Chapter II Pyrrophyta（甲藻门）

Mesokaryotes: nucleus enveloped the nuclear membrane (Eukaryotes), but has no histone and its chromatin is circular (Monera)

Department of Oceanography

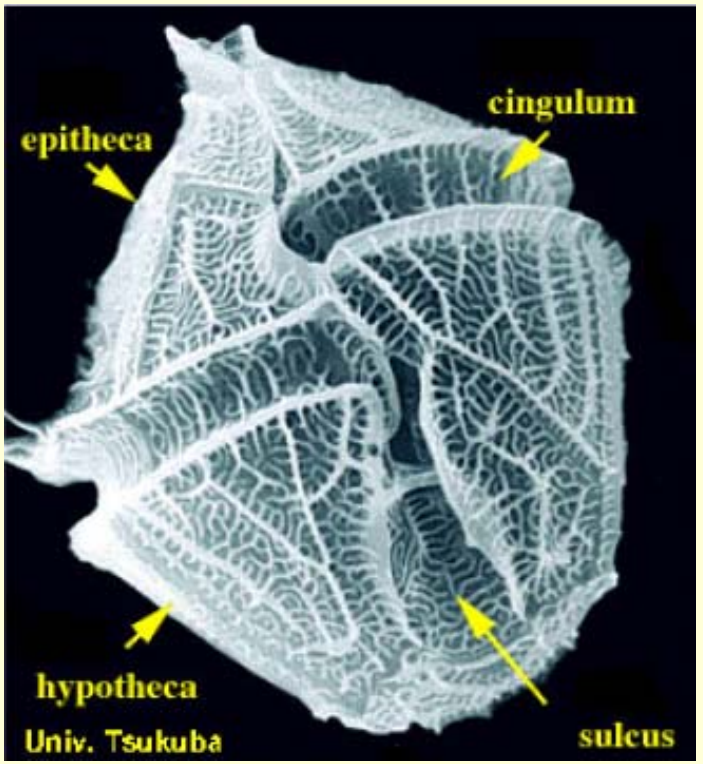
Xiamen University

References

- **Hallegraeff G. M. et al., 1995. Manual on harmful marine microalgae. UNESCO. 551p**
- **Tomas C. R., 1997. Identifying marine phytoplankton. Academic Press. 858p**
- **Garces E. et al., 2001. Life histories of microalgal species causing harmful blooms. 208p**
- **Botes L., 2003. Phytoplankton identification catalogue – Saldanha Bay, South Africa, April 2001. GloBallast Monograph Series, 7. IMO London. 87p**
- 国家海洋环境监测中心 《中国近海赤潮生物图谱——简本》

Contents

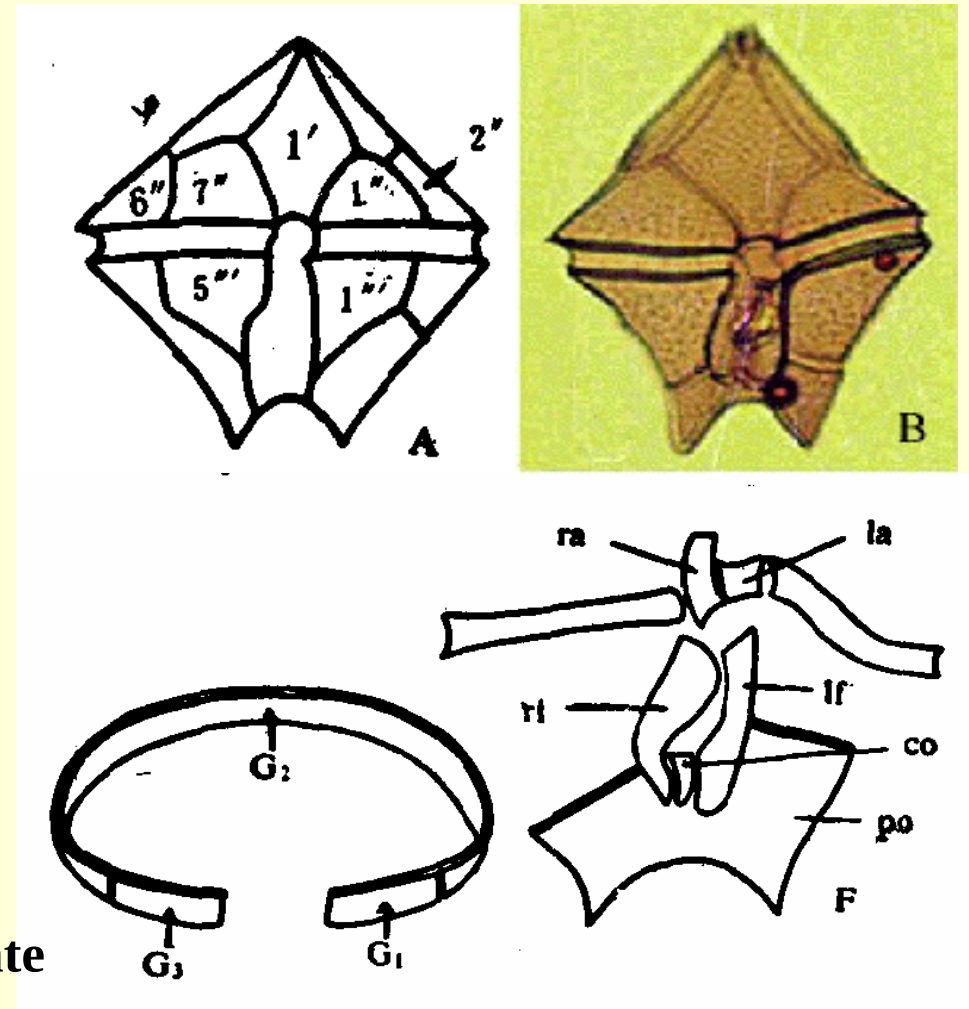
- 2. 1 Morphological Characteristics
  - 2.1.1 Cell Wall
  - 2.1.2 Flagellum
  - 2.1.3 Chromatoplast
  - 2.1.4 Nucleus
  - 2.1.5 Organelles
- 2. 2 Classification
- 2. 3 Biology
- 2. 4 Economic Significance

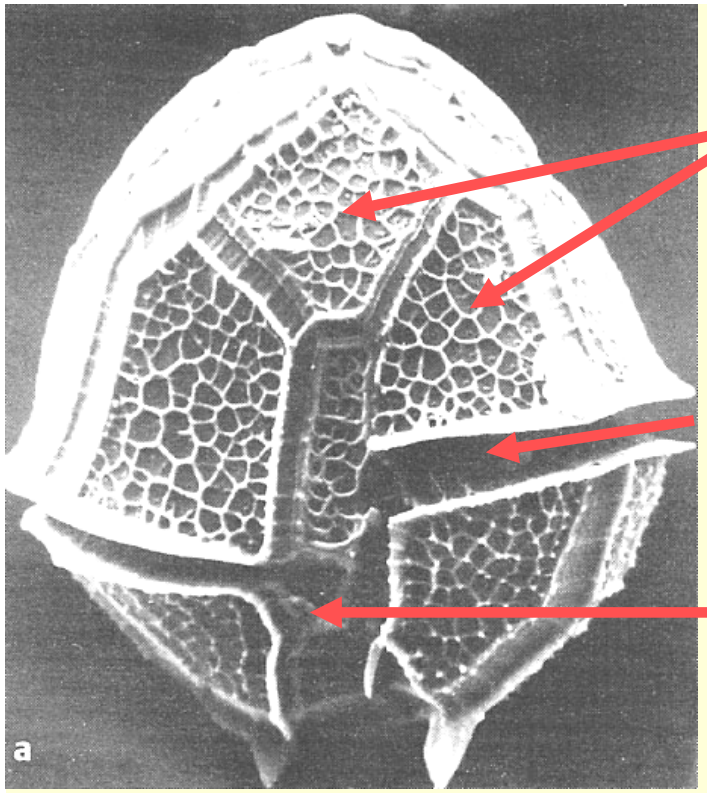


2.1.1 Cell Wall

The cells are coated with a quite strong layer of amphiesma secreted by protoplasm; the cell wall of some naked species without theca are covered by thin plates

- **epicone**
  - **apical pore plate**
  - **apical plate**
  - **precingular plate**
  - **anterior intercalary plate**
- **hypocone**
  - **antapical plate**
  - **postcingular plate**
- **girdle plate**
- **ventral area**
  - **left and right anterior plate**
  - **left and right flagellar pore plate**

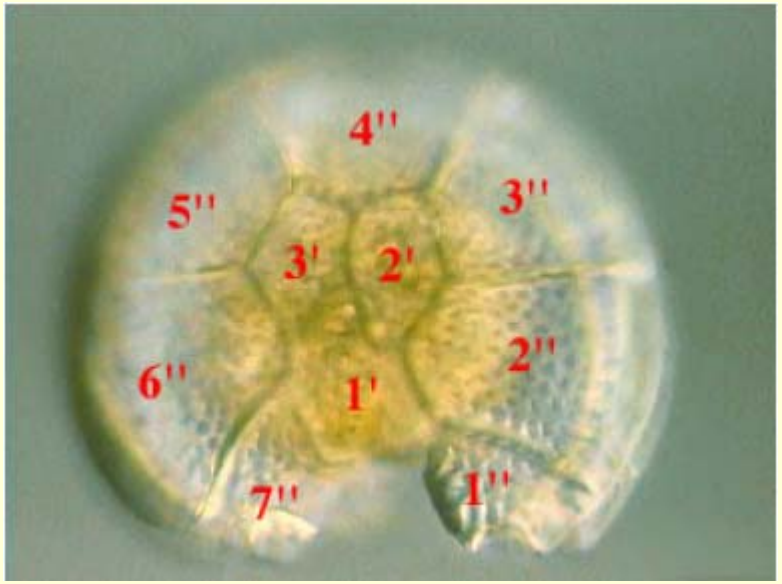




Thecal plates

Girdle

Sulcus

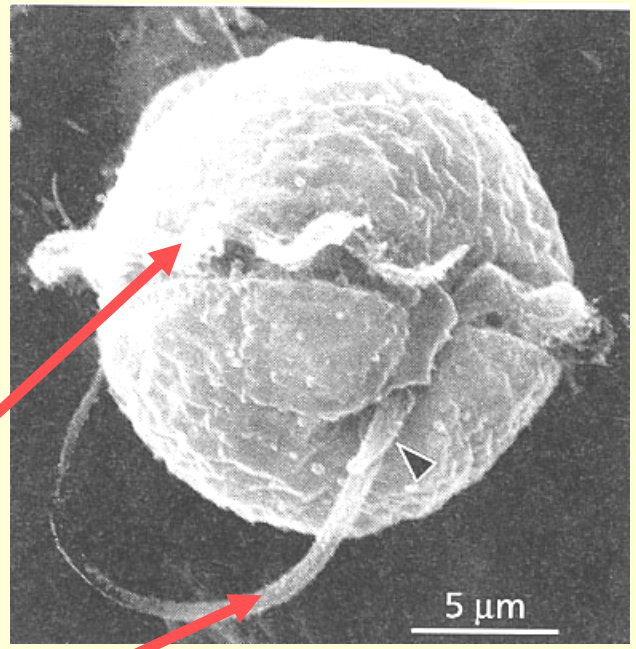


2.1. 2 Flagellum

Desmokontae: two dissimilar flagella emerge from the anterior part of the cell, flagella band-shaped

Dinokontae: two flagella are inserted ventrally, one flagellum is transverse and housed in a cingulum and the other is longitudinal and housed in a sulcus, flagella located on the ventral face (TF: propulsion, LF: direction)

Prorocentrium micans



2.1. 5 Organelles

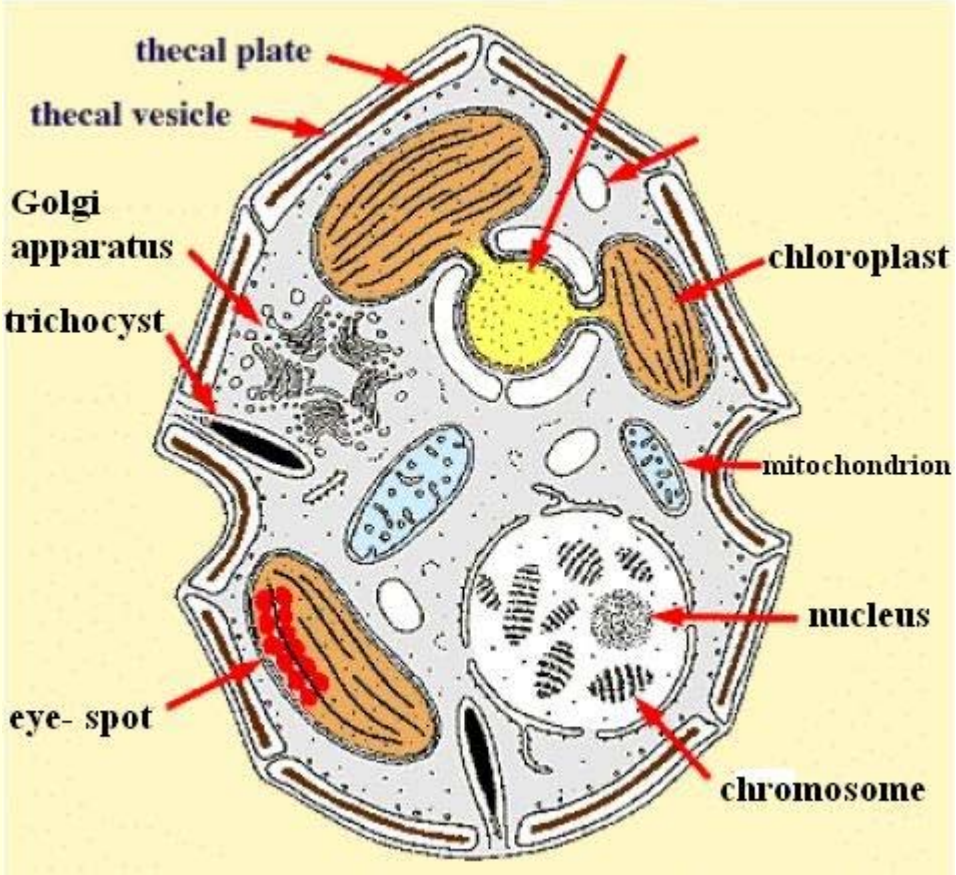
pusule

a large sac-like structure

osmoregulatory function

eye-spot

trichocyst



Contents

one class, Dinophyceae

Based on living habits and the location of flagellum, the class is divided into 3 subclasses

2.2.1 Subclass Desmokontae（纵裂甲藻亚纲）

2.2.1.1 Order Desmonadales（纵裂甲藻目）

2.2.1.2 Order Prorocentrales（原甲藻目）

2.2.2 Subclass Dinokontae（横裂甲藻亚纲）

Order Peridinales（多甲藻目）

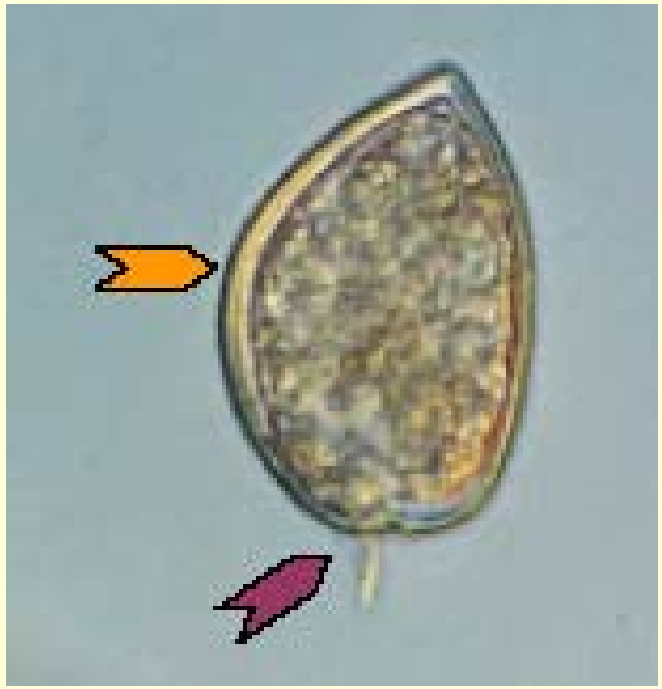
2.2.2.1 Suborder Gymnodiniineae（裸甲藻亚目）

2.2.2.2 Suborder Dinophysidineae（翅甲藻亚目）

2.2.2.3 Suborder Peridiniineae（多甲藻亚目）

2.2.3 Subclass Blastodinophycidae（囊甲藻亚纲）

Prorocentrum micans（海洋原甲藻）

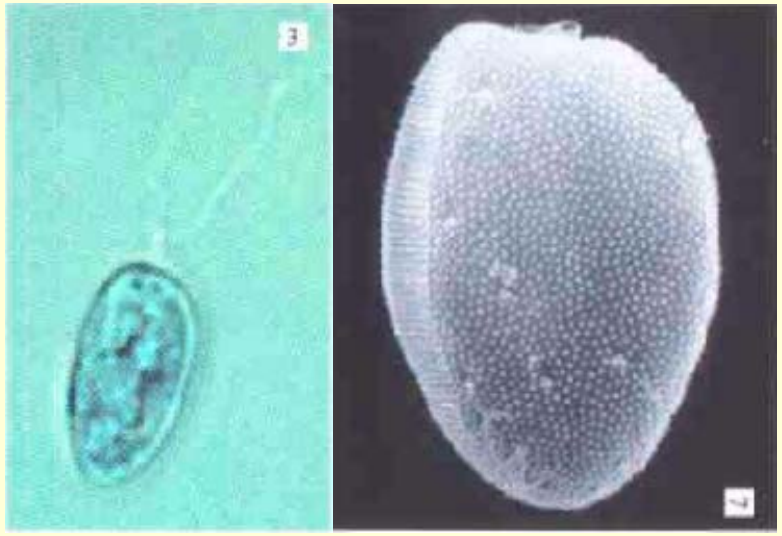


- Cells are tear-drop shaped to heart shaped.
- Rounded anterior end and a pointed posterior end.
- In valve view have one convex side and one arched side.
- The convex arch profile is typically in the middle of the cell where the cell is the broadest.
- Prominent spine with a triangular wing is present.

Order Prorocentrales（原甲藻目）

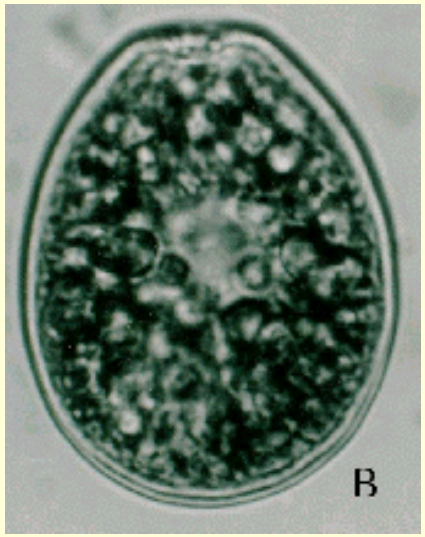
海洋原甲藻

Prorocentrum micans



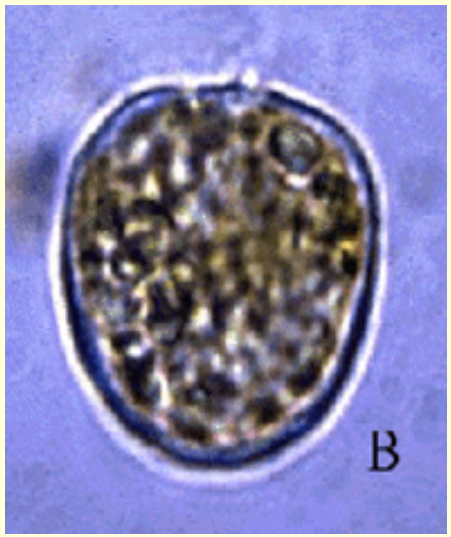
东海原甲藻

(*Prorocentrum donghaiense*)



利马原甲藻

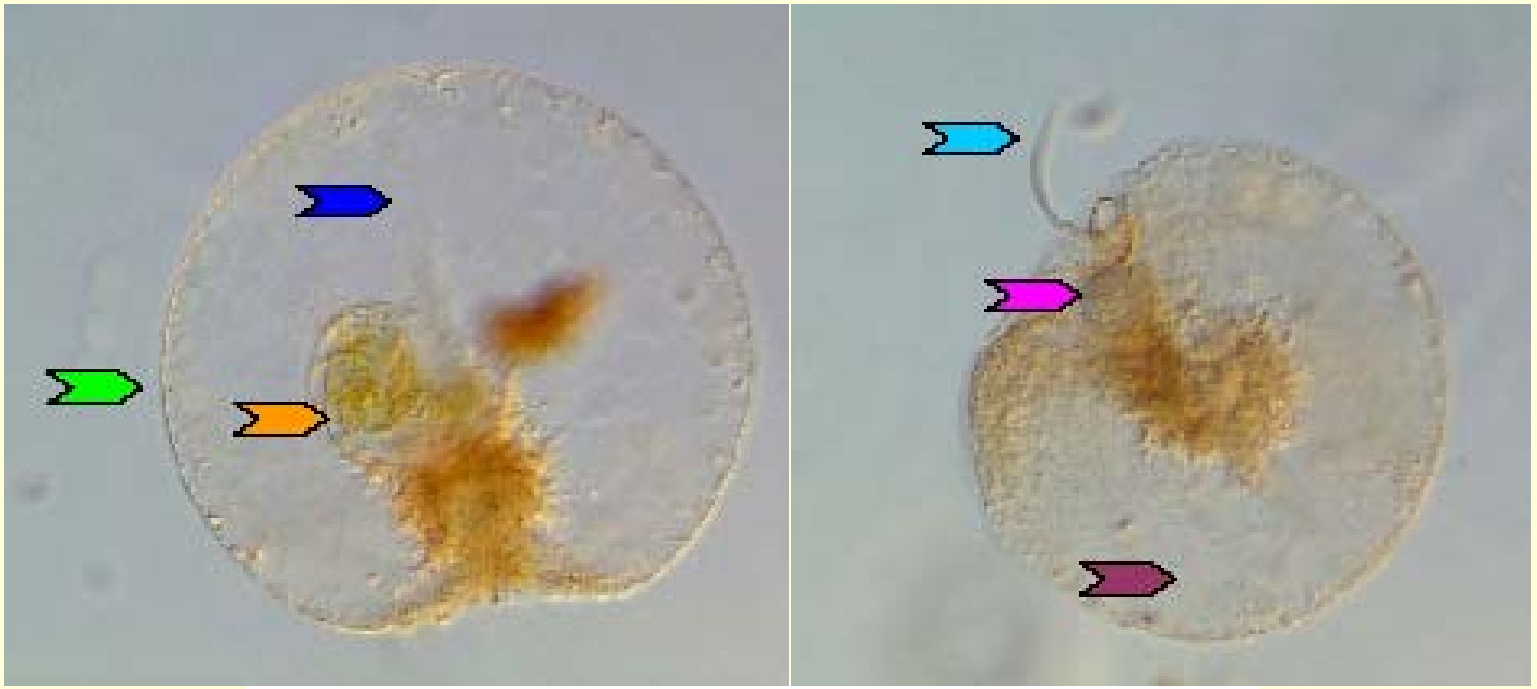
Prorocentrum lima



微小原甲藻

Prorocentrum minimum

Noctiluca scintillans（夜光藻）



Cells large, subspherical and inflated.

Cells not differentiated into epitheca and hypotheca.

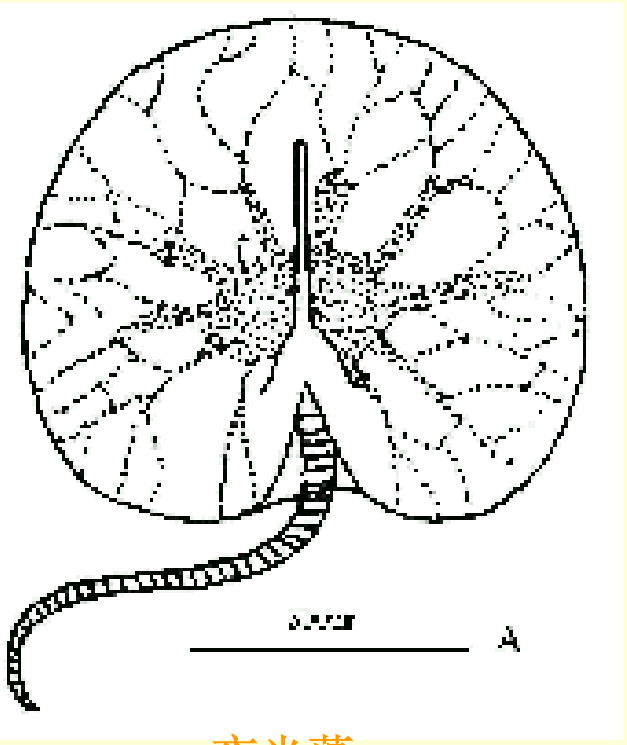
Two flagella and a striated tentacle.

Numerous food vacuoles, often containing diatoms

Chloroplasts are absent and the cytoplasm is colourless.

Eucaryotic nucleus situated near the sulcus.

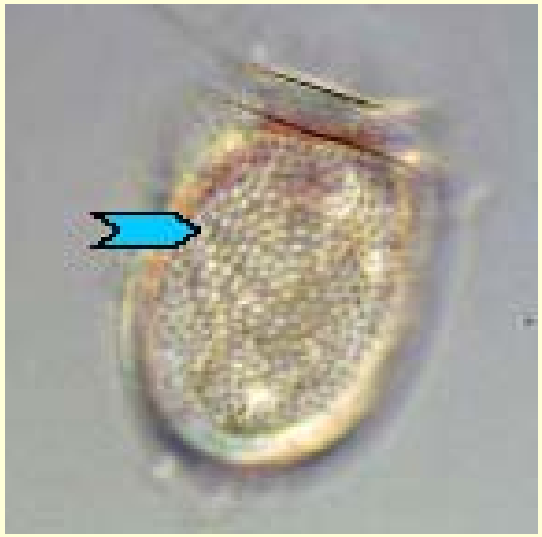
Suborder Gymnodiniineae（裸甲藻亚目）

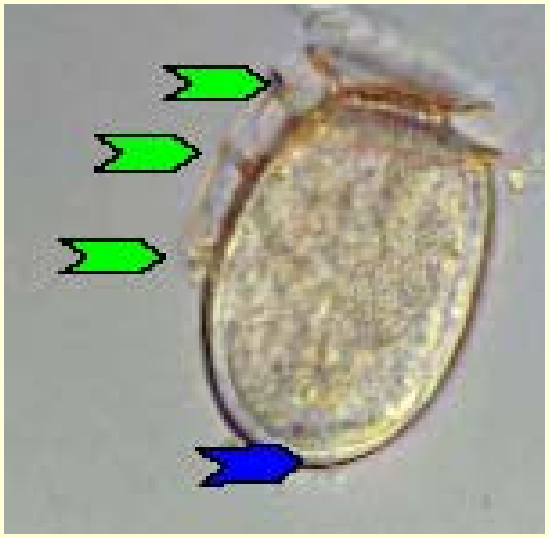


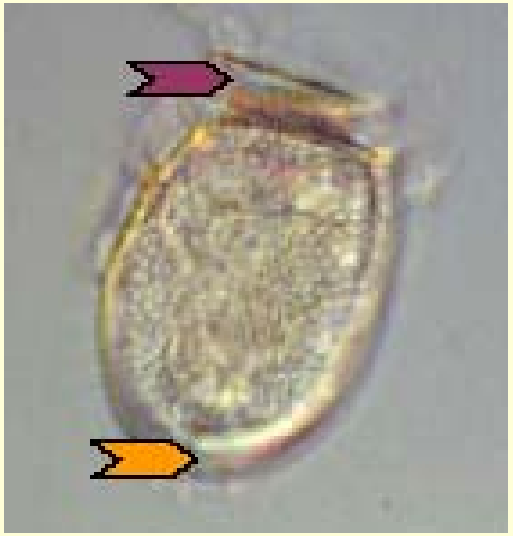
夜光藻

Noctiluca scintillans

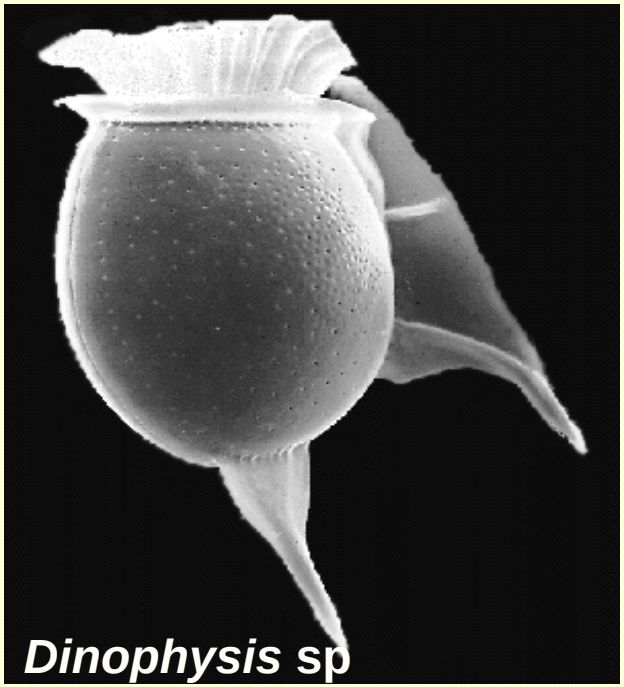
Dinophysis acuminata （渐尖鳍藻）



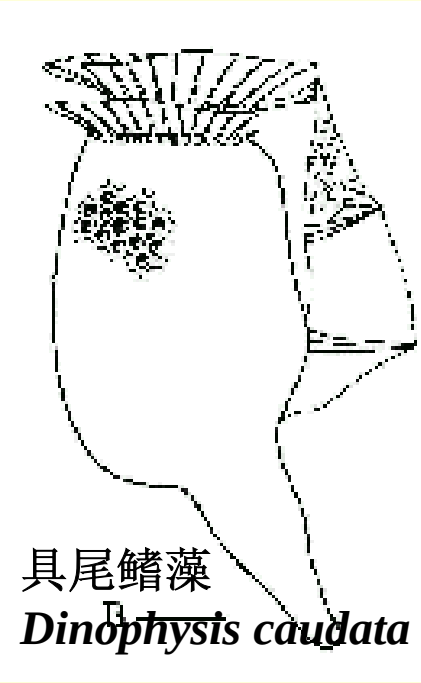




- Cell oval or elliptical in shape.
- Left sulcal list is well developed, supported by 3 ribs and extends beyond the midpoint of the cell.
- Surface covered with areolae, each with a pore.
- Posterior profile of hypotheca is rounded.
- Epitheca is dorsoventrally reduced.
- Nucleus.

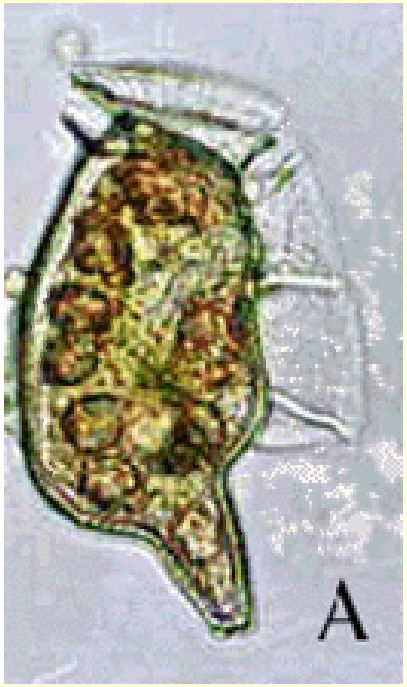


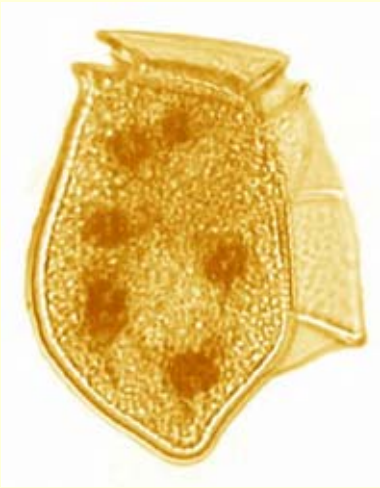
Dinophysis sp



具尾鰓藻

Dinophysis caudata

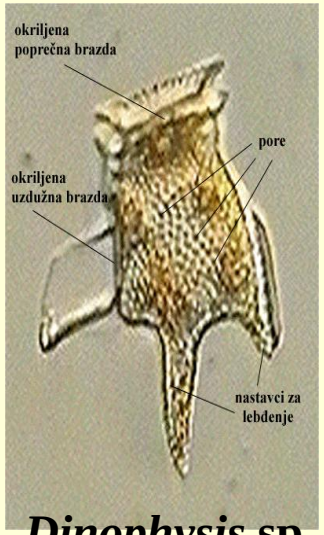




Dinophysis acuta

倒卵形鰓藻

Dinophysis fortii

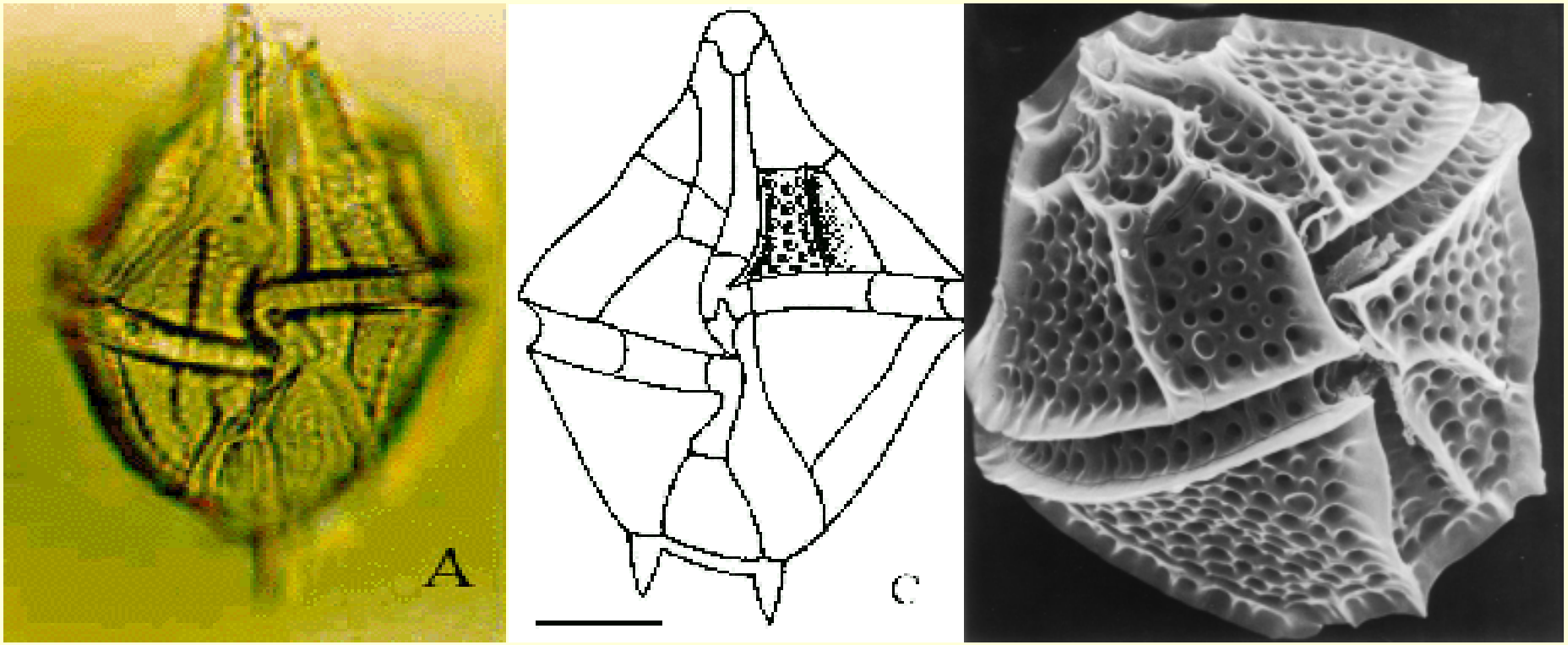


Dinophysis sp

Gonyaulax spinifera（刺膝沟藻）

- Cells thecate, elongated and tetragonal in dorso-ventral view.
- Girdle relatively wide, descending in about twice its width with a large overhang.
- Hypotheca bearing two antapical spines.
- Epitheca with convex sides leading into an apical horn.

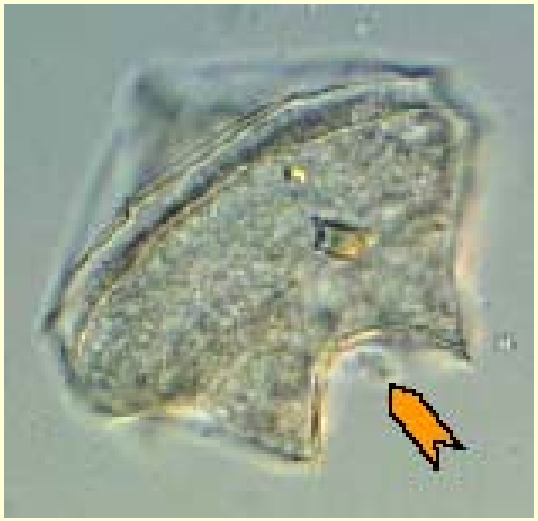
Suborder Peridiniineae（多甲藻亚目）

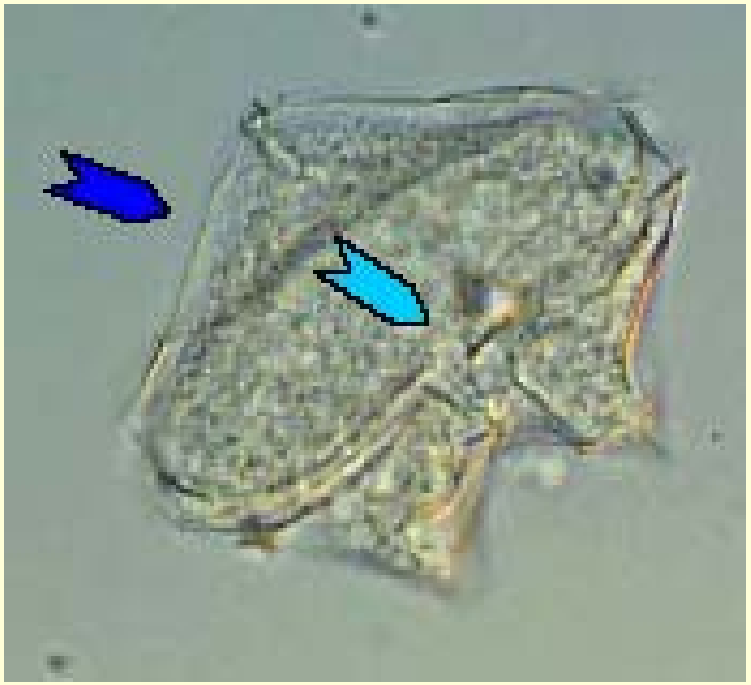


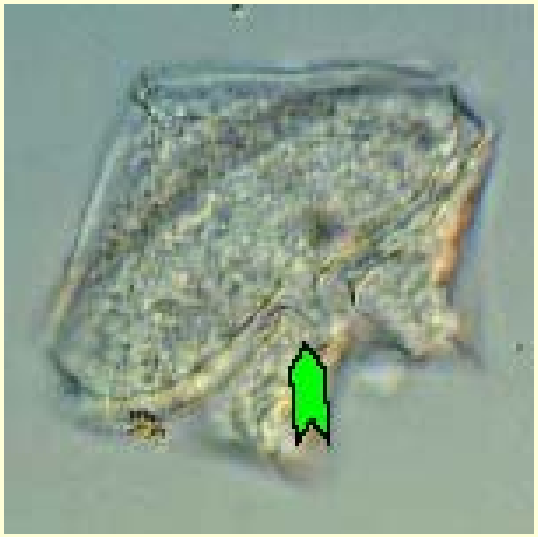
多纹漆沟藻

Gonyaulax polygramma

Protoperidinium pentagonum（五边原多甲藻）

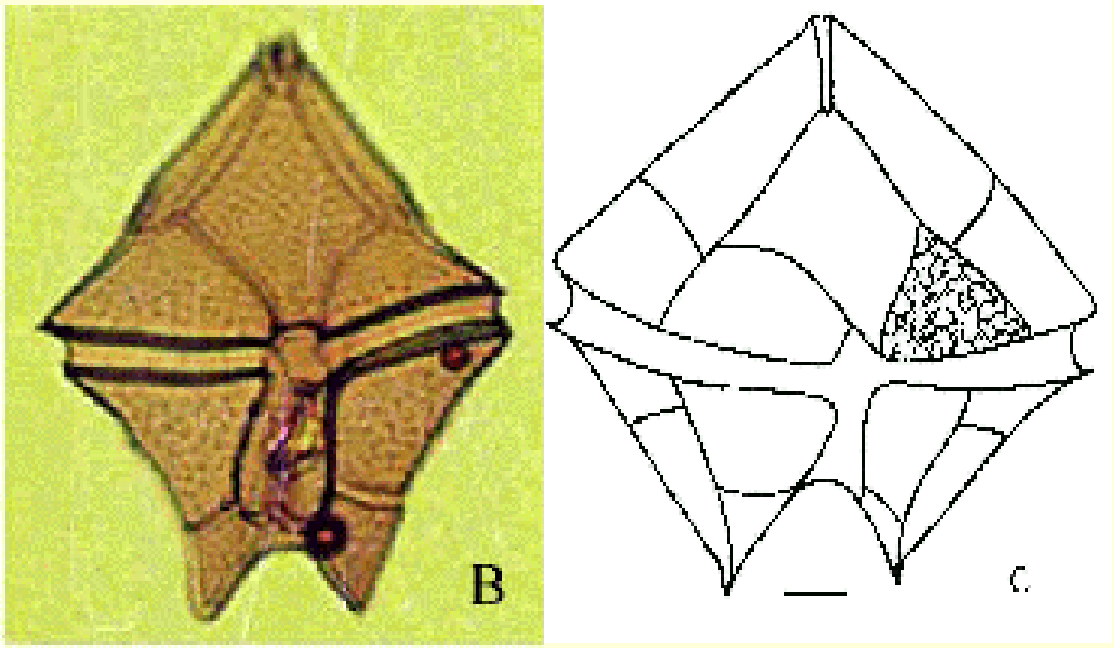






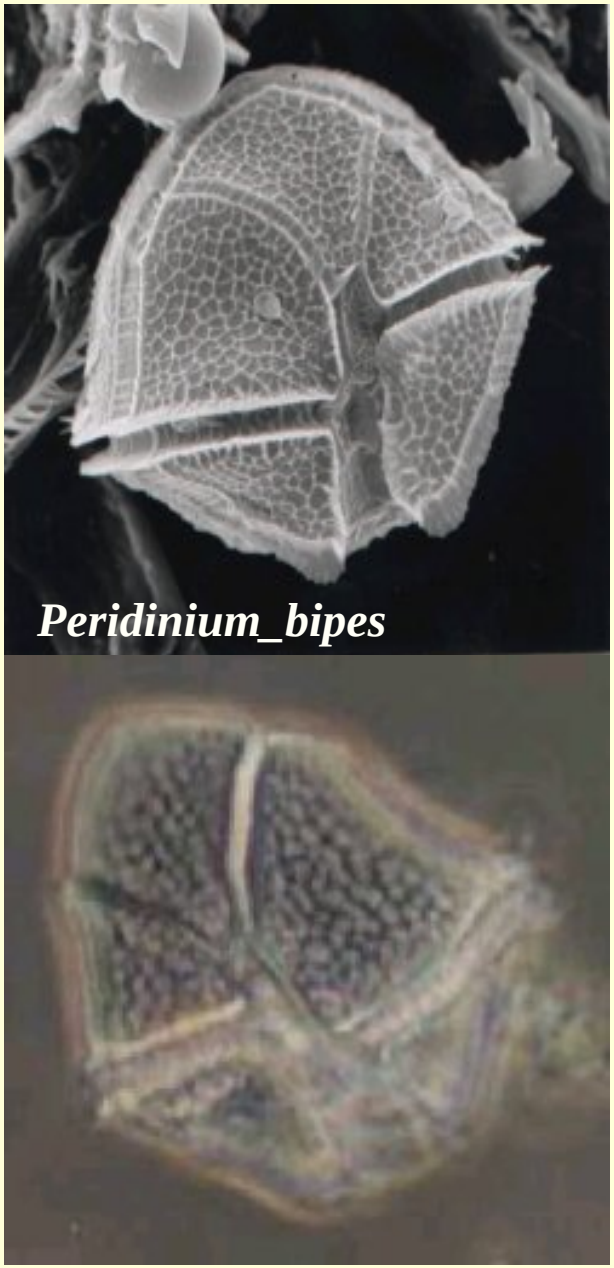
- Cell large to broadly pentagonal.
- Sulcus short and shallow.
- Cingulum descending.
- Two antapical horns present.

Suborder Peridiniineae（多甲藻亚目）

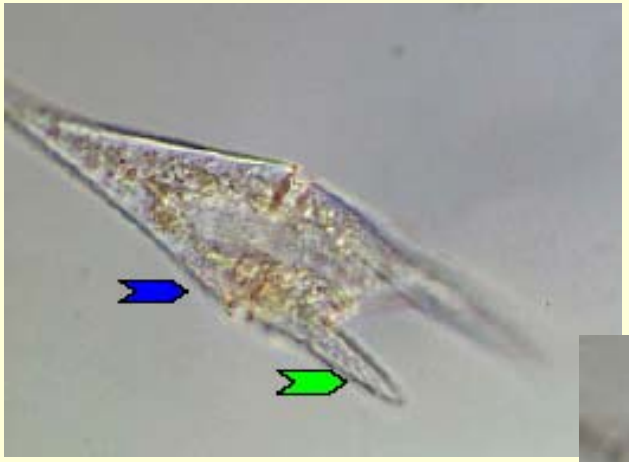


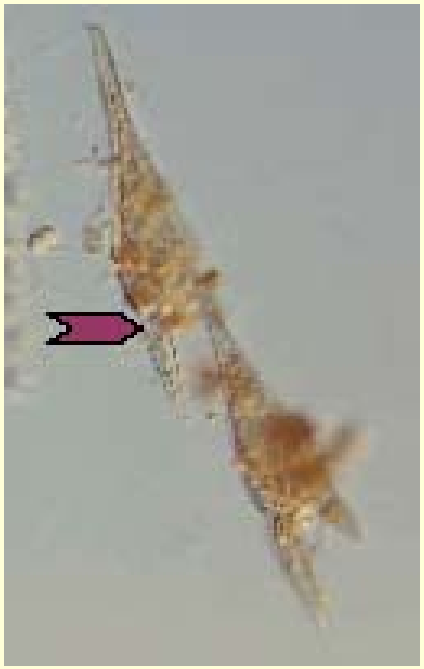
锥形多甲藻

Peridinium conicum



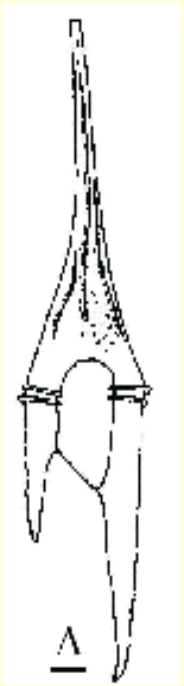
Ceratium furca（叉状角藻）



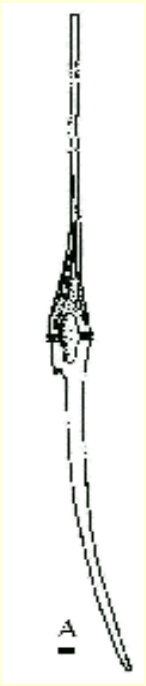


- Large, straight body with cell being the widest either side of the girdle.
- Two unequal, parallel or slightly divergent hypothecal horns, the right shorter than the left.
- Epitheca tapering gradually into an apical horn.
- Thecal plates thick and ornamented with surface ridges
- Chain forming species.

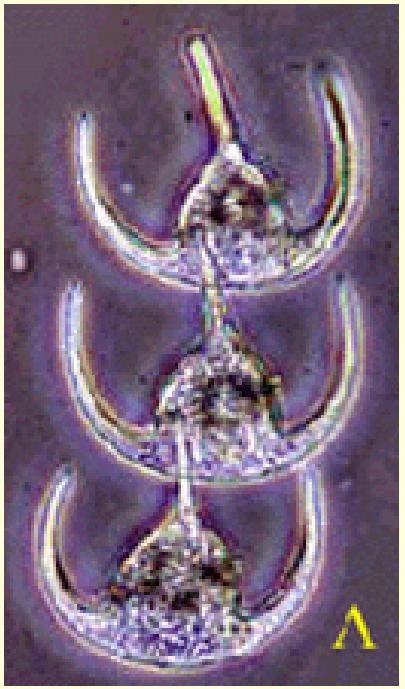
Suborder Peridiniineae（多甲藻亚目）



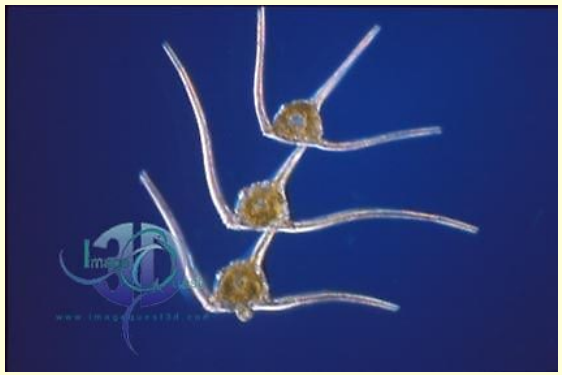
叉状角藻
Ceratium furca



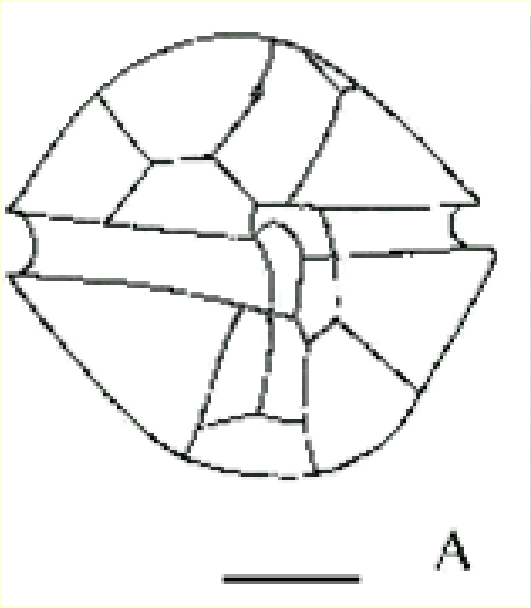
梭角藻
Ceratium fusus

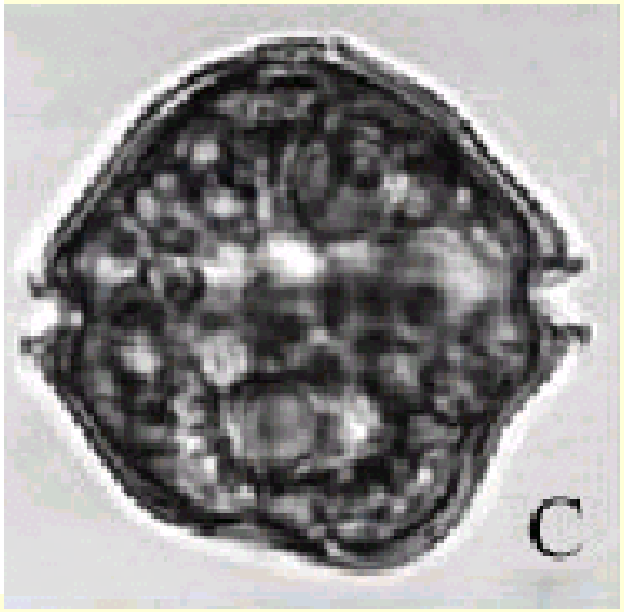


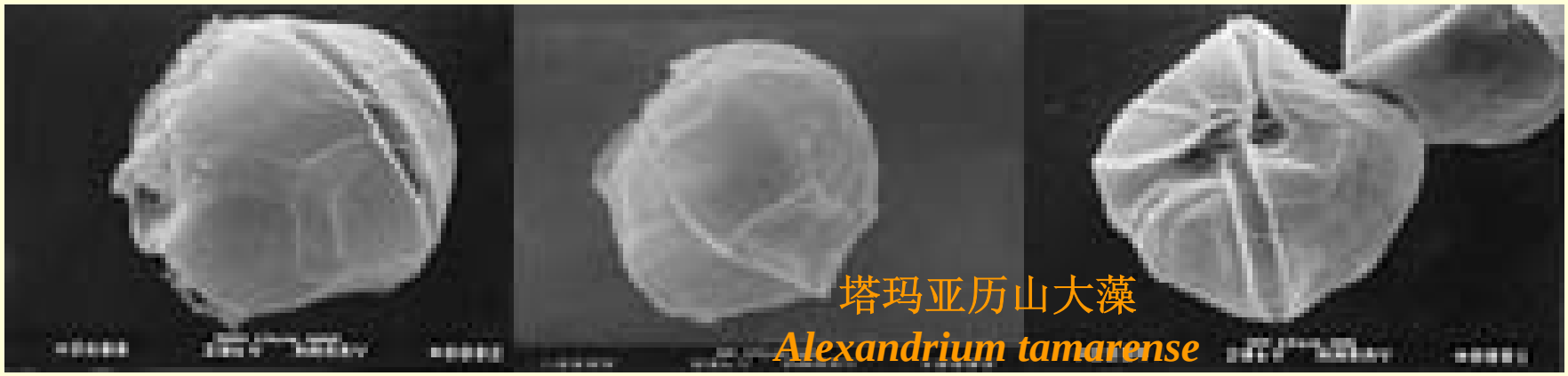
三角角藻
Ceratium tripos



Alexandrium tamarense







Contents

2.3.2 Red Tide: “Cells From Hell”

- **Algae blooms “a good thing gone bad”**
- **Rapid cell division and high abundance**
- **Millions to tens of millions of cells per liter**
- **Diatoms and dinoflagellates**
- **Red and brown tides**
- **Can discolor the water**

Red tide in China

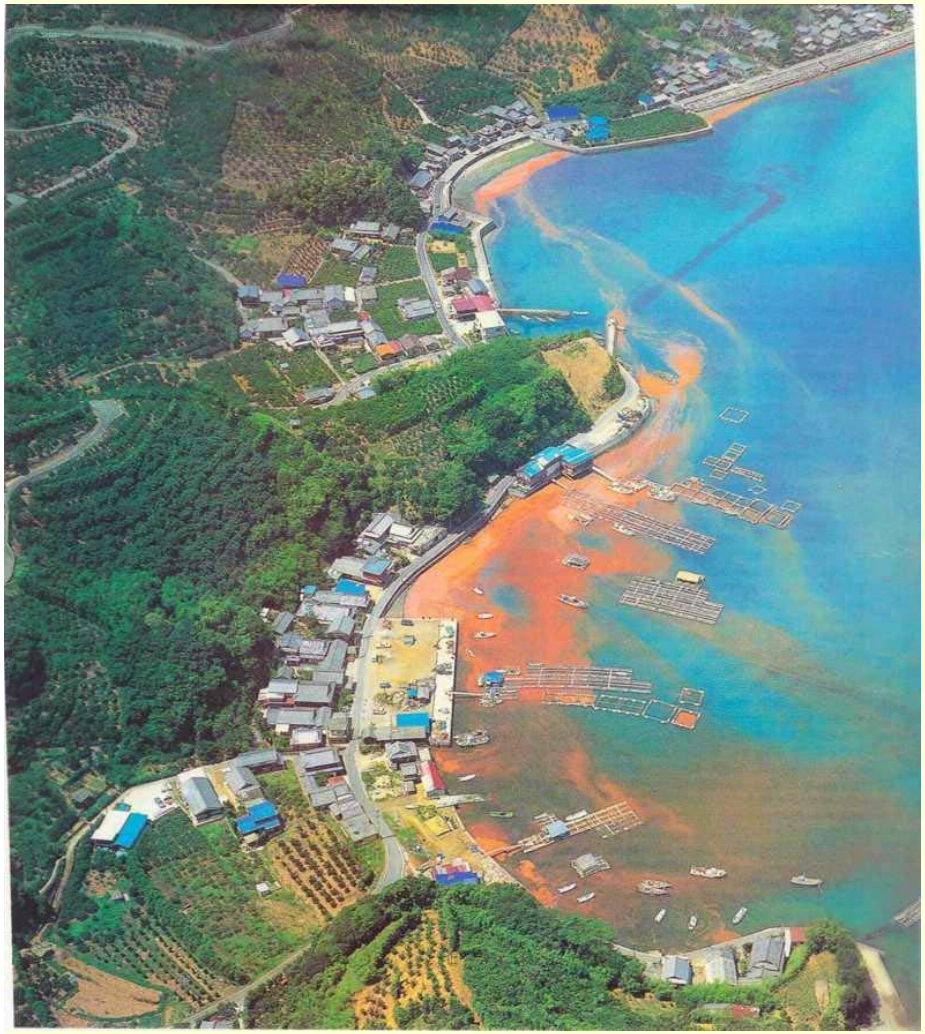
60s 3

70s 9

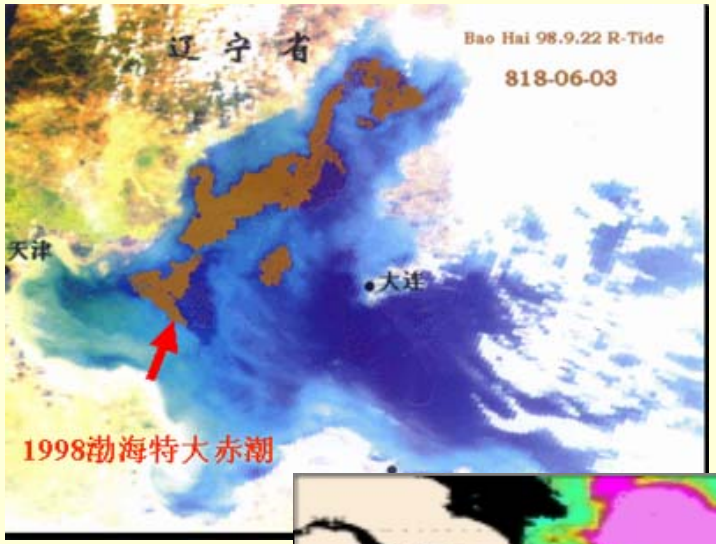
80s 74

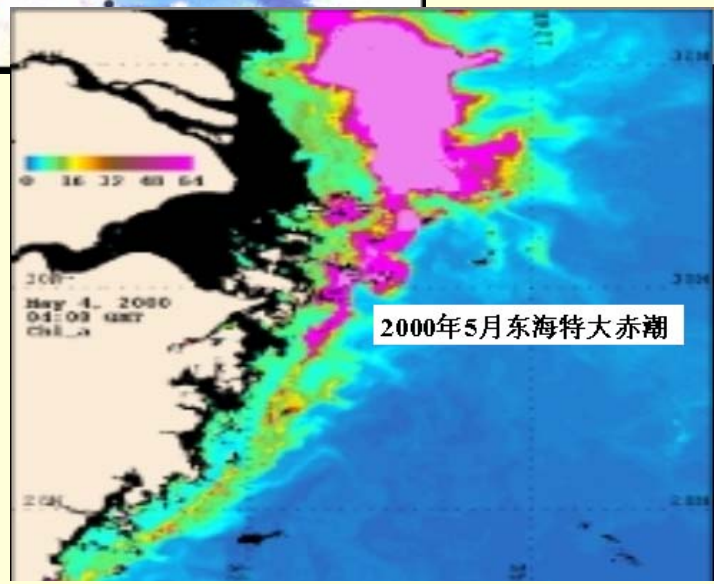
90s- >380

GEOHAB (The Global Ecology and Oceanography of Harmful Algae Blooms)



Red Tide of Hawaiyi





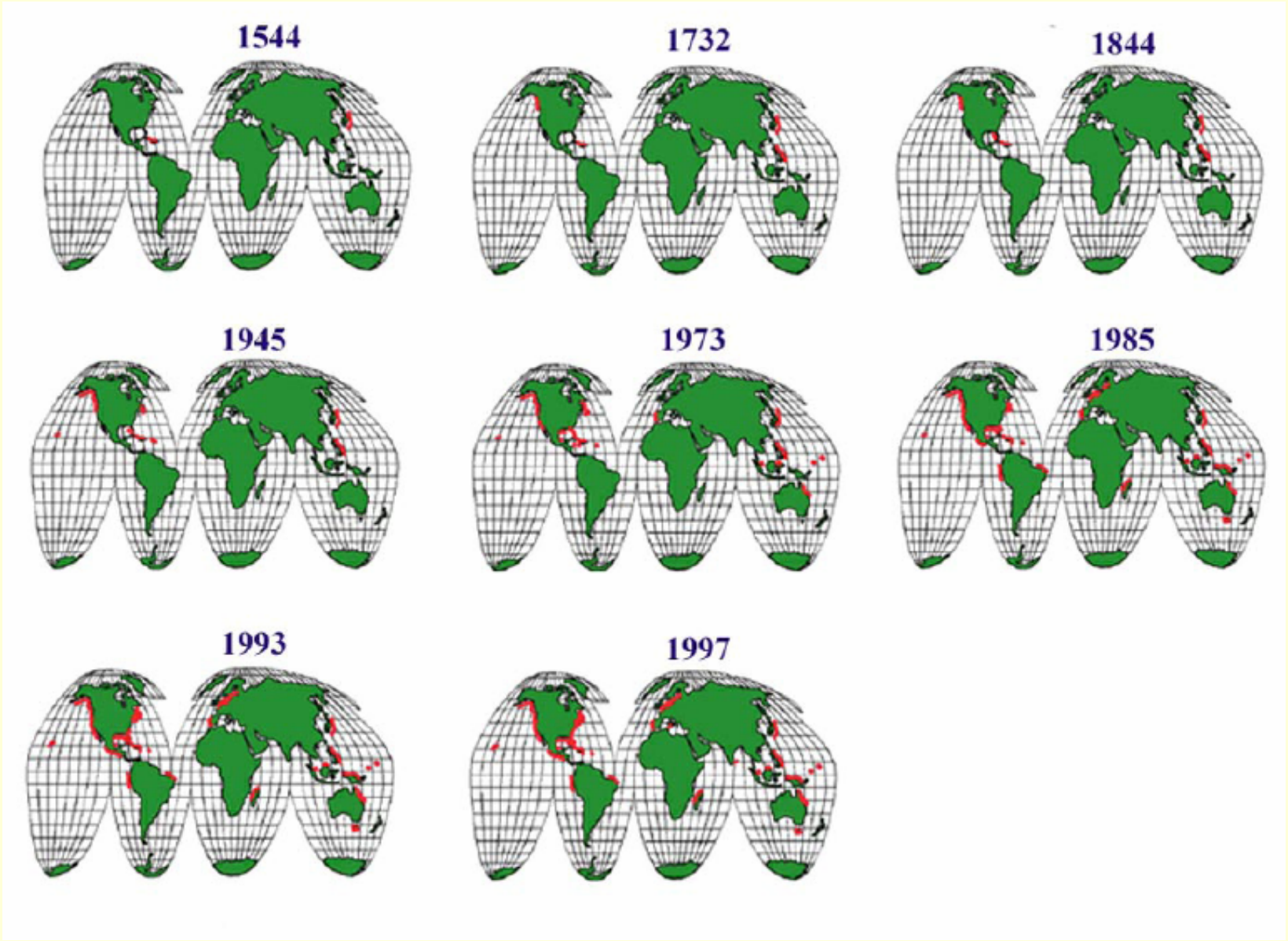
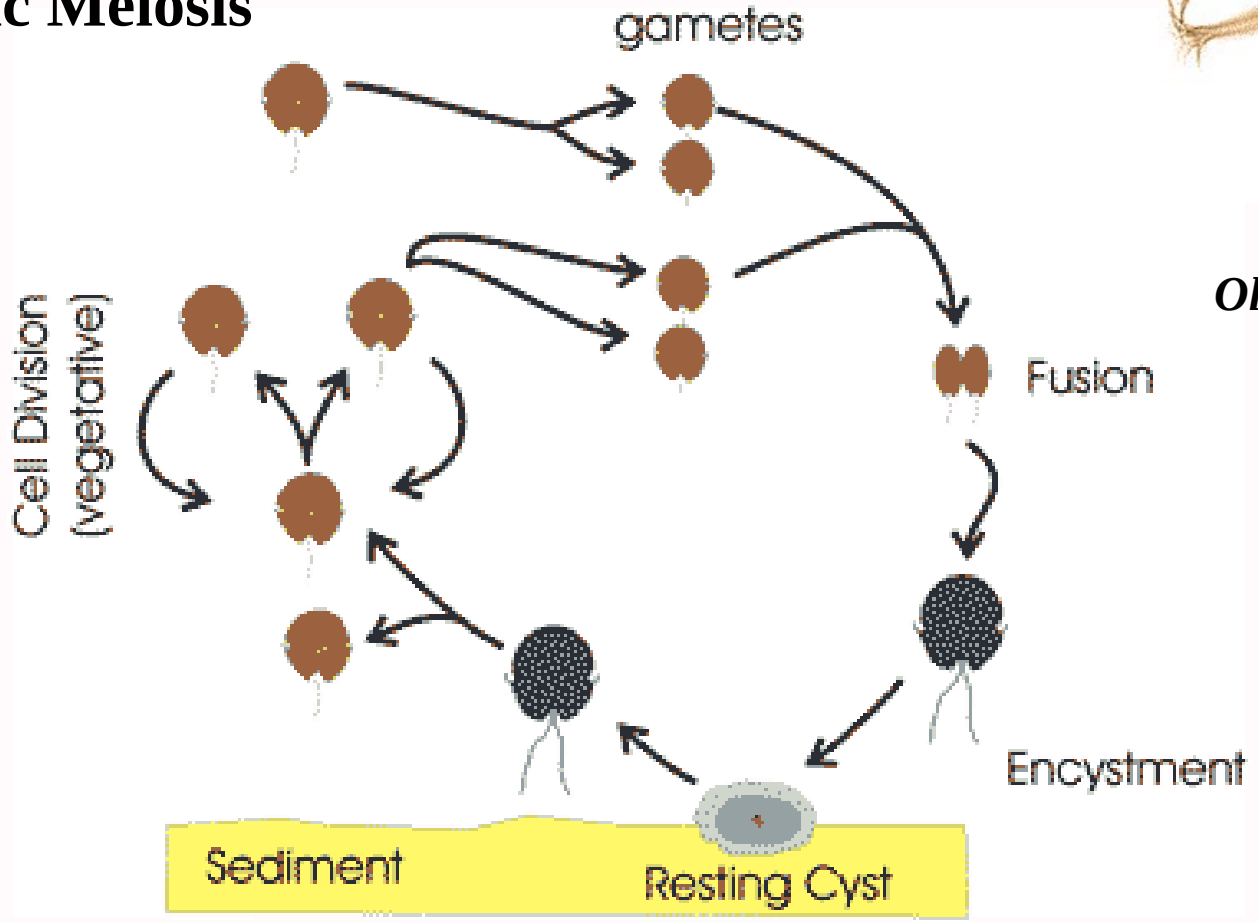


Fig. Worldwide HABs distribution, 1544-1997 (D.G. Baden, 1998)

2.3.4 Reproduction

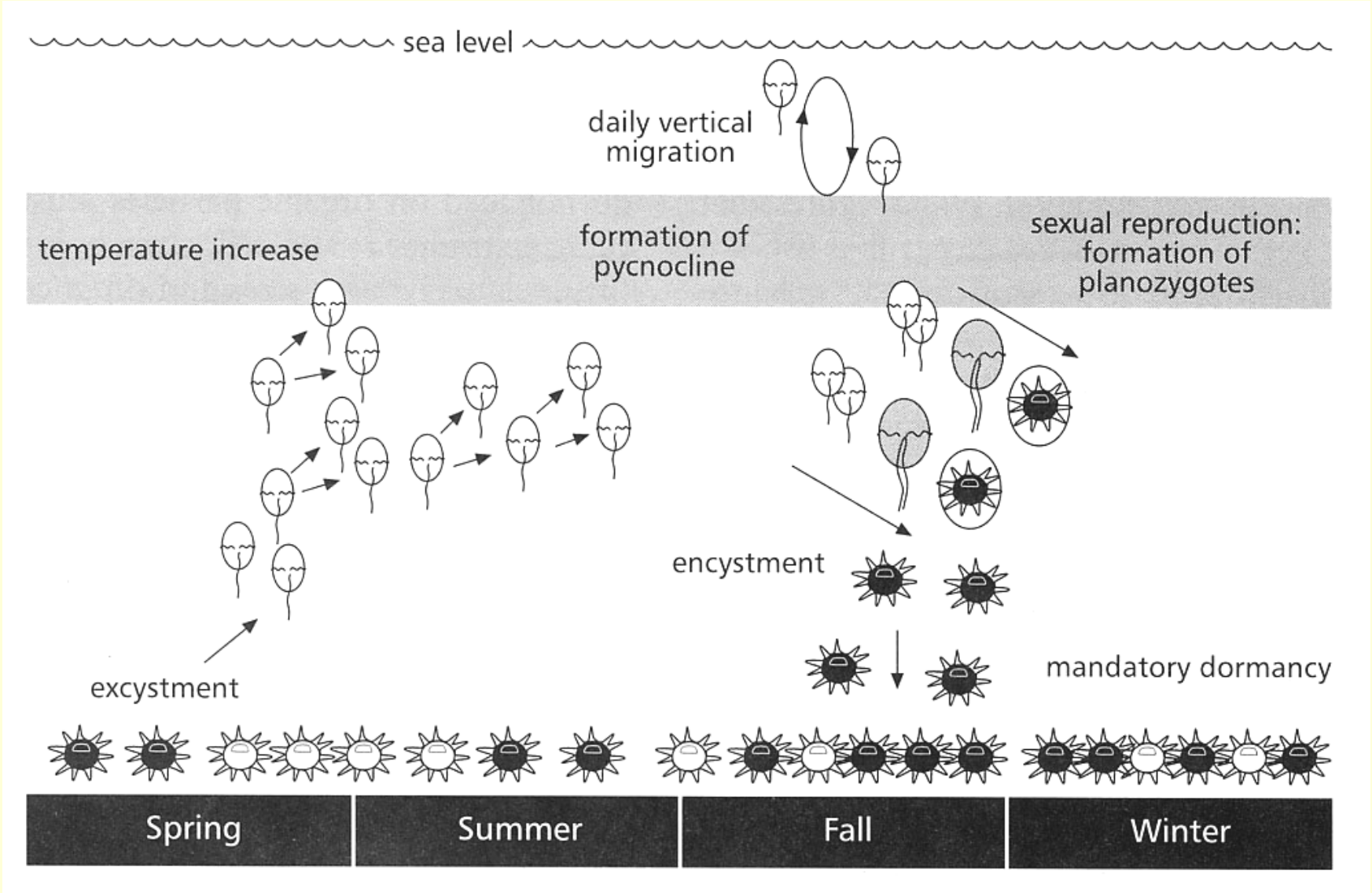
Zygotic Meiosis



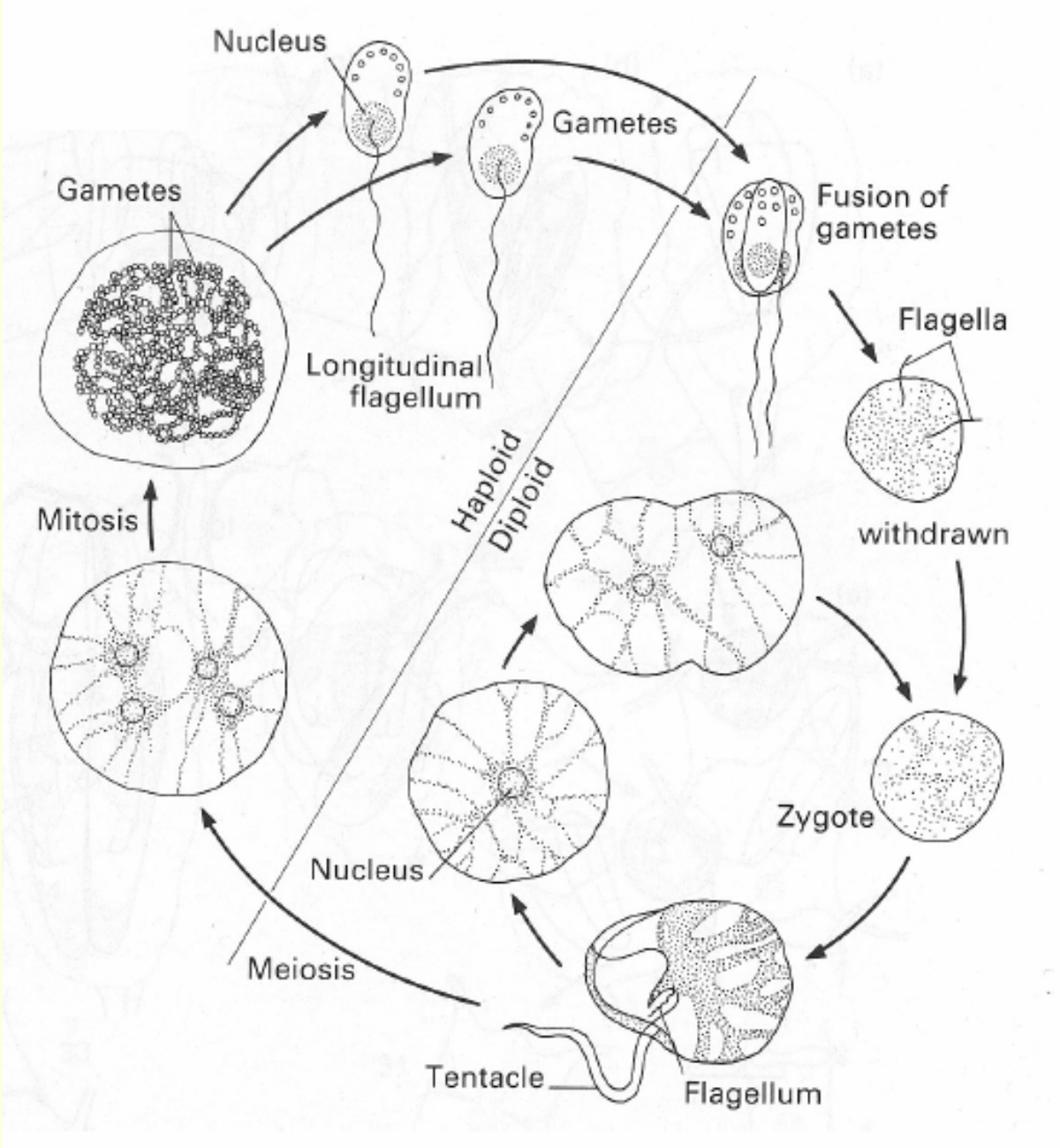
Cyst of *Oligosphaeridium abaculum*

The life cycle in *Alexandrium*: the diploid cyst, dormant at the seabed, excysts and forms two haploid vegetative cells, which divide vegetatively until they form gametes, which fuse to eventually produce the diploid cyst; diploid phases of the life cycle are in blue

Lifestyles


sea level
daily vertical migration
temperature increase
formation of pycnocline
sexual reproduction: formation of planozygotes
encystment
excystment
mandatory dormancy
Spring
Summer
Fall
Winter


Noctiluca


Nucleus
Gametes
Gametes
Fusion of gametes
Flagella
Longitudinal flagellum
Haploid
Diploid
withdrawn
Mitosis
Zygote
Nucleus
Meiosis
Tentacle
Flagellum

Contents

- 2.1 Morphological Characteristics
- 2.2 Classification
- 2.3 Biology
- **2.4 Economic Significance**
  - **2.4.1 Usefulness**
  - **2.4.2 Harmfulness**

Fish mortality

General Diagram of HAB Effects on Communities