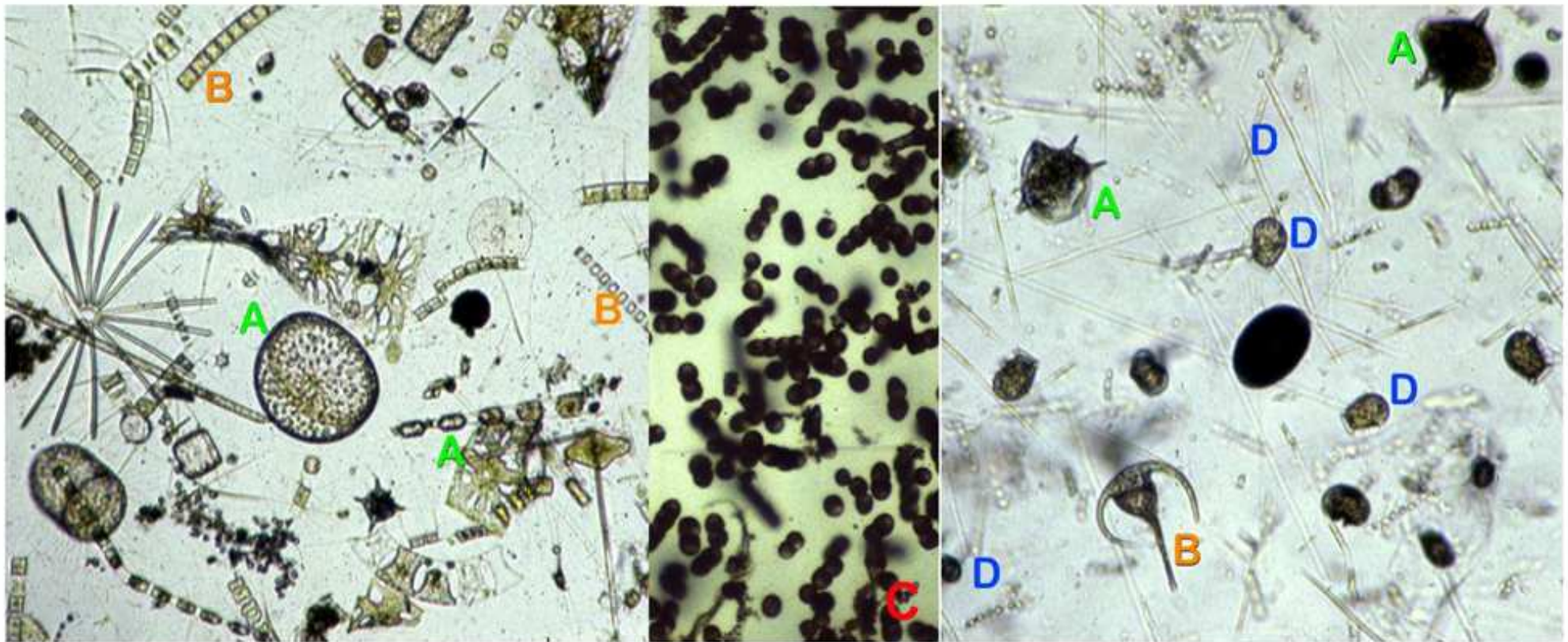


Four Types of Microplankton (unicellular phyto- and zooplankton)



Type **A**: Usefull as foods for marine organisms; Never make red tide.

Type **B**: Potentially harmful, as they make red tide in which mass mortality of marine orgnisms due to oxygen depletion may occur.

Type **C**: Harmful, as they make red tide in which mass mortality of marine orgnisms almost always occur.

Type **D**: Harmful, as they produce toxins occasionally accumulated in fish and shellfish; If people eat the contaminated fish and shellfish more than permitted level, they get poisoning.

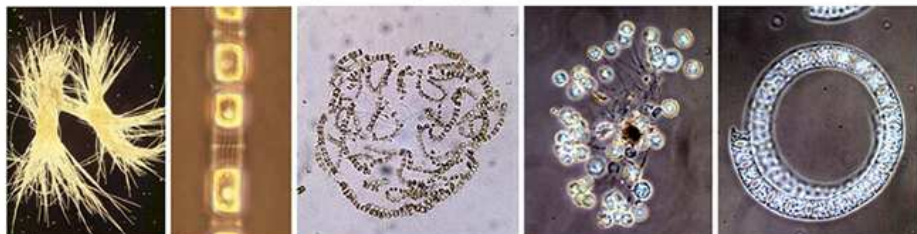
Red Tide Microalgae

WESTPAC/IOC/UNESCO

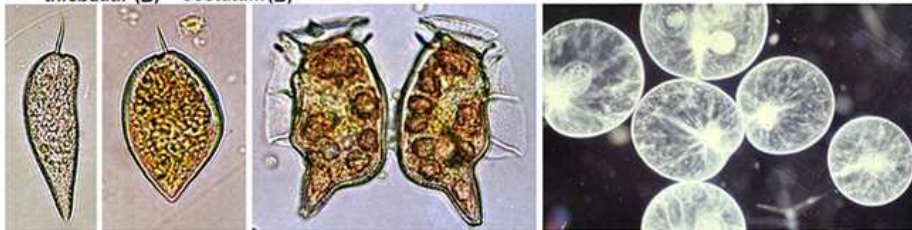
Ver. 1.4 2000.1.1

ed. by Yasuwo Fukuyo (ufukuyo@mail.ecc.u-tokyo.ac.jp)

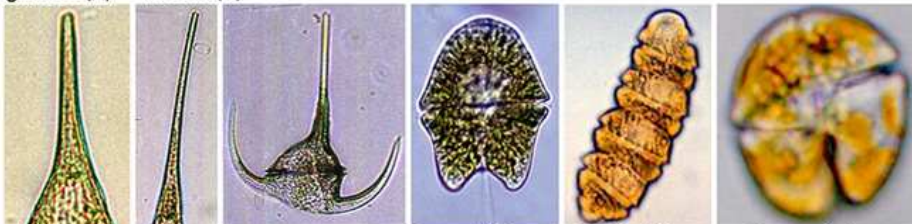
A: Useful, mostly harmless B: Potentially harmful by oxygen depletion C: Harmful, responsible for fish mass mortalities



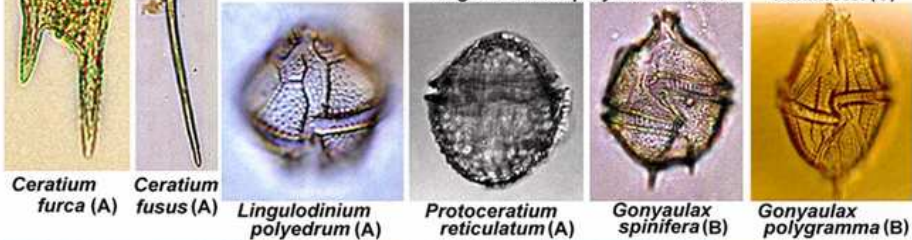
Trichodesmium thiebautii (A) *Skeletonema costatum* (B) *Chaetoceros sociale* (A) *Thalassiosira mala* (B) *Eucampia zodiacus* (A)



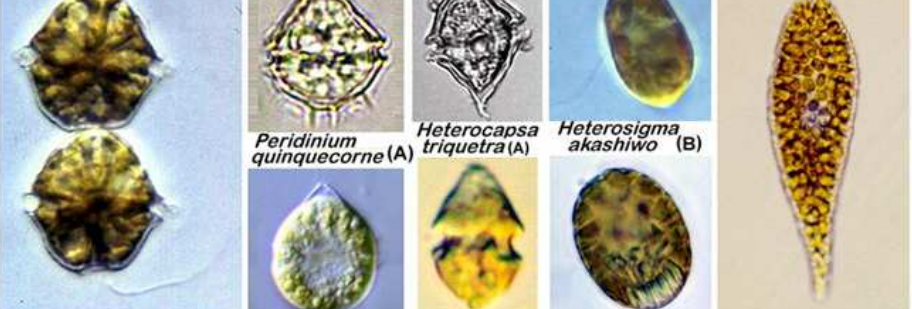
Prorocentrum sigmoides (A) *Prorocentrum micans* (B) *Dinophysis caudata* (B) *Noctiluca scintillans* (B)



Ceratium tripos (A) *Gymnodinium sanguineum* (A) *Cochlodinium polykrikoides* (C) *Gymnodinium mikimotoi* (C)



Ceratium furca (A) *Ceratium fusus* (A) *Lingulodinium polyedrum* (A) *Protoceratium reticulatum* (A) *Gonyaulax spinifera* (B) *Gonyaulax polygramma* (B)



Alexandrium affine (A) *Scrippsiella trochoidea* (A) *Heterocapsa triquetra* (A) *Heterosigma akashiwo* (B) *Chattonella antiqua* (C)

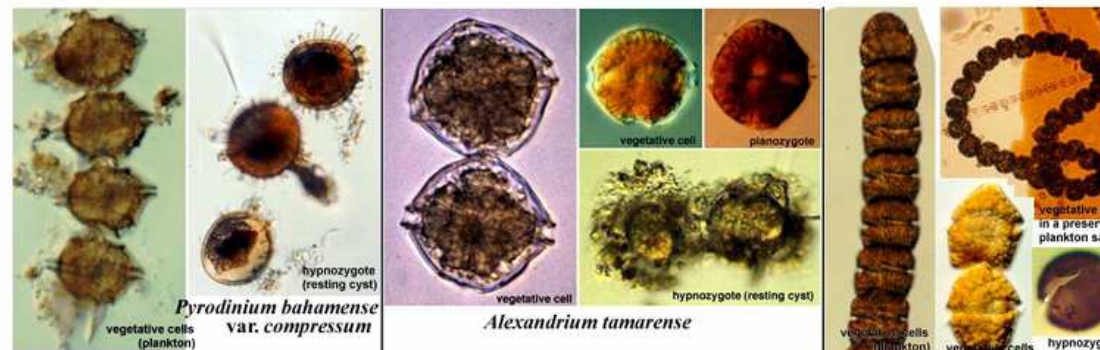
Toxic Microalgae

WESTPAC/IOC/UNESCO

Ver. 2.2 2000.1.1

ed. by Yasuwo Fukuyo (ufukuyo@mail.ecc.u-tokyo.ac.jp)

Species Responsible for Paralytic Shellfish Poisoning

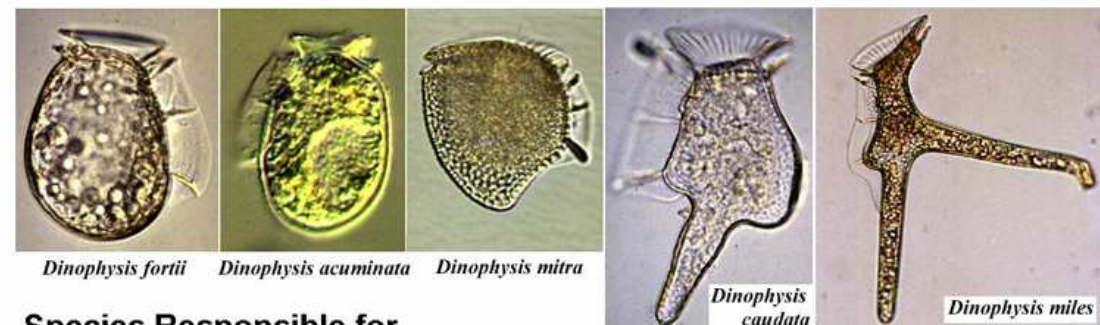


Pyrodinium bahamense var. *compressum*

Alexandrium tamarense

Gymnodinium catenatum

Species Responsible for Diarrhetic Shellfish Poisoning



Dinophysis fortii *Dinophysis acuminata* *Dinophysis mitra*

Dinophysis caudata

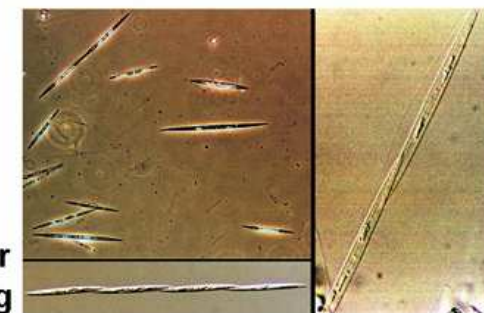
Dinophysis miles

Species Responsible for Neurotoxic Shellfish Poisoning



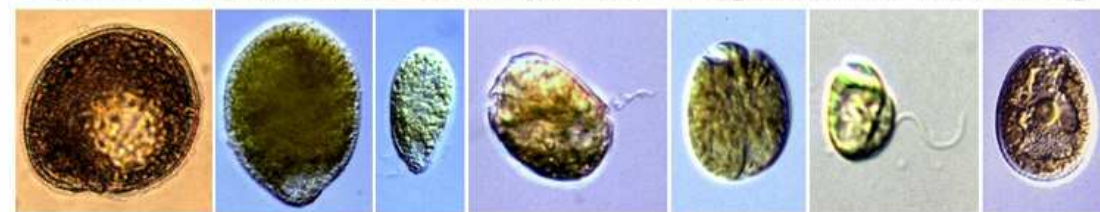
Gymnodinium breve

Species Responsible for Amnesic Shellfish Poisoning



Pseudonitzschia spp.

Species Responsible for and implicated in Ciguatera Fish Poisoning



Gambierdiscus toxicus

Ostreopsis lenticularis

Ostreopsis ovata

Coolia monotis

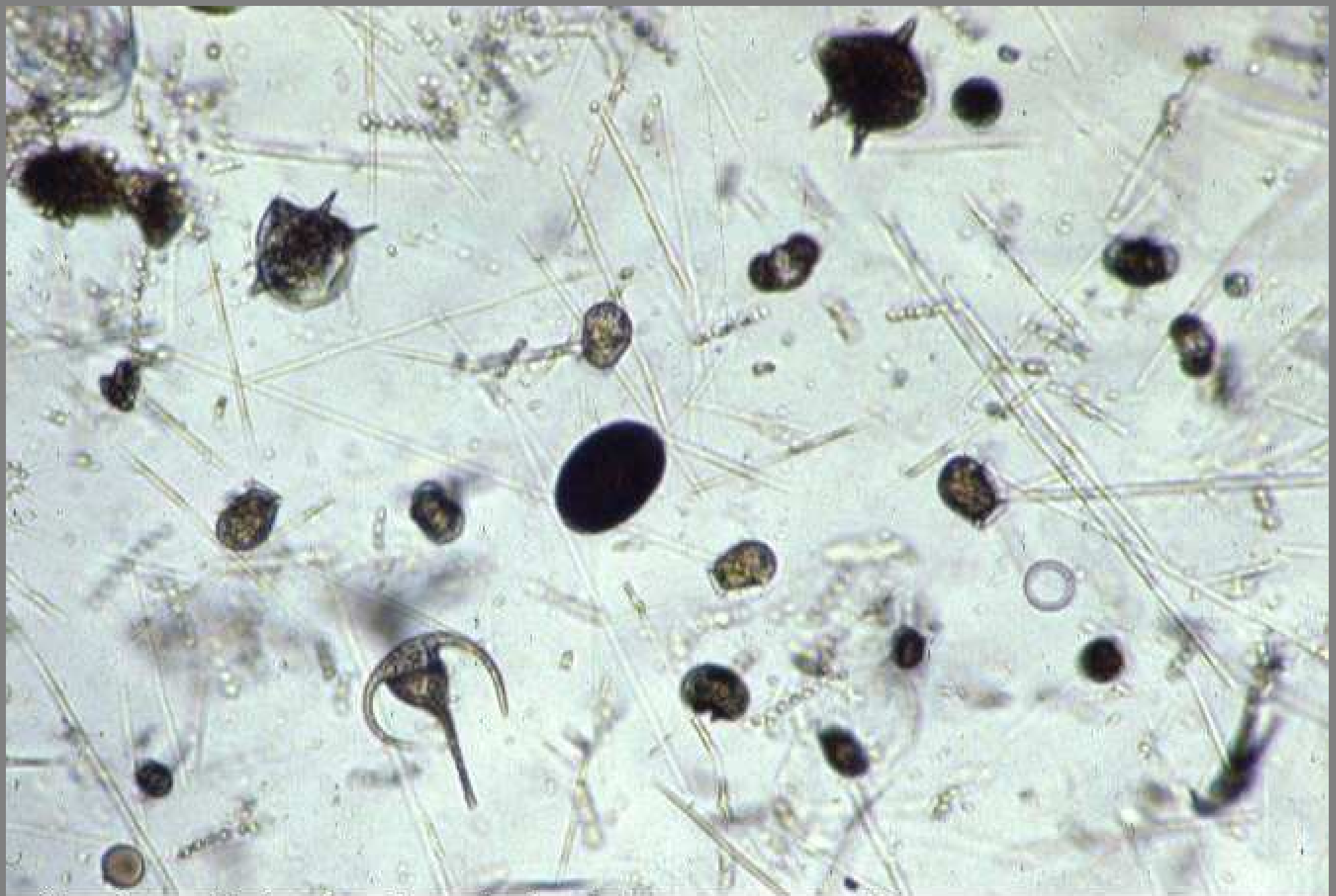
Amphidinium klebsii

Amphidinium carterae

Prorocentrum lima



Diatom dominant plankton community



Dinoflagellate dominant plankton community

Photomicrograph by Yasuhiro Fukuyo

IOC-WESTPAC HAB R0008

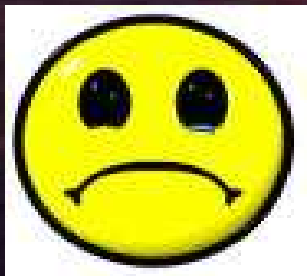


Lake Tovel was renowned in the world for the particular reddening phenomenon of its waters due to bloom of a dinoflagellate, *Glenodinium sanguineum* Marchesoni, which accumulated carotenoids. This phenomenon suddenly ceased in 1964. From the beginning of the XX Century, well known Italian and foreign scientists studied Lake Tovel and its reddening phenomenon and, after 1964, research focussed on the identification of the factors responsible for the ceasing of the reddening. The limnological studies of Prof. Edgardo Baldi of the University of Milan, carried out in collaboration with the Museum of Trento in 1937-1939 led to a first understanding of the reddening phenomenon and were, at that time, one of the major efforts, both scientific and economic, for the understanding of the limnology of a mountain lake. On a preliminary report published on the Journal of the Museum, Baldi pointed on the importance of establishing a limnological station on the shores of Lake Tovel, because this would have allowed to face many issues in the study of mountain freshwaters. Since May 2001, an important Research Project (SALTO / BEST – Blooms and Environment: Science for Tovel) was funded by the Research Fund of the Autonomous Province of Trento for a thorough understanding of the reddening phenomenon and of the causes responsible for its ceasing.

Le fioriture o “blooms” di microalghe: le maree colorate



COMPONENTI BASE DELLE RETI
TROFICHE



ALTERAZIONE DEL COLORE DELLE ACQUE

IPOSSIA O ANOSSIA DELLE ACQUE

SPECIE TOSSICHE



LE FIORITURE DI ALGHE CHE CAUSANO PROBLEMI NELLE ACQUE SONO CHIAMATE IN INGLESE HABs (Harmful Algal Blooms)

Nell'insieme sono fenomeni diversi accomunati da due caratteristiche:

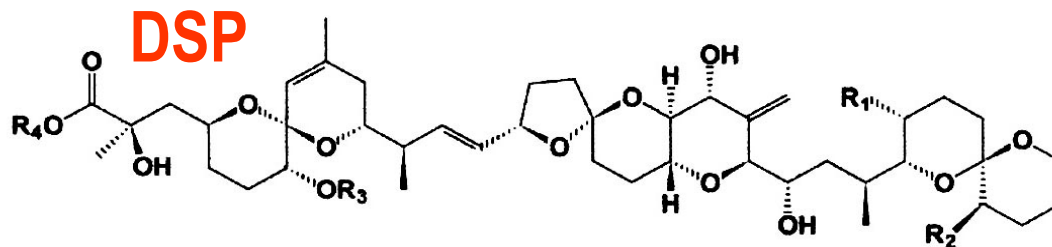
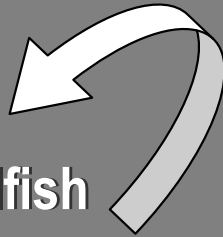
- sono causati da cianobatteri e microalghe (1-100 μm)
- hanno un impatto negativo sulle attività umane

Attualmente si osserva un incremento di tali fenomeni a livello globale

Lungo le coste italiane, gli HABs hanno interessato le coste del nord Adriatico, ma da alcuni anni questi fenomeni si sono estesi alle coste meridionali adriatiche e al Tirreno

QUALI SONO LE TOSSINE PRODOTTE E I LORO EFFETTI SULL'UOMO

Diarrhetic Shellfish
Poisoning



Okadaic acid: $R_1=CH_3$; $R_2=R_3=R_4=H$

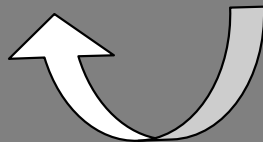
ACIDO OKADAICO
DINOPHYSISTOSSINE
YESSOTOSSINE
PECTENOTOSSINE

ENTRO POCHE ORE
DALL'INGESTIONE

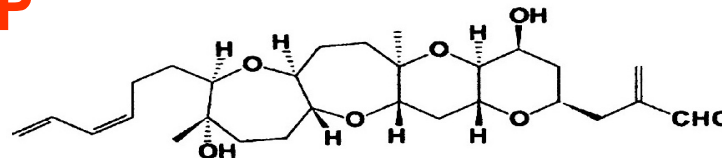
Disturbi gastrointestinali:
diarrea, nausea, vomito e
crampi addominali.

Esposizione cronica
induce tumori

Neurotoxic Shellfish
Poisoning



NSP



BREVETOSSINE

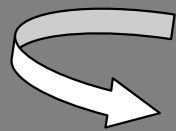
ENTRO 3-6 h
DALL'INGESTIONE

Freddo, diarrea, dolore e
debolezza muscolare,
nausea e vomito.

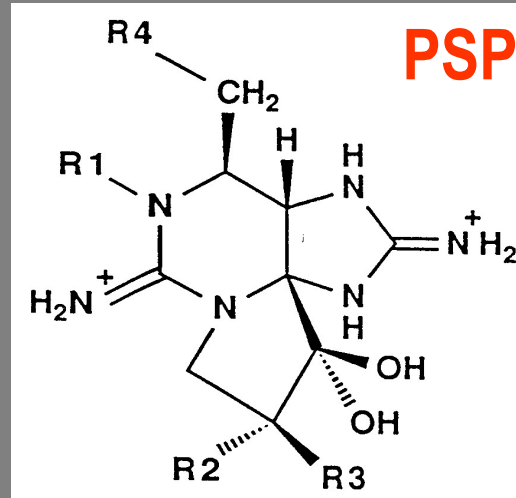
Parestesia, difficoltà nella
respirazione, visione
doppia, difficoltà nel
parlare e nel deglutire.

QUALI SONO LE TOSSINE PRODOTTE E I LORO EFFETTI SULL'UOMO

SAXITOSSINE



Paralytic Shellfish
Poisoning

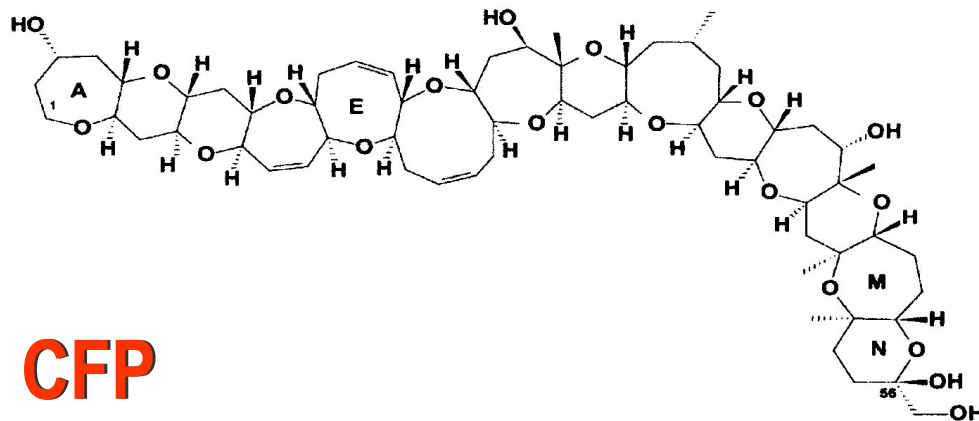


ENTRO 30 MINUTI:

intorpidimento del capo;
sensazione spinosa sulle dita;
mal di testa, febbre.

ENTRO 2-24 ore:

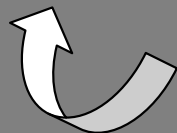
morte per arresto respiratorio.



CFP

Ciguatera Fish
Poisoning

CIGUATOSSINE
MAITOTOSSINE



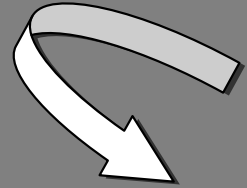
ENTRO 2-6 ore:

disturbi gastrointestinali

disturbi neurologici: inversione della
sensibilità per la temperatura degli oggetti;
intorpidimento, formicolio di bocca ed
estremità, vertigini e abbassamento della
pressione sanguigna.

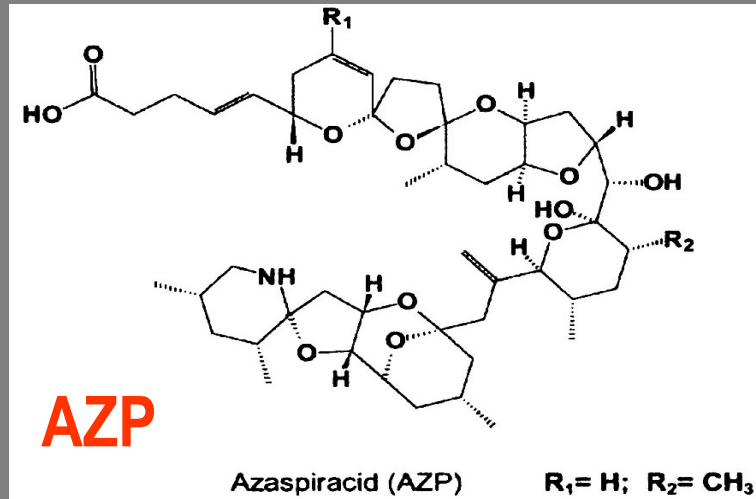
Paralisi e morte per arresto
respiratorio.

QUALI SONO LE TOSSINE PRODOTTE E I LORO EFFETTI SULL'UOMO



**Azaspiracid
Poison**

AZASPIRACIDI

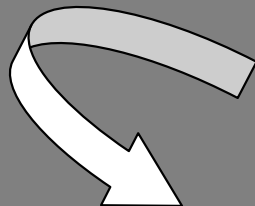


Sintomi simili alla DSP

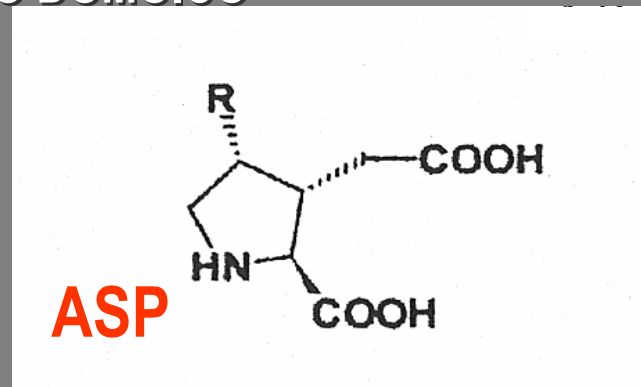


Danni al livello del sistema
linfatico.

ACIDO DOMOICO



**Amnesic Shellfish
Poison**



ENTRO 24- 48 ore:

Gastroenterite, sintomi
neurologici, mal di testa, perdita
della memoria a breve termine,
difficoltà respiratorie, coma.

Effetti dannosi degli HABs

Rischio per la salute umana

Effetto tossico indiretto, mediato da organismi vettore, molluschi e pesci, che attraverso il consumo alimentare raggiungono l'uomo causando varie sindromi (almeno 2000 casi all'anno nel mondo fino agli anni '90)

Impatto sulle risorse alimentari acquatiche

Effetto diretto delle tossine sugli stocks ittici coltivati e non, danno meccanico di alcune alghe non tossiche

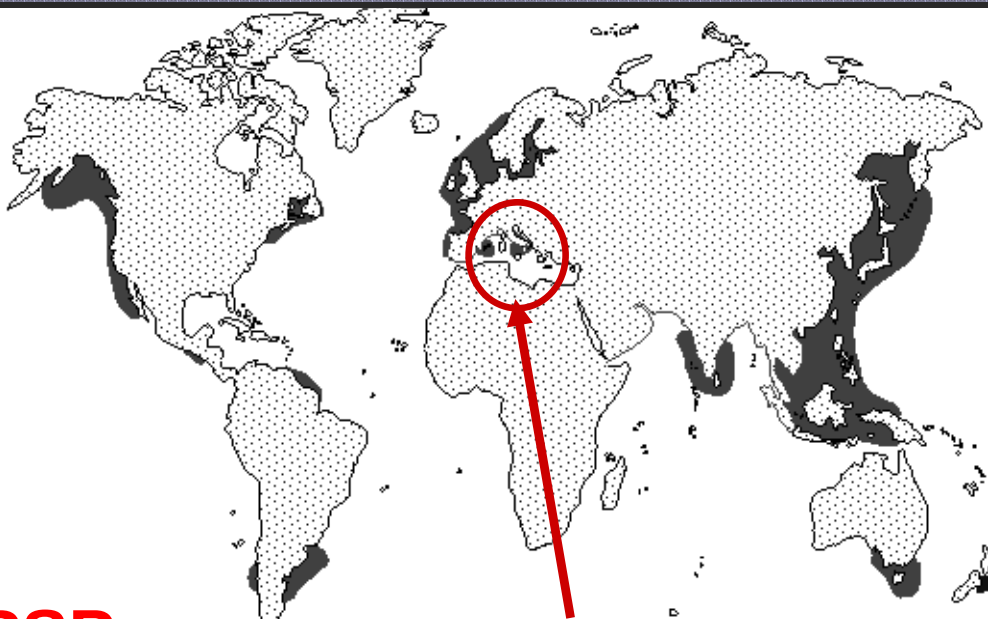
Danni al turismo e all'utilizzo ricreazionale delle coste

Discolorazione delle acque, produzione di schiume, odori ecc.

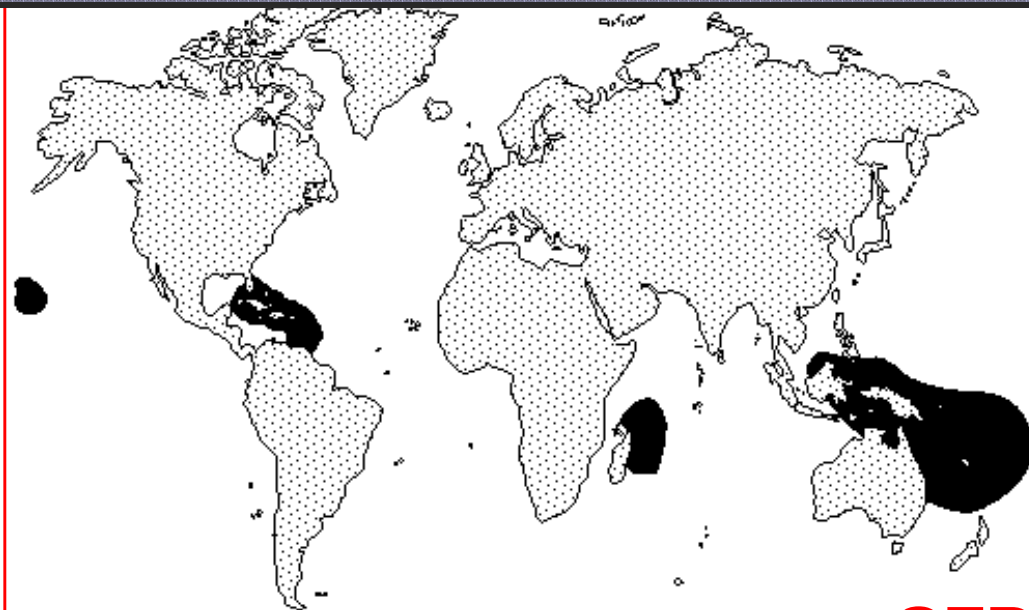
Danni agli ecosistemi acquatici

Degrado ambientale, scarsa ossigenazione dei fondi

DOVE SI SONO VERIFICATI CASI DI INTOSSICAZIONI DA ALGHE



PSP



CFP

Anche lungo le coste italiane !!!



DSP



NSP

Ann. 43/ BK 3

JOURNAL OF

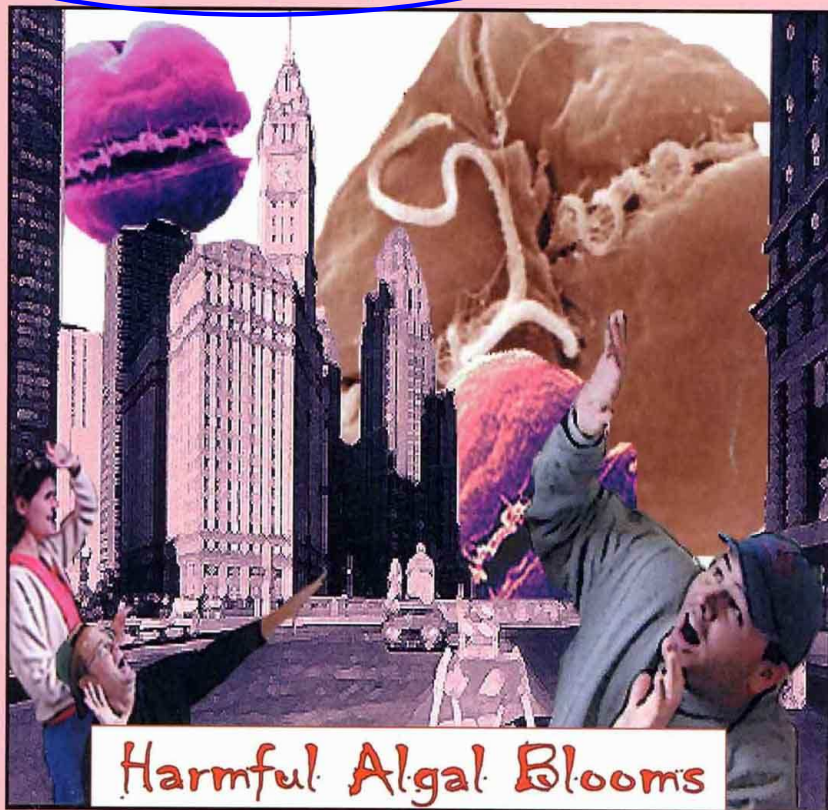
VOLUME 35
NUMBER 6
SUPPLEMENT

PHYCOLOGY

A Bimonthly of the Phycological Society of America
www.allenpress.com/jphycol



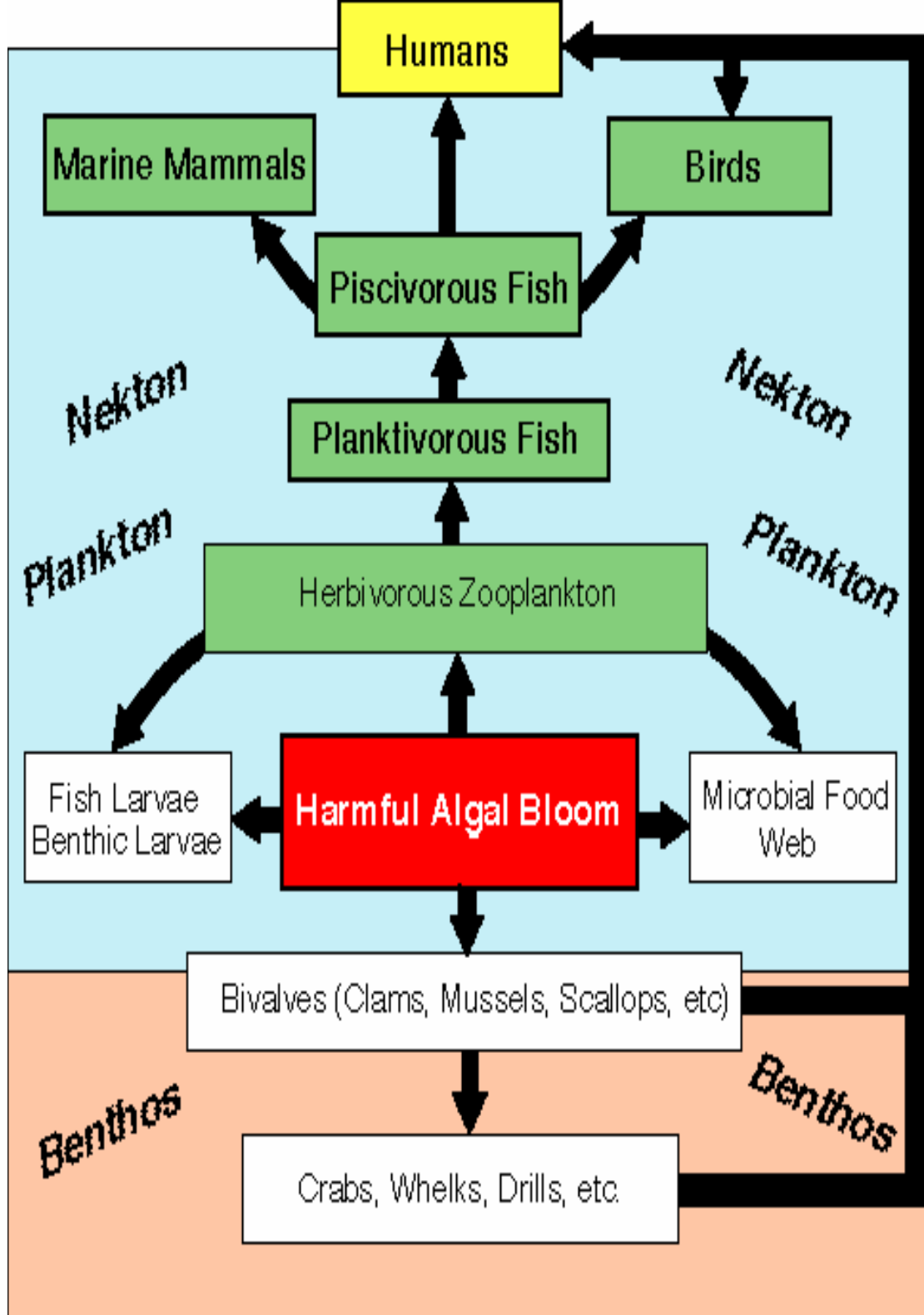
a phycological phenomenon with attitude
coming to a bay near you



a special supplement of the Journal of Phycology
special editors Oscar Schofield, David Millie, & Gary Kirkpatrick

Questi fenomeni sono oggi
sempre più studiati perché:

- DI NOTEVOLE INTERESSE SCIENTIFICO
- IN RELAZIONE AI CAMBIAMENTI CLIMATICI
- SONO CAUSATI DA EUTROFIZZAZIONE DELLE ACQUE
- DERIVANO SPESSO DA FORME PRESENTI NELLE ACQUE DI ZAVORRA DELLE NAVI
- SI DIFFONDONO GRAZIE AL TRASPORTO DI STOCKS DI MOLLUSCHI DA ALTRI PAESI
- HANNO IMPATTO SULLO SFRUTTAMENTO DELLE ACQUE COSTIERE

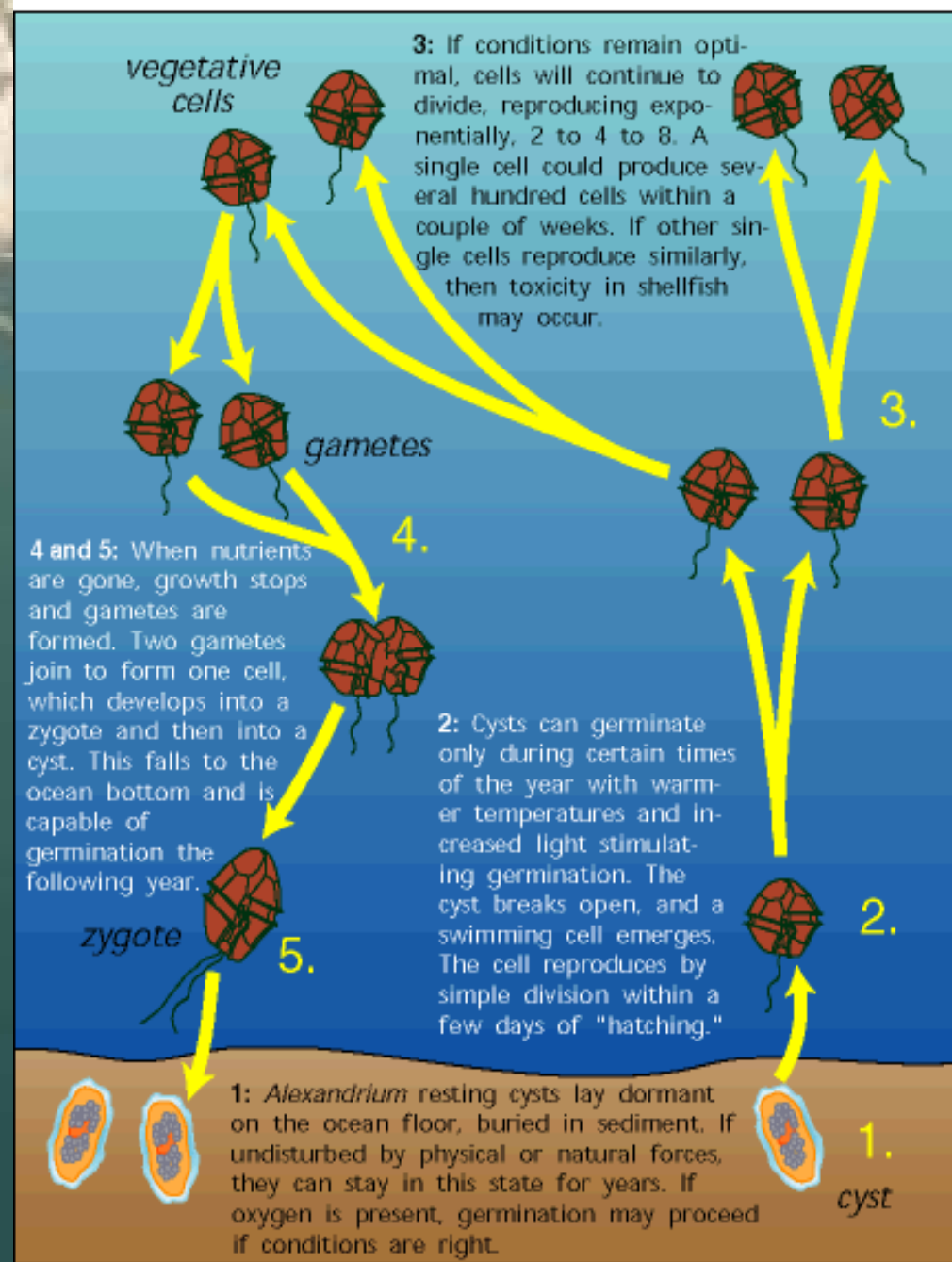


Le microalghe tossiche formano spesso fioriture “*blooms*”

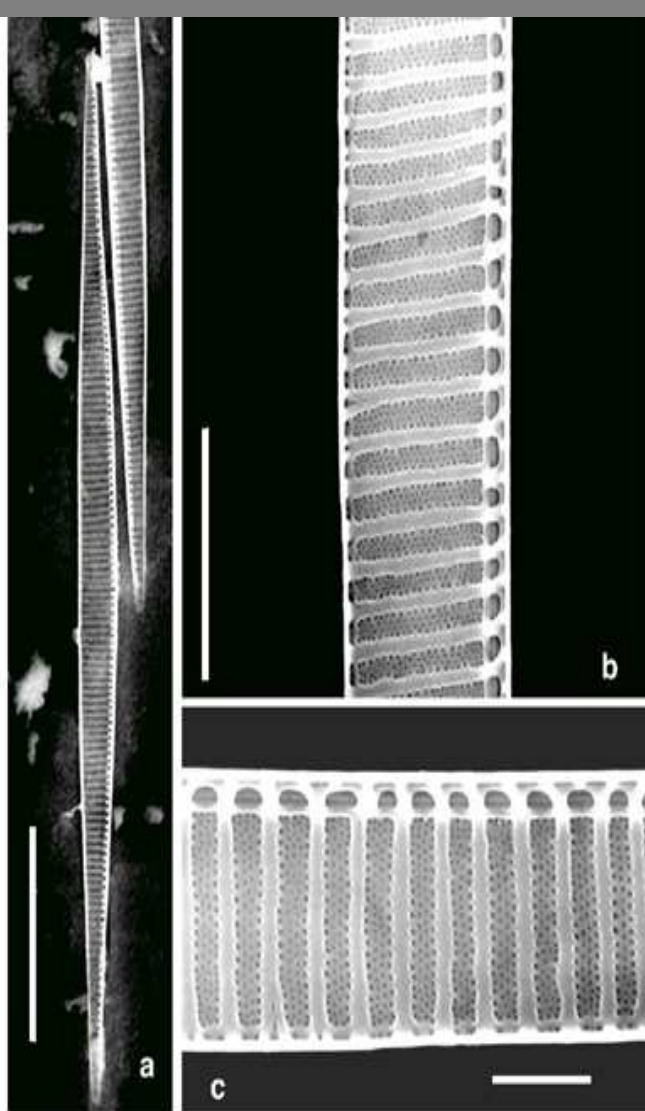
Appartengono a vari gruppi tassonomici alcuni dei quali richiedono l'uso della microscopia elettronica (SEM, TEM) o analisi molecolari per l'identificazione rendendo così molto complesse le attività di monitoraggio e controllo delle acque

How a Toxic Algal Bloom Occurs

The life cycle of one cell

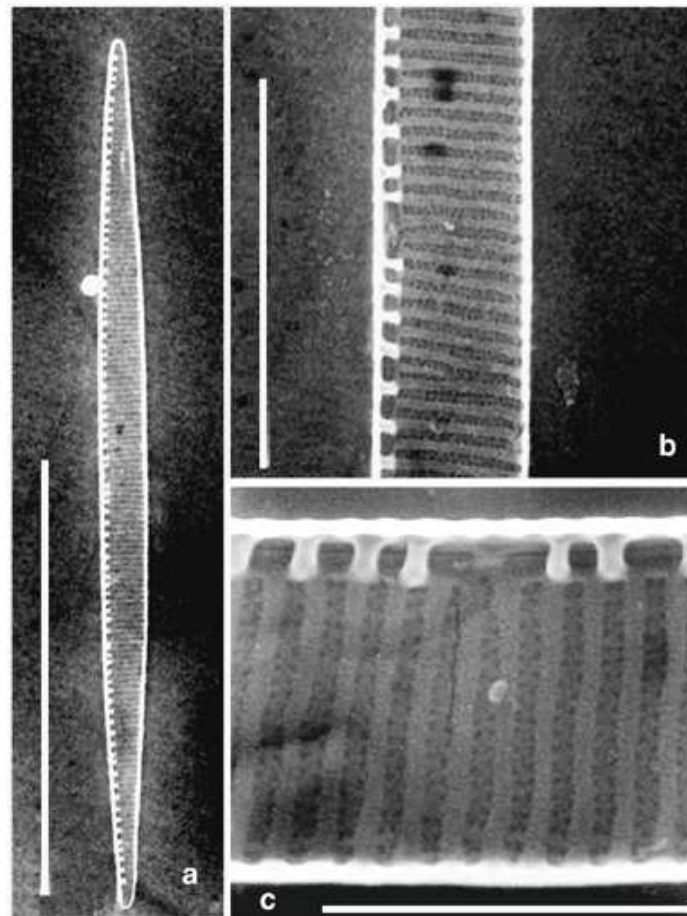


Toxic
Pseudo-nitzschia

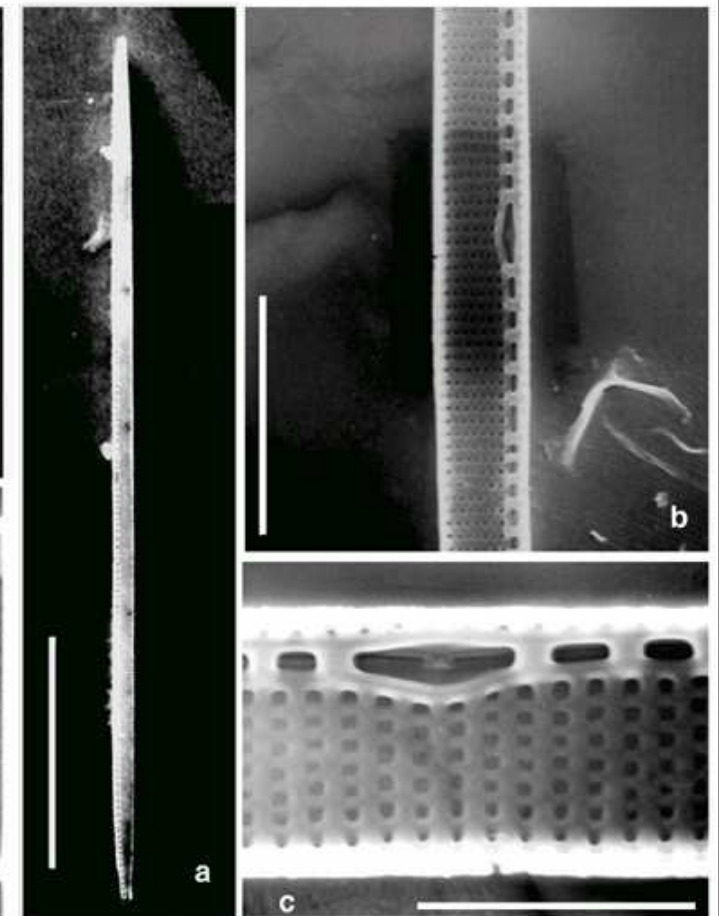


Pseudonitzschia multiseries

ASP



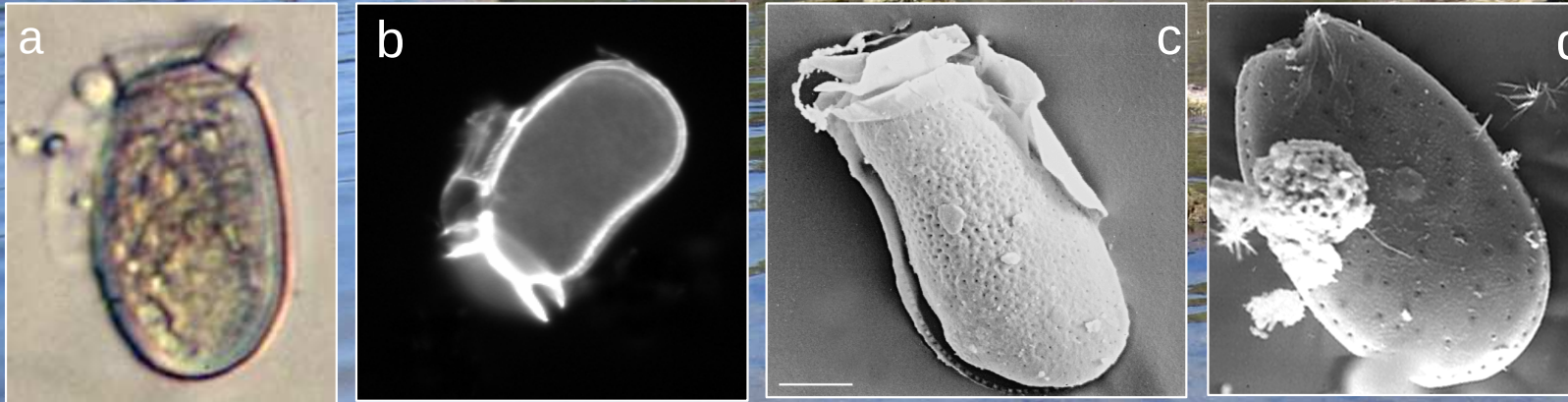
Pseudonitzschia delicatissima



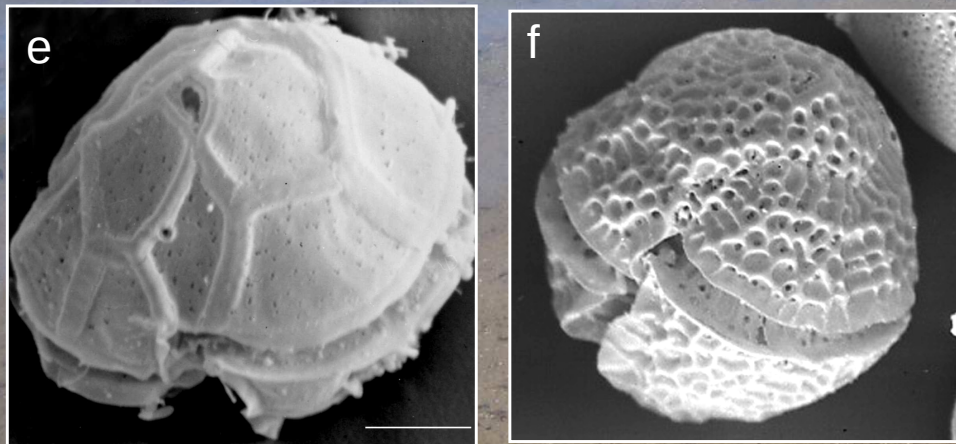
Pseudonitzschia pseudodelicatissima

DINOFLAGELLATI RESPONSABILI DI INTOSSICAZIONI IN ITALIA

Dinophysis (a-c), *Phalacroma* e *Prorocentrum* (d) - DSP



Alexandrium (e, f), *Gymnodinium catenatum*, *Pyrodinium* - PSP



Le specie bentoniche *Ostreopsis* spp. (g) e *Coolia monotis* sono ritenute responsabili di morie di animali e di sindromi respiratorie e dermatiti nell'uomo





www. bentoxnet.it



HARMFUL ALGAE NEWS

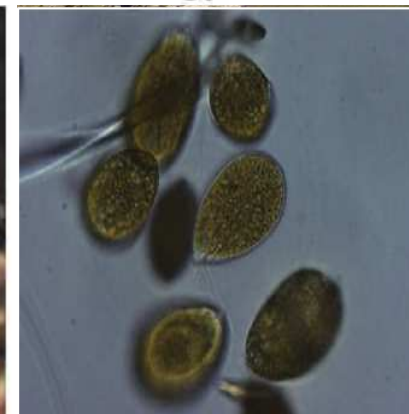
An IOC Newsletter on toxic algae and algal blooms

<http://ioc.unesco.org/hab/news.htm>

No. 33

• Italy

Behavioural trait of *Ostreopsis ovata* (Dinophyceae) in Mediterranean rock pools: the spider's strategy



or a *Ostreopsis ovata* cell contributing to the formation of entires

[Barone, 2007]

inous networks.

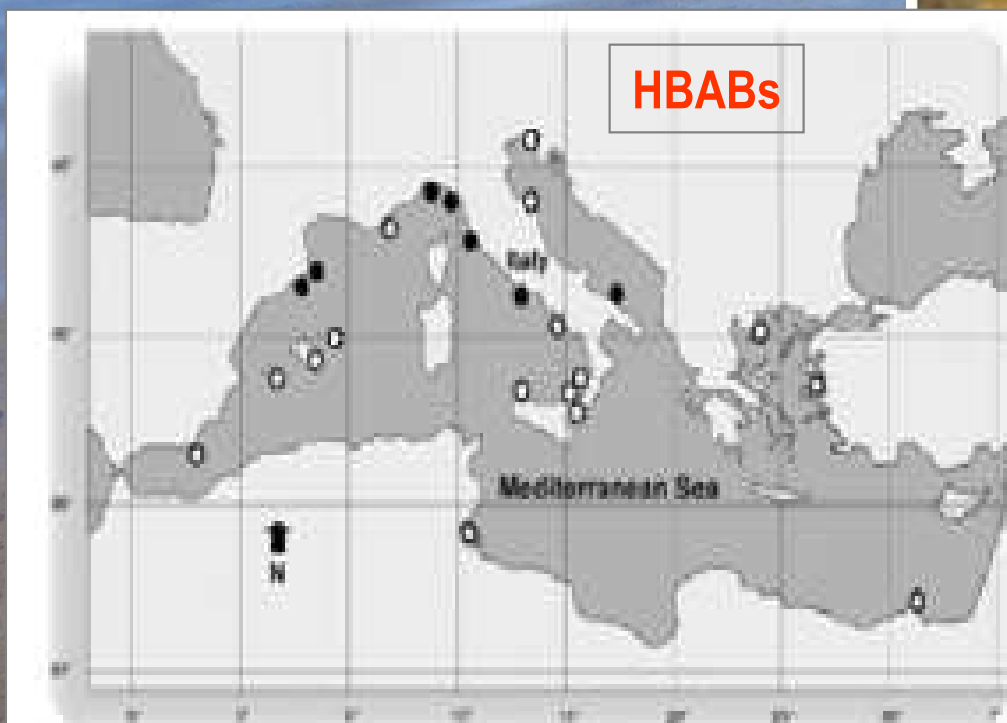
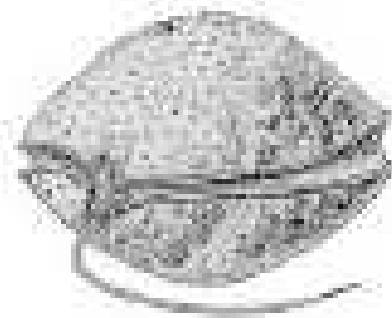


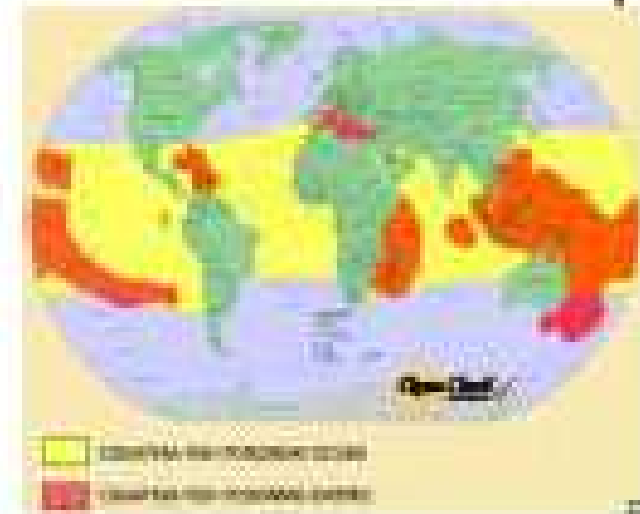
Figure 2. Map of Mediterranean localities where *Ostreopsis* spp. have been detected. Pull circles mark sites where problems have been reported.

Another Toxic Dinoflagellate:

- Ciguatera fish poisoning
- Affects humans who eat fish poisoned by *Gambierdiscus toxicus* accumulated in fish
- Two potent toxins:
 - Ciguatoxins
 - Maitotoxins
- Diarrhea for 2 days, general weakness for 1-2 days after
- Affects 10,000 to 15,000 people annually



- Common in the Tropics



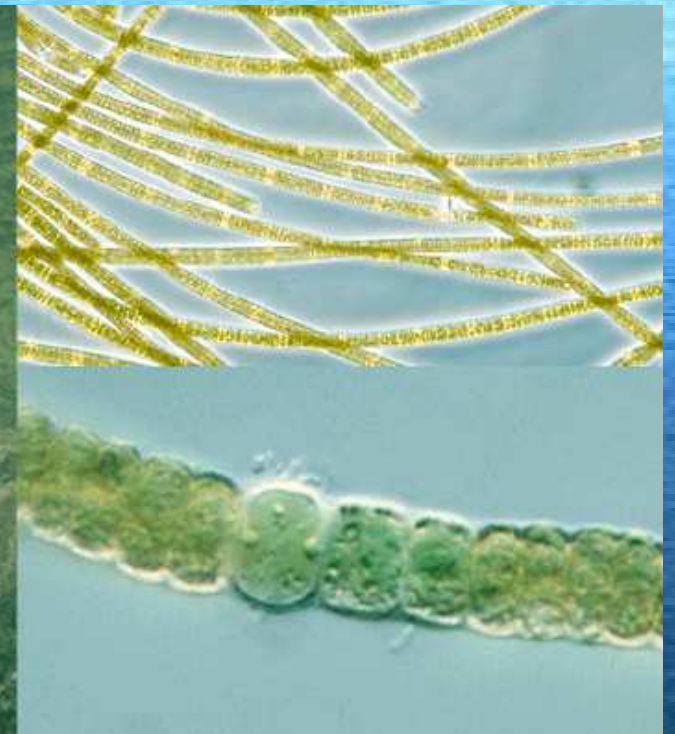
Freshwater blooms of toxic cyanobacteria





Alcuni cianobatteri fitoplanctonici sono produttori di potenti tossine, che accumulandosi lungo la catena trofica raggiungono anche l'uomo. Durante le fioriture spesso formano schiume sulla superficie dell'acqua. Sono riportati molti casi di contaminazione di acque destinate al consumo umano e sindromi umane, anche fatali.

Nodularia



Baltic Sea

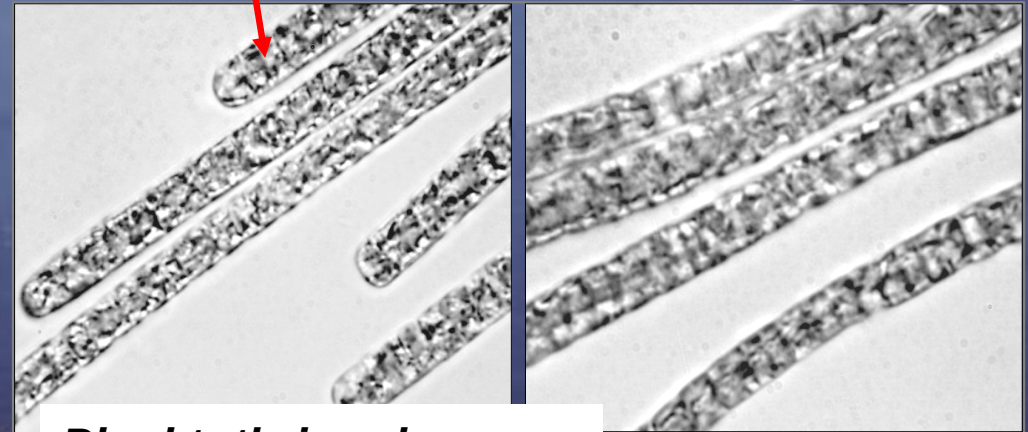
Nodularia bloom

Fioritura di cianobatteri planctonici tossici

Lago di Albano



vescicole gassose



Planktothrix rubescens

QUALI TOSSINE PRODUCONO VARIE SPECIE DI CIANOBATTERI

Epatotossine:

- Microcistine (eptapeptidi ciclici)
- Nodularine (pentapeptidi ciclici)
- Cilindrospermopsine (alcaloidi)

Neurotossine:

- Anatossine (alcaloidi)
- Saxitossine (alcaloidi)

Dermatotossine

- Lyngbyatoxin
- Aplisiatossine

On Canadian coasts *Lyngbya*
bloom covered 30 km² in
March 2000

