

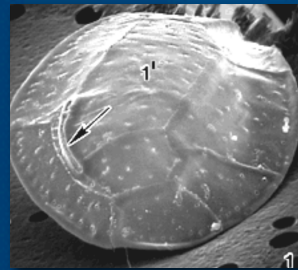


Harmful benthic algal species in the Mediterranean Sea: genetic diversity and ecological aspects

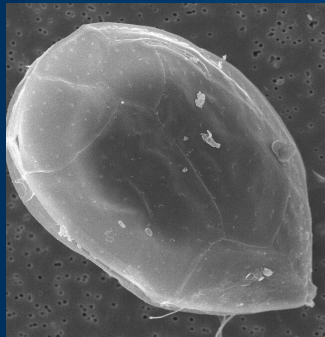
Antonella Penna

Environmental Biology, Dep. Biomolecular Sciences,
University of Urbino, Italy
email: antonella.penna@uniurb.it

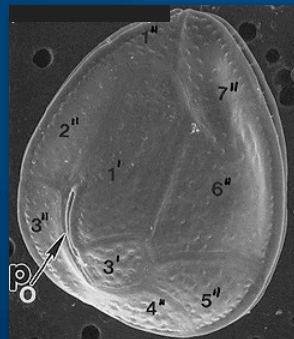
benthic *Ostreopsis* species



O. lenticularis



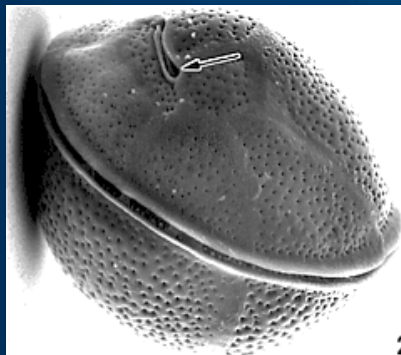
O. cf. ovata



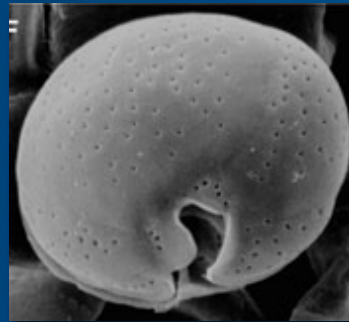
O. labens

Order Gonyaulacales
Family Ostreopsidaceae Lindeman (1928)
Genus *Ostreopsis* Schmidt (1901)

benthic *Coolia* species



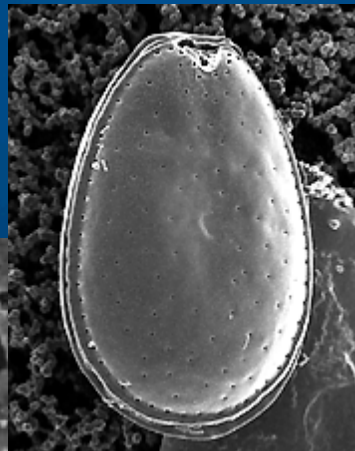
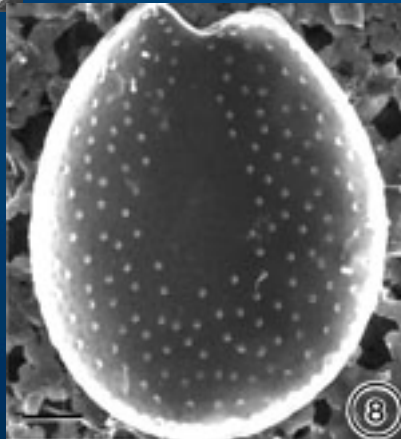
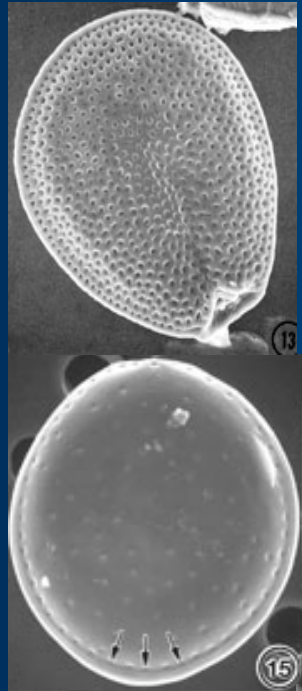
Coolia monotis



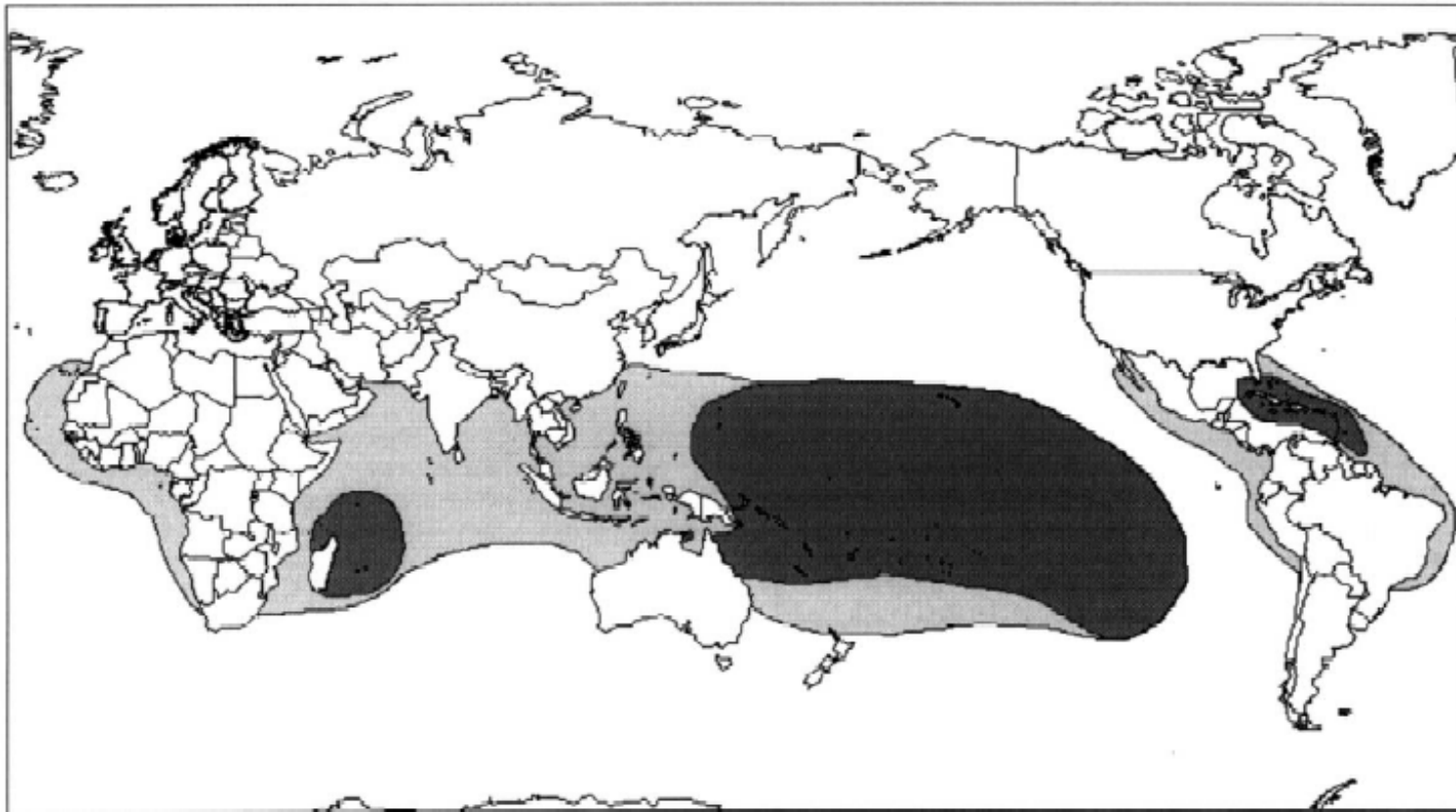
Coolia malayensis

Order Gonyaulacales
Family Ostreopsidaceae Lindeman (1928)
Genus *Coolia* Meunier (1919) Balech (1956)

benthic *Prorocentrum* species



Order Prorocentrales
Family Prorocentraceae
Genus *Prorocentrum* (Ehrenberg)



Geographical distribution of the endemic Ciguatera in the world

Lehane and Lewis, 2000

Ciguateric Dinoflagellate species and their respective toxins

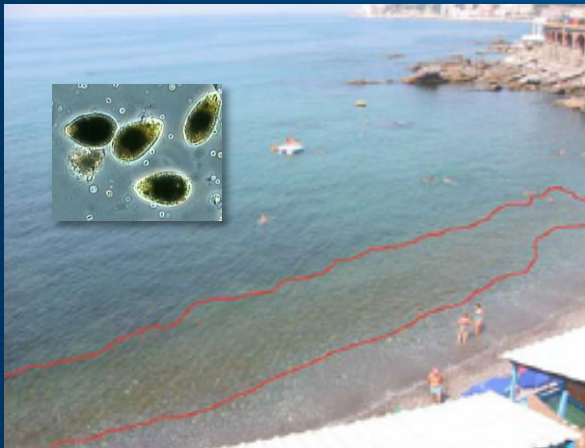
| SPECIES | TOXINS | References |
|------------------------------------|-------------------------------------|--|
| <i>Amphidinium carteri</i> | Hemolysins 1-5 | Yasumoto et al. 1987 |
| <i>Coolia monotis</i> | unnamed | Nakajima et al. 1981 |
| <i>Gambierdiscus toxicus</i> | Ciguatoxins Maitotoxins | Yasumoto et al. 1977 Yokoyama et al. 1988 |
| <i>Ostreopsis heptagona</i> | unnamed | Norris et al. 1985 |
| <i>Ostreopsis lenticularis</i> | Ostreotoxin unnamed | Tindall et al. 1990 Ballantine et al. 1988 |
| <i>Ostreopsis cf. ovata</i> | OVTX a, b,c,d,e | Ciminiello et al. 2006; 2010 Rossi et al. 2010 |
| <i>Ostreopsis cf. siamensis</i> | Ostreocin D | Ukena et al. 2001 |
| <i>Prorocentrum lima</i> | FAT Okadaic acid Prorocentrolide | Tindall et al. 1990 Murakami et al. 1982 Torigoe et al. 1988 |

- *Ostreopsis* is a benthic dinoflagellate which produces potent biotoxins
- The genus *Ostreopsis* has recently been receiving greater attention from researchers and public authorities, since its proliferation has been associated with human intoxication by toxic aerosols along the western Mediterranean coasts

NEW INVASIVE SPECIES IN THE MEDITERRANEAN SEA

Toxic Benthic Dinoflagellates

Invasive high density species
abundance $10^5 - 10^6$ cells g fw⁻¹



- *Ostreopsis* spp. occurrence summer-autumn periods
- Epiphytic on soft and hard substrata
- Blooms with toxic aerosol
- High biomass proliferation, biofilm or mucilage
 - Human intoxication
- Water quality deterioration
- Benthic communities suffering or mortalities
- Bivalve PLTX - contamination

Oceanic Climate Change

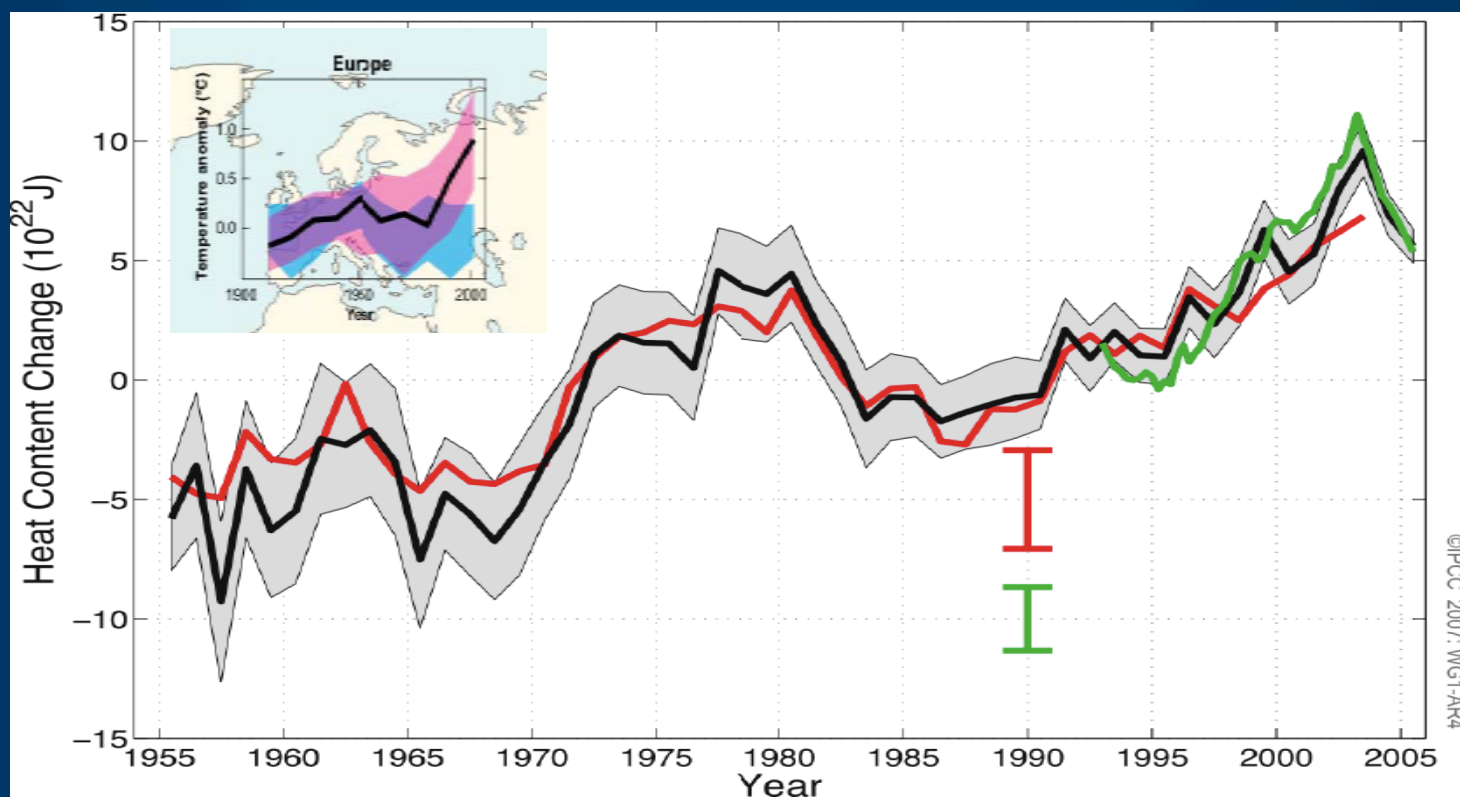
- Changes in Ocean Salinity, Temperature, Heat Uptake, Heat Content
- Biogeochemical Tracers
- Changes in Ocean Circulation and Water Mass Formation

Increase in sea water temperature

CIGUATERA

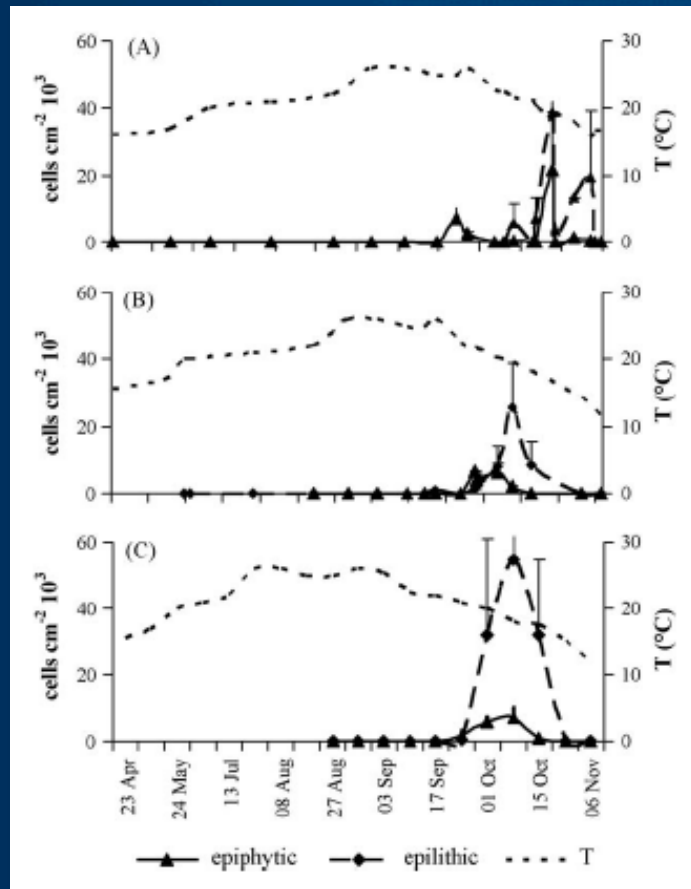
- Expansion in distribution of warm water species (Mediterranean Sea)
 - Ciguatera and coral bleaching (tropical/subtropical areas)

Ocean heat content increasing



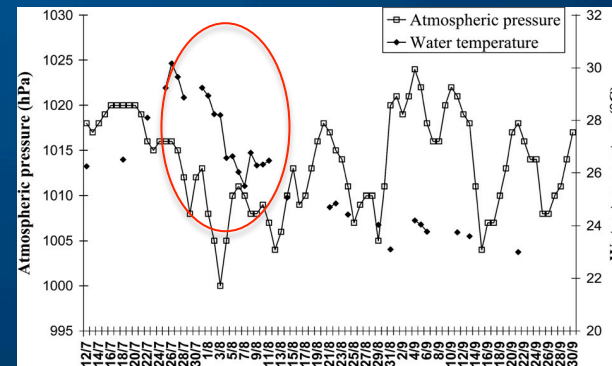
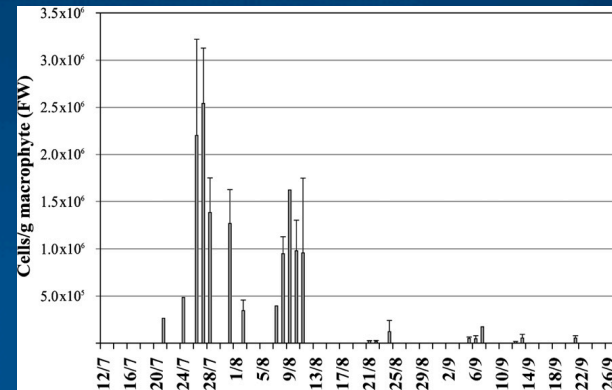
©IPCC 2007: WG1-AR4

Ostreopsis cell concentration and temperature trends at Conero Riviera during summer 2007 Adriatic Sea



Totti et al. 2010 Harmful Algae

Ostreopsis cell concentration at Genova coastline during summer 2006 Tyrrhenian Sea



Mangialajo et al. 2008 Mar. Poll. Bull.

Few identified genetic species as

O. cf. ovata,
O. cf. siamensis,
O. lenticularis,
O. labens

were analysed based on the phylogeny and nucleotide diversity at inter and intra species level at the Mediterranean area.

Genetic References

C. Battocchi, C. Totti, M. Vila, M. Masò, S. Capellacci, S. Accoroni, A. Renè, M. Scardi, A. Penna **2010**. Monitoring toxic microalgae *Ostreopsis* (dinoflagellate) species in coastal waters of the Mediterranean Sea using molecular PCR-based assay combined with light microscopy. **Marine Pollution Bulletin** 60: 1074-1084

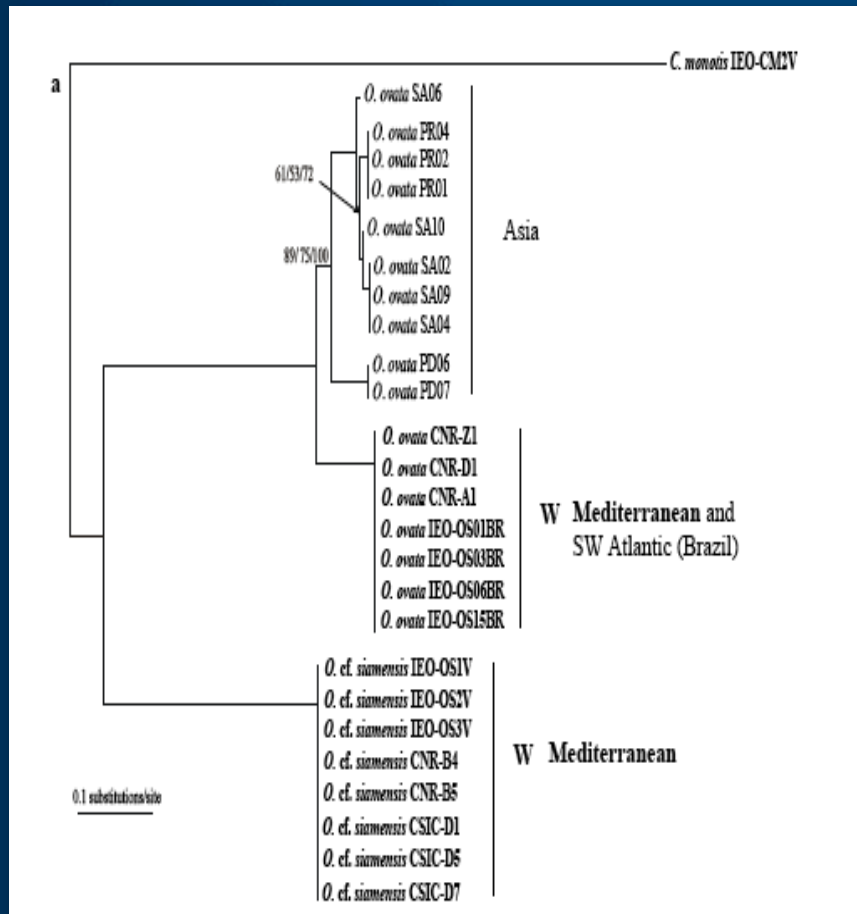
A. Penna, S. Fraga, C. Battocchi, S. Casabianca, M.G. Giacobbe. **2010**. A phylogeographical study of the toxic benthic dinoflagellate genus *Ostreopsis* Schmidt. **Journal of Biogeography** 37: 830-841.

A. Penna, M. Vila, S. Fraga, M.G. Giacobbe, F. Andreoni, P. Riobò, C. Vernesi. **2005**. Characterization of *Ostreopsis* and *Coolia* (Dinophyceae) isolates in the Western Mediterranean Sea based on morphology, toxicity and ITS-5.8S rDNA sequences. **Journal of Phycology** 41: 212-225.

C.P. Leaw, P.T. Lim, A. Asmat, G. Usup. **2001**. Genetic diversity of *Ostreopsis ovata* (Dinophyceae) from Malaysia. **Marine Biotechnology** 3: 246-255.

Phylogenetic analyses within genus

ML tree ITS-5.8S rDNA



Penna et al. *J. Phycol.* 2005

Morphological and morphometric characters are high variable in cultured specimens and field material

- Previous morphological observations of Mediterranean isolates fitted well with the original description of *O. ovata* by Fukuyo and *O. siamensis* by Schmidt.
- Phylogenetic analyses based on 5.8S rDNA and ITS confirmed the clustering of isolates in two distinct species in the Mediterranean Sea.
- Mediterranean/Atlantic clade of *O. cf. ovata* is well separated from Asian clade.
- Mediterranean/Atlantic and Asian clades of *O. cf. ovata* evolved independently based on the molecular diversity index.

PROJECT "***OSTREOPSIS* cf. *OVATA* AND *OSTREOPSIS* SPP.: NEW RISKS OF TOXICITY FROM MICROALGAL BLOOMS IN THE ITALIANS SEAS**"

Project coordinator: **ISPRA** – National Institute for Environmental Protection and Research (PI: Erika Magaletti and Michele Giani)
supported by the **Italian Ministry of Environment**

Duration period: 2009-2010

Project **"MARINE BIOTOXINS IN ITALIAN COASTAL WATERS: CHARACTERISTICS, ORIGIN, ACTIONS "**
 supported by the Italian **MIUR** (grant 2007FXSCL2)

Teams involved:

MO, University of Modena - Reggio Emilia

AN, University Politecnica of Marche

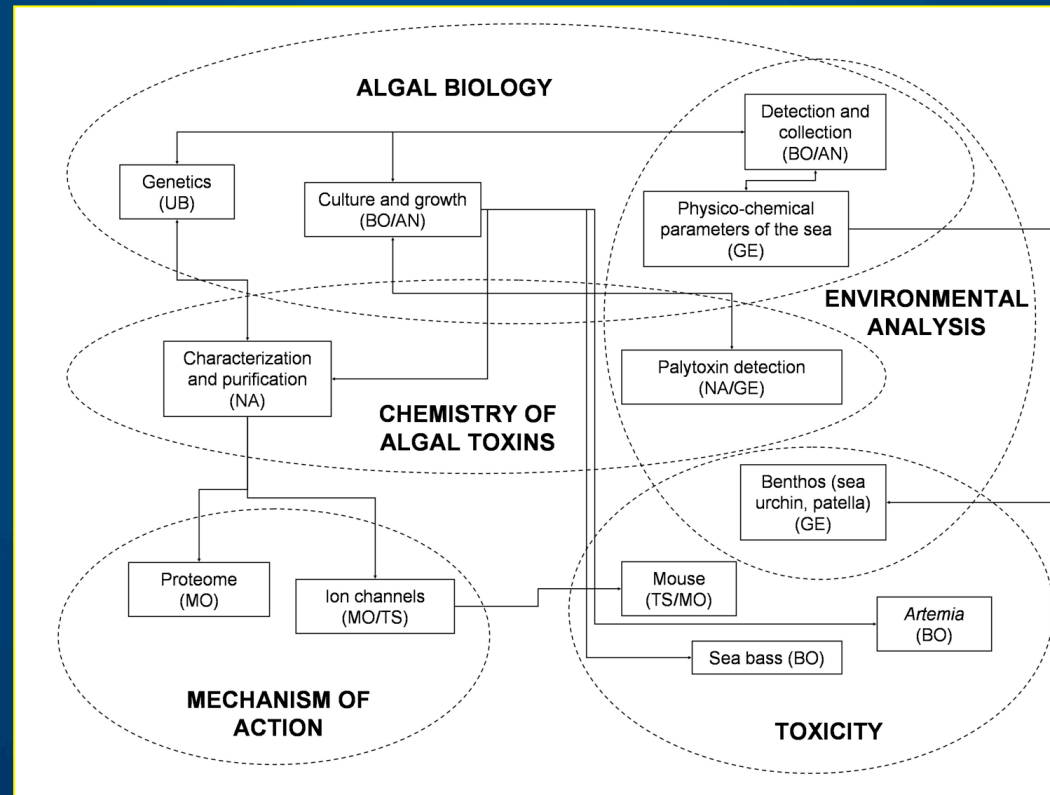
GE, University of Genova

NA, University of Napoli "Federico II"

TS, University of Trieste;

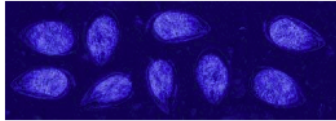
BO, University of Bologna

UB, University of Urbino "Carlo Bo"



Website: www.bentoxnet.it

email: info@bentoxnet.it

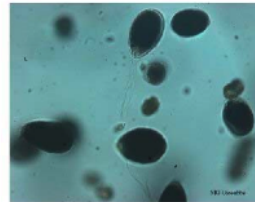


BENTOX-NET

A network for the study of *Ostreopsis* spp. and other potentially toxic benthic microalgae

- [Home](#)
- [Ostreopsis and other HBABs](#)
- [Participants](#)
- [Aims](#)
- [Research](#)
- [Literature](#)
- [News](#)
- [Links](#)
- [Contacts](#)

BENTOX-NET is a network of Italian researchers with sound experience in the study of phytoplankton blooms, including those caused by harmful and toxic microalgae. Expertise is also available in the fields of marine macroalgae, ecology of planktonic and benthic ecosystems and algal toxins. The network aims at improving knowledge on all aspects of Harmful Benthic Algae blooms (HBAB).



These phenomena have rather unique, but still scarcely known, features. Their impact on the marine ecosystem and human health can be significant. Since 1998, the requirement of intervention by public officers and scientists has been increasing alarmingly.

Blooms of *Ostreopsis* spp. do not seem to follow the same trends of other blooms, thus leaving many open questions as to their short and long term management activity.



It is therefore urgent to improve the provisional and protection strategies in the coastal areas where these blooms occur, especially in cases of particular high intensity and impact risk (health and economic). To this end, it is also important to identify the areas and periods of the year of high risk, in order to be able to mitigate problems and implement adequate plans to protect human health and coastal marine environments.

Adequate management of environmental and public health emergencies caused by Harmful Algal Blooms requires a thorough knowledge of these phenomena and their consequences. BENTOX-NET is a tool to optimise the use of the available knowledge, through a rapid dissemination of the relevant information. The aim is to organise a national multidisciplinary research program to quickly provide the information to better manage the problems caused by HBABs. The gathered information will include the distribution, ecology and physiology of the responsible organisms.

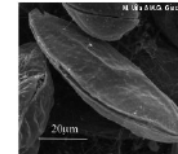
Participants

- * Roberta Congesti, Patrizia Albertano, Michele Scardi
Università di Roma "Tor Vergata"
- * Antonella Penna, Centro Biologia Ambientale, Università di Urbino
- * Adriana Zingone, Diana Sarno, Stazione Zoologica "A. Dohrn" di Napoli
- * Maria Grazia Giacobbe, Istituto per l'Ambiente Marino Costiero, CNR, Messina
- * Cecilia Totti, Scienze del Mare, Università Politecnica delle Marche, Ancona
- * Caterina Nuccio, Università di Firenze
- * Patrizia Ciminiello, Ernesto Fattorusso, Università di Napoli "Federico II"
- * Antonella Lugliè, Giulia Seccherelli, Università di Sassari
- * Antonella Bottalico, Dipartimento di Biologia e Patologia Vegetale, Università di Bari
- * Mauro Bastianini, Giorgio Socal, ISMAR CNR, Istituto Scienze Marine, Venezia
- * Claudio Grillo, Nunzia Melchiorre, ARPAL, UO Laboratori e R.M., Dip. La Spezia
- * Roberto Poletti, Marnella Pompei, Centro Ricerche Marine, Cesenatico
- * Rossella Pistocchi, Franca Guernini, Università di Bologna, Ravenna
- * Monica Casotti, A.R.P.A.T., Massa Carrara
- * Carmela Caroppo, Fernando Rubino, IAMC-C.N.R., Sez. Talassografico Taranto
- * Rossella Barouse, Dipartimento di Scienze Botaniche, Università di Palermo
- * Marina Cabrini, Marina Mouti, Alfred Beran, Istituto di Oceanografia e Geofisica Sperimentale (OGS), Trieste
- * Luisa Mangialajo, Chiara Chiantore,
Dipartimento per lo Studio del Territorio e delle sue Risorse, Università di Genova
- * Aurelia Tubaro, DEMREP, Università di Trieste
- * Giorgio Houssel, Biologia ed Economia Agro-Industriale, Università di Udine

Contacts

BENTOX-NET is coordinated by:

- * **Roberta Congesti**
Dipartimento di Biologia
Università di Roma "Tor Vergata"
- * **Antonella Penna**
Centro Biologia Ambientale
Università di Urbino
- * **Adriana Zingone**
Stazione Zoologica "A. Dohrn" di
Napoli



Website: www.bentoxnet.it

email: info@bentoxnet.it

BENTOX-NET is supported by:



Società Botanica Italiana



Società Italiana di Tossicologia

Some conclusions on benthic harmful algae:

- *Ostreopsis* spp. is not an alien or introduced species into Mediterranean Sea
- *Ostreopsis* is probably an hidden flora along the coasts
- *Ostreopsis* could start blooming under an internal clock and synchronizing environmental factors during recent years
- *Ostreopsis* can be a successful species and blooms under favourable conditions or season competing with the other benthic species (diatoms)

Gambierdiscus sp. nov.: new first record of Ciguateric species in the Mediterranean Sea

- Relatively low abundance levels (<100 cells g⁻¹ fwm)
- Found epiphytically on phaeophytes and rhodophytes

- Detected in Greek waters (South and South East Aegean, Cretan Sea, in summer and autumn months)

Gaps in knowledge:

- resting cysts?
- Is the Mediterranean *Gambierdiscus* an invasion in the Med Sea? **OR**
- It has always been around as a different, more temperate species than the known tropical ones?

Aligizaki et al. 2008. HAN 36, 6-7.

Aligizaki, Nikolaidis, 2008. J. Biol. Res. Thessalon. 9, 75-82.

Caillaud et al. 2010. Mar. Drugs 8, 1838-1907.