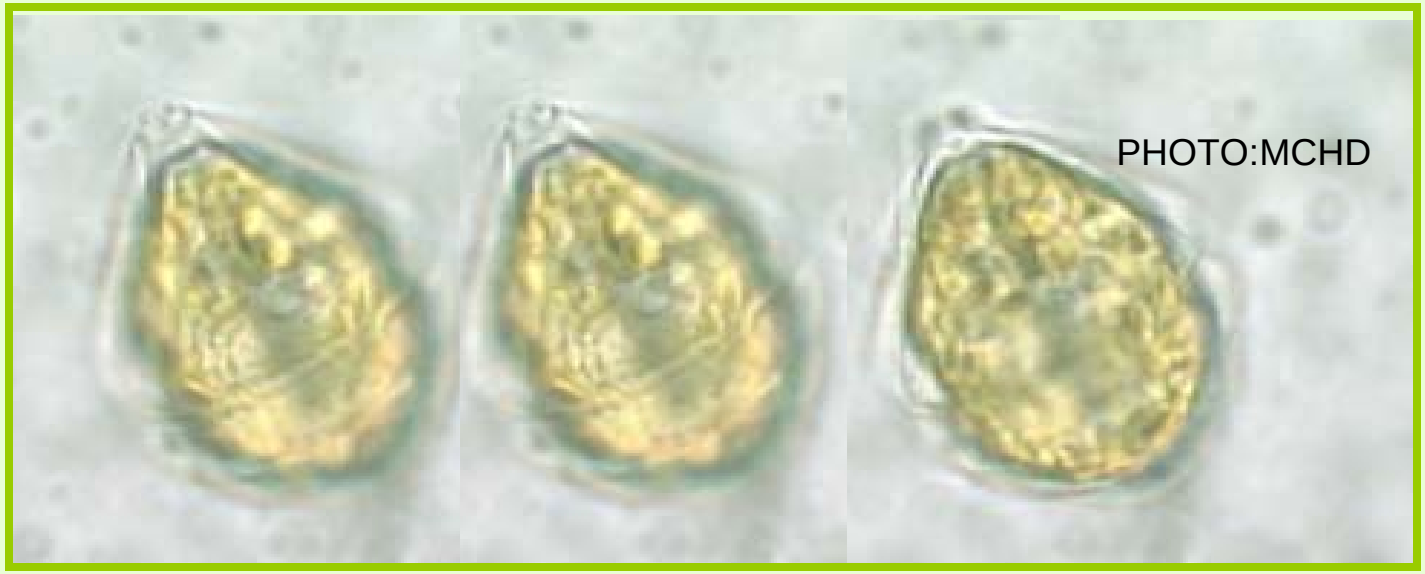

PHOTO:MCHD

Gyrodinium estuariale

An unarmoured dinoflagellate. Cell length 11-16um. Cell width 9-12um. Length to width ratio 1:3. Epicone and hypocone are about equal in size. Nucleus is located centrally. Chloroplasts two, one in the epicone and one in the hypocone. Girdle displacement is less than 1/3 of the total cell length. One transverse flagellum and one longitudinal. Toxicity has not been detected in this species. It is common in the Raritan Bay.

Scrippsiella trochoidea

This dinoflagellate is a mesohaline species. Listed by UNESCO as a harmful algal bloom forming species due to its ability to reach very high densities in stratified water bodies. 18-34 um long, 17-28 um wide. Chloroplasts are yellow brown. Two dissimilar flagella emerge from anterior.



Prorocentrum minimum

- An armoured marine, bloom forming dinoflagellate species
- A toxic cosmopolitan species common in cold temperate brackish waters to tropical regions
- potentially toxic; producer of venerupin (hepatotoxin)
- High density blooms may cause water to become discolored a reddish-brown, sometimes called Mahogany tides
    - shellfish poisoning in Japan, Gulf of Mexico and Florida
- cell shape is triangular to oval-round
- cell size is 15-20 X 13-17 um wide
- valves are flattened and covered by minute spines and trichocyst pores
- Apical spine very small or lacking
- 2 dissimilar flagella emerge from V-shape depression at the anterior of the cell
    - transverse flagellum for providing propulsion
    - longitudinal flagellum provides direction

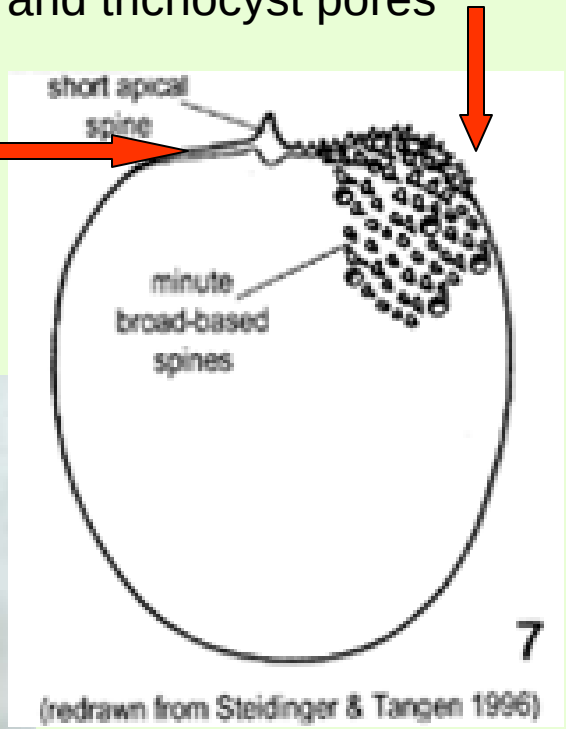
Photo: MCHD

Prorocentrum minimum, cont

valves are flattened and covered by minute spines and trichocyst pores

PHOTO:MCHD

Apical spine very small or lacking



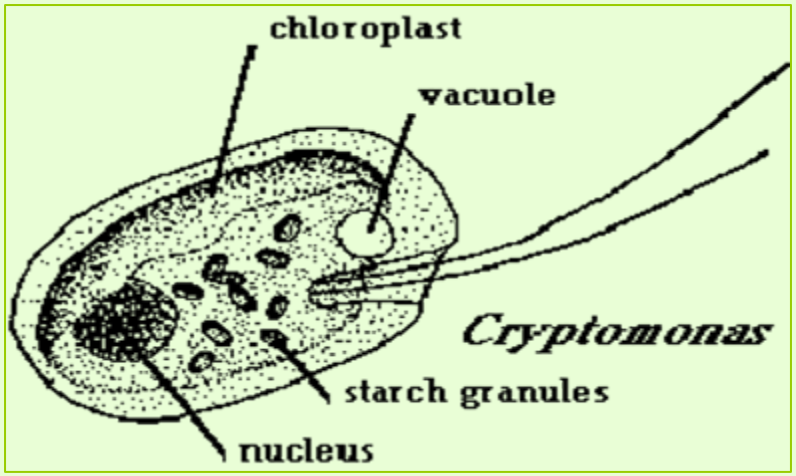
(redrawn from Steidinger & Tangen 1996)

PHOTO:MCHD

Protoperidinium sp.

- Armored dinoflagellates
- Cells often have spines
- Surface of cell is broken by grooves that hold 2 flagella
- cross-wise groove cuts the cell into an upper and lower half
- In those cases where the groove goes up towards the upper half, it does so only a little bit

Cryptomonas sp.



Cells oval or broadly rounded, or asymmetrical at the anterior end, with 2 (or 1) parietal, olive-green chloroplasts which are often red; flagella 2, attached within an apical gullet. Fast moving.