Spatial distribution and identification of resting cysts of *Cochlodinium polykrikoides* in surface sediments from the aquaculture sites of southern South Korea.

Vera Pospelova

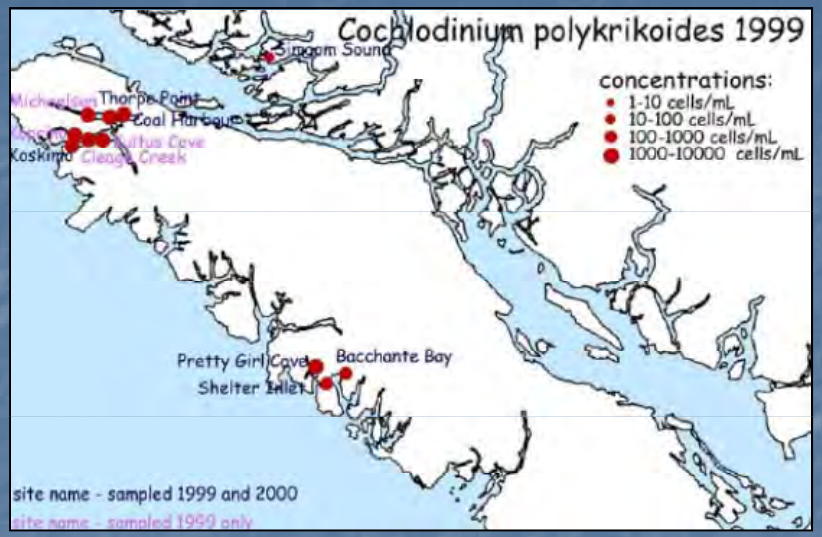
School of Earth and Ocean Sciences, University of Victoria, Canada

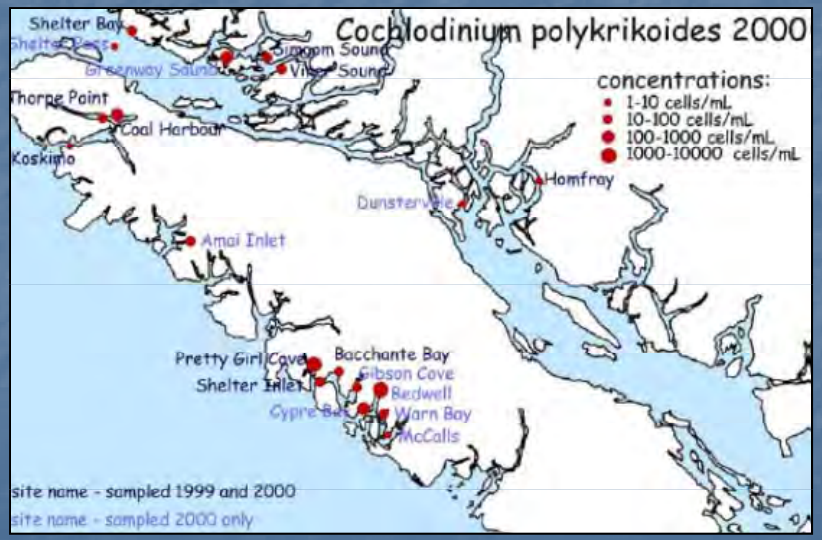
SEOS School of Earth and Ocean Science

University of Victoria | British Columbia Canada

NSERC CRSNG

Cochlodinium polykrikoides in BC



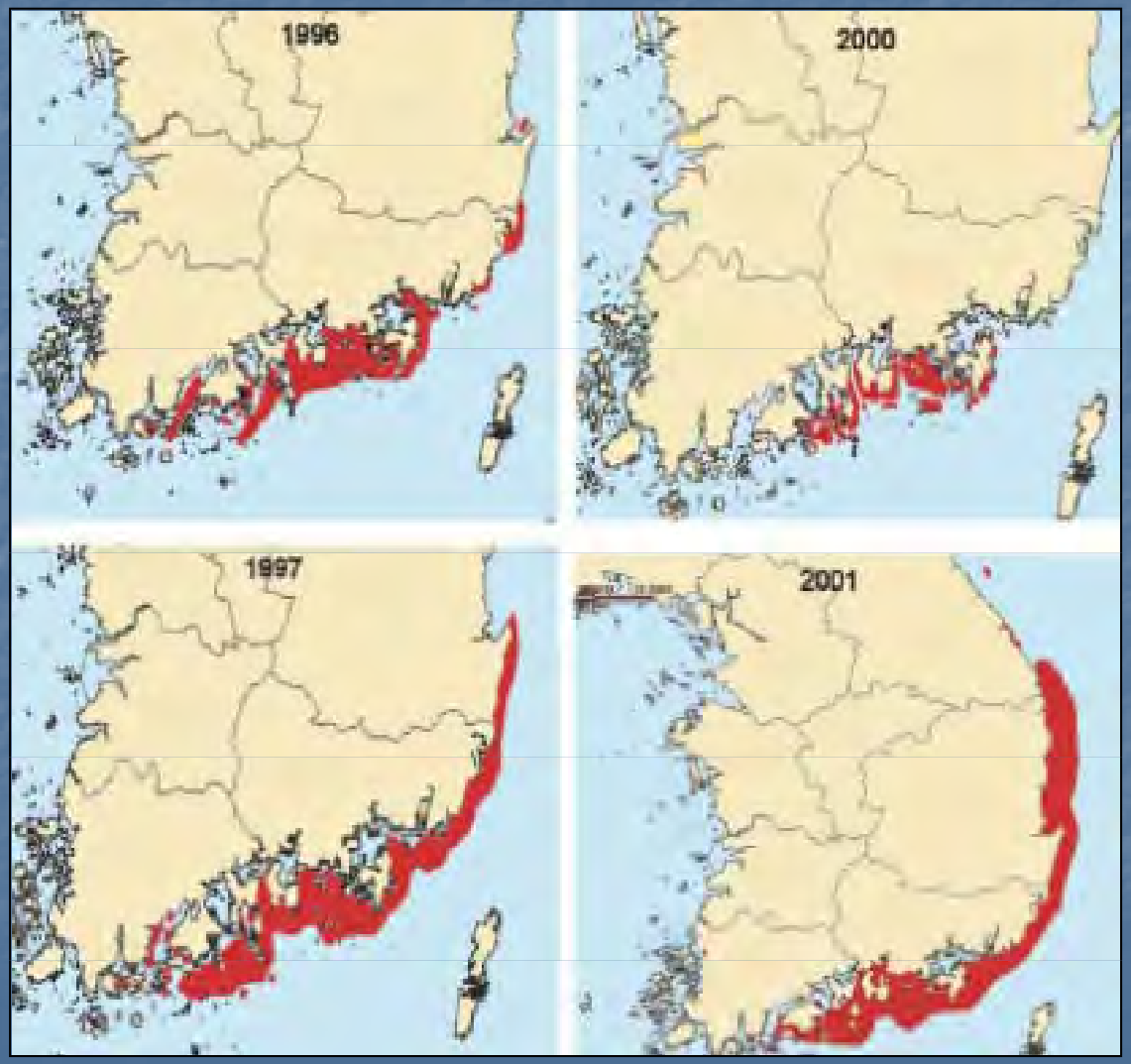


Cochlodinium sp.

In the summer of 1999 a series of salmon kills at farms on the west coast of Vancouver Island was linked to a bloom of the naked dinoflagellate *Cochlodinium* sp. (Whyte *et al.* 2001). The cells resembled *C. polykrikoides*, the major fish killer of Korea and in Japan (see this report) but showed less chain formation, usually occurring in pairs or singly. The initial outbreak was estimated to cause losses of approximately CDN$ 2 million. This phenomenon has recurred less severely in subsequent years with a suggestion of southward spread along the coast of Vancouver Island. The cause of death is unknown although a similar mechanism to that in Korea and Japan (oxygen radical production leading to gill, and perhaps also liver damage) is suspected.

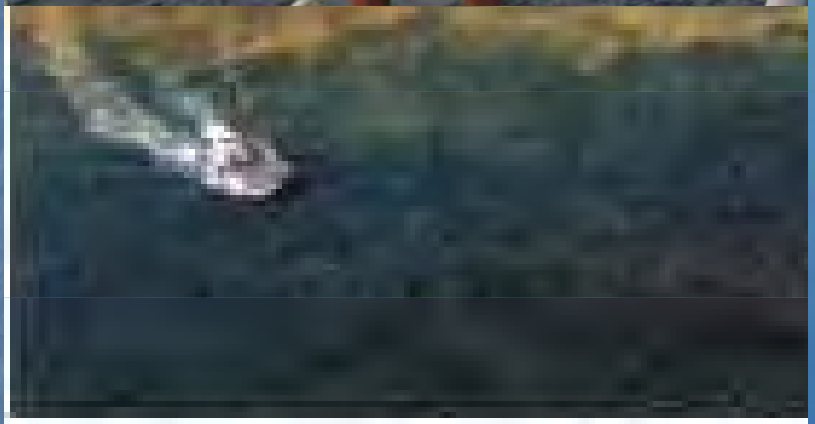
Distribution and concentration of *C. polykrikoides* in 1999-2000.
(Whyte, 2001, Canadian Technical report of Fisheries and Aquatic Sciences)

Cochlodinium polykrikoides blooms

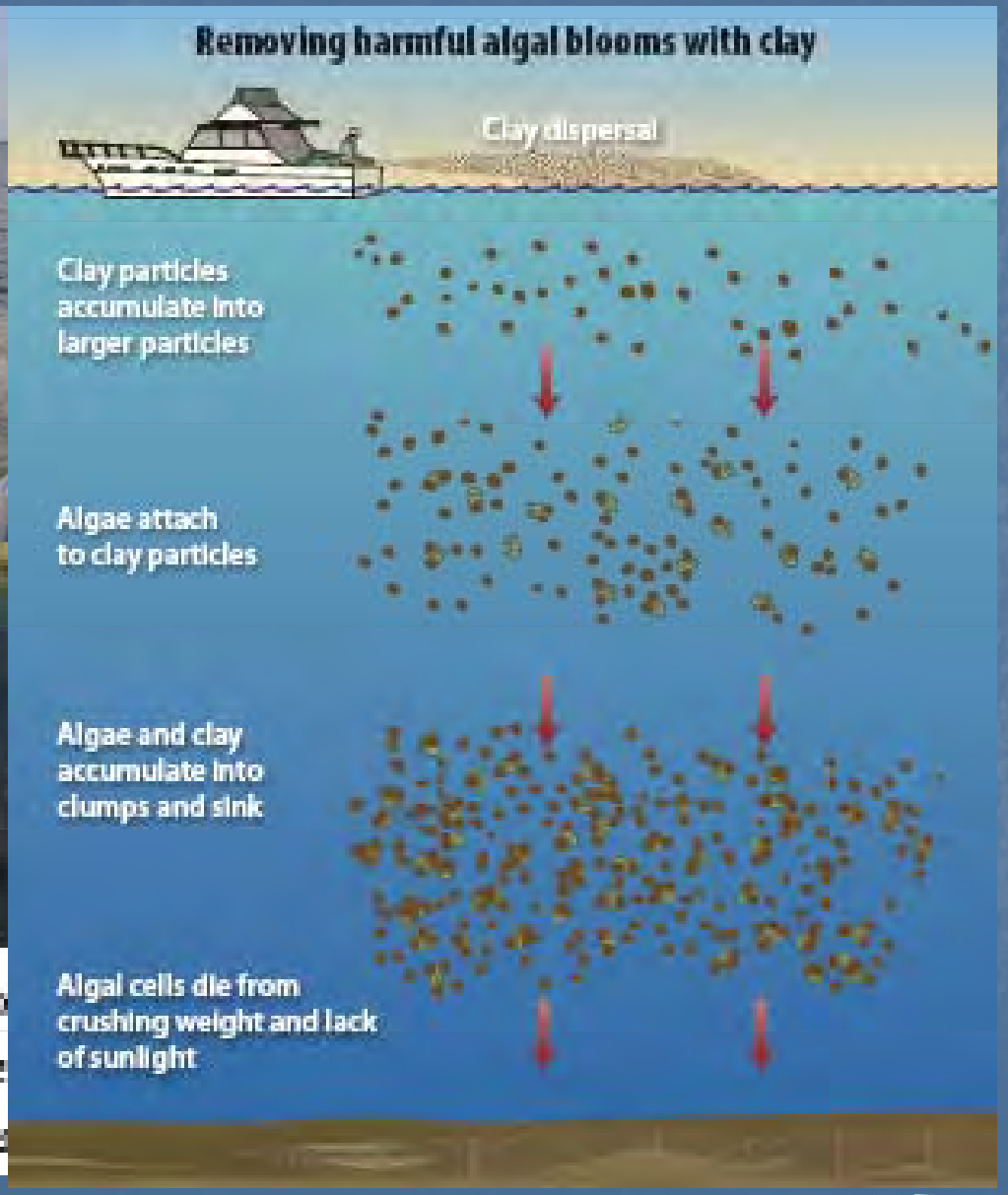


(http://www.nfrdi.re.kr)

Control of *Cochlodinium polykrikoides blooms*

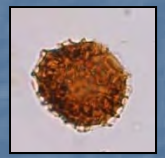


ON GUARD AGAINST ALGAE—In South Ko
algae that could devastate the crop in the
Koreans began clay treatments, fishery lo

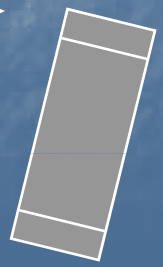


Oceanus, 2007

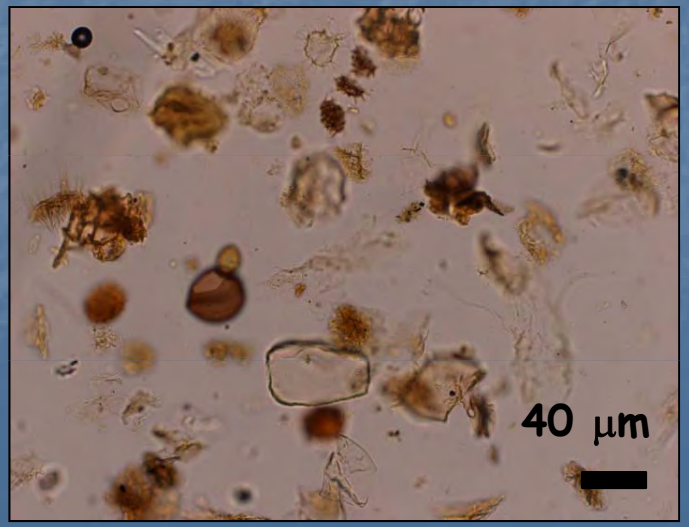
Cyst extraction form sediments



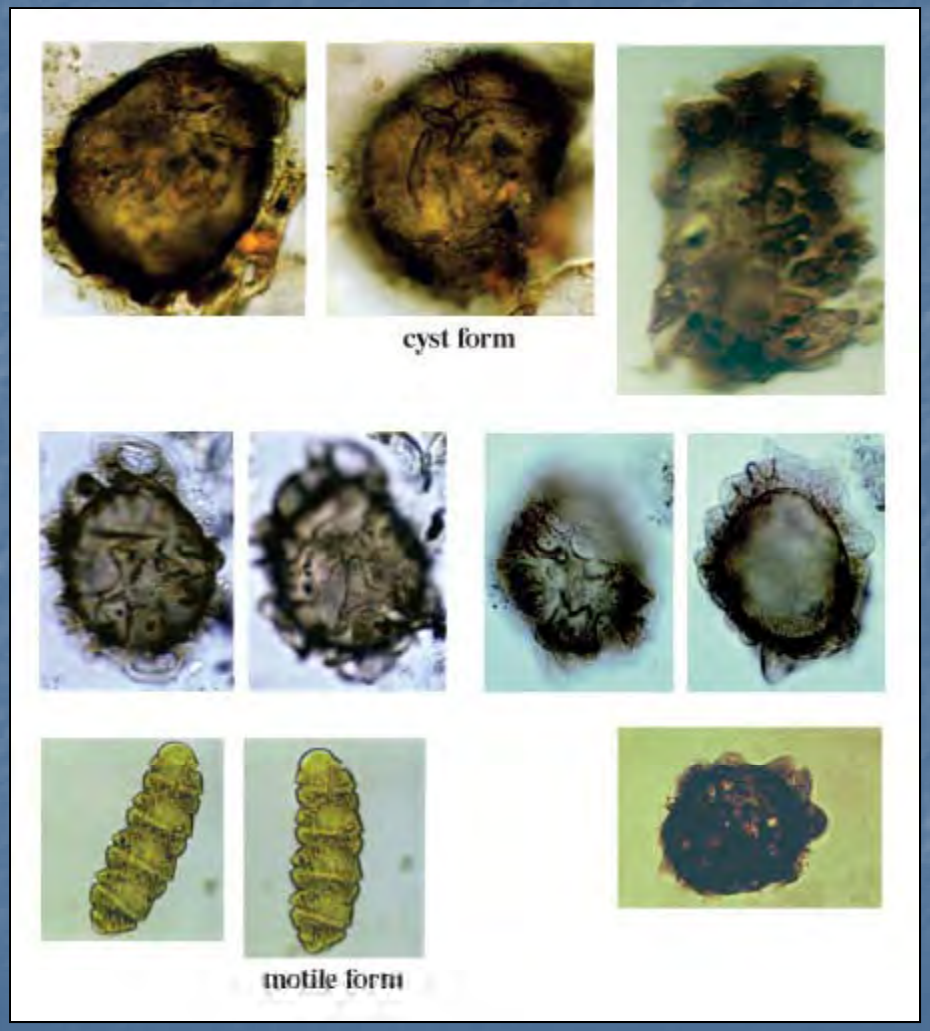
48% HF & 10% HCl



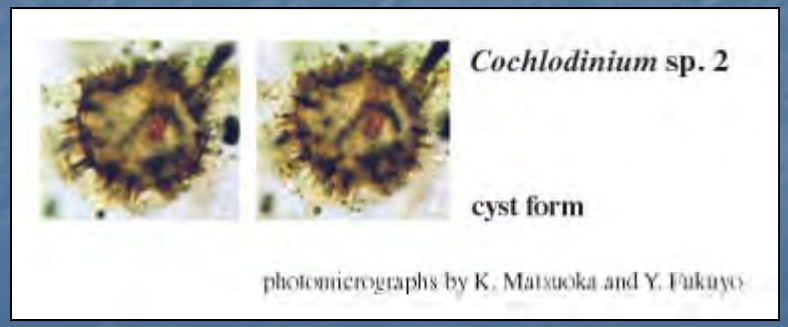
10 & 120 μm



Cysts of *Cochlodinium polykrikoides*

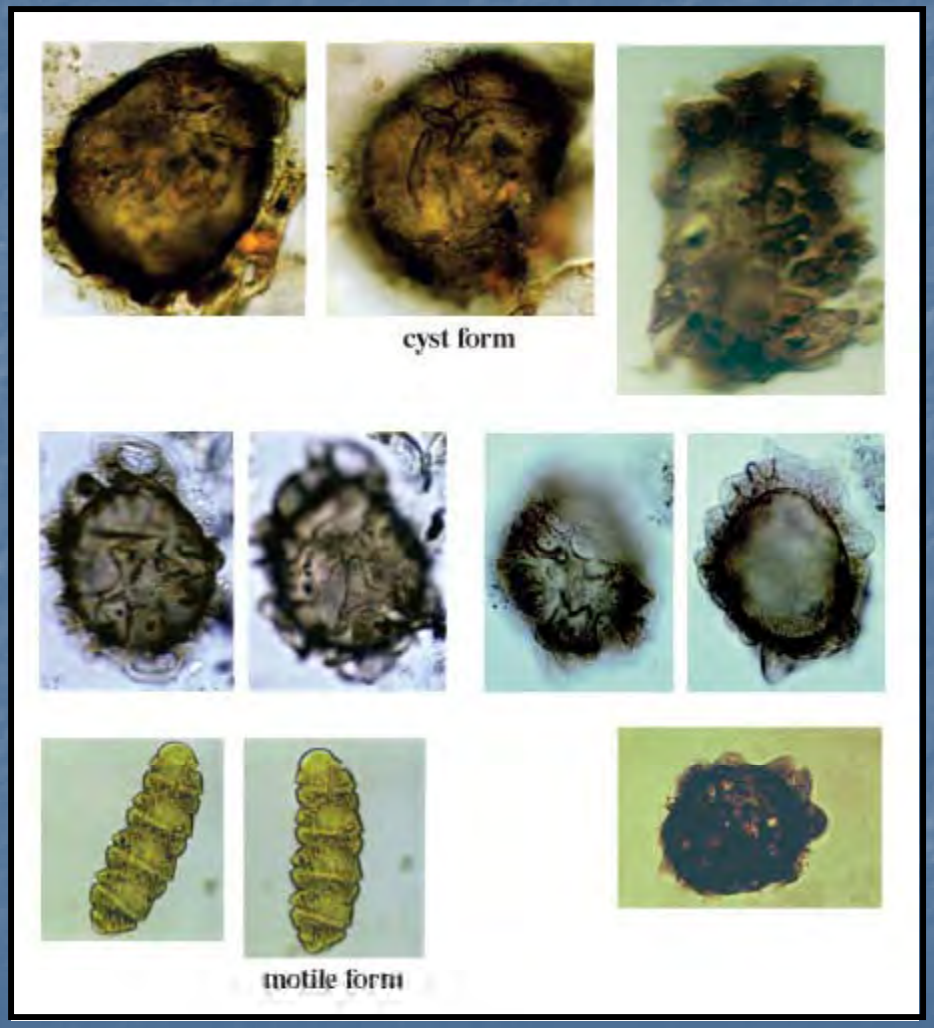


- Rosales-Loessener et al (1996)
  "ovoidal cysts covered with brownish fin-like projections"
- Matsuoka and Fukuyo (2000)
  Provided illustrations

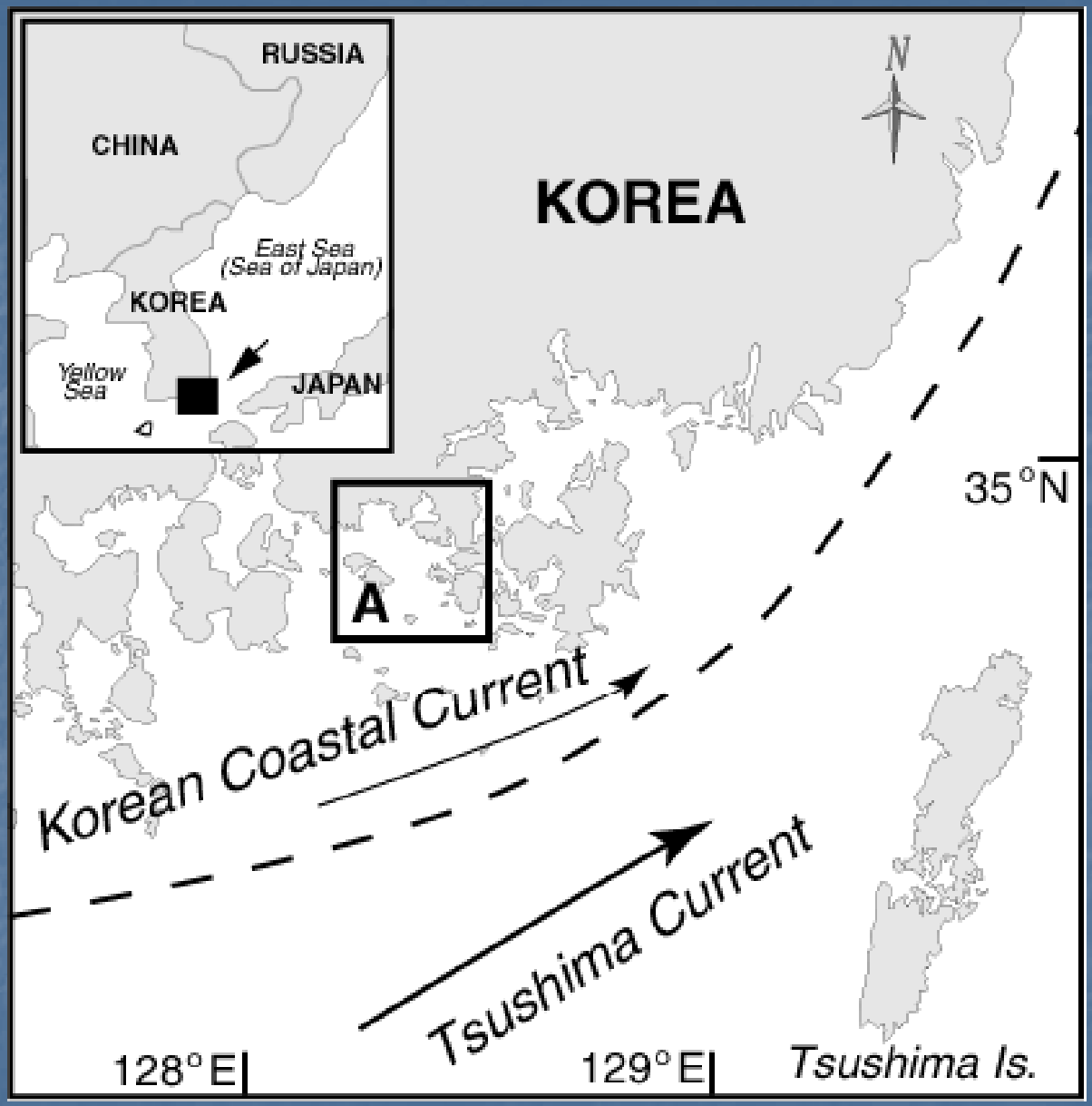


2000. Matsuoka, K., Fukuyo, Y. Technical guide for modern dinoflagellate cyst study. WESTPAC-HAB/WESTPAC/IOC, Japan Society for the Promotion of Science, pp. 29.

Cysts of *Cochlodinium polykrikoides*

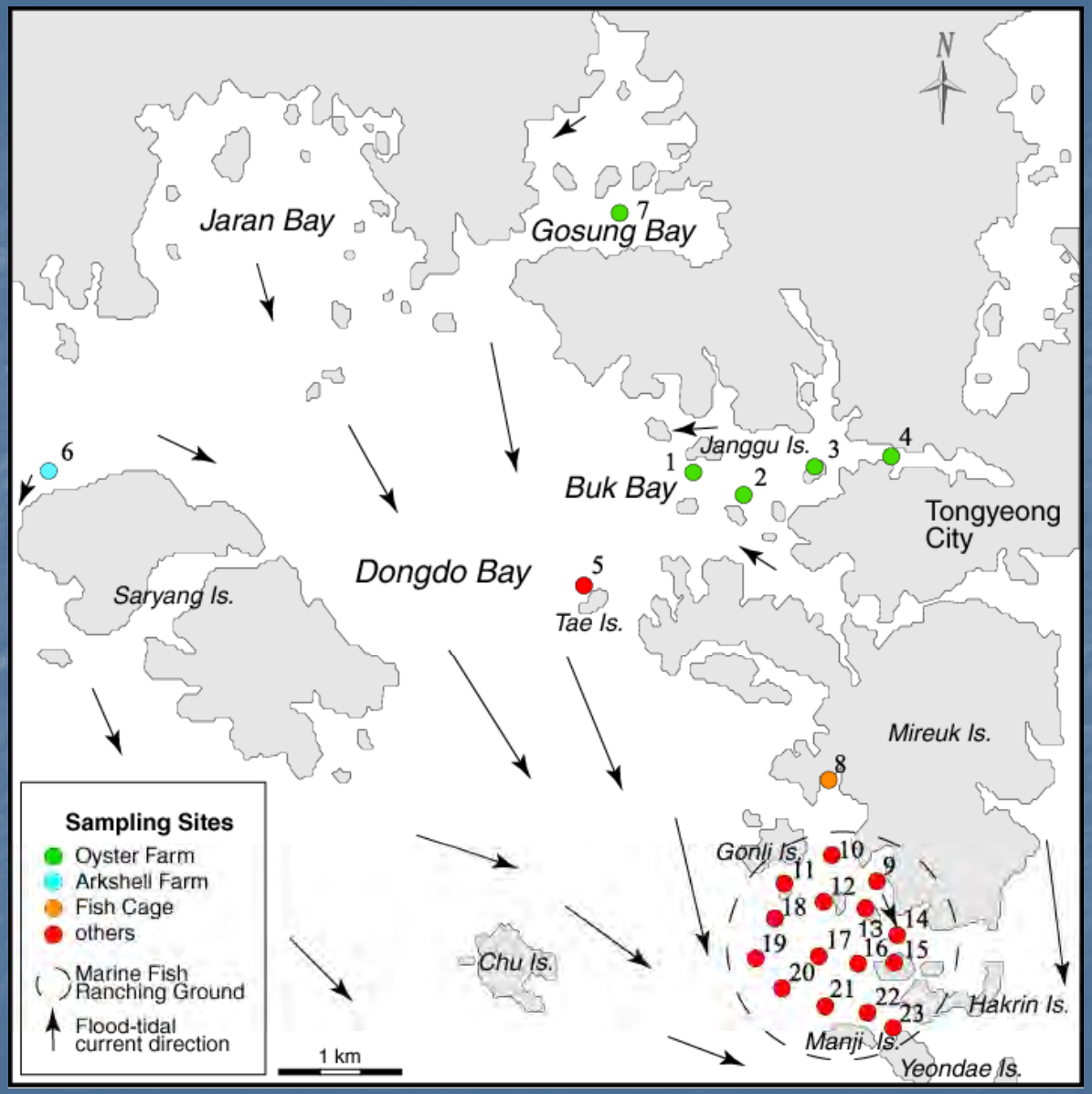


Kim C.-H. (2002) recorded hyaline cysts of *C. polykrikoides* during a lab incubation experiment



2010. Pospelova, V., Kim, S.J. Dinoflagellate cysts in recent estuarine sediments from aquaculture sites of southern South Korea. Marine Micropaleontology 76, 37–51.

Sites



Pospelova and Kim (2010)

23 sampling sites

WD: 5-40m

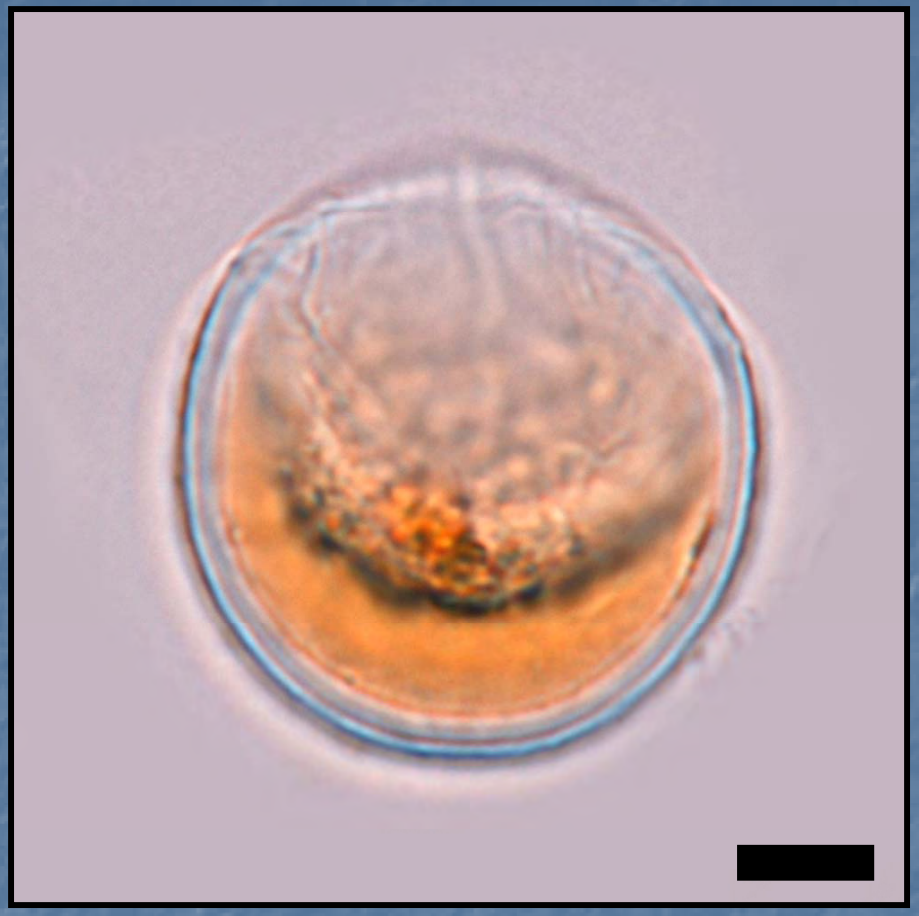
SST:
Winter 7-10C
Summer 28-31C

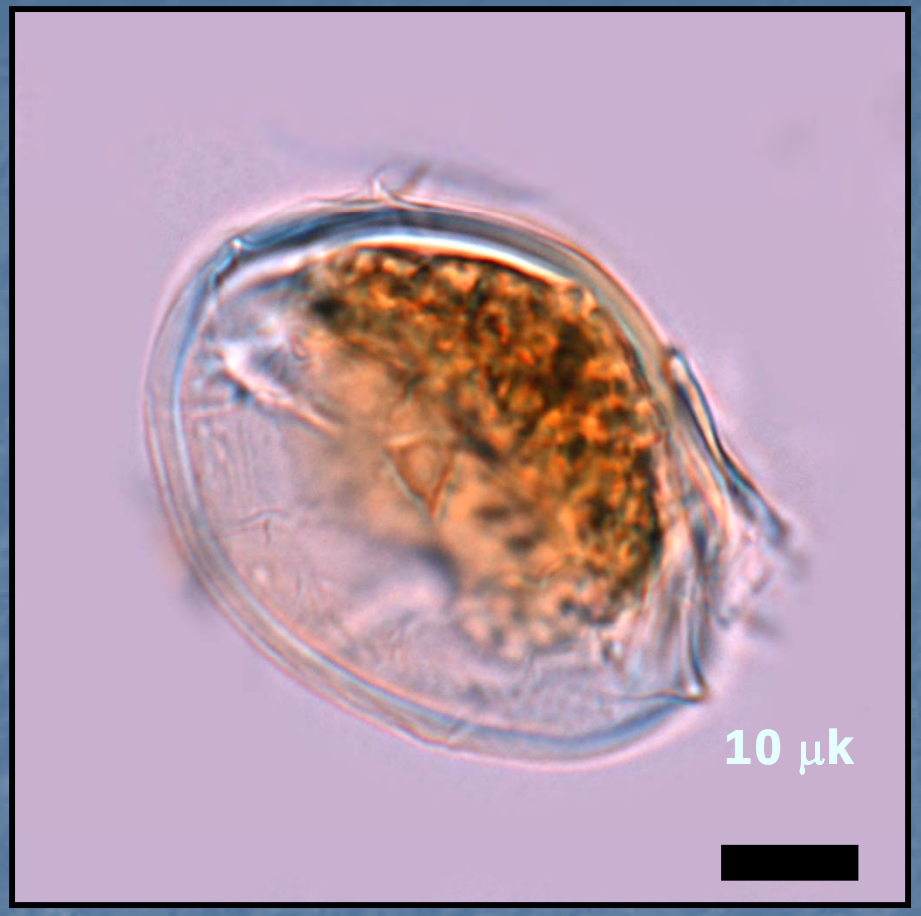
SSS: 32-34
Buk Bay 31-32

Tongyeong & Gosung cities with the total population of 180,000

Aquaculture

"Strange Cysts"





Haline round cysts, commonly folded.

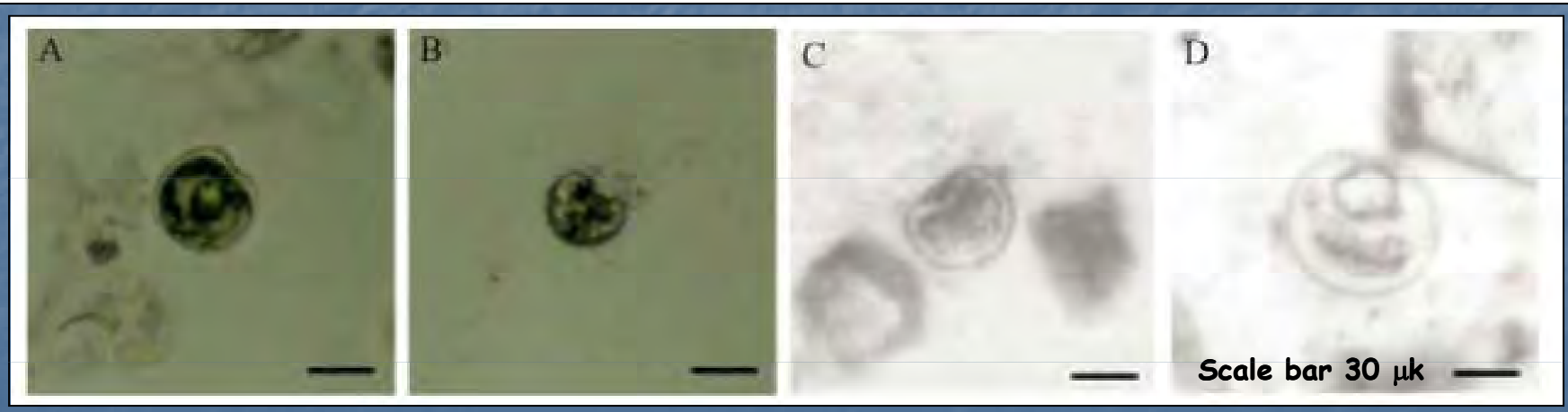
2010. Pospelova, V., Kim, S.J. Dinoflagellate cysts in recent estuarine sediments from aquaculture sites of southern South Korea. Marine Micropaleontology 76, 37–51.

Fig. 6. Resting cysts produced from armored type at room temperature (A-B) and collected from natural sediments (C-D)

Available online at www.sciencedirect.com
ScienceDirect
ELSEVIER
Harmful Algae 6 (2007) 104–111
HARMFUL ALGAE
www.elsevier.com/locate/hal

Life cycle of the ichthyotoxic dinoflagellate *Cochlodinium polykrikoides* in Korean coastal waters

Choong-Jae Kim [a], Hak-Gyoon Kim [b], Chang-Hoon Kim [c], Hee-Mock Oh [a,*]



2007. Kim, C.-J., Kim,H.-G., Kim, C.-H.,Oh,H.-M. Life cycle of the ichthyotoxic dinoflagellate *Cochlodinium polykrikoides* in Korean coastal waters. Harmful Algae 6, 104–111.

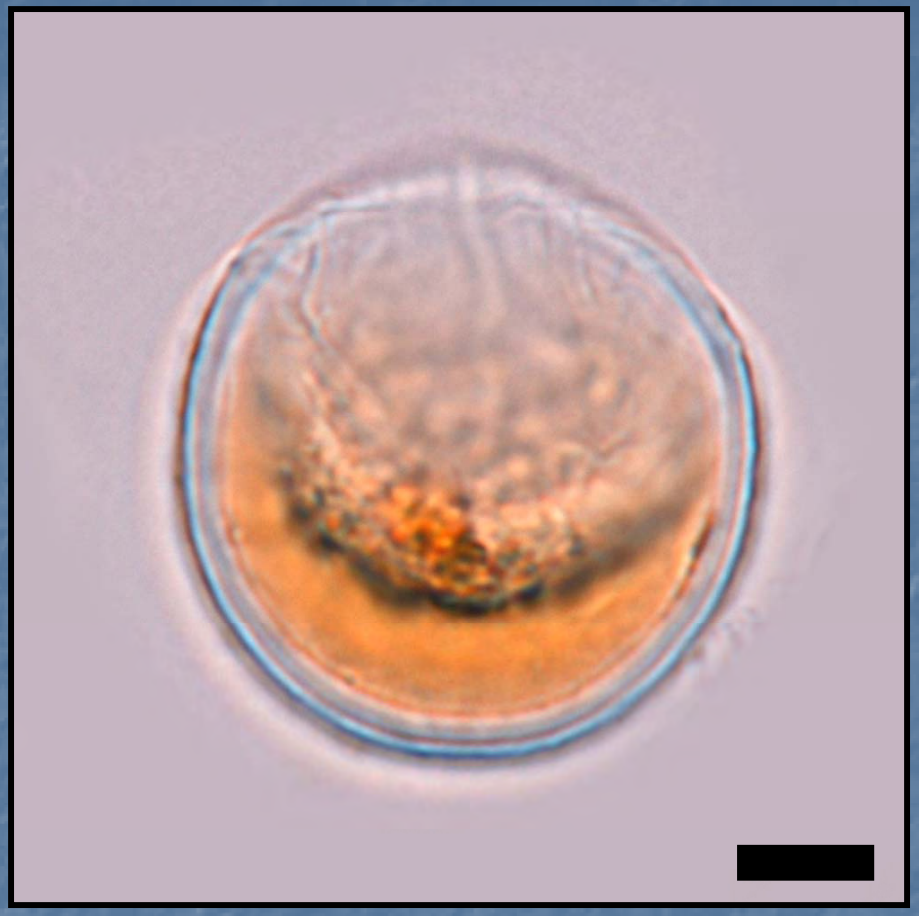
" The life cycle of *C. polykrikoides* has two morphologically different stages: an **armored** and an **unarmored** vegetative stage.

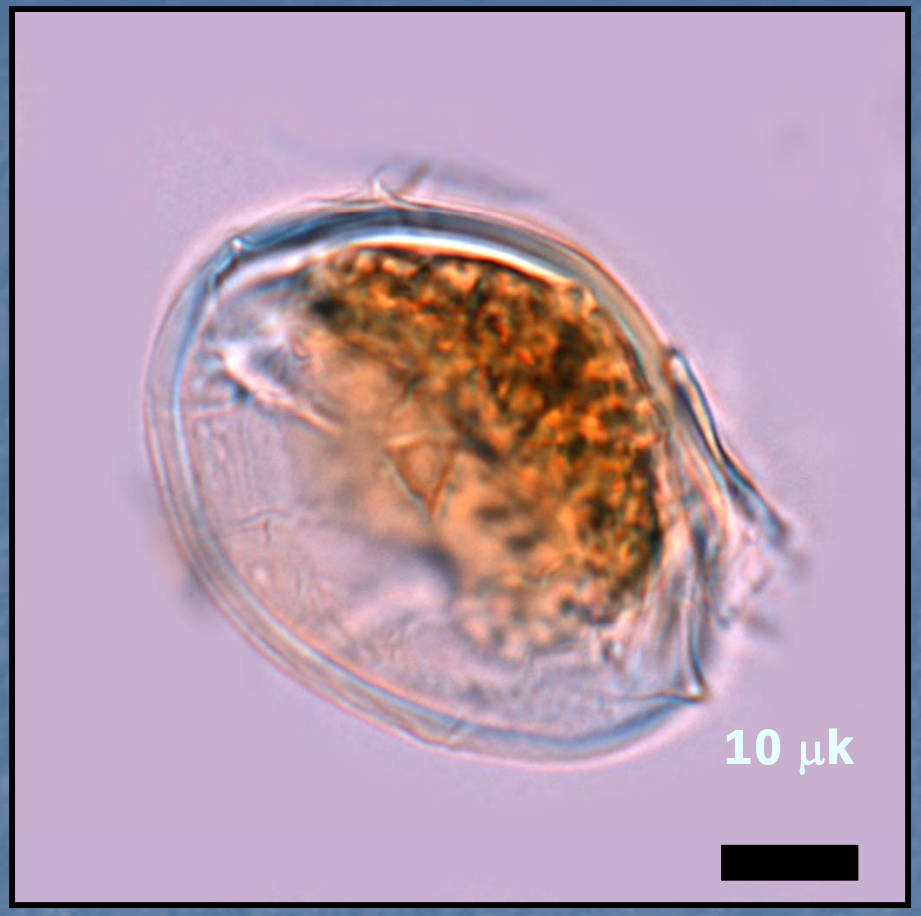
Armored vegetative cells were found in **seawater** samples collected in late-November **and developed** into four-cell chained, **unarmored vegetative cells under laboratory culture.**

A presumptive resting cyst, round but folded at one side, was produced from armored type cells in laboratory conditions. **It was also collected from natural bottom sediments, which suggests it is the dormant resting cyst of *C. polykrikoides*".**

2007. Kim, C.-J., Kim,H.-G., Kim, C.-H.,Oh,H.-M. Life cycle of the ichthyotoxic dinoflagellate *Cochlodinium polykrikoides* in Korean coastal waters. Harmful Algae 6, 104–111.

Cysts of *Cochlodinium polykrikoides*

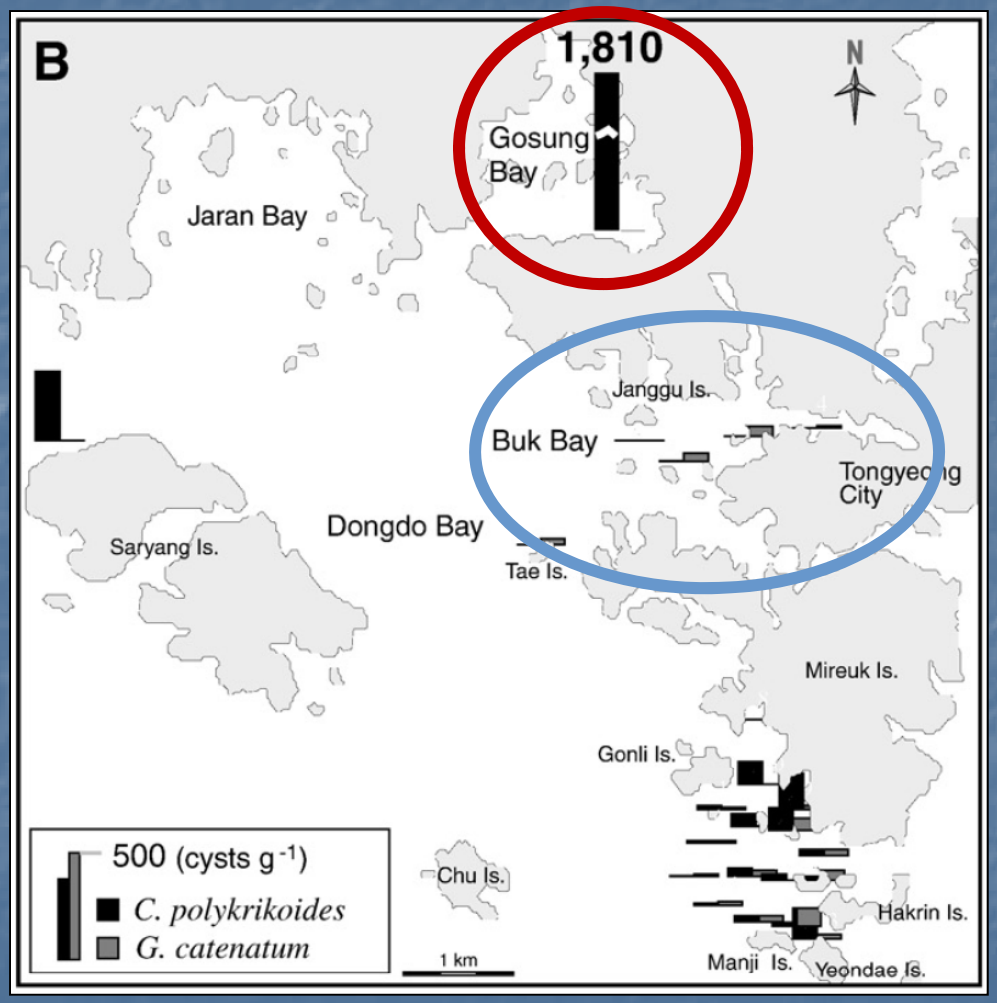




Haline round cysts of *Cochlodinium polykrikoides*

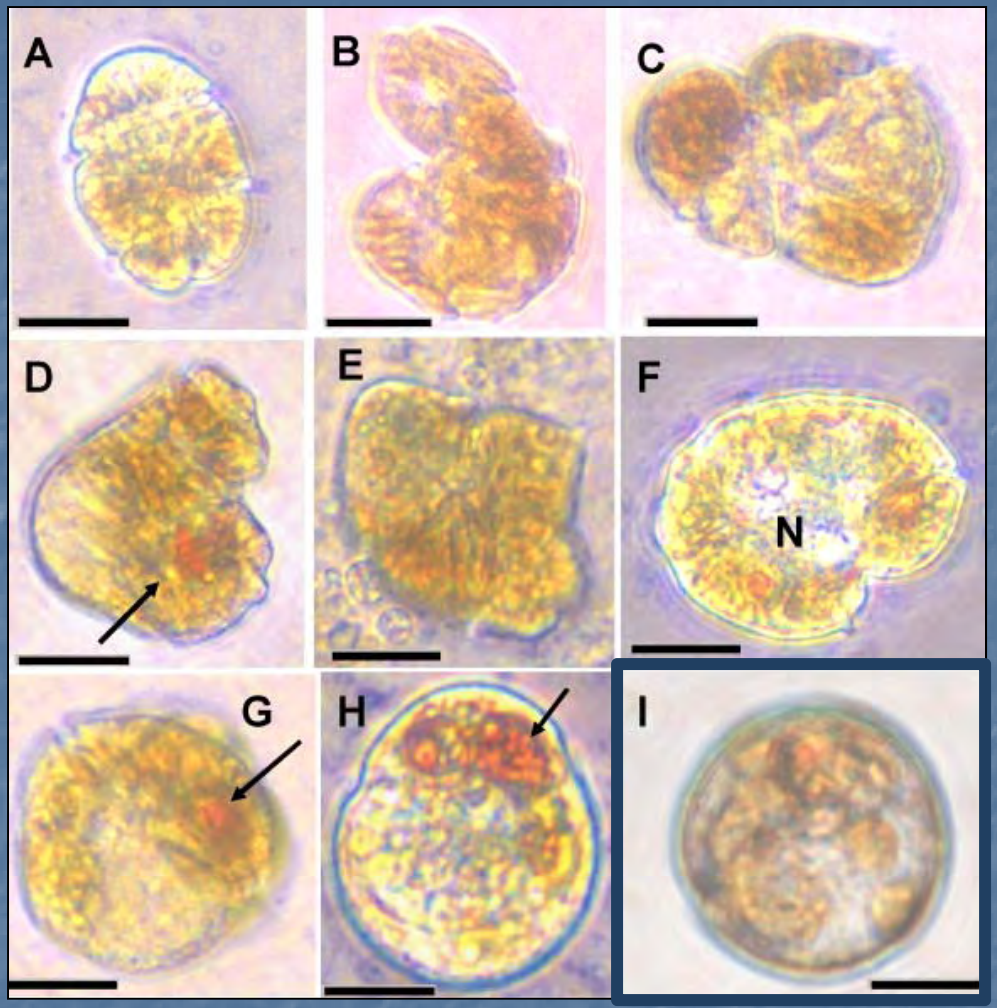
2010. Pospelova, V., Kim, S.J. Dinoflagellate cysts in recent estuarine sediments from aquaculture sites of southern South Korea. Marine Micropaleontology 76, 37–51.

Sedimentary concentrations of cysts of *Cochlodinium polykrikoides*



Cysts of *C. polykrikoides* were not found in Buk Bay, and were otherwise recorded in most of the studied sites in low proportions, except in Gosung Bay where they contribute up to 41% of the cyst assemblage. Agreement with previously bloom observations

Tang and Gobler (2012)



2012. Tang, V.Z., Gobler, C.J. The toxic dinoflagellate *Cochlodinium polykrikoides* (Dinophyceae) produces resting cysts. Harmful Algae 20, p. 71-80.

2013. Reñé, Garcés, Camp. Phylogenetic relationships of *Cochlodinium polykrikoides* Margalef (Gymnodiniales, Dinophyceae) from the Mediterranean Sea and the implications of its global biogeography. Harmful Algae 25, p. 39-46

Conclusions

The significant presence of smooth, haline cysts of *Cochlodinium polykrikoides* in the sediments from Gosung Bay, correlates well with the records of blooms of that species.

Given a significant hazard posed by *Cochlodinium polykrikoides*, it would be extremely desirable to conduct the studies of cores with recent sediments from the same area in order to be able to see the temporal shifts in the geochemistry and in the dinoflagellate cyst assemblages.