

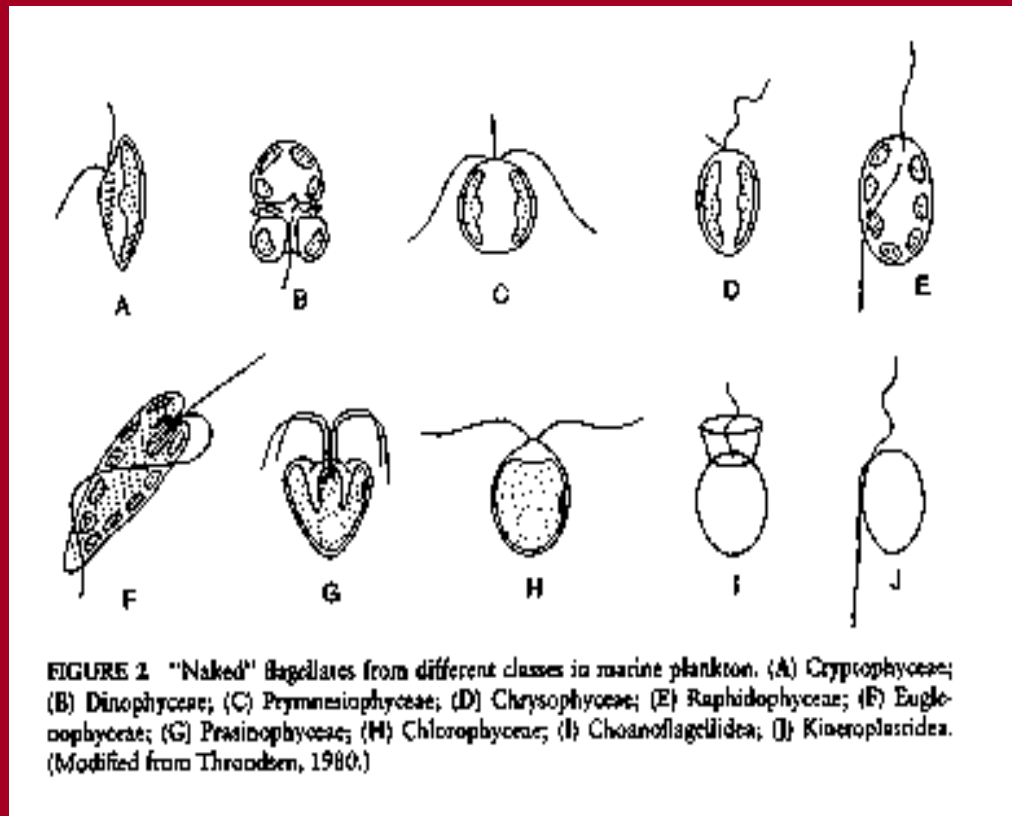
Fitoplâncton do sistema de afloramento Ibérico

M. Teresa Moita



Grupos do fitoplâncton

- Bacillariophyceae (diatomáceas)
- Dinophyceae (dinoflagelados)
- Prymnesiophyceae/ Haptophyceae (cocolitóforos e outros)
- Raphidophyceae
- Euglenophyceae
- Chlorophyceae
- Prasinophyceae
- Crysophyceae
- Dictyochophyceae (silicoflagelados)
- Cryptophyceae
- Cyanophyceae
- Outros



Pigmentos do Fitoplâncton Marinho

Pigmentos	Bacillariophyceae	Dinophyceae	Haptophyceae	Chlorophyceae	Cryptophyceae
Clorofila a	+++ ^e	+++ ^e	+++	+++ ^e	+++ ^e
b				++	
c	++	++	++		++
Caroteno α					+++
β	+++	+++	+++	+++	
γ					
<i>Xantofilas</i>					
Fucoxantina	+++	+	+++		
Neofucoxantina	++		++		
Diadinoxantina	++	++	++		
Diatoxantina	+		+		
Dinoxantina		+			
Peridinina		+++			
Neoperidinina		+			
Luteina				+++	
Zeaxantina				+	
Flavoxantina				+	
Violaxantina				+	
Neoxantina				+	
Aloxantina					+++
Crocoxantina					++
Etc.					

Características Gerais dos Grandes Grupos de Fitoplâncton

Classes	Organização	Cobertura das células	Motilidade	Flagelos	Biótopos	Nutrição
Diatomáceas	unicelulares cadeias	<i>Frústulas</i> : sílica e membrana orgânica	<u>Não</u> <u>Sim</u> : apenas nas células com rafe	Apenas nos gâmetas Γ	Pelágico Bentónico	Autotróficos
Dinoflagelados	unicelulares cadeias	<i>Placas</i> : polissacáridos (celulose, galactose, etc)	<u>Sim</u> : f ^{as} vegetativas <u>Não</u> : f ^{as} quísticas	2 dimórficos	Pelágico Bentónico	Autotróficos Mixotróficos Heterotróficos (fagocíticos, parasitas, etc.)
Cocolitóforos	unicelulares	<i>Cocólitos</i> : Carbonato de cálcio: calcite (esta pode ser substituída por aragonite)	<u>Sim</u> : a maior parte <u>Não</u> : algumas f ^{as} vegetativas e nas f ^{as} filamentosas	2 iguais ou diferentes	Pelágico	Autotróficos Parasitas

Diatomáceas

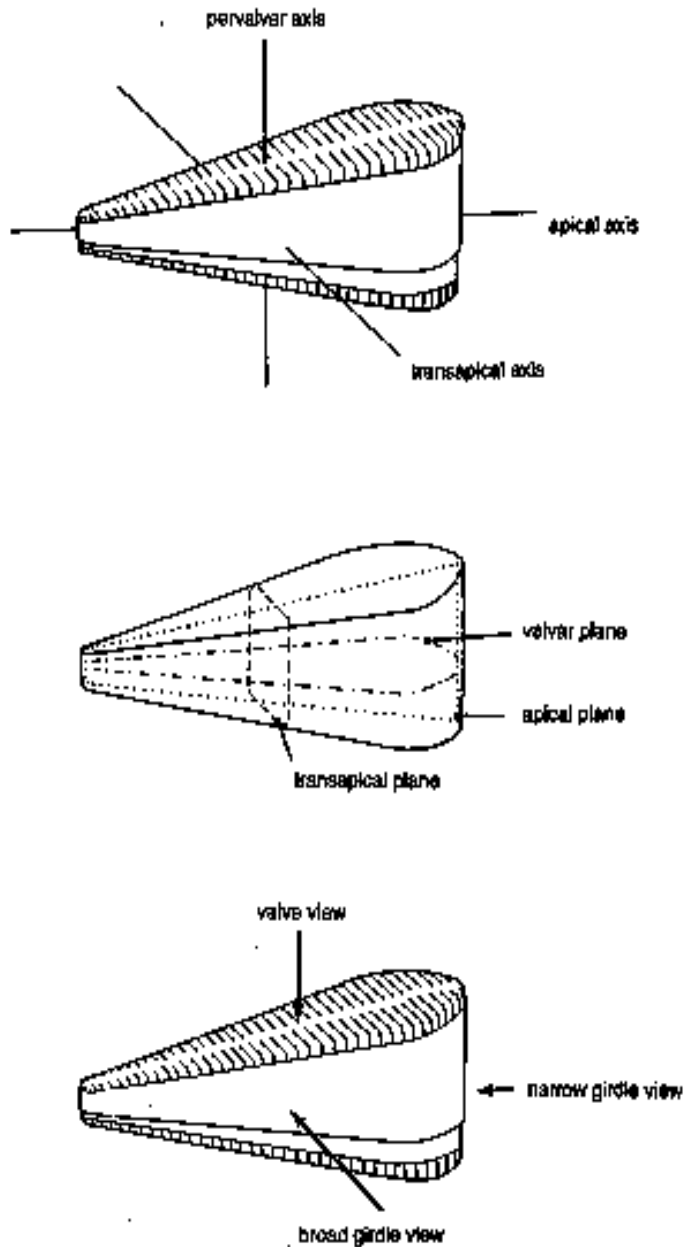
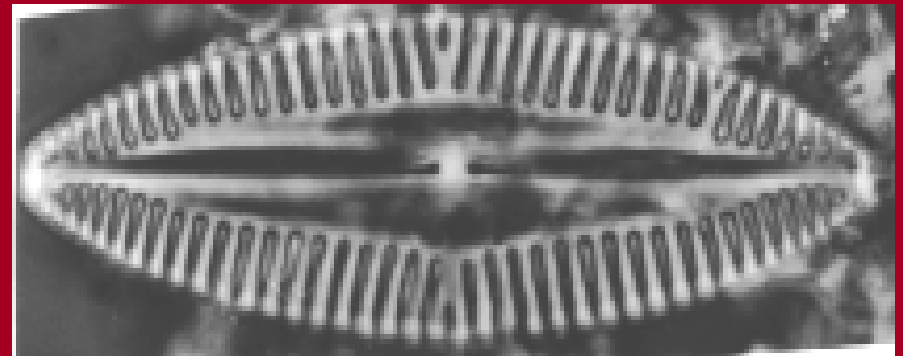
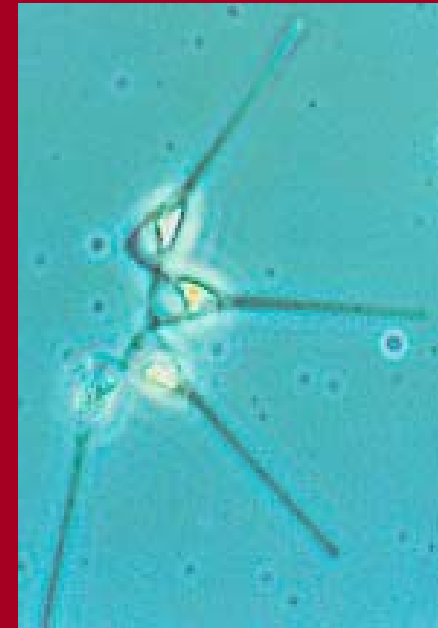
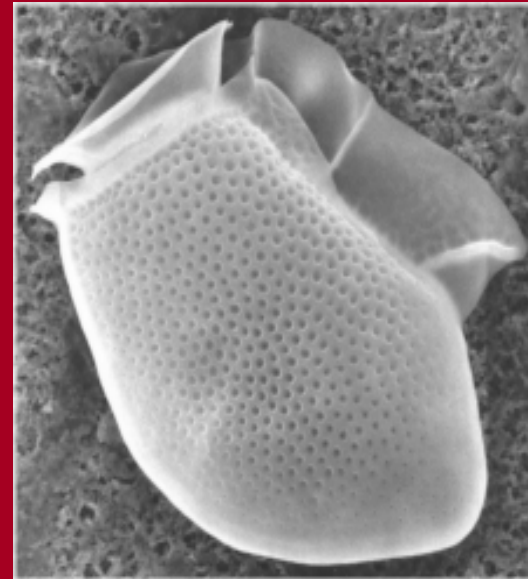
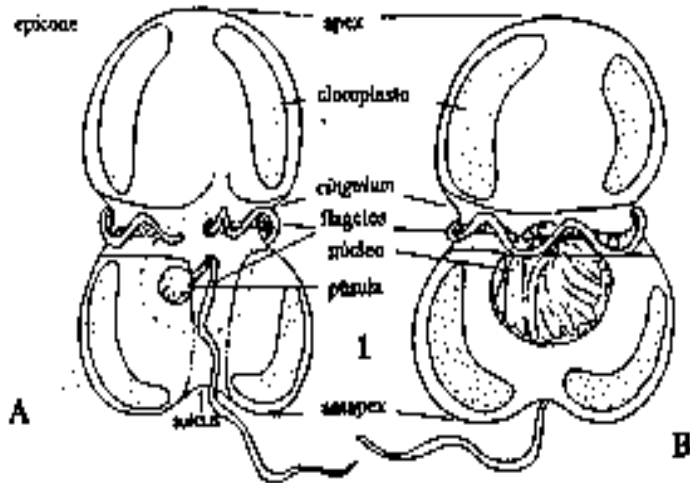


FIGURE 3 Axes and planes of a diatom frustule.

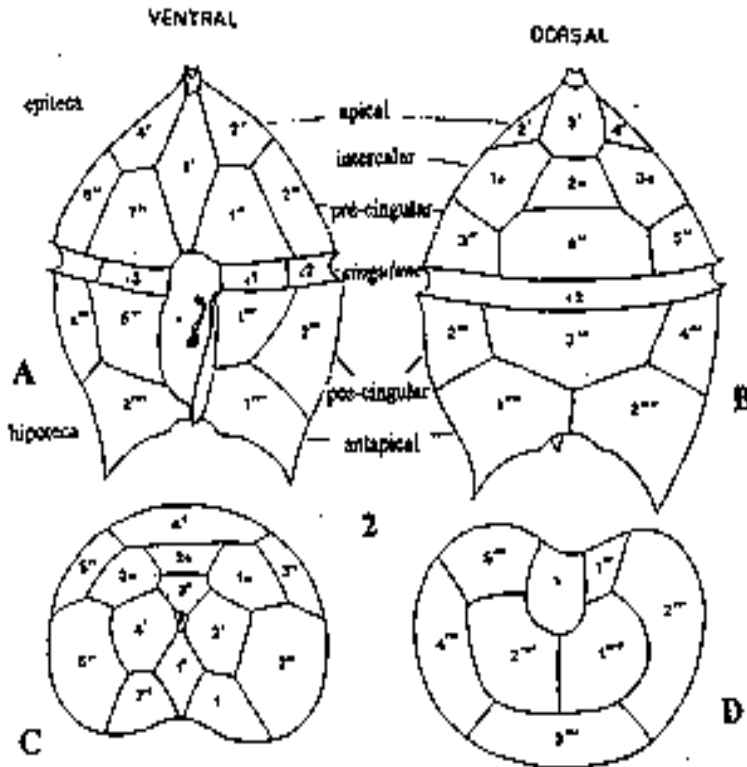


Dinoflagelados

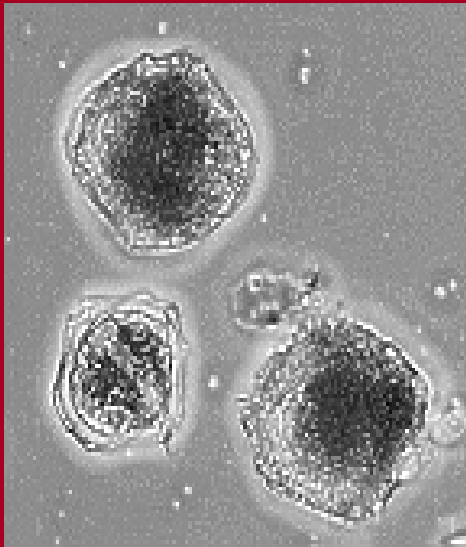


Dinophysis acuta

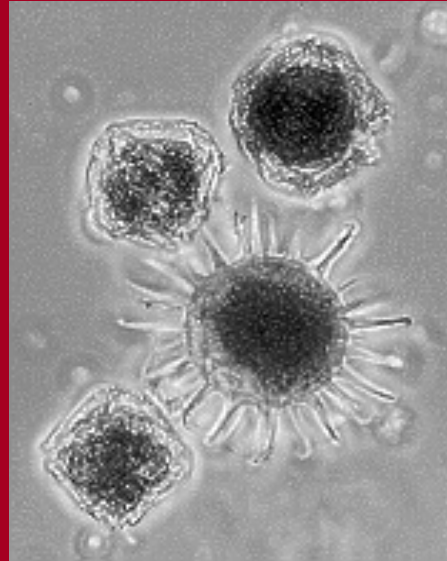
Gymnodinium catenatum



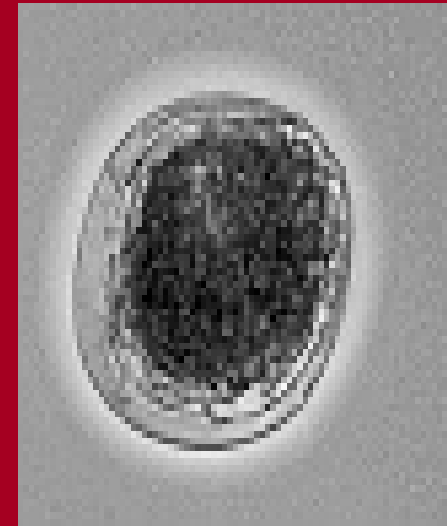
Lingulodinium polyedrum



**Células vegetativas
e gameta (44-45 μm)**

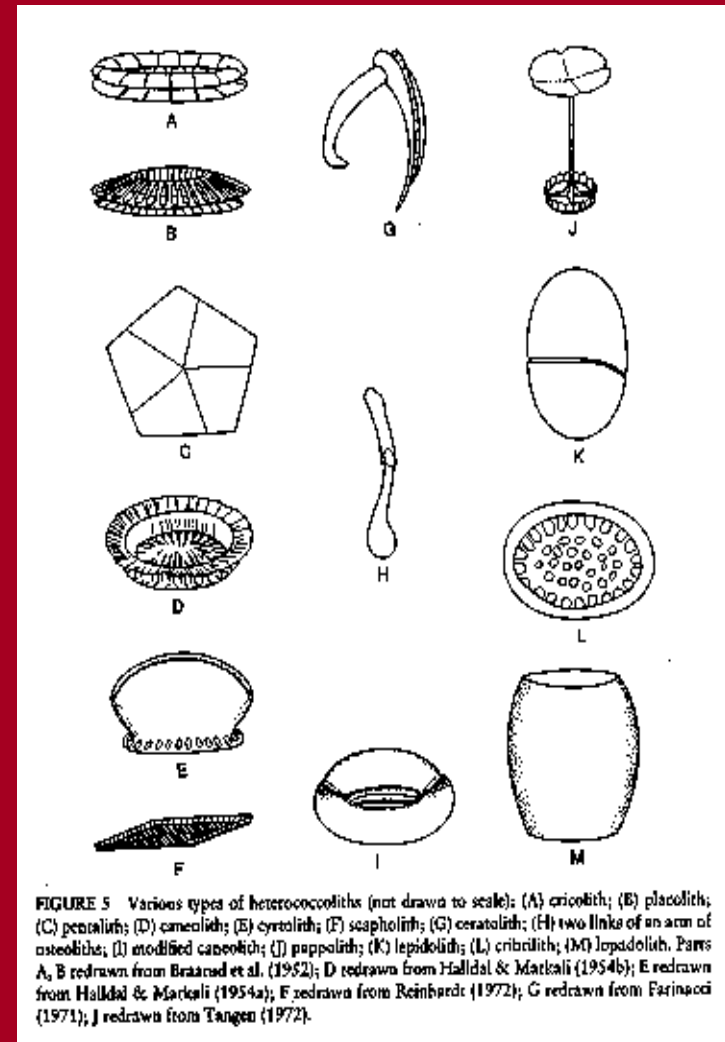
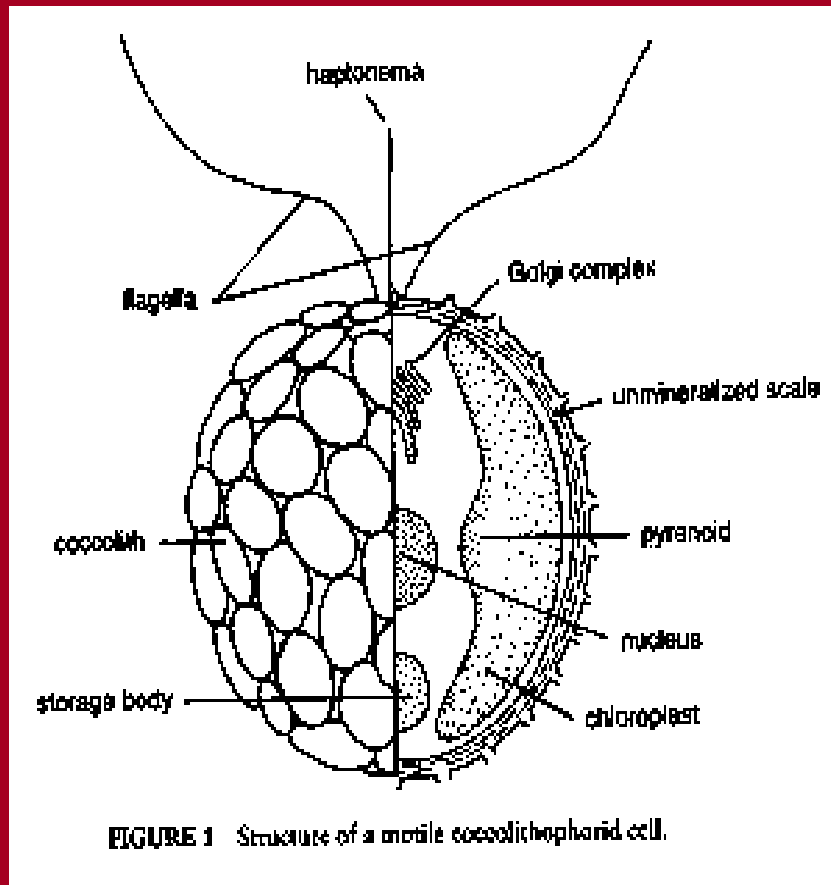


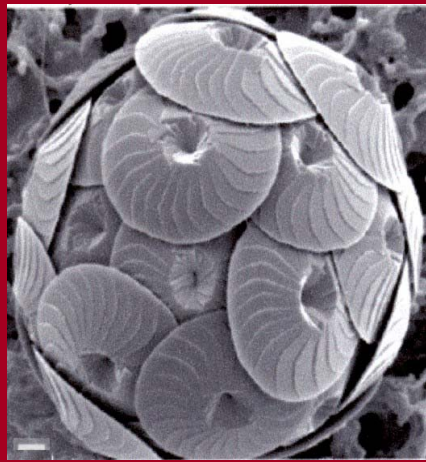
**Hipnozigot
o (47 μm)**



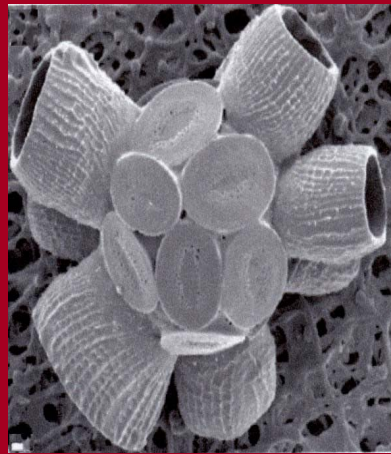
**Estádio de
ecdísia (44
 μm)**

Cocolitóforos

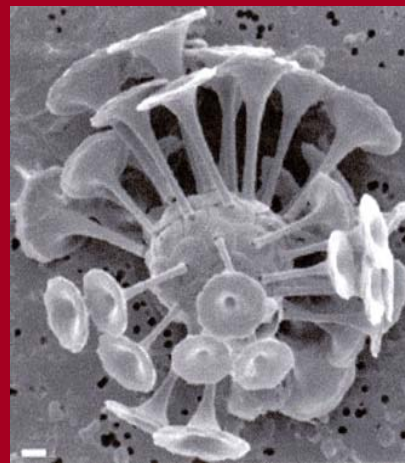




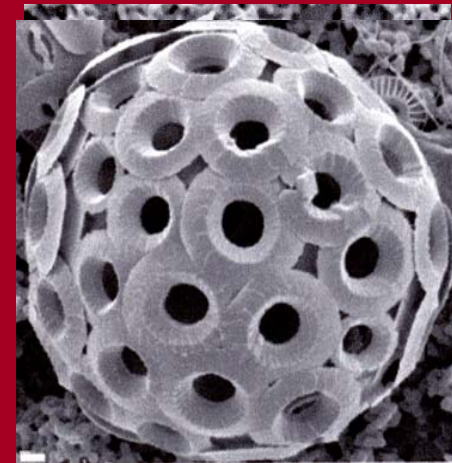
*Calcidiscus
leptoporus*



*Scyphosphaera
apsteinii*



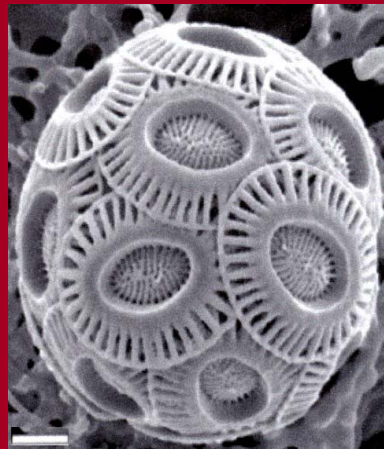
*Discosphaera
tubifer*



*Umbilicosphaera
sibogae*



*Helicosphaera
carteri*



*Emiliana
huxleyi*



*Gephyrocapsa
oceanica*

Estrutura fitoplanctónica no espaço e no tempo

Variabilidade no Espaço

Estrutura horizontal:

Macroscala - >1000km. As fronteiras de variação das espécies, da abundância do fitoplâncton e da variação da produção primária reflecte principalmente os efeitos das principais correntes dos oceanos e da sua interacção com os continentes **Ex: Principais biomas dos oceanos**

Mesoscala - 1-1000km. **Ex: Frentes oceânicas, afloramento costeiro, meandros e anéis da corrente do Golfo**

Microscala - < 1 km. **Ex: "Patchiness"**

Estrutura vertical:

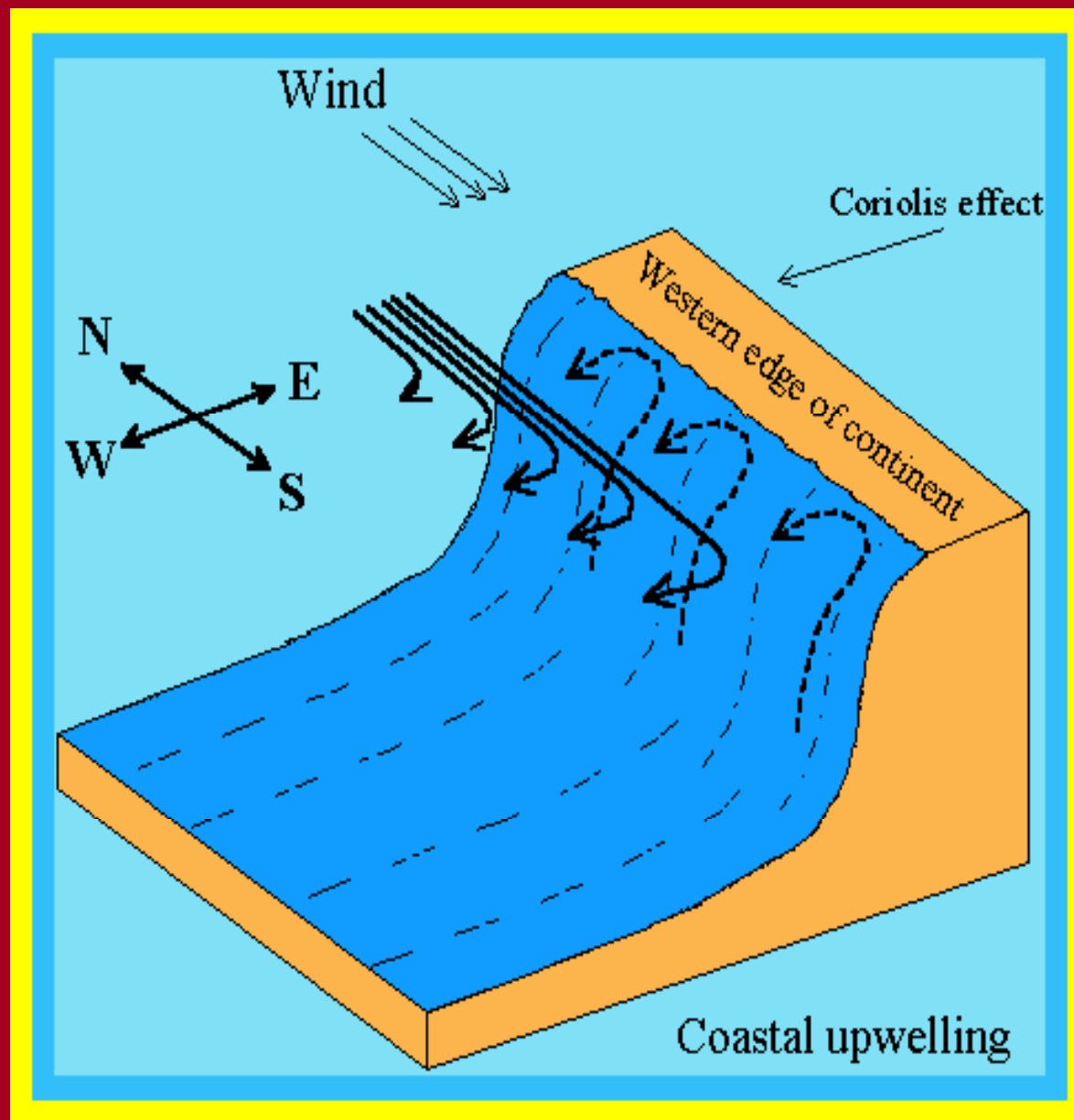
Larga escala -10³m

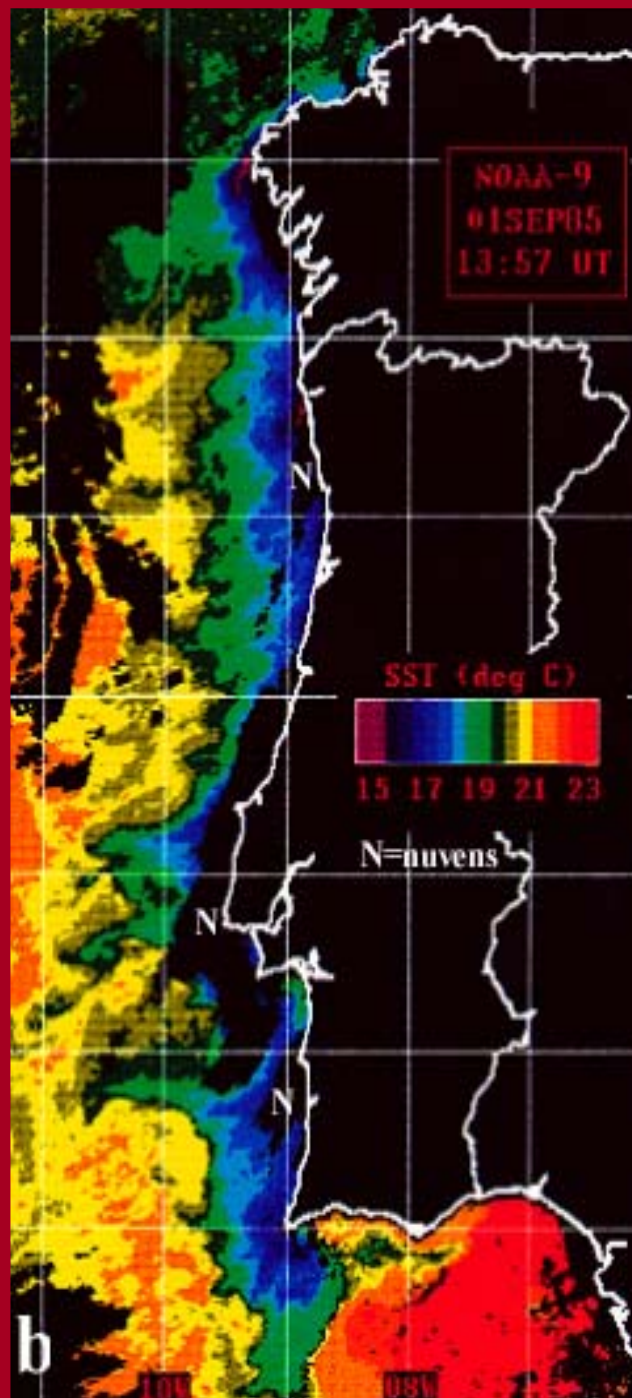
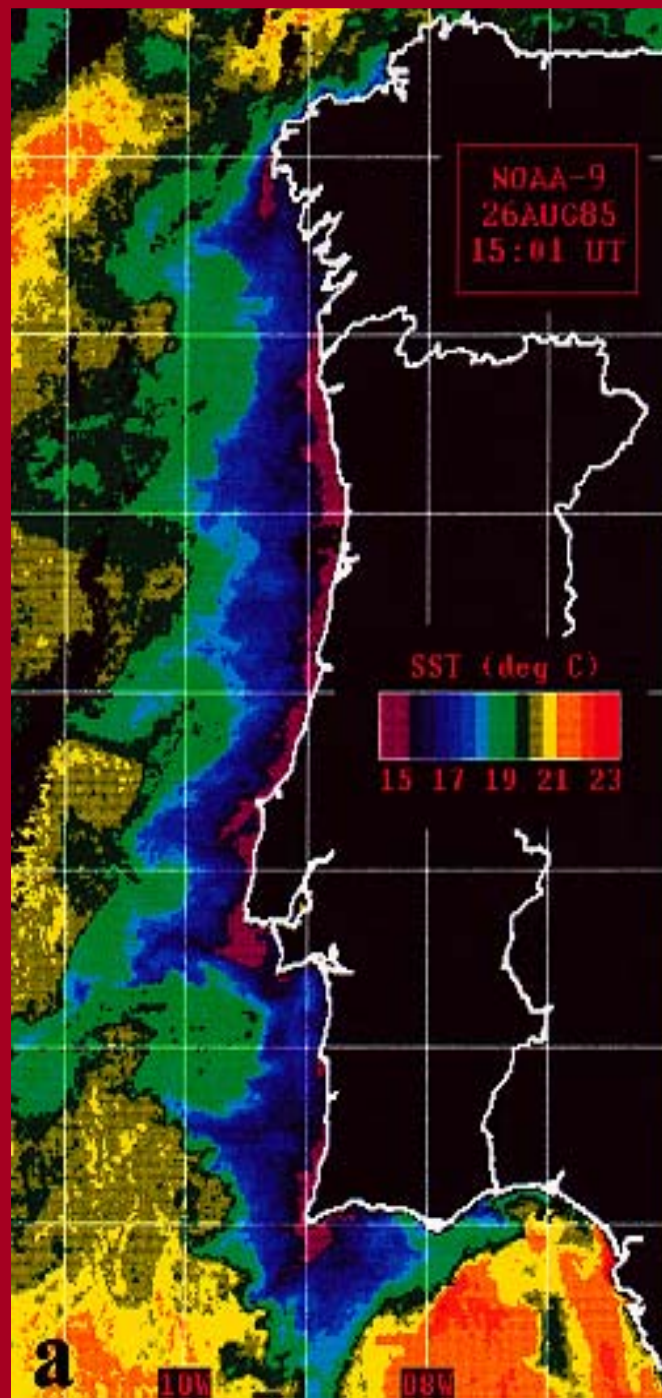
Média escala - 10-100m

Pequena escala -1-10m

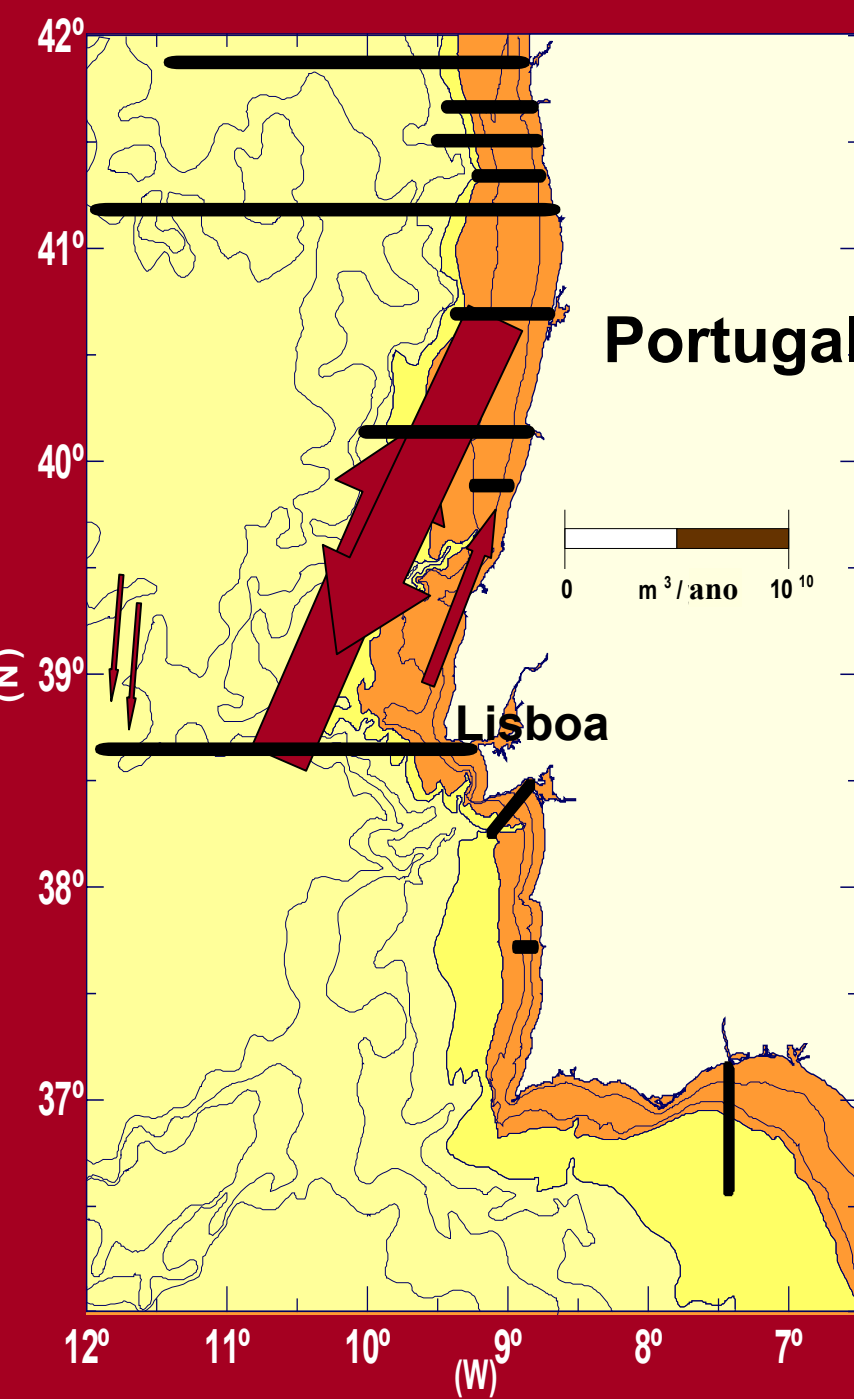
Escala fina -1-10cm

Processo de Afloramento Costeiro





Algumas características oceanográficas da costa W de Portugal



- Plataforma Noroeste aplanada e larga
- Plataforma Noroeste influenciada por um maior fluxo de rios -> lente de menor salinidade
- Plataforma Noroeste com uma menor influência de águas subtropicais mais quentes e salinas
- Afloramento: Forte sazonalidade (Primavera até ao final do Verão)
- Circulação superficial: em geral para Norte

Estação de Convergência:

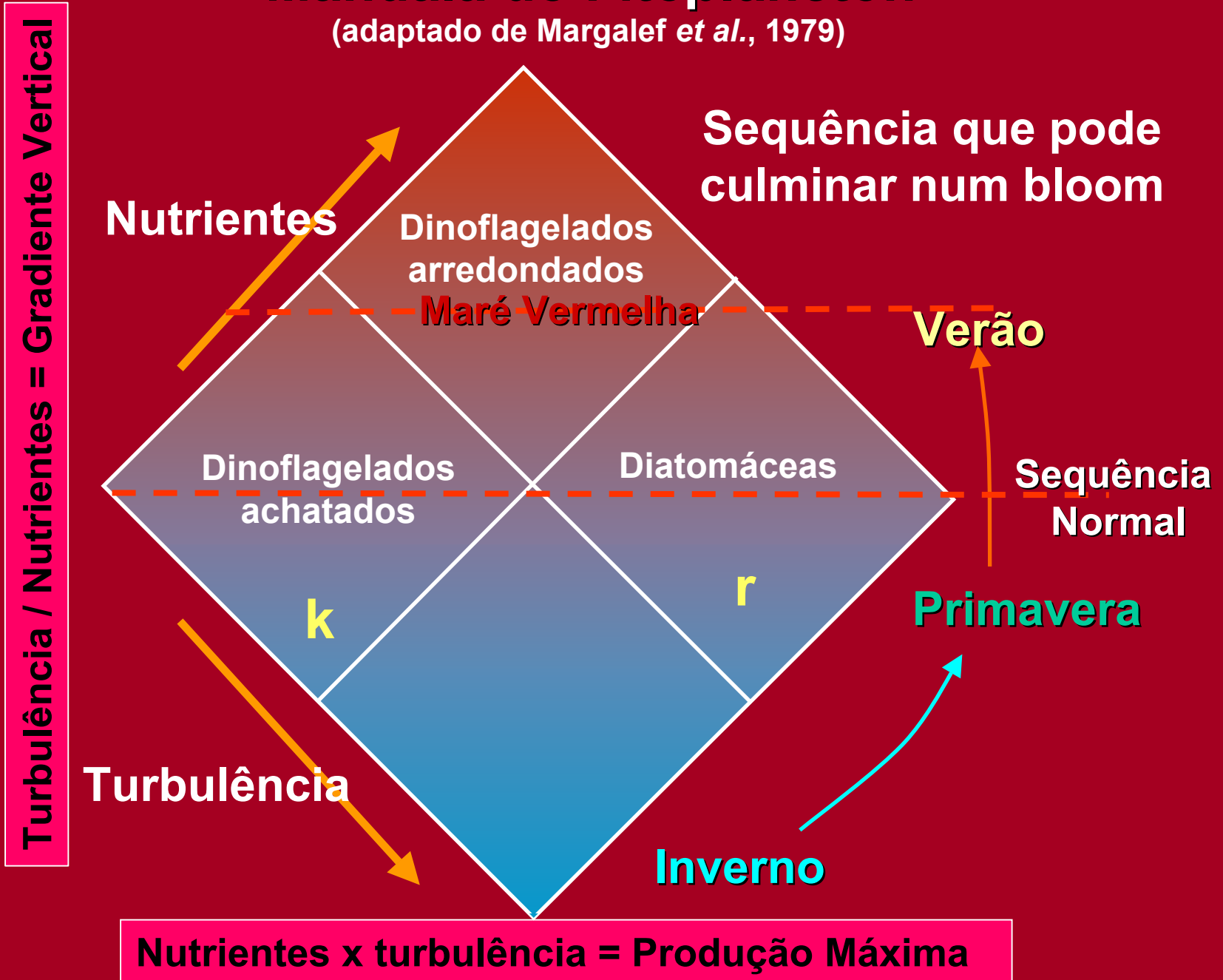
- Corrente para N mais intensa sobre o bordo da plataforma e vertente

Estação de afloramento :

- Jactos de afloramento para Sul, associados a contra correntes costeiras para Norte

Mandala do Fitoplâncton

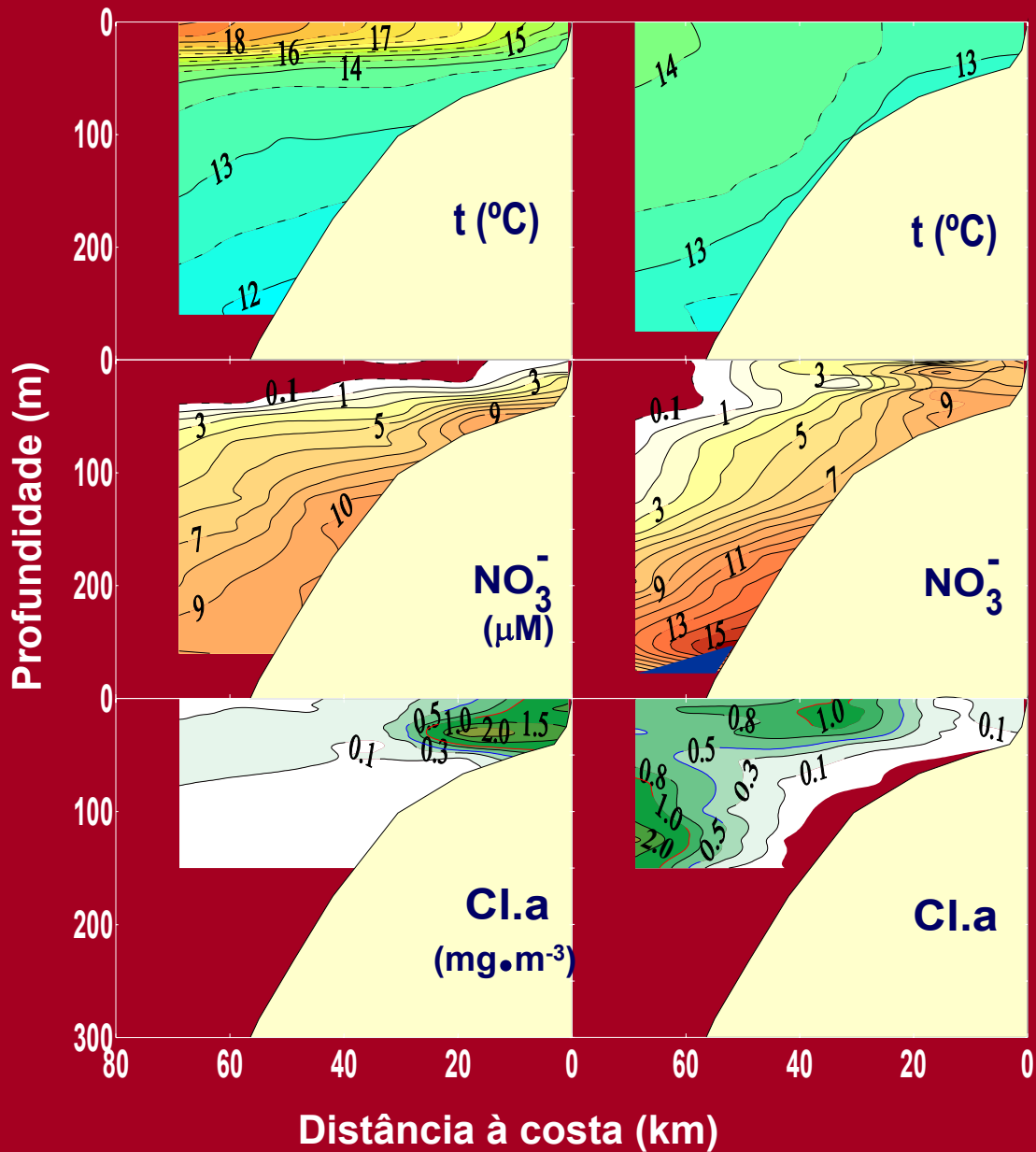
(adaptado de Margalef *et al.*, 1979)



Verão

Peniche

Primavera



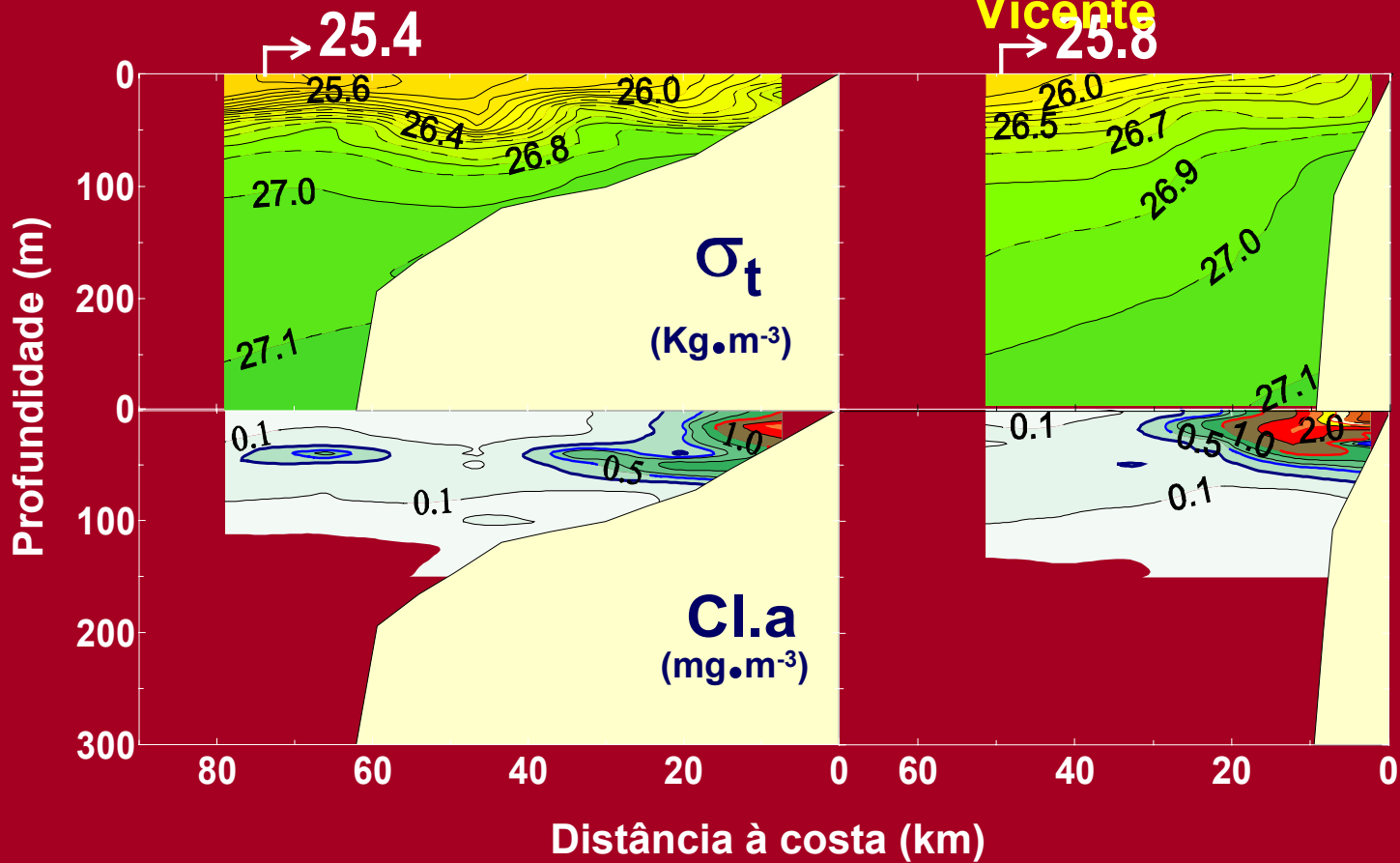
Verão 85

Costa NW

Costa SW

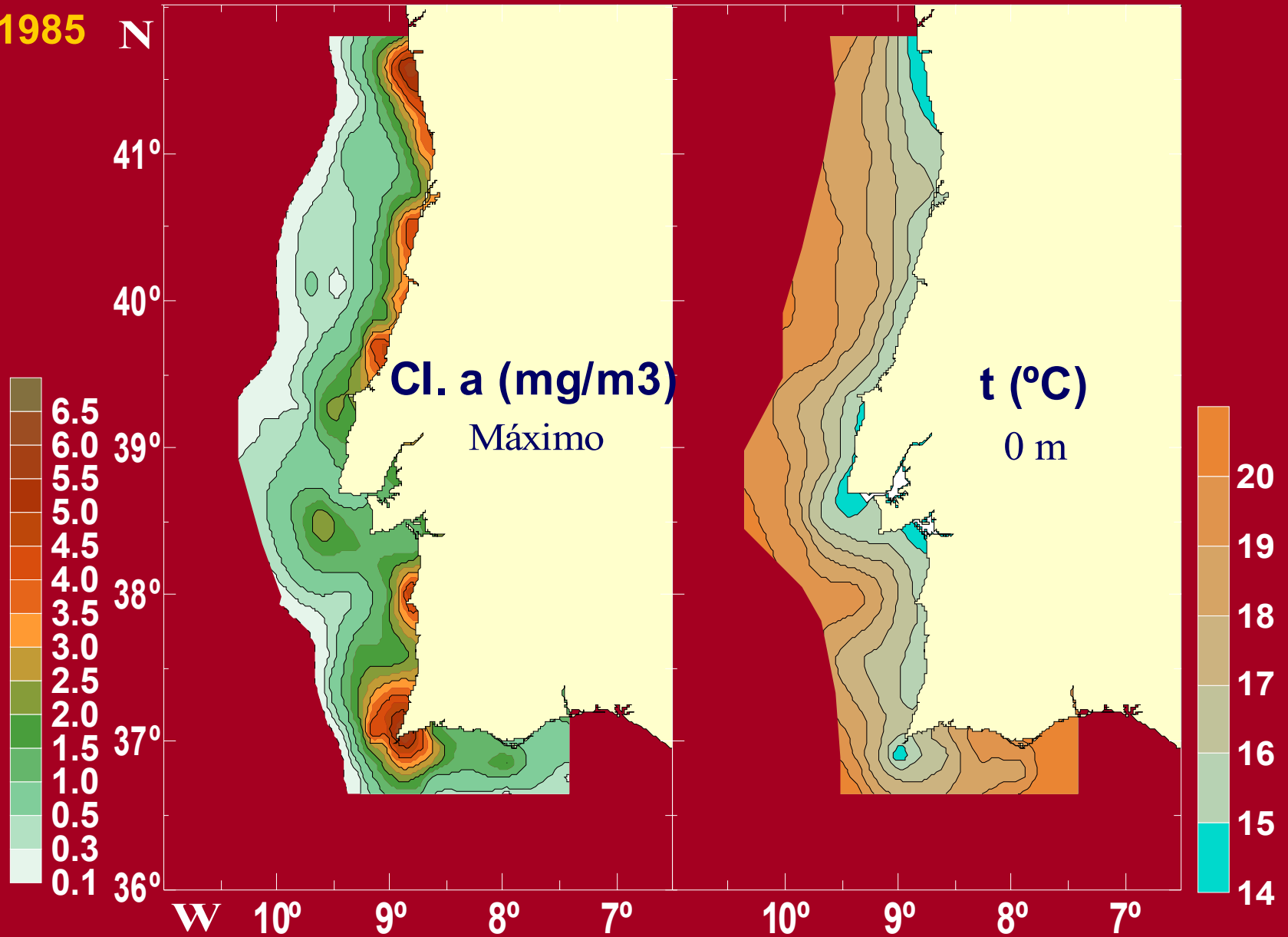
Figueira da Foz

Cabo S. Vicente



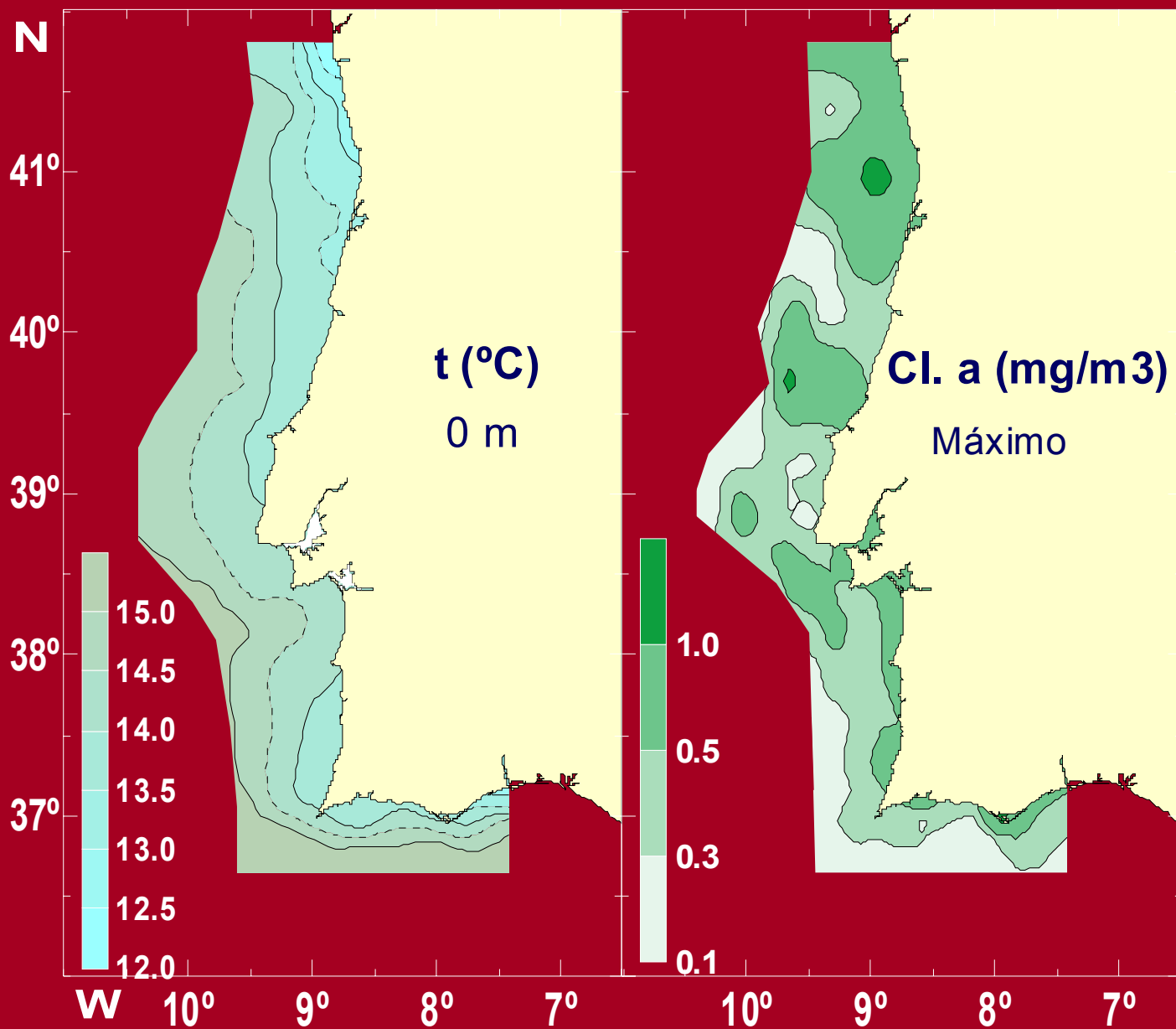
Verão

1985



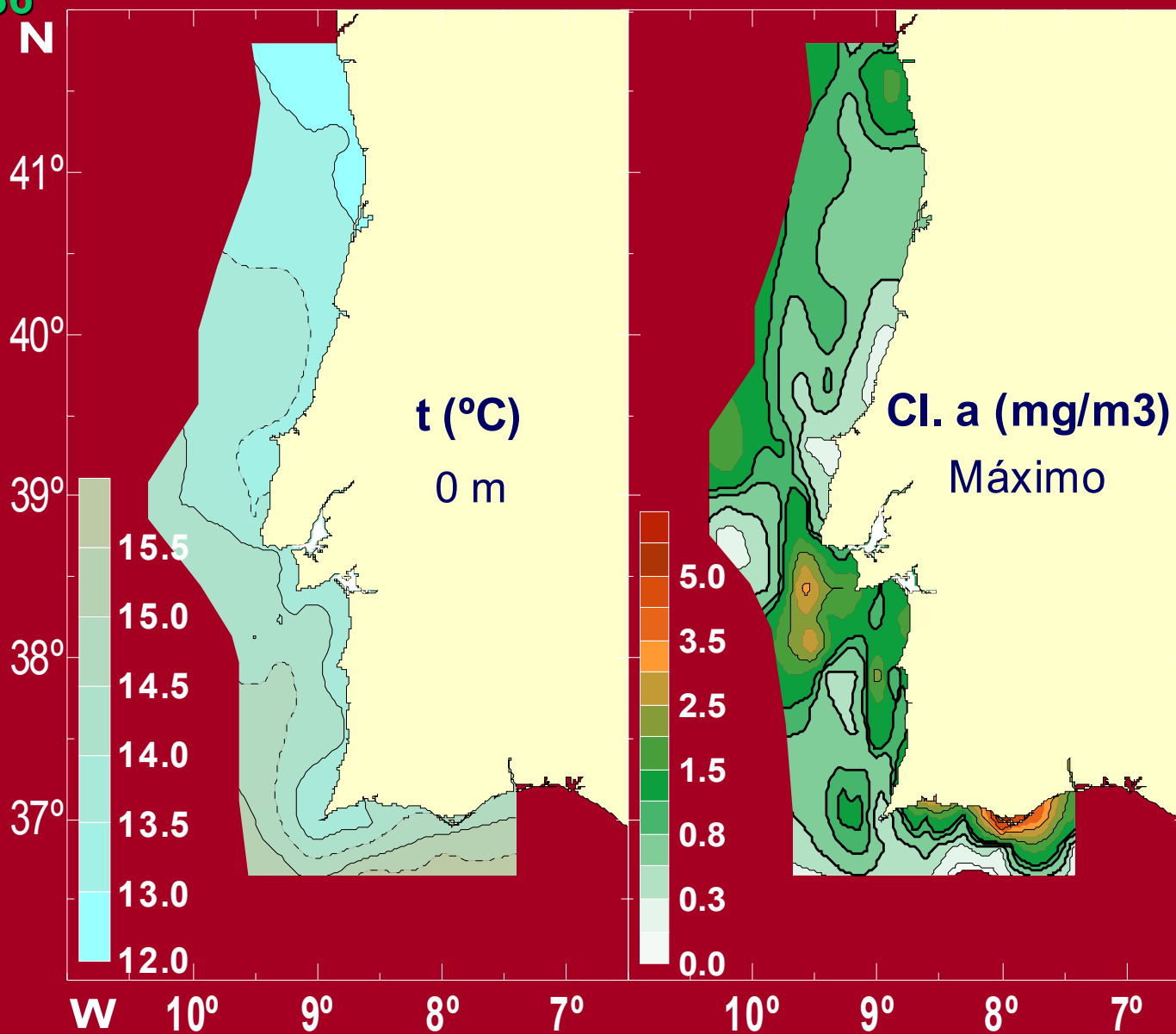
Inverno

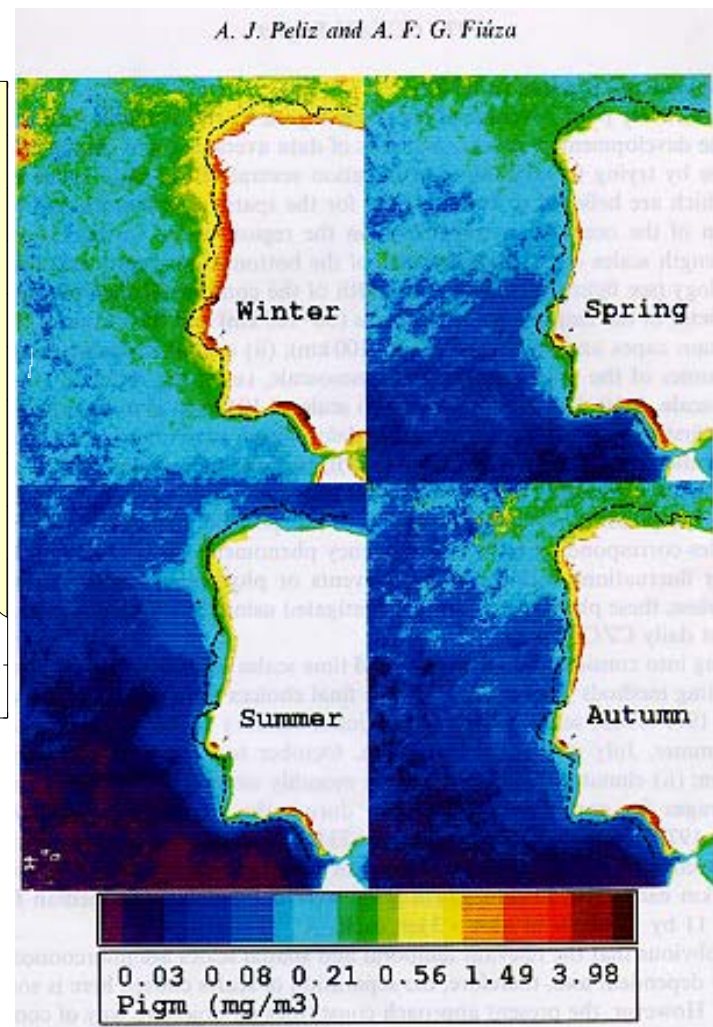
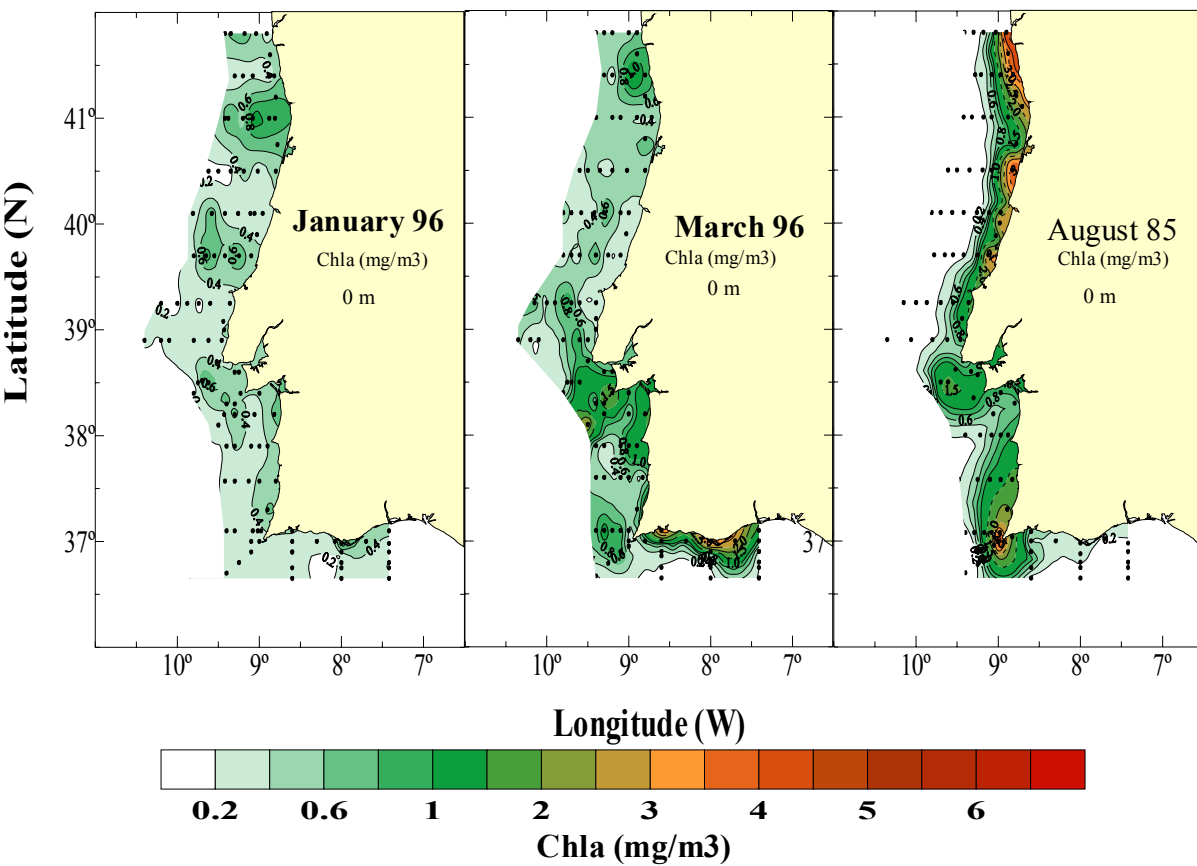
1986



Primavera

1986





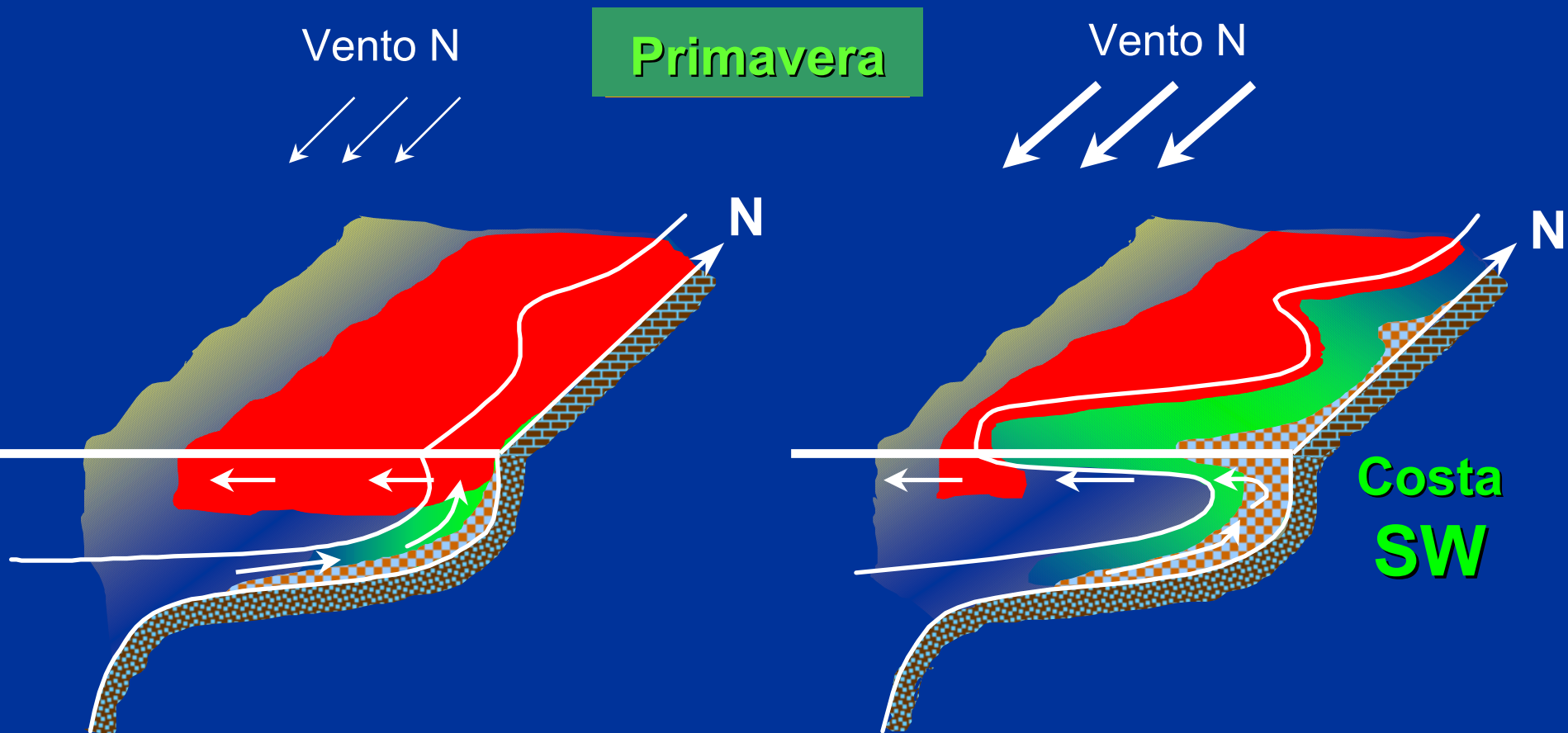
Afloramento fraco

Afloramento moderado

Vento N

Primavera

Vento N



Costa SW

Principais Comunidades

Afloramento

Estratificação

Oceânica

Bentônicas e neríticas (mistura)

Convergência

Outono

Ventos S



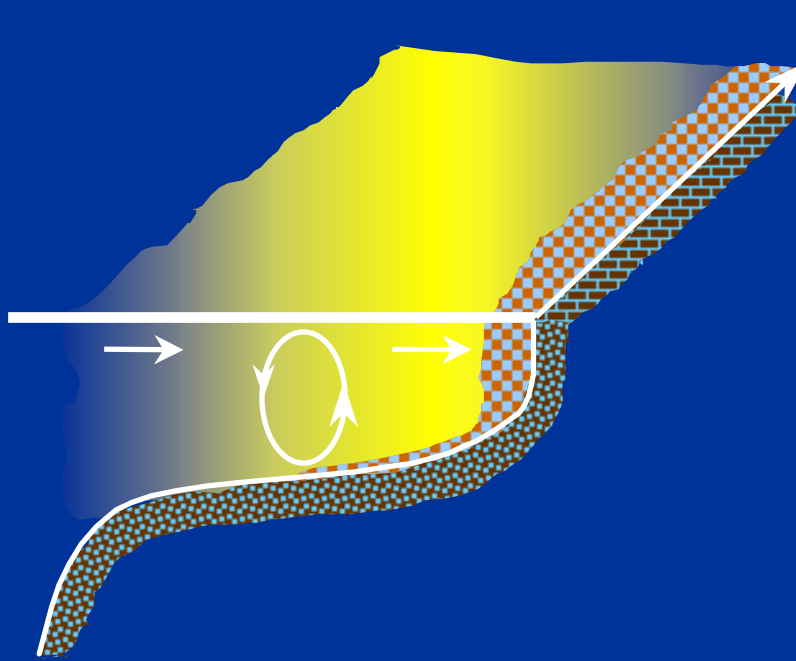
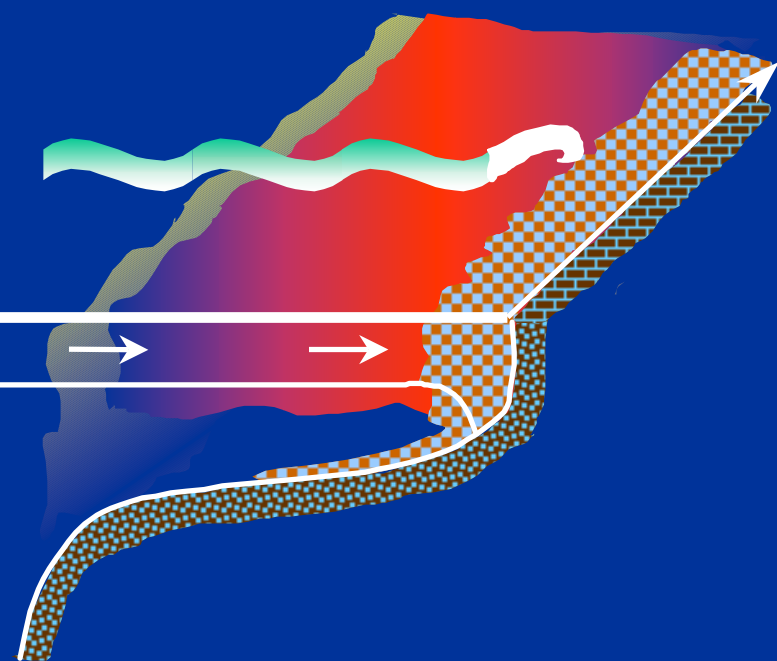
Inverno

Ventos S, N



N

N



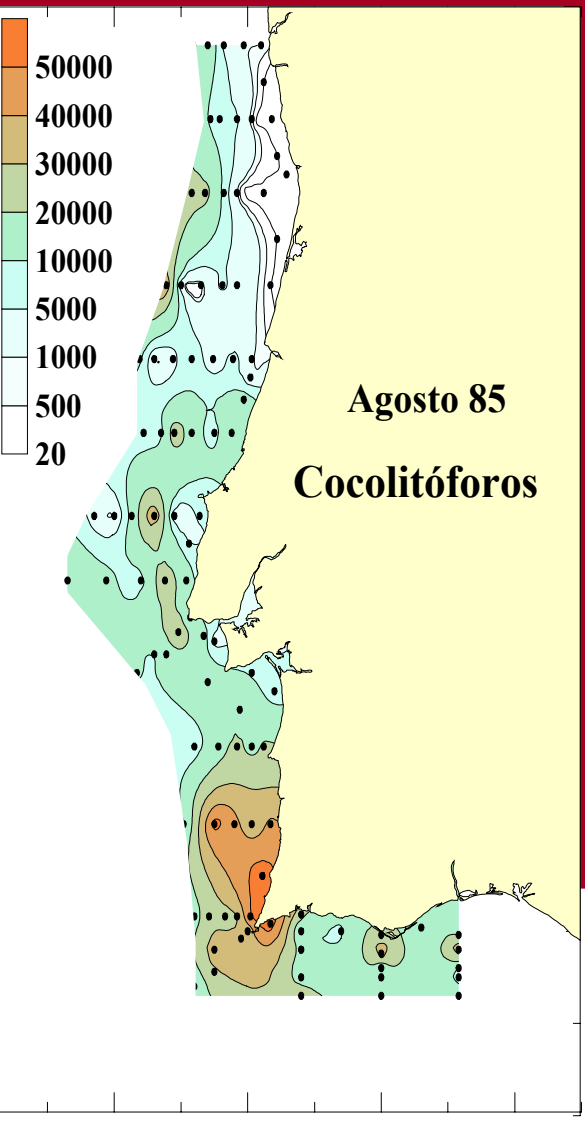
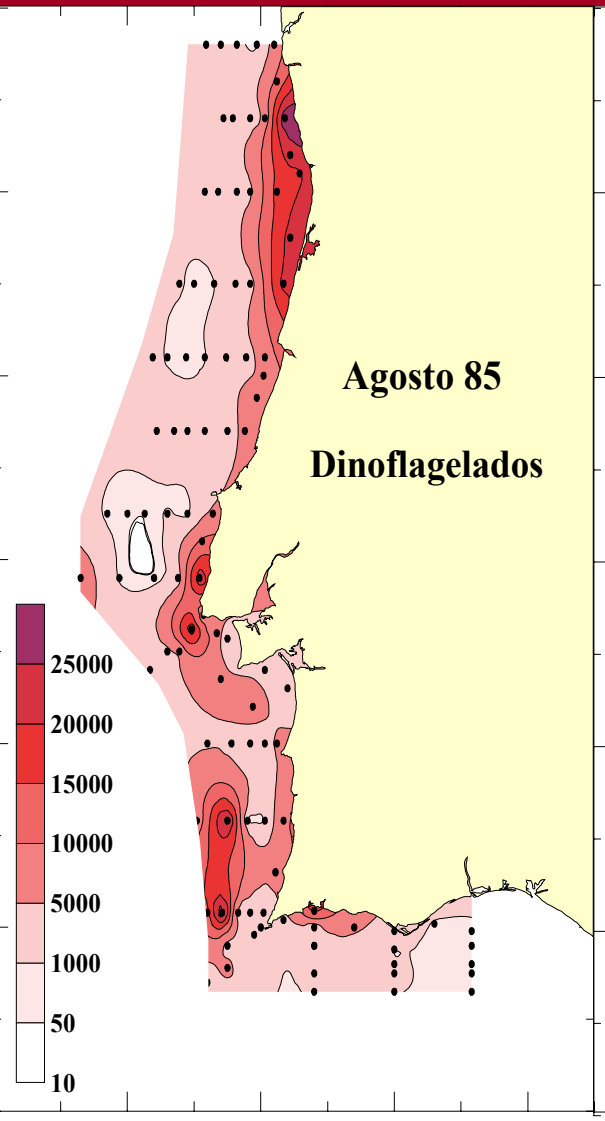
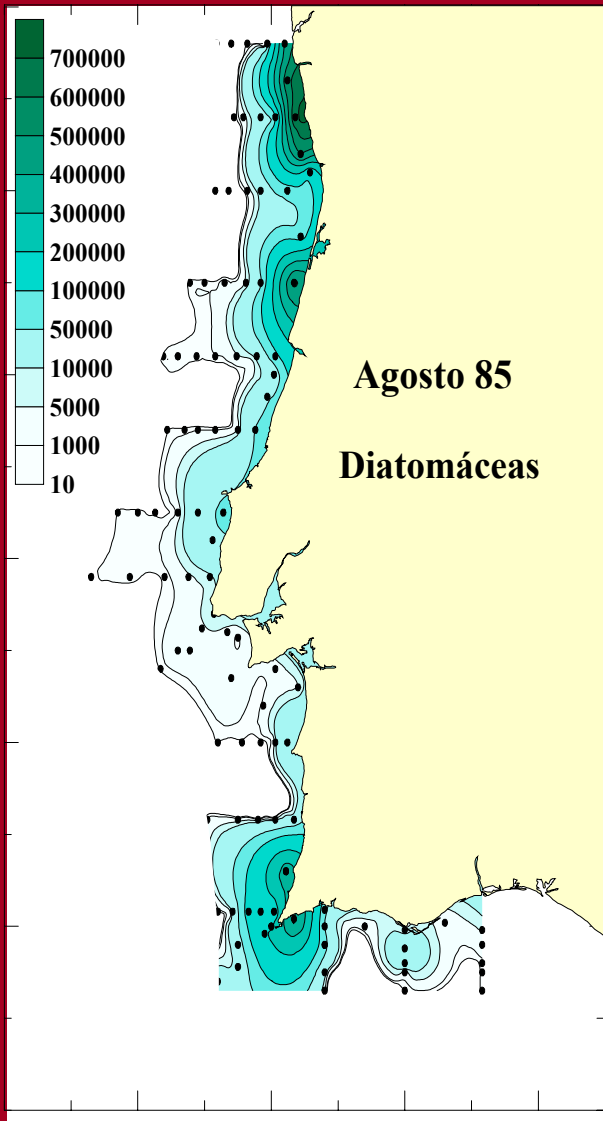
Principais Comunidades

Oceânica

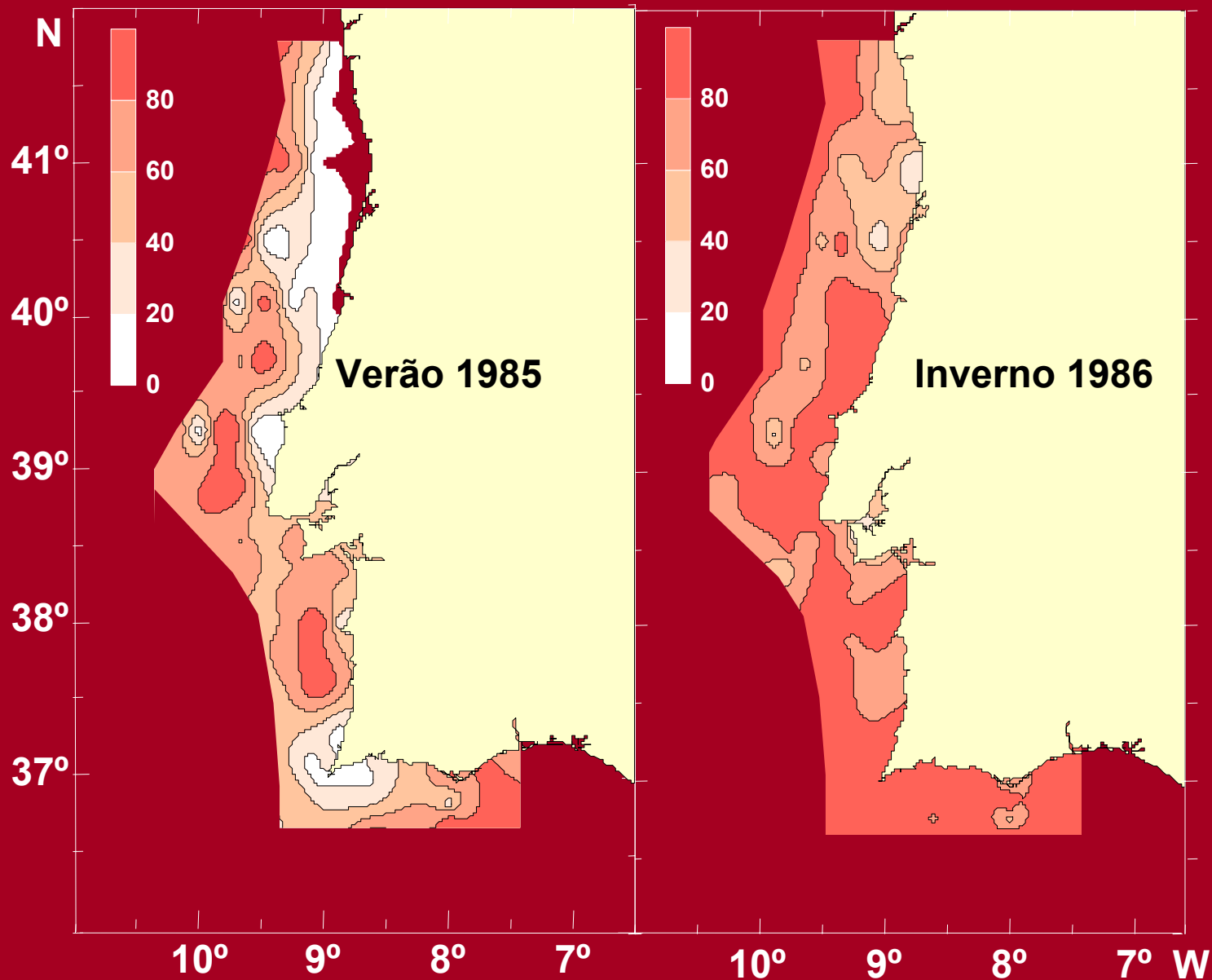
Fortes nadadores

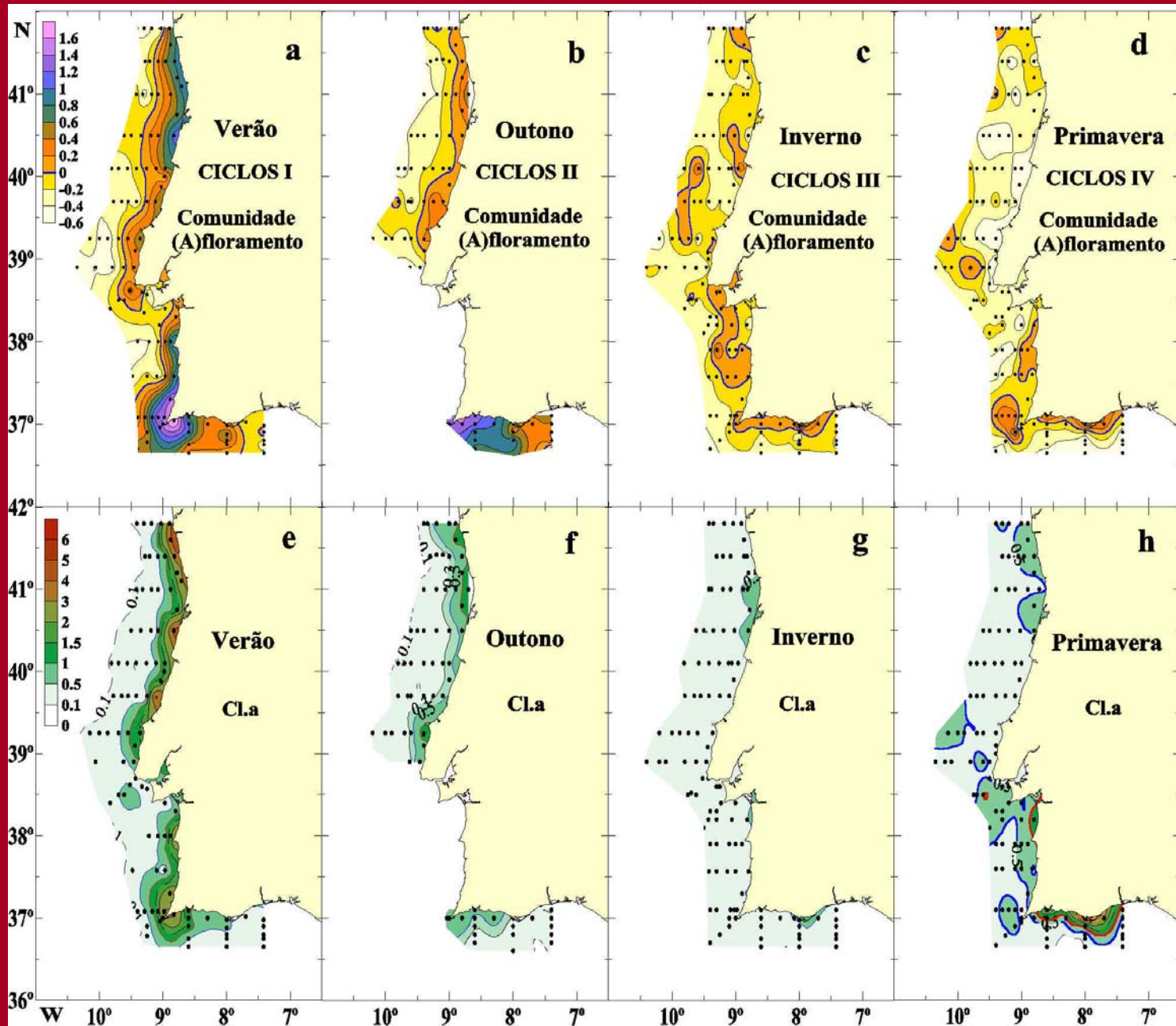
Bentônica and nerítica (mistura)

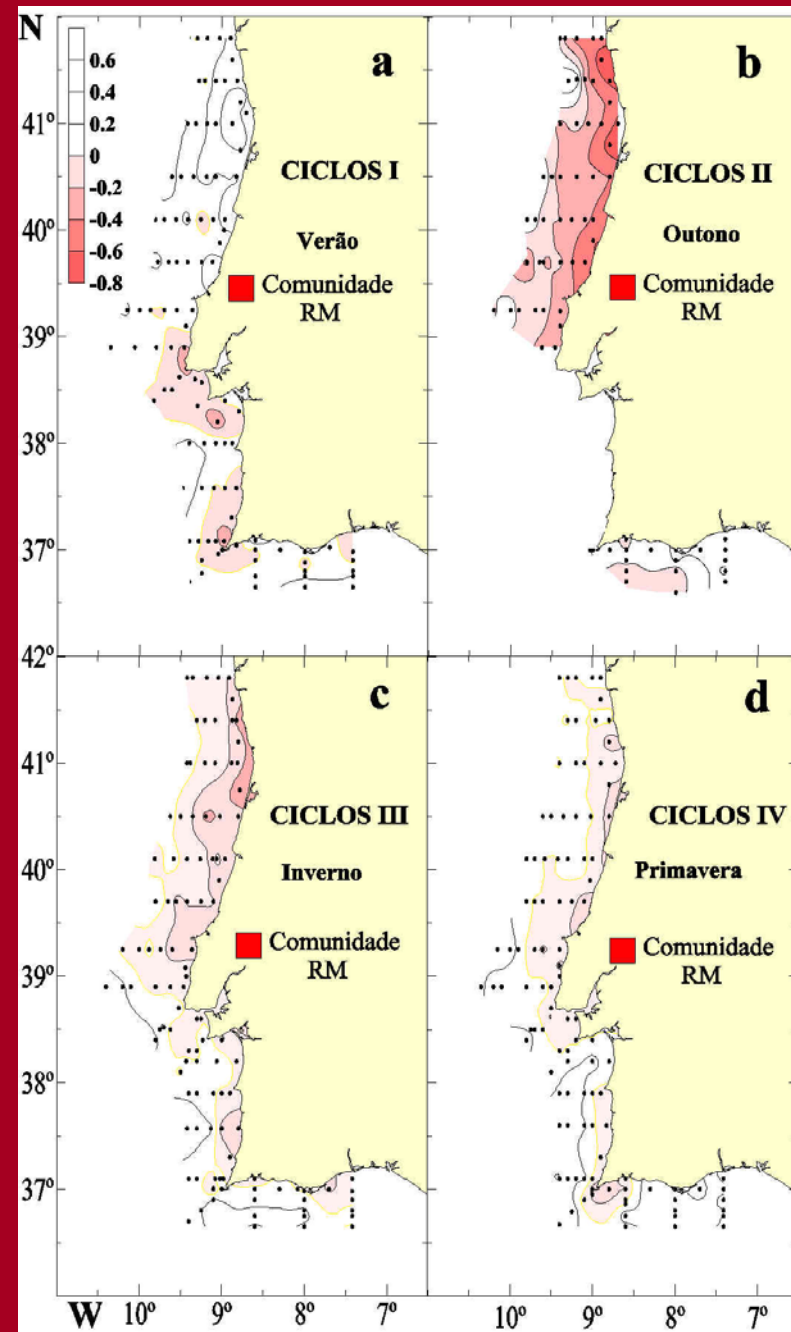
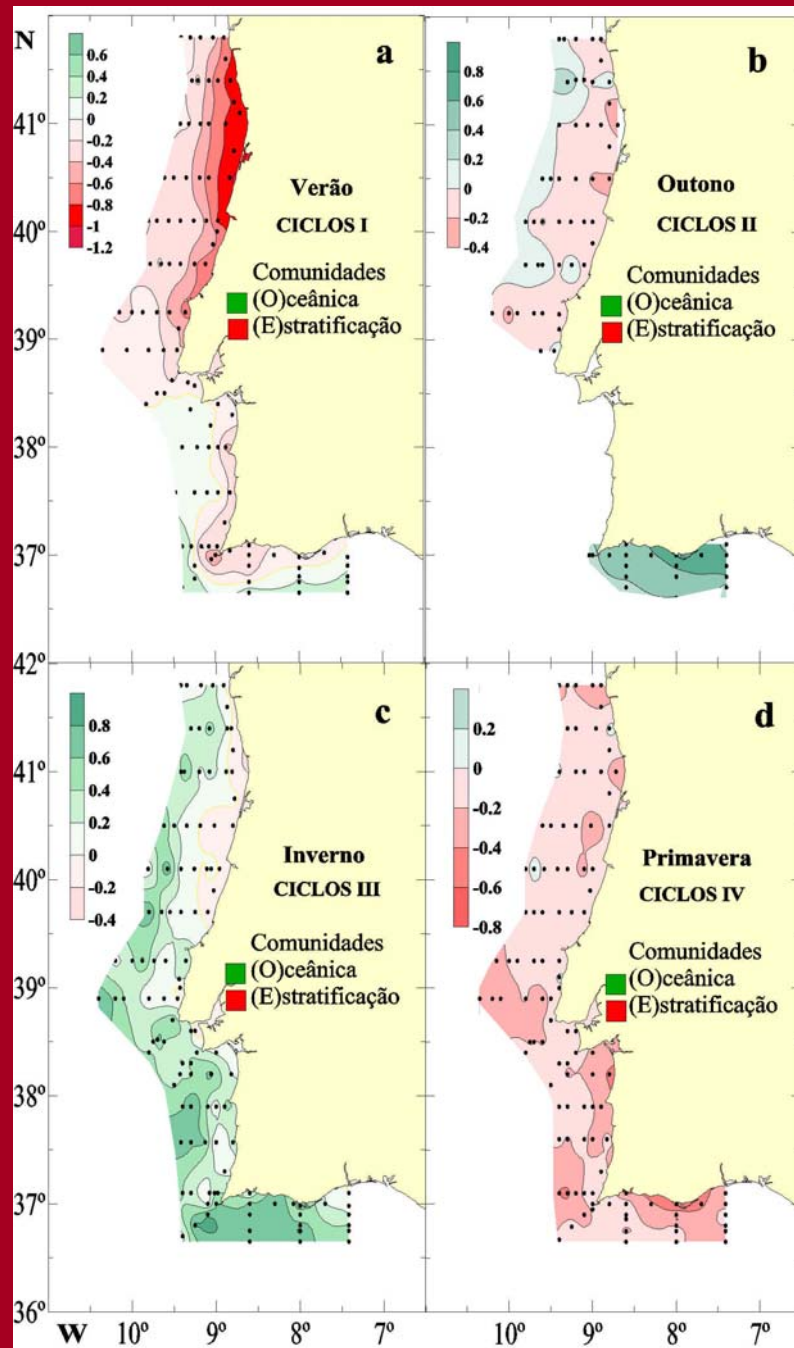
42
41
40
39
38
37



% Cocolitóforos





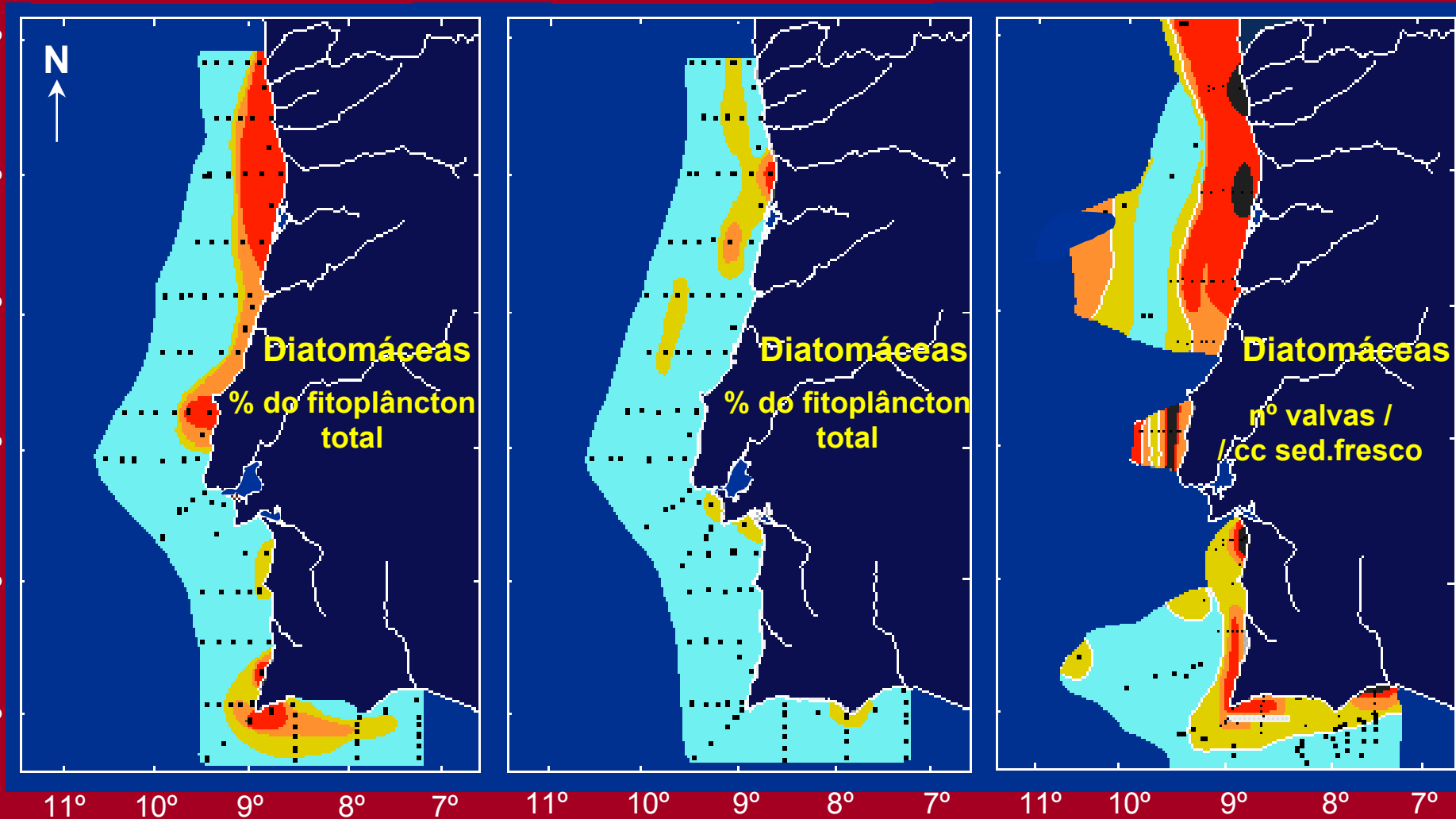


COLUNA de água

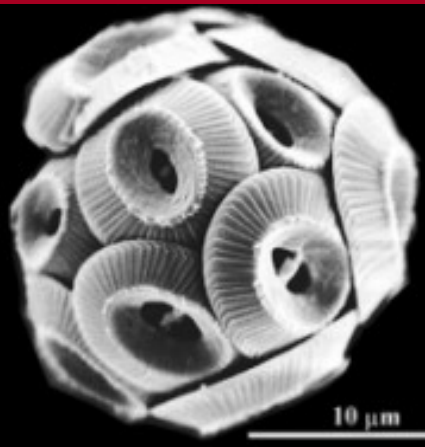
Afloramento
Verão

Convergência
Inverno

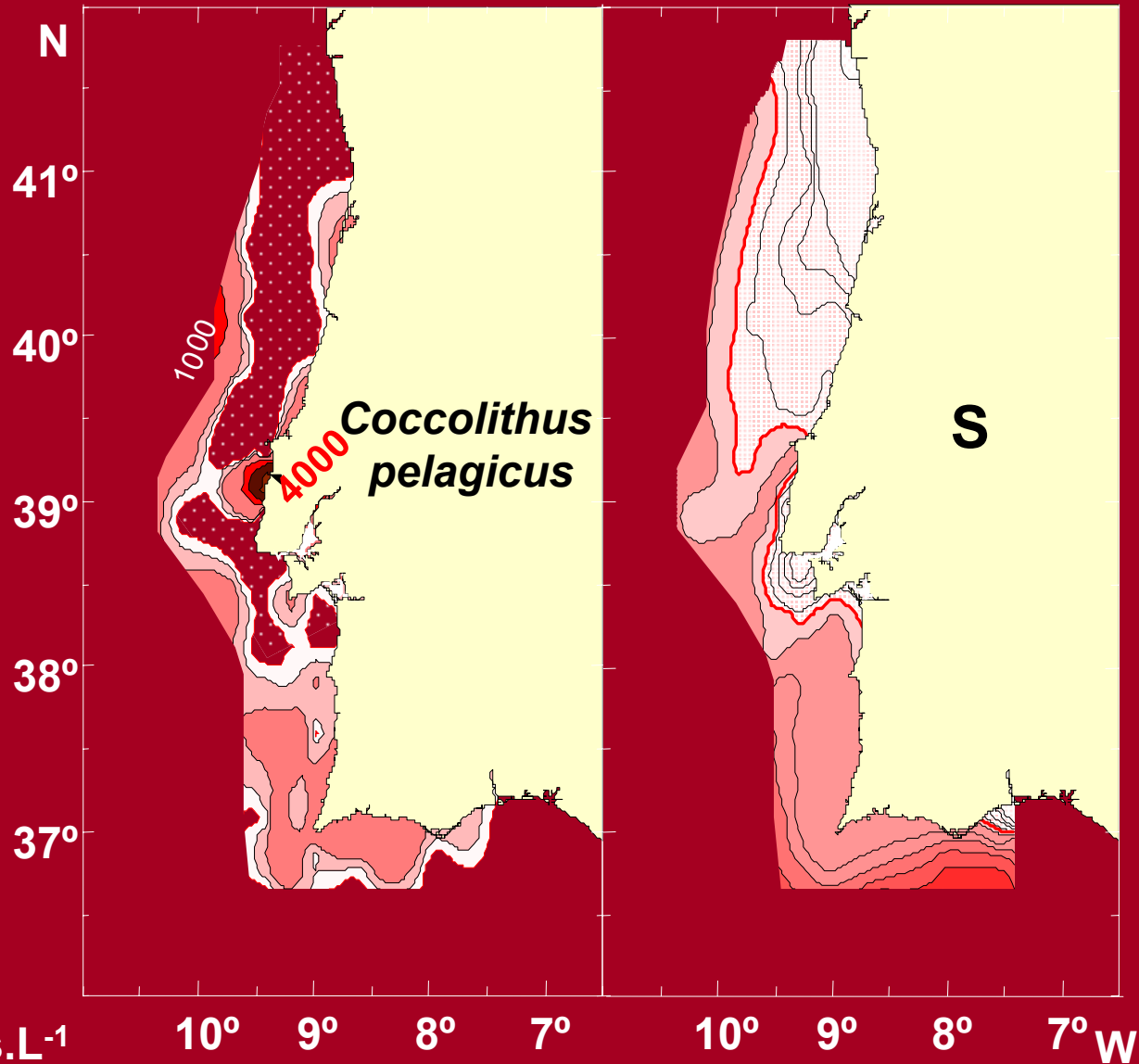
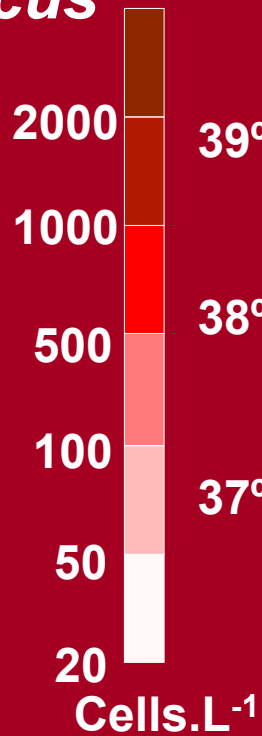
SEDIMENTOS superficiais



Primavera 1986

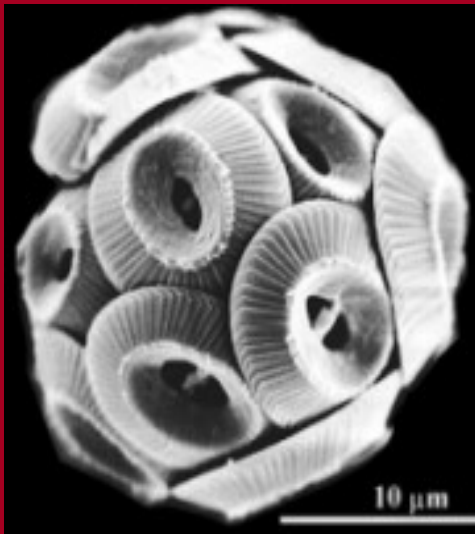
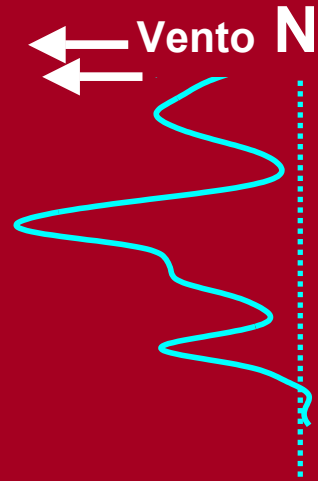


Coccolithus pelagicus

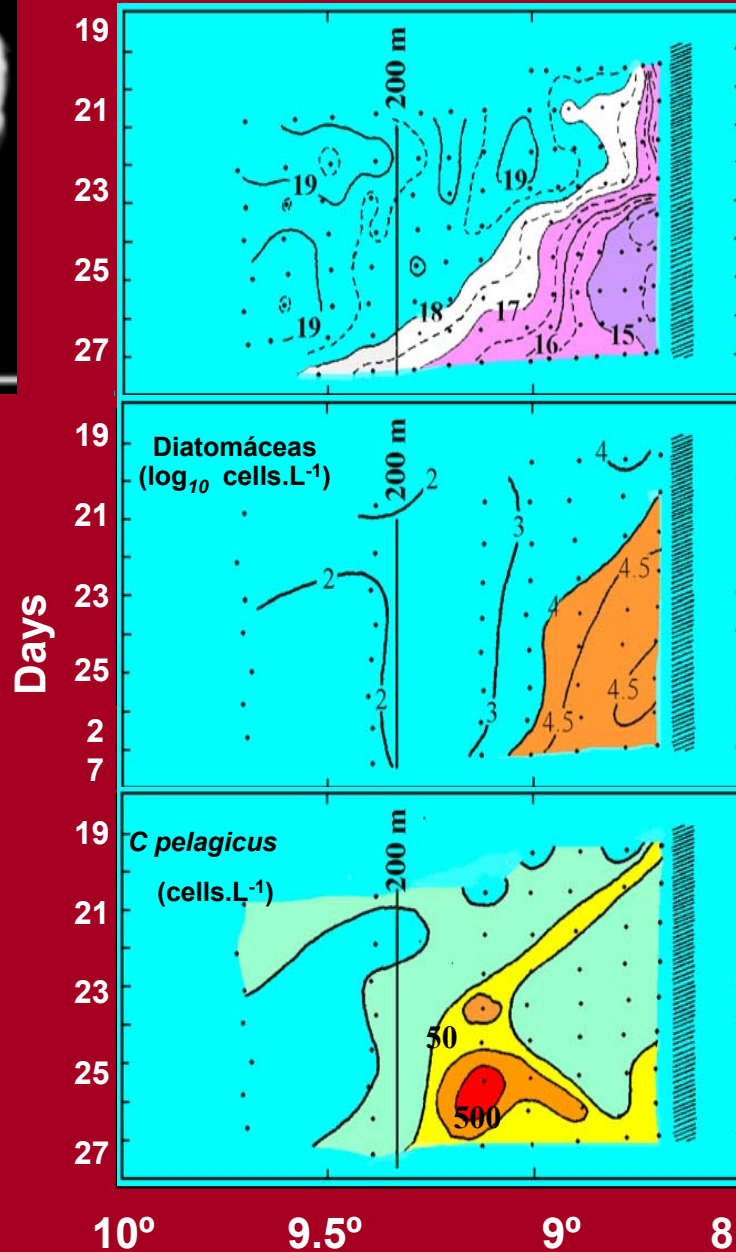


Verão 1987

Secção na Latitude 41.05'N

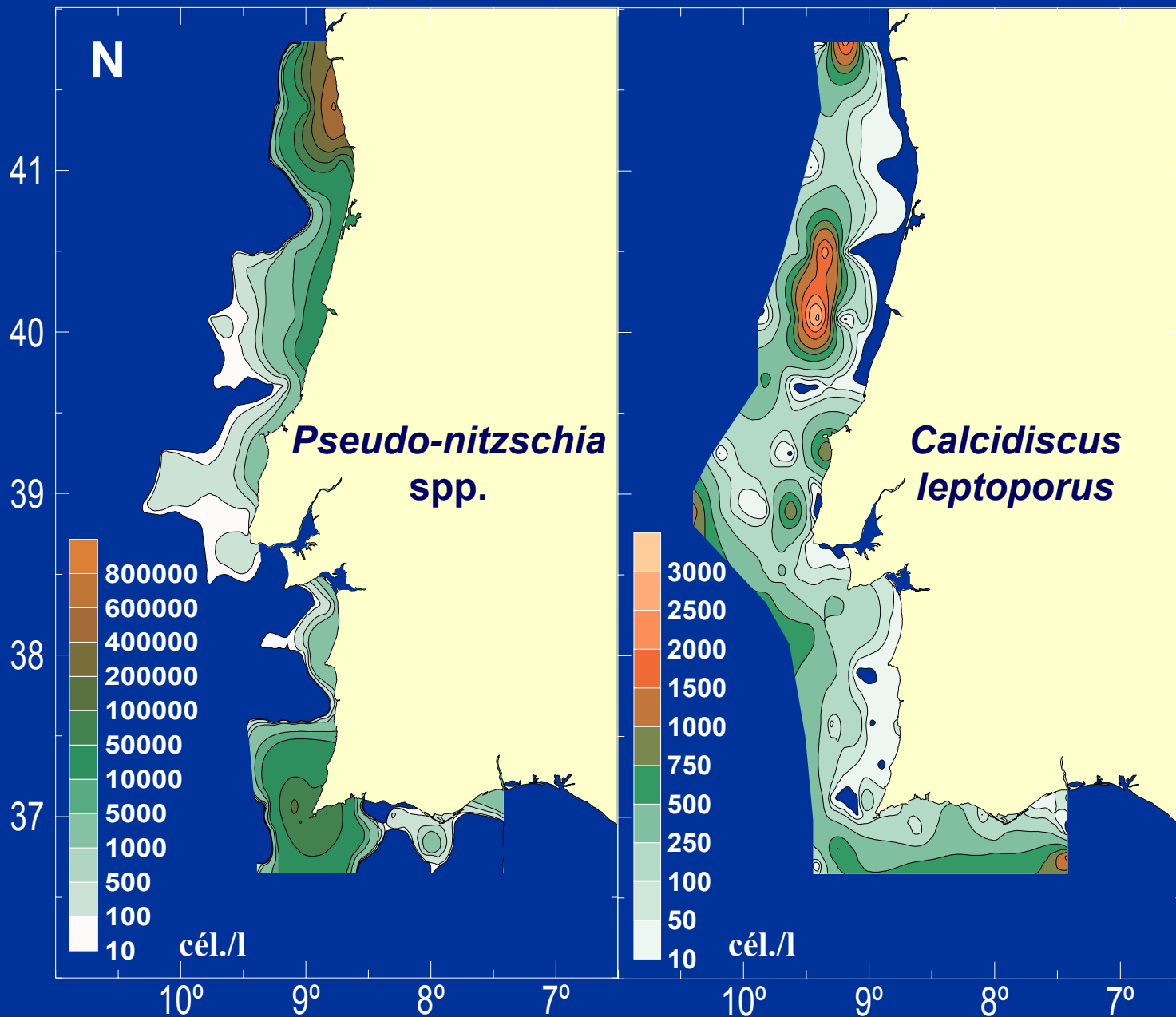


Coccolithus pelagicus



Verão

Inverno





Blooms de algas tóxicas

HABS- “Harmful algal blooms”

- **Blooms e marés vermelhas.**
- **Fitoplâncton tóxico e tipos de toxicidade produzida.**
- **Exemplos da distribuição do fitoplâncton tóxico em águas portuguesas**

Aerosols and wind transport may cause human health problems

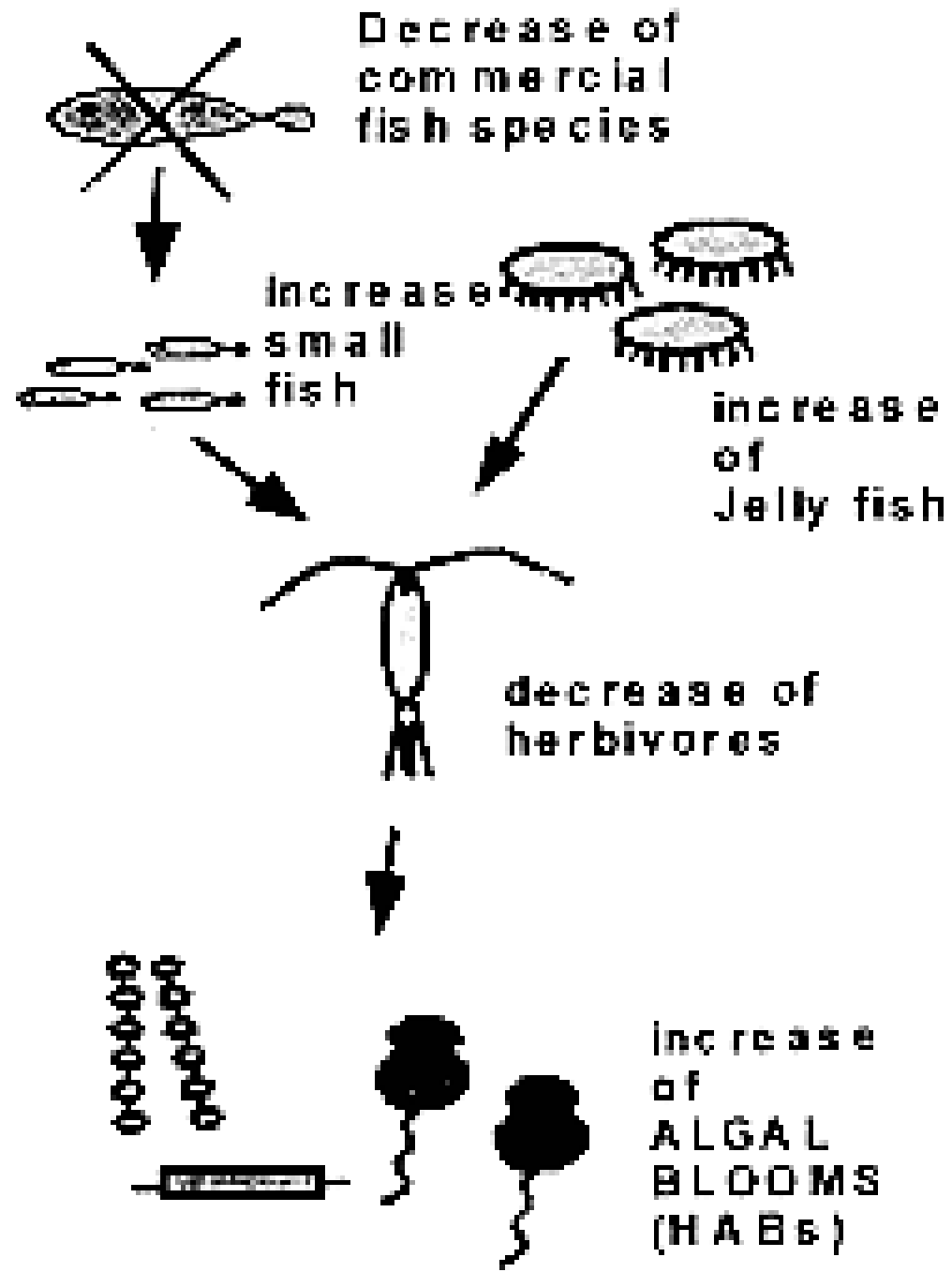
Foams may aggregate on the water surface

Algae may accumulate causing visual discolouration and may result in hypoxia or declines in submerged aquatic vegetation upon their decay

Fish kills may occur due to toxic algae

Shellfish may become contaminated with algal toxins

The impacts of HABs are numerous, and the effects may be felt by many components of the ecosystem.





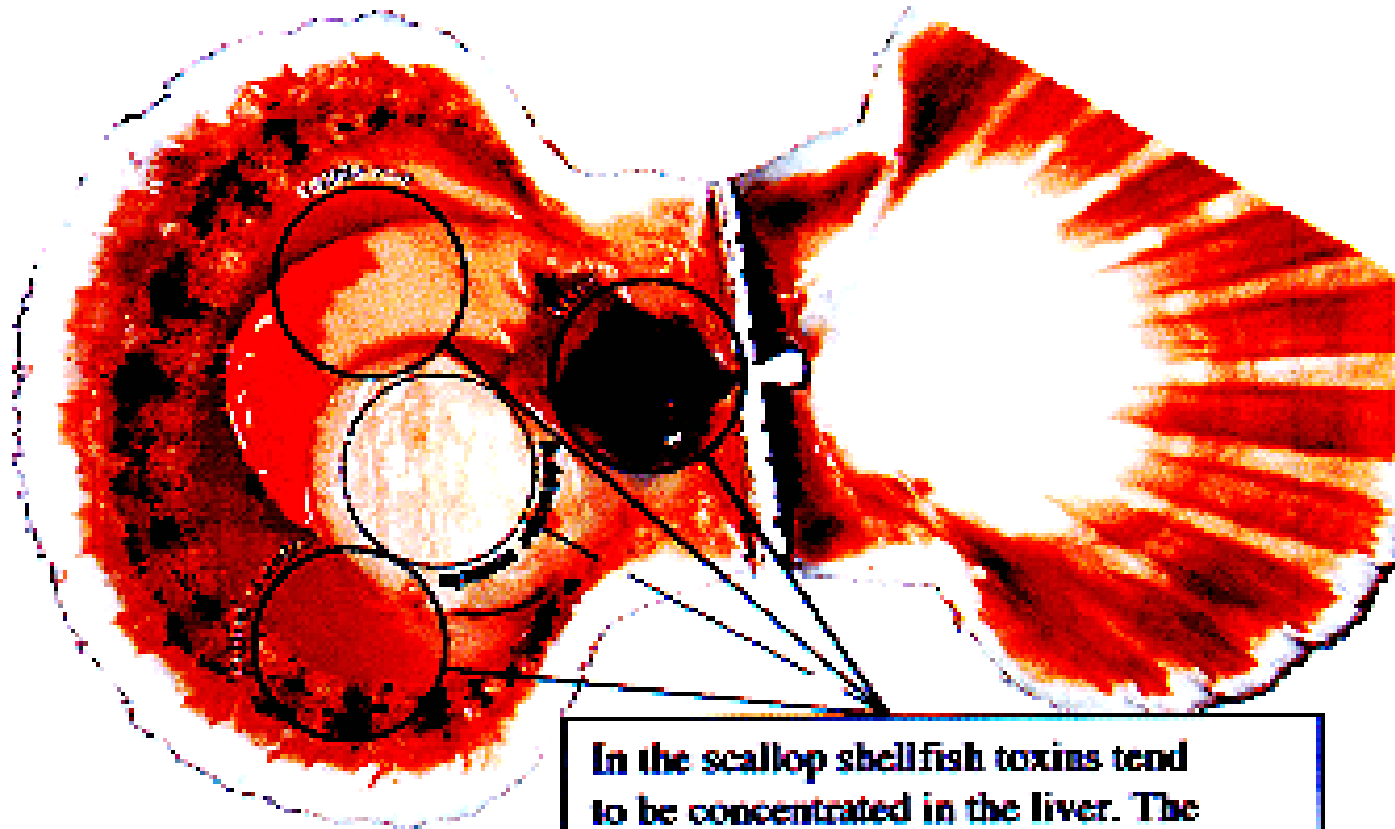


A high biomass bloom of the prymnesiophyte *Phaeocystis pouchetii* on the Belgian coast. Photo by V. Rousseau, courtesy of Eurohab Science Initiative, 1998.



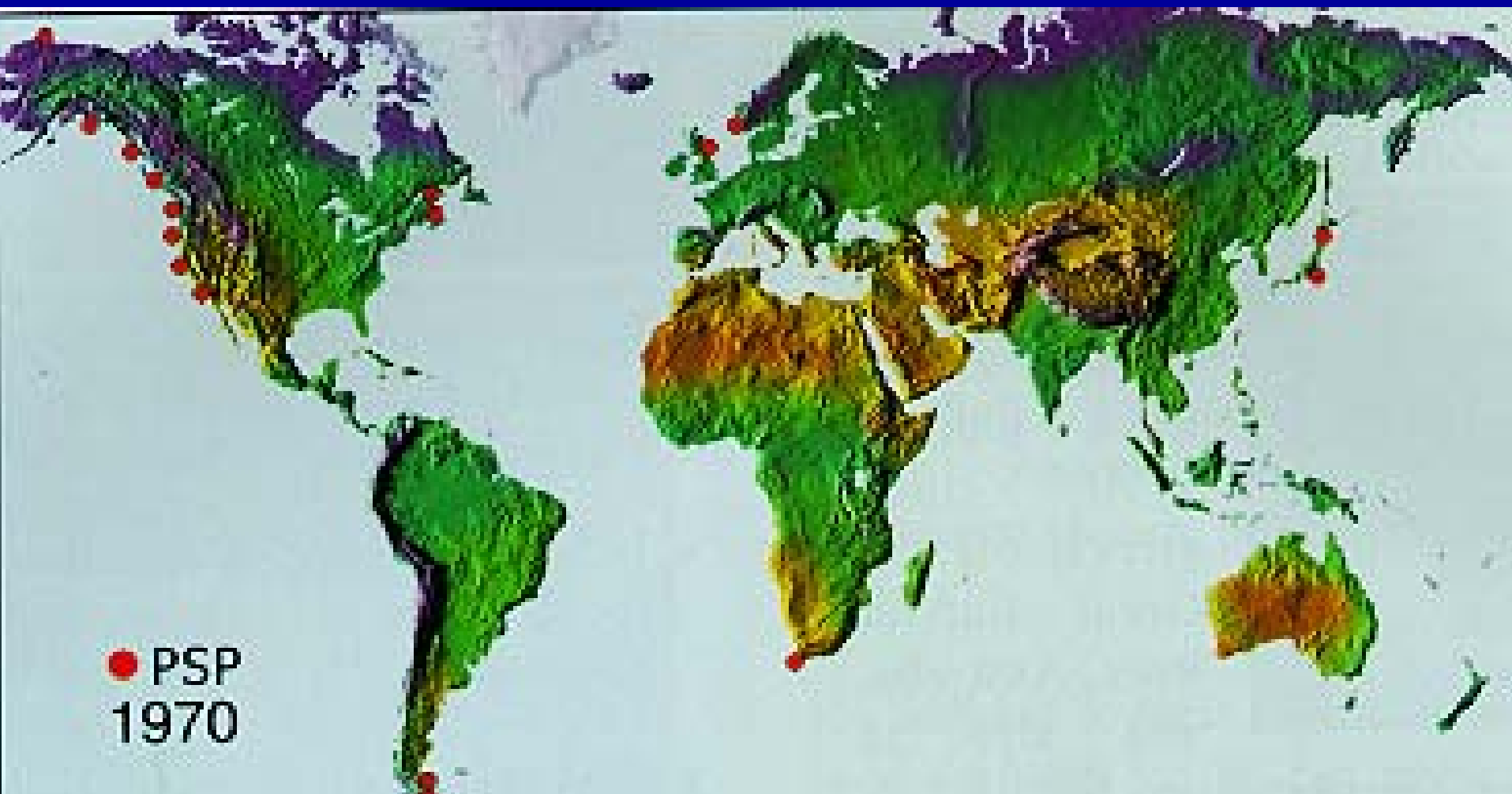
TABLE 1.1 Human illnesses associated with harmful algal blooms. (Modified from Morris 1999.)

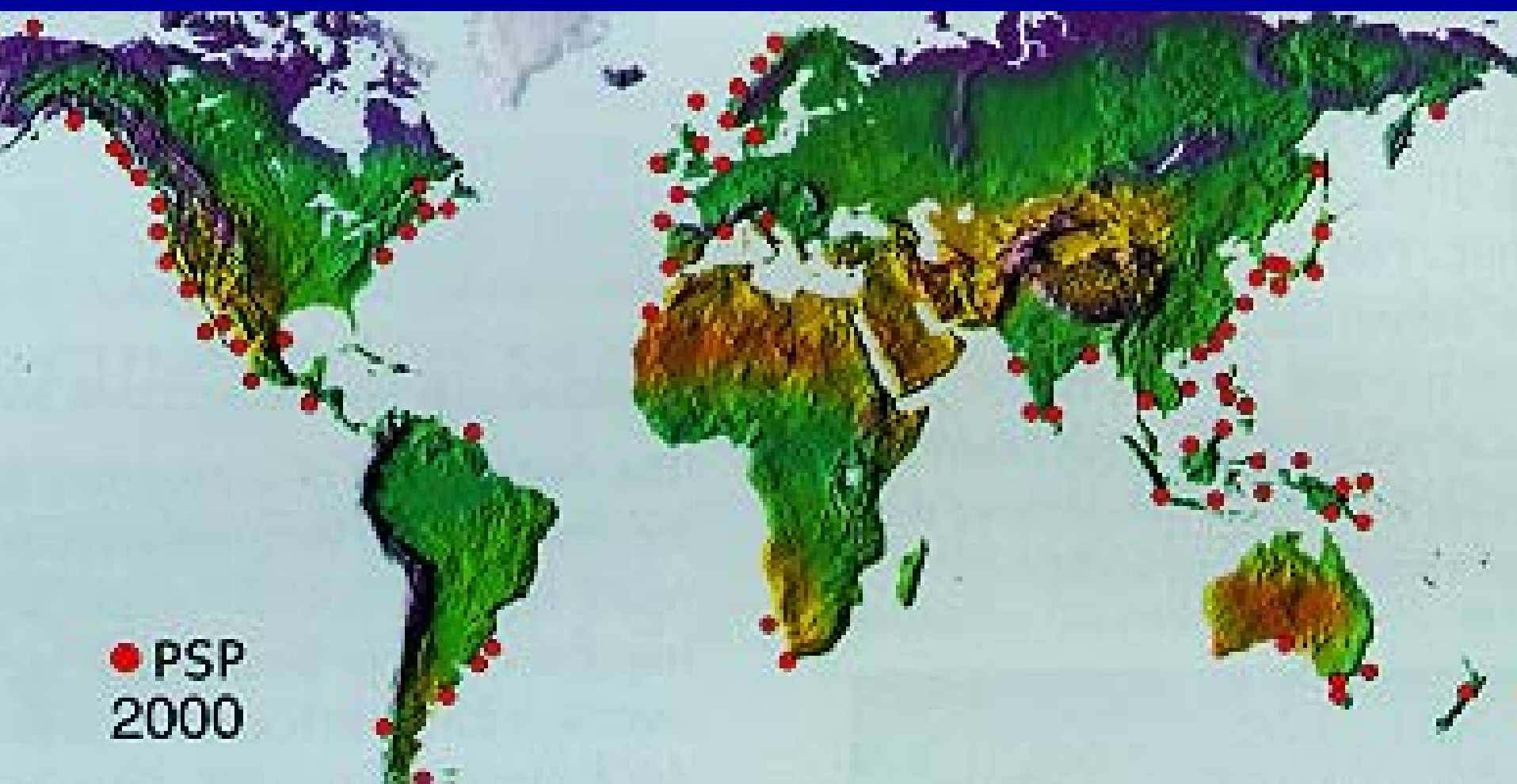
Syndrome	Causative organisms	Toxins produced	Route of acquisition	Clinical manifestations
Ciguatera fish poisoning (CFP)	<i>Gambierdiscus toxicus</i> (benthic) and others	Ciguatoxins	Toxin transfer up the marine food chain; illness generally results from eating large, carnivorous reef fish	Acute gastroenteritis, paresthesias and other neurological symptoms
Paralytic shellfish poisoning (PSP)	<i>Alexandrium</i> spp., <i>Gymnodinium catenatum</i> , <i>Pyrodinium bahamense</i> var. <i>compressum</i> and others	Saxitoxin family	Eating shellfish harvested from affected areas	Acute paresthesias and other neurologic manifestations; may progress rapidly to respiratory distress, muscular paralysis and death
Neurotoxic shellfish poisoning (NSP)	<i>Gymnodinium breve</i> , <i>G. brevisulcatum</i> and others	Brevetoxins	Eating shellfish harvested from affected areas; toxins may be aerosolized by wave action	Gastrointestinal and neurological symptoms; respiratory and eye irritation with aerosols
Diarrhetic shellfish poisoning (DSP)	<i>Dinophysis</i> spp.	Okadaic acid and dinophysistoxins (DTXs)	Eating shellfish harvested from affected areas	Acute gastroenteritis
Azspiracid shellfish poisoning (AZP)	<i>Protoperidinium crassipes</i>	Azspiracids	Eating shellfish harvested from affected areas	Neurotoxic effects with severe damage to the intestine, spleen, and liver tissues in animal tests
Amnesic shellfish poisoning (ASP)	<i>Pseudo-nitzschia</i> spp.	Domoic acid and isomers	Eating shellfish (or, possibly, fish) harvested from affected areas	Gastroenteritis, neurological manifestations, leading in severe cases to amnesia (permanent short-term memory loss), coma, and death
Possible estuary-associated syndrome	<i>Pfiesteria piscicida</i> and other <i>Pfiesteria</i> spp.	Unidentified	Exposure to water or aerosols containing toxins	Deficiencies in learning and memory, acute respiratory and eye irritation, acute confusional syndrome



In the scallop shellfish toxins tend to be concentrated in the liver. The mantle and the edible roe may be toxic, while the edible adductor muscle is rarely toxic.

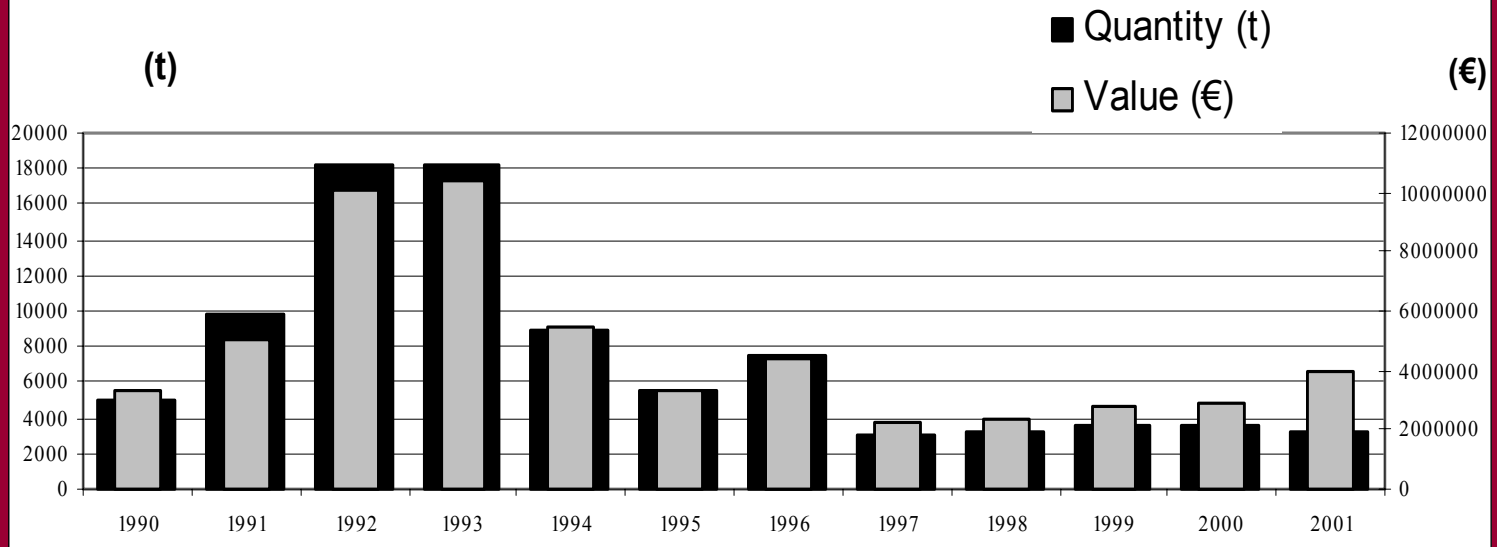
Fig. 7. Dissected scallop showing the edible parts where algal toxins accumulate. Photo courtesy of Tom McKinnon, Fisheries Research Services, Aberdeen, UK.



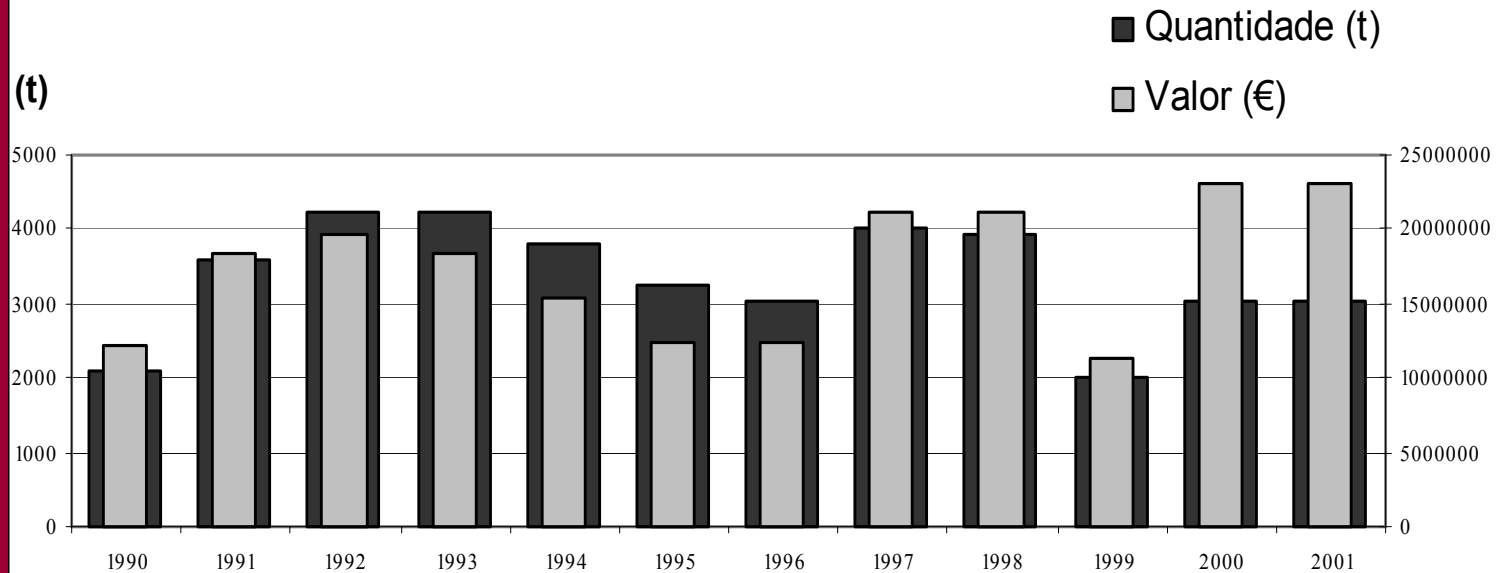


● PSP
2000

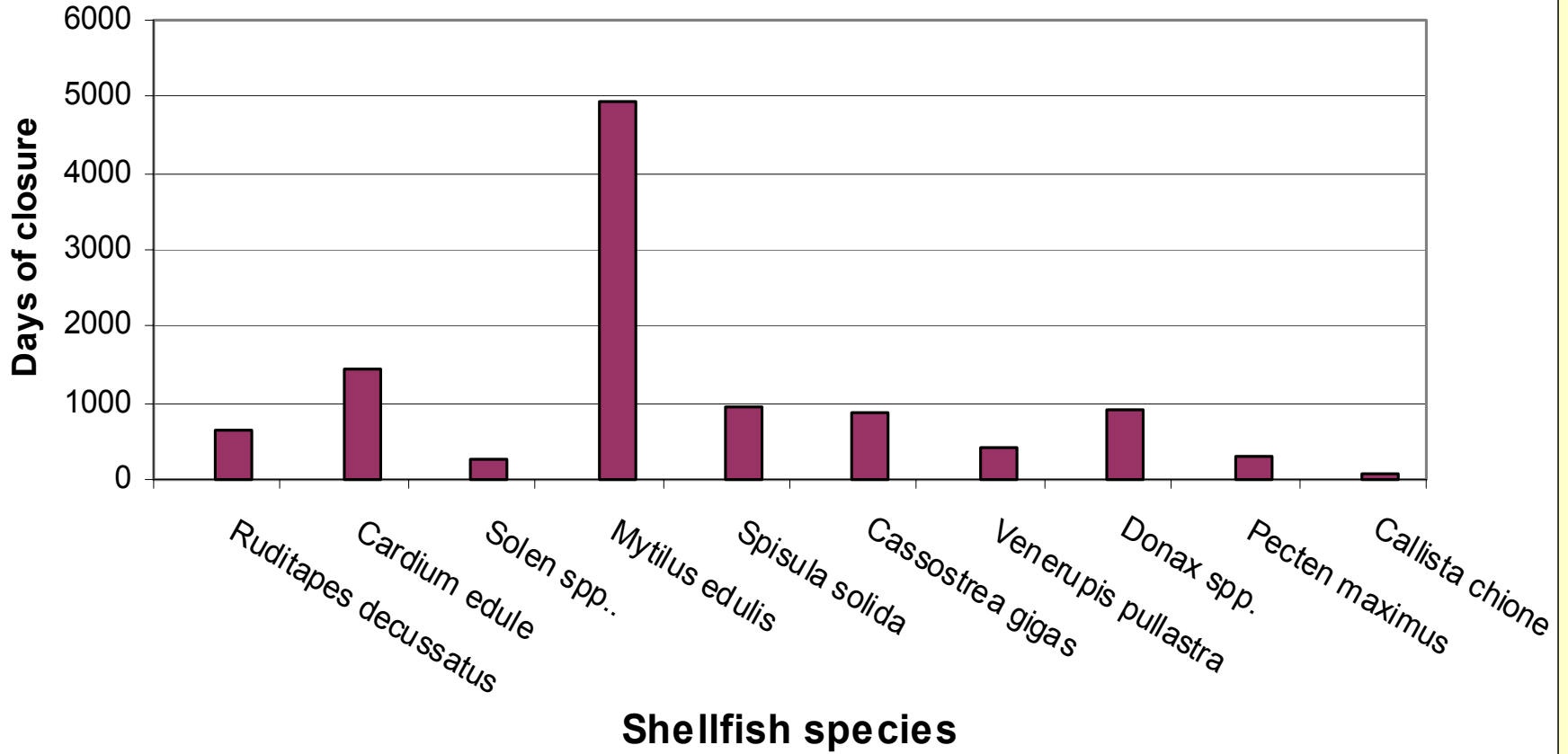
Total Bivalve Fishery in Portugal



Total Bivalve culture in Portugal



1995-2001



Blooms de *Pseudo-nitzschia*.
***P. australis* espécie produtora de**
toxinas amnésicas

Espécies identificadas na costa portuguesa:

Pseudo-nitzschia Peragallo in H. & M. Peragallo

P. australis Frenguelli

P. cuspidata (Hasle) Hasle

P. delicatissima (Cleve) Heiden in Heiden & Kolbe

P. fraudulenta (Cleve) Hasle

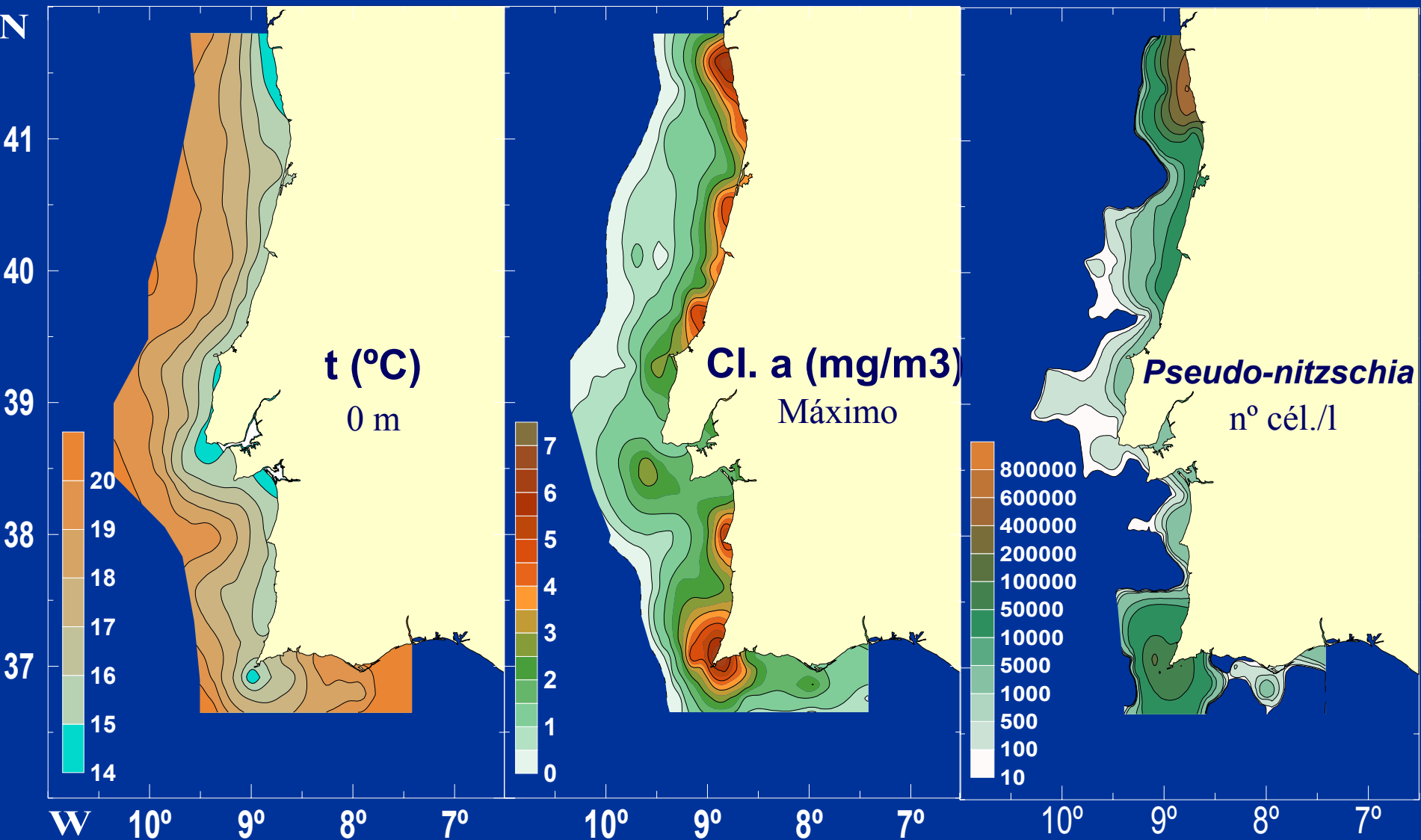
P. pseudodelicatissima (Hasle) Hasle

P. pungens (Grunow ex Cleve) Hasle

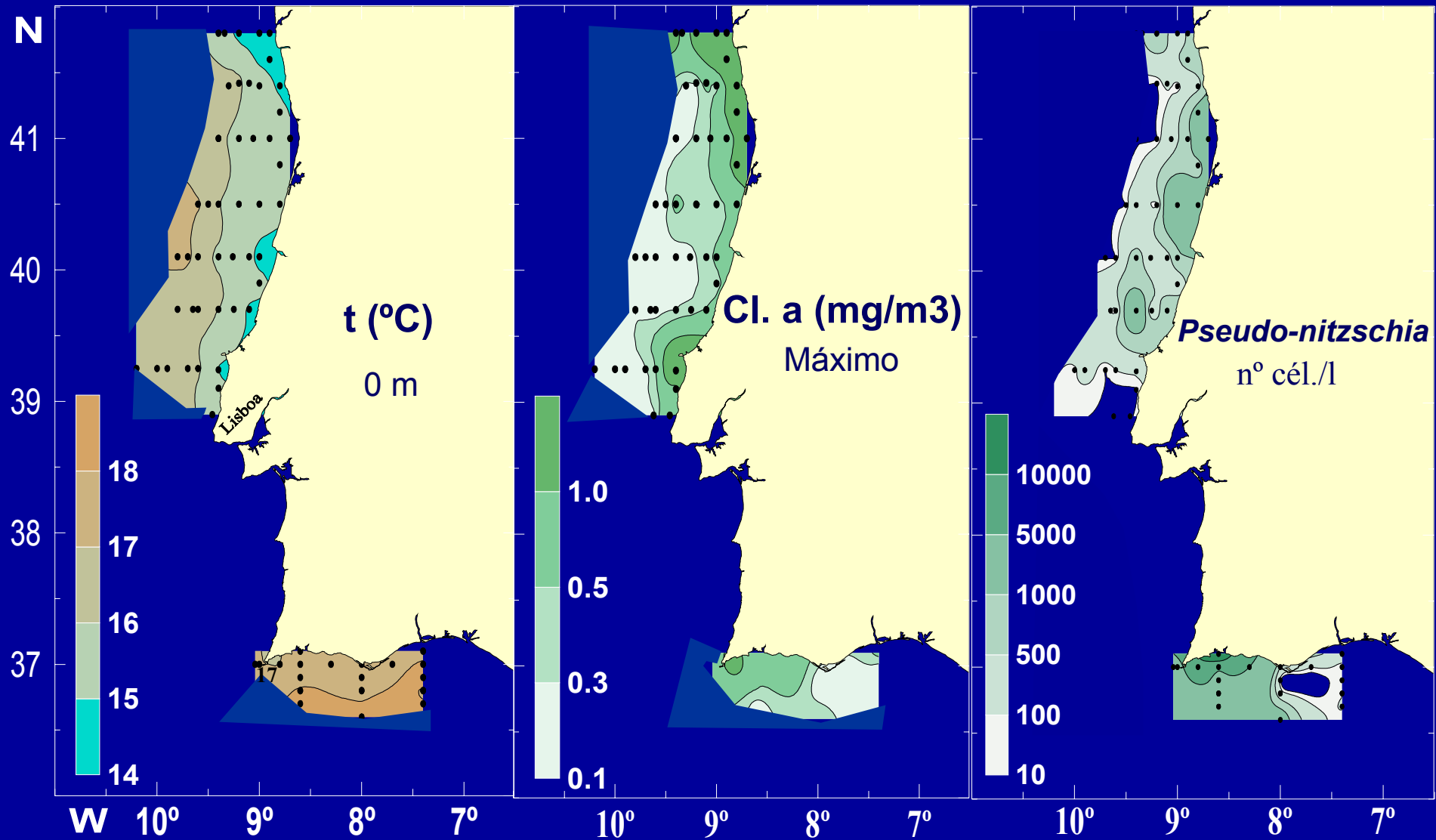
P. cf. seriata (Cleve) Peragallo *1

*1 Restritas a latitudes elevadas
de águas do hemisfério Norte

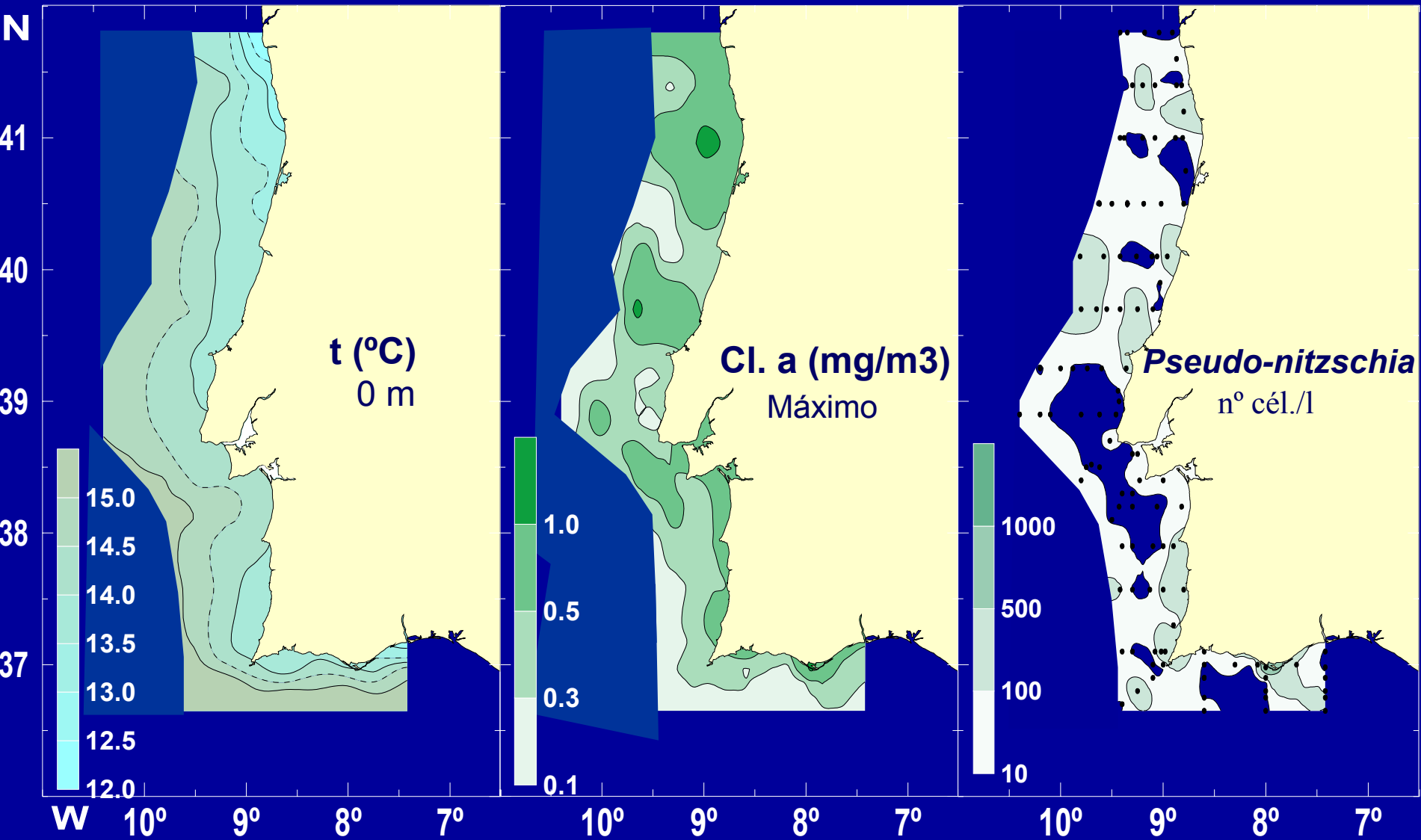
Verão 85



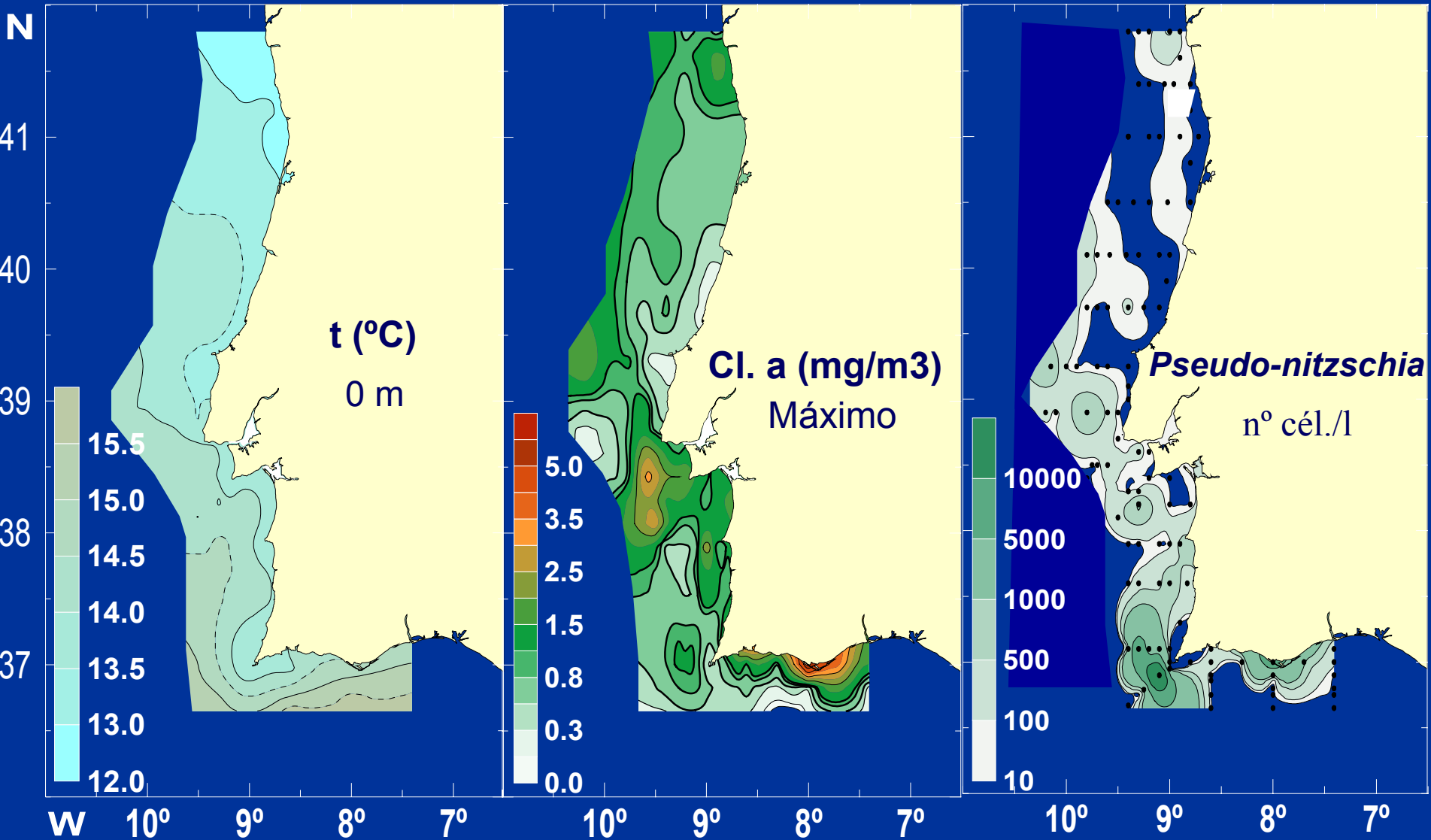
Outono 85



Inverno 86

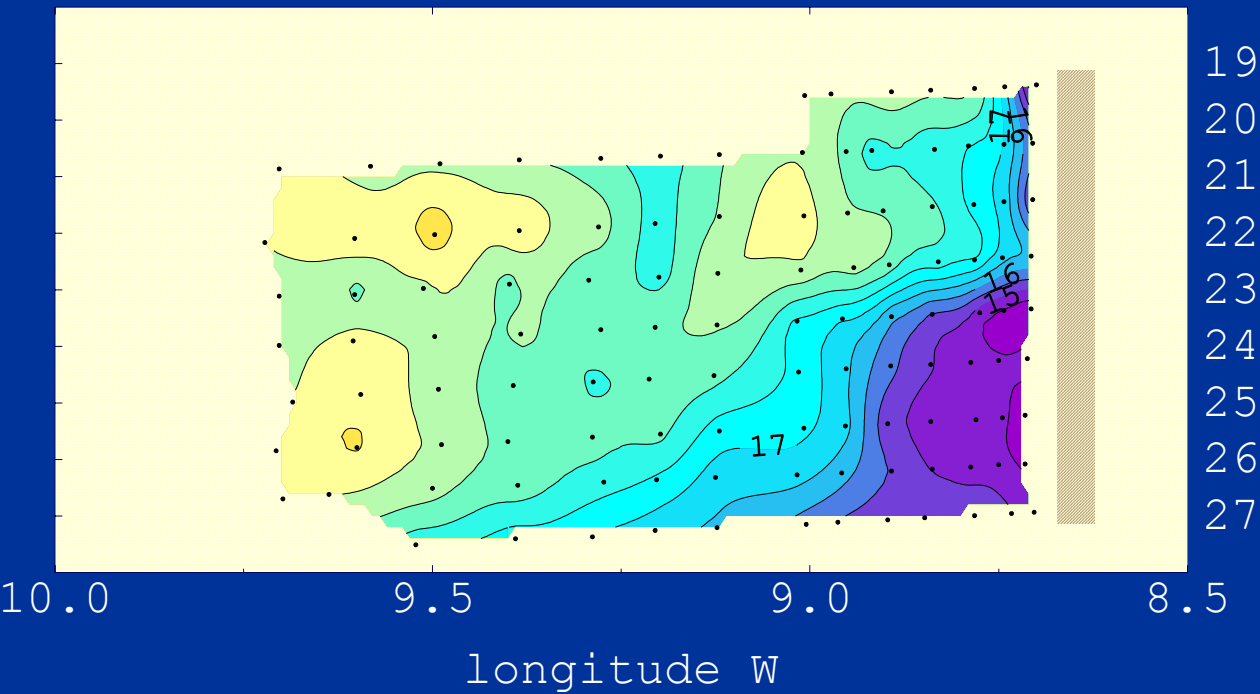


Março 86



Secção frente a Espinho, Lat.: 41.05'N

temperatura (°C) - 5 m



Dias (Agosto, 1987)



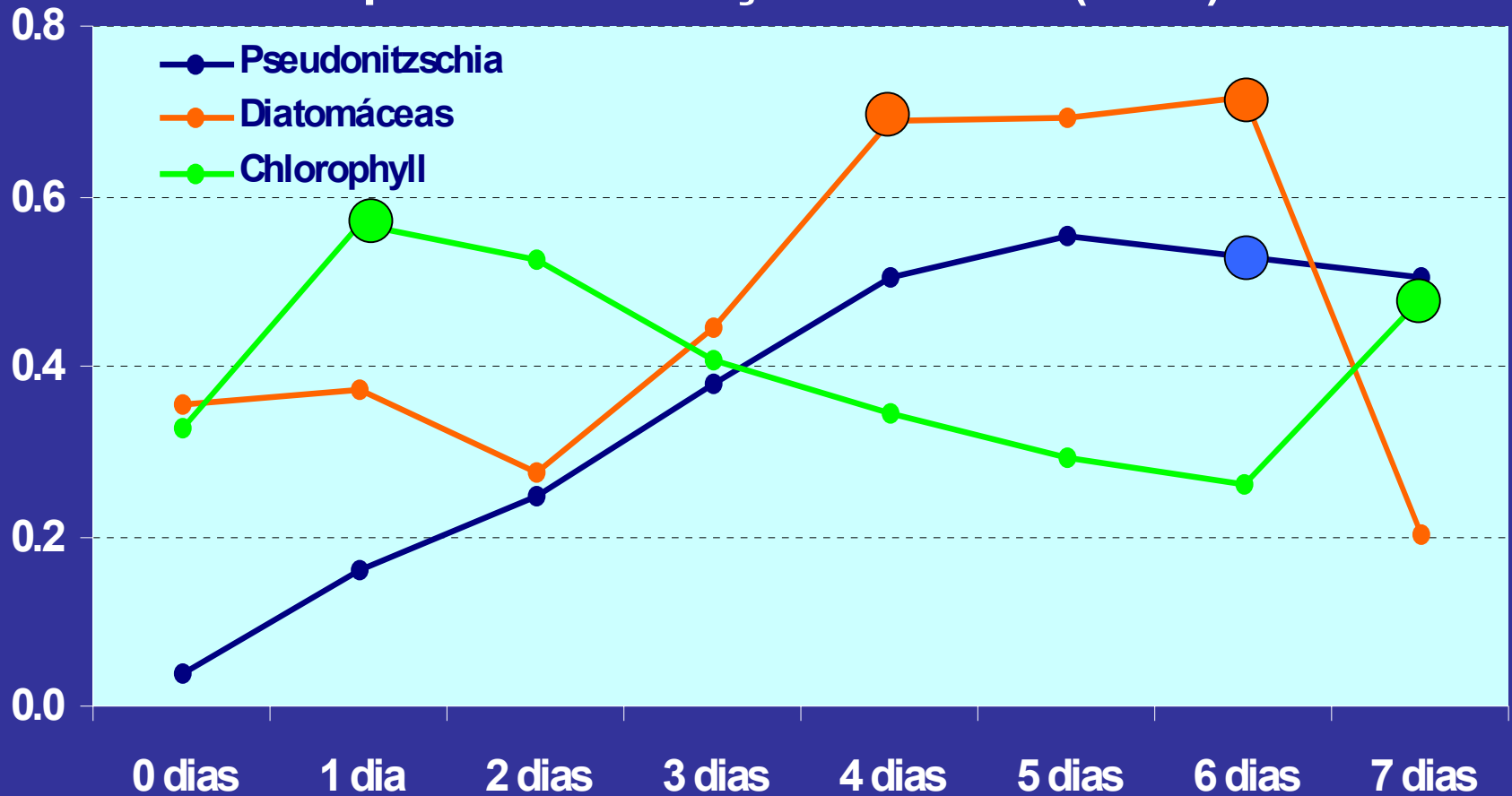
Séries Temporais

(Análises provisórias)

Cruzeiros - 32 (1985-2000)

- dados de vento diários da estação meteorológica do Cabo Cavoeiro
- dados de fitoplâncton de uma secção transversal à costa na região da Figueira da Foz

Correlações entre I.A. (C. Carvoeiro) e dados de superfície das estações costeiras (F.Foz)



Variabilidade explicada



23.3 %

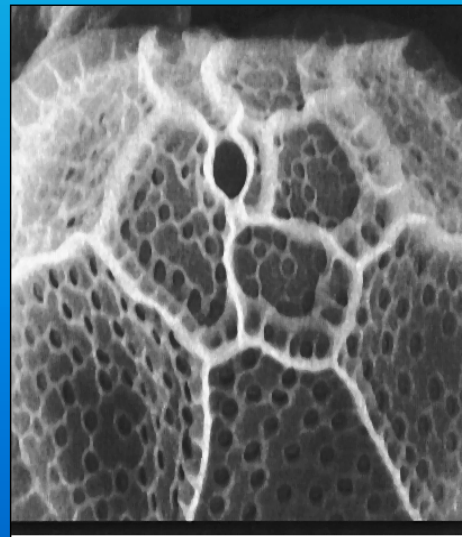
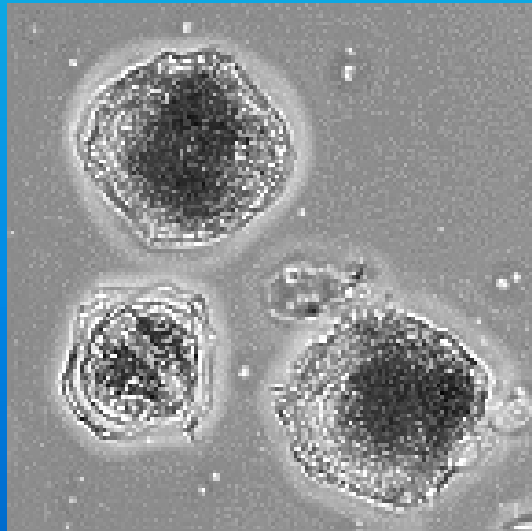


59.4 %



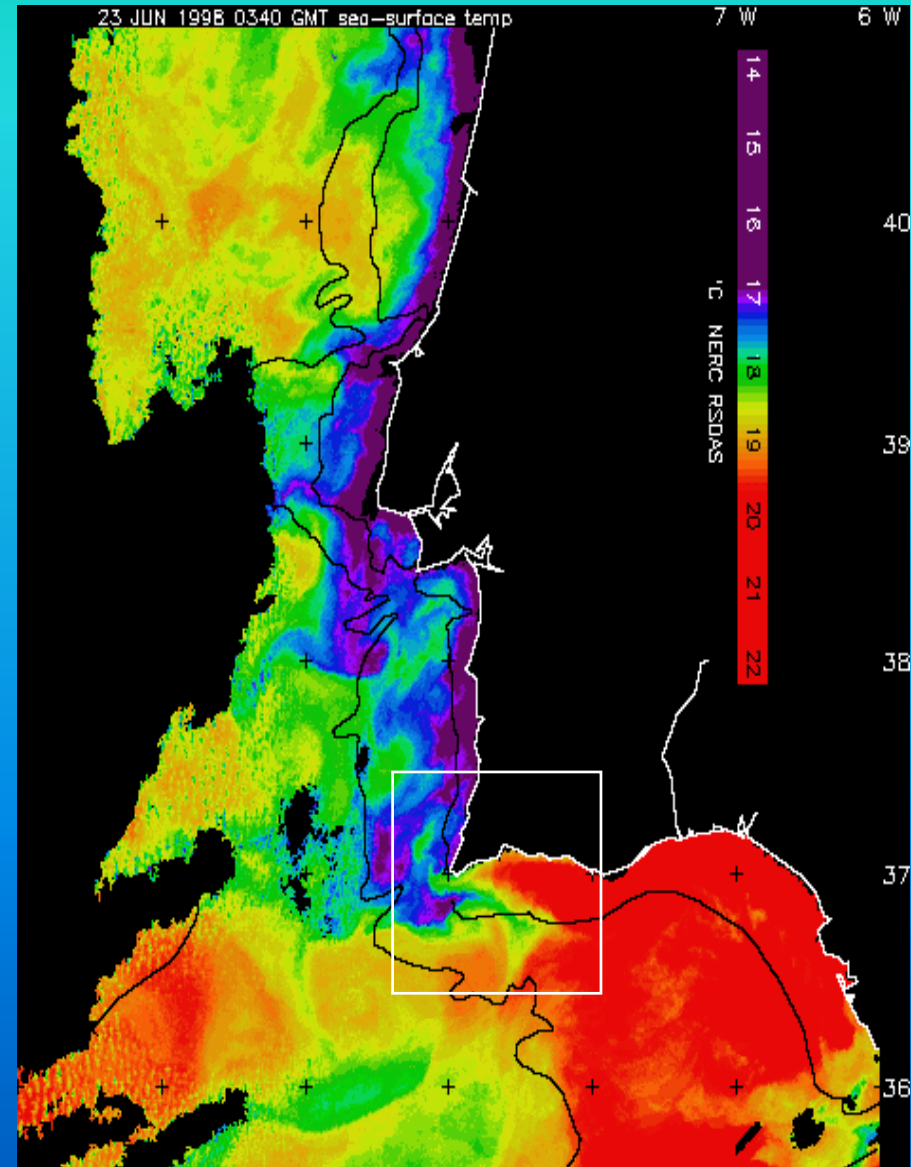
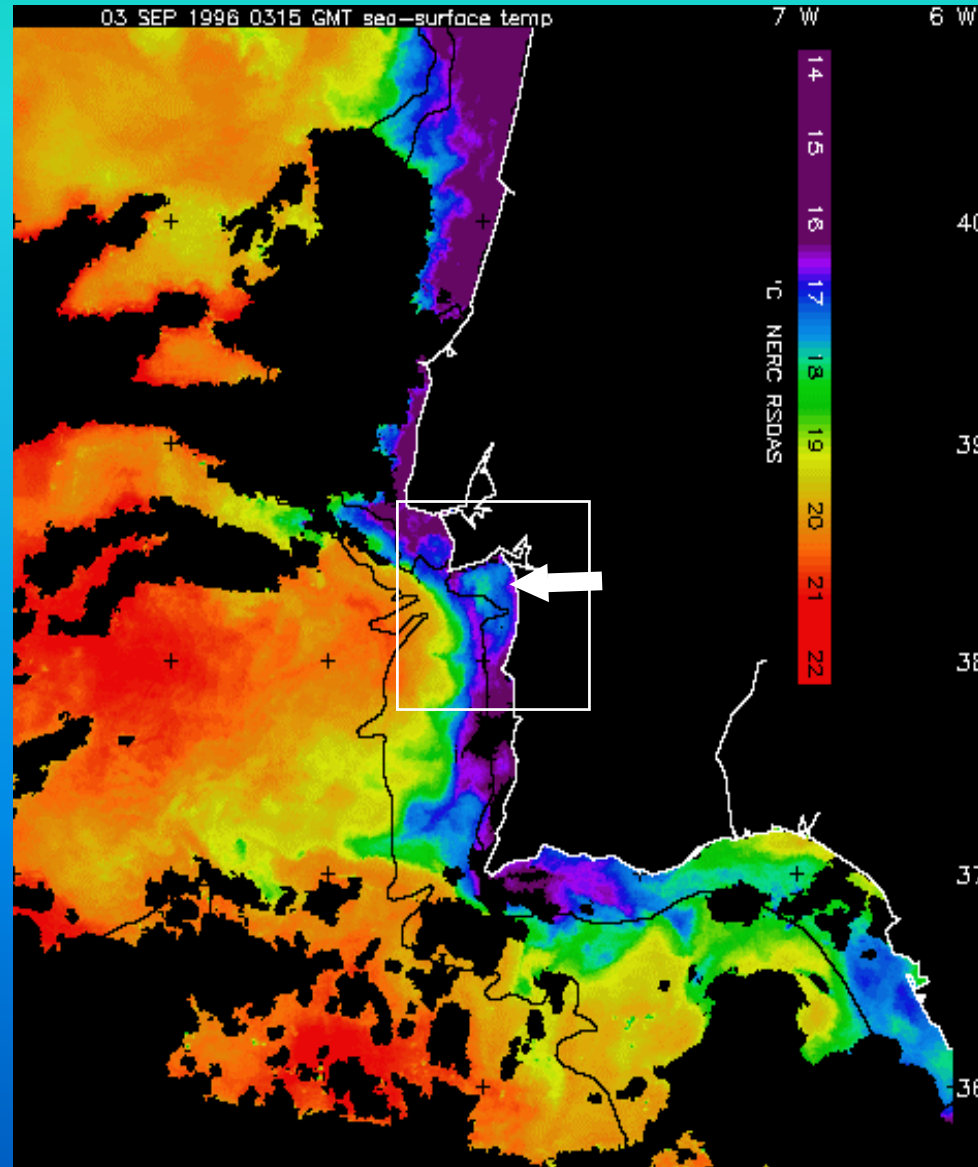
46 %

Blooms de
***Lingulodinium polyedrum*,**
espécie produtora de
yessotoxinas

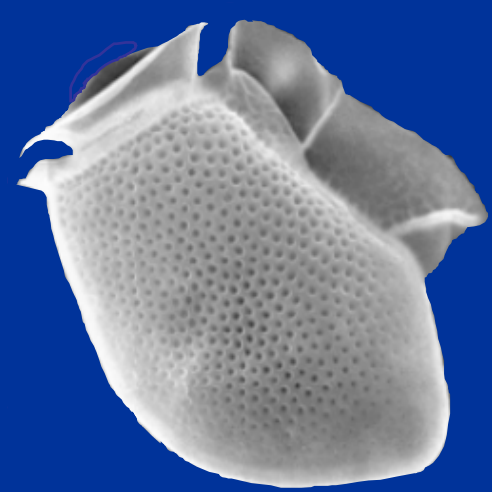


Lingulodinium polyedrum blooms

SST (°C)



Blooms de
Dinophysis acuta e
D. acuminata,
espécies produtoras de
toxinas diarreicas



Dinophysis acuta

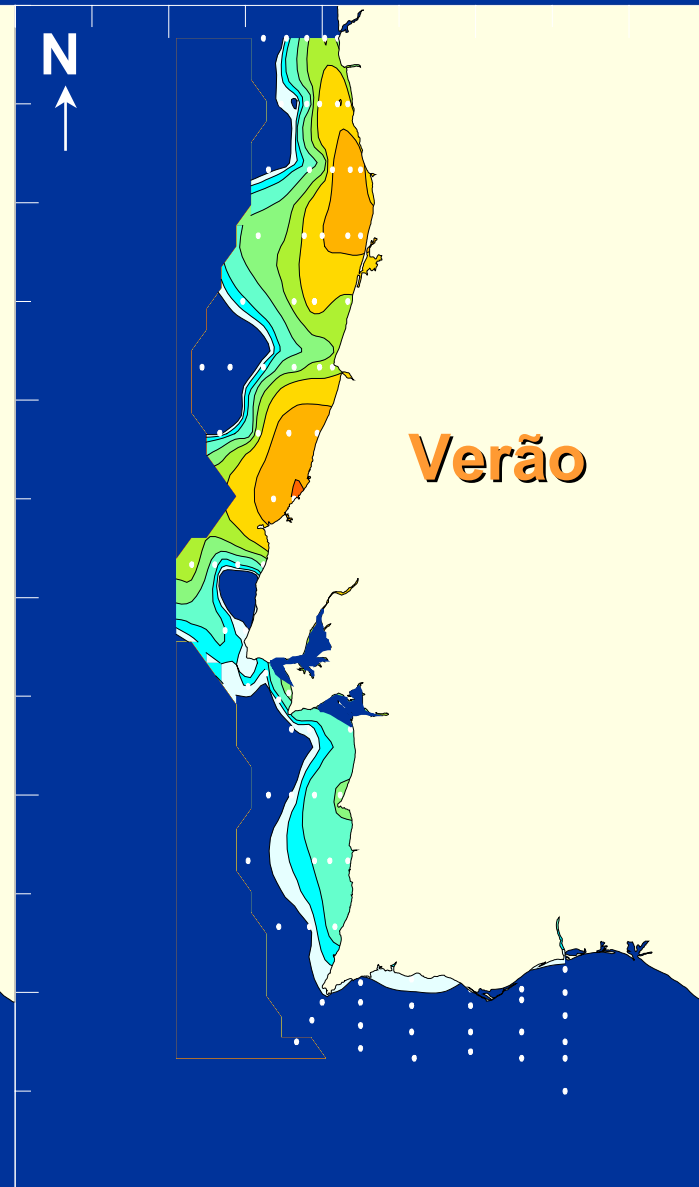
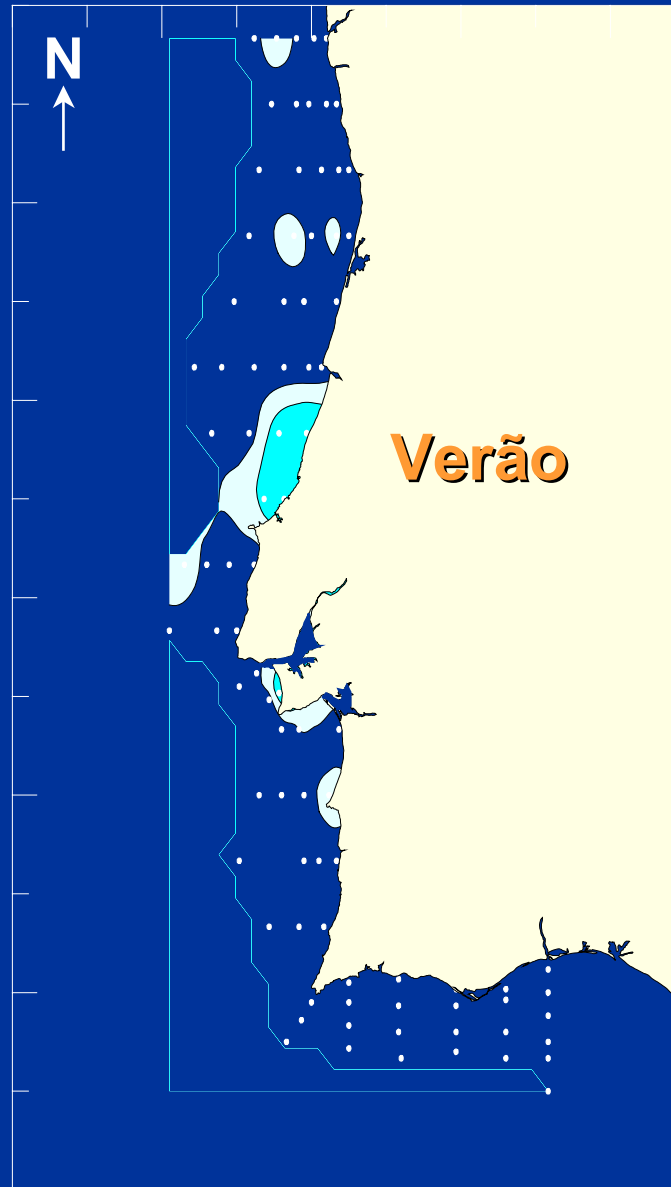
cél. l⁻¹

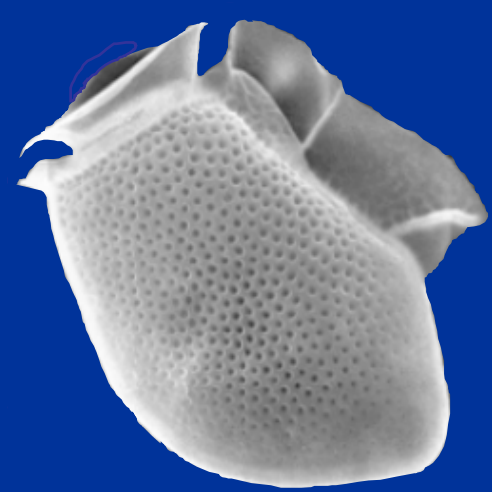


D. acuta

1991

D. acuminata



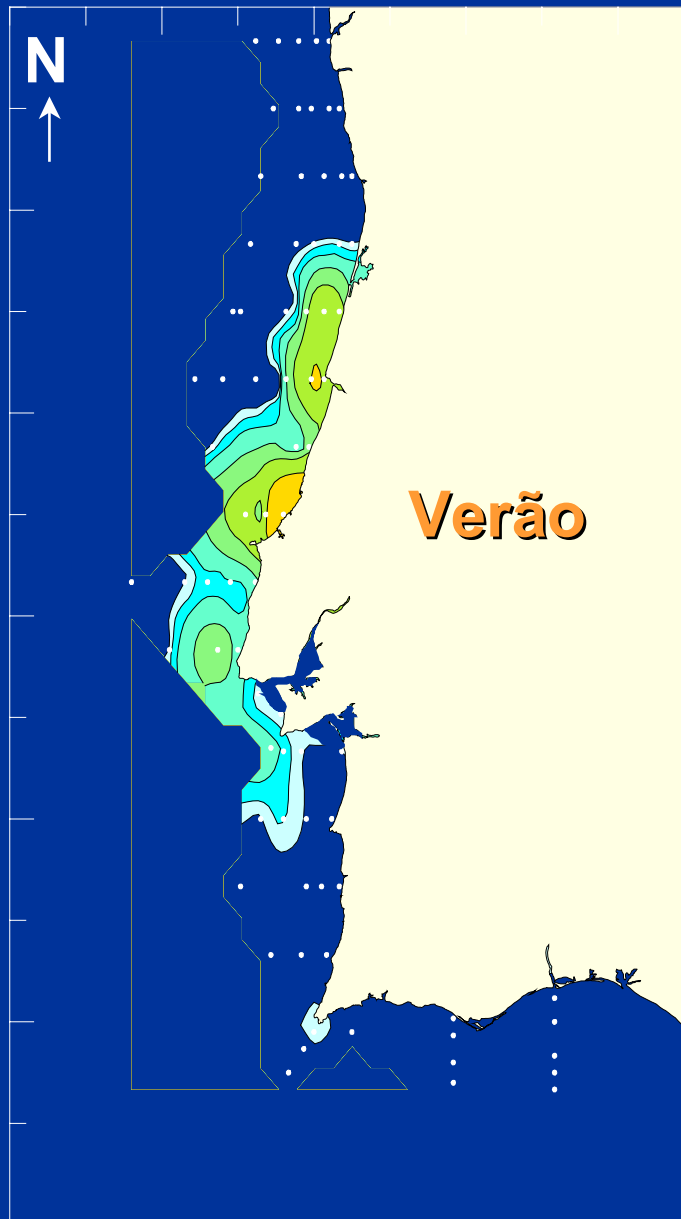


Dinophysis acuta

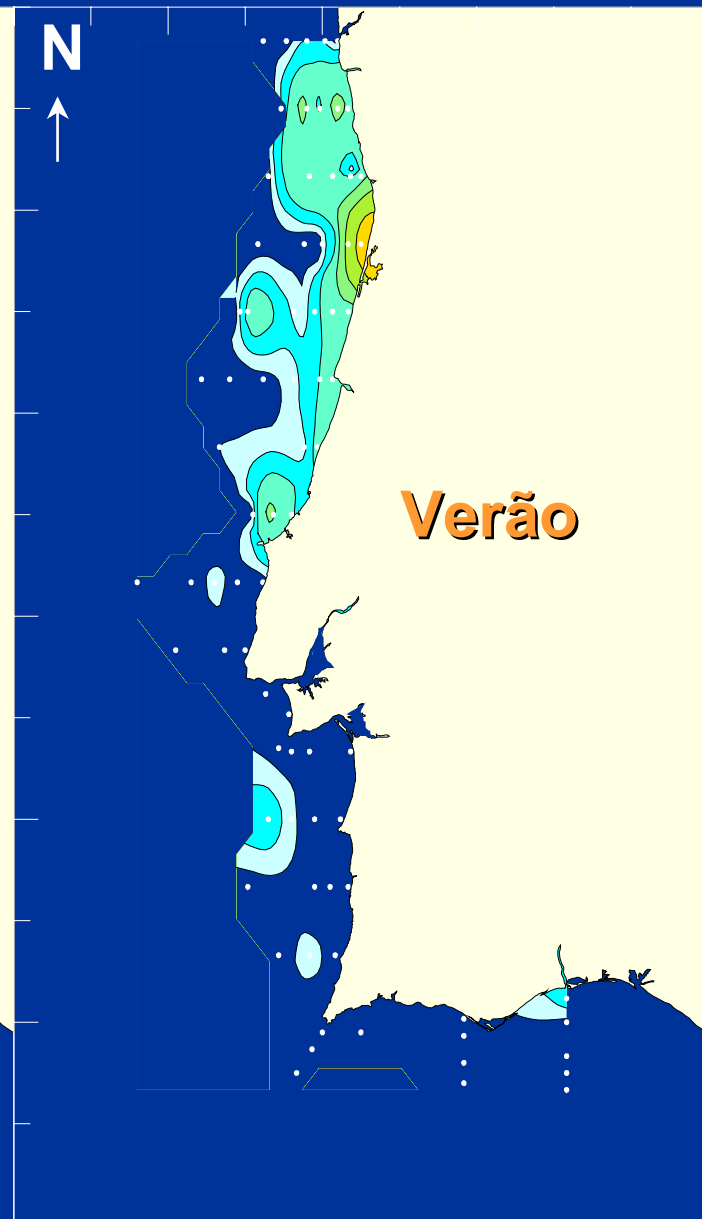
cél. l⁻¹

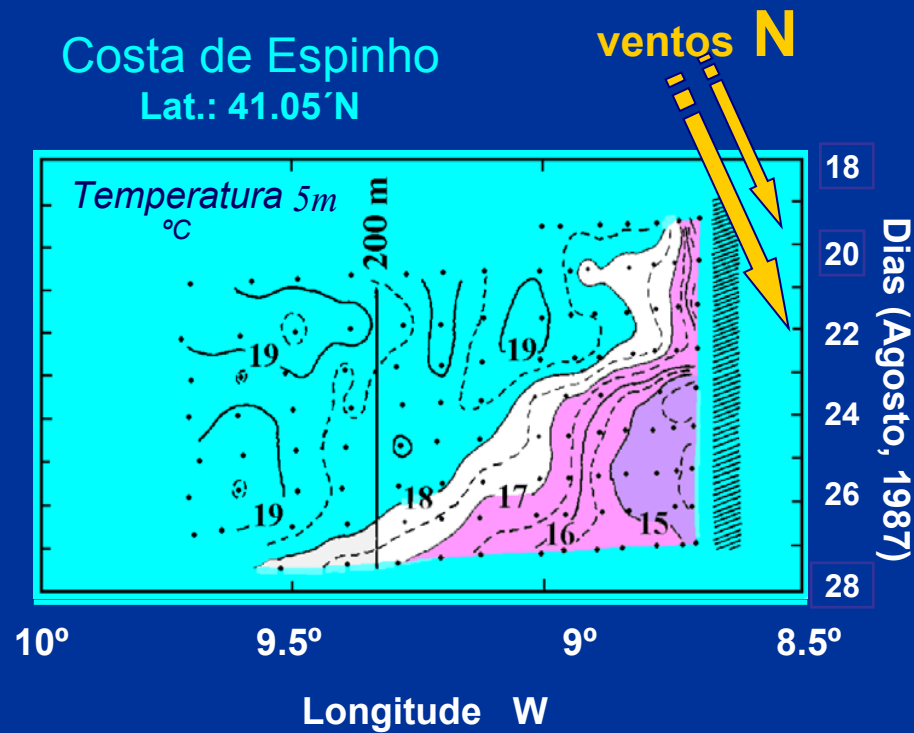
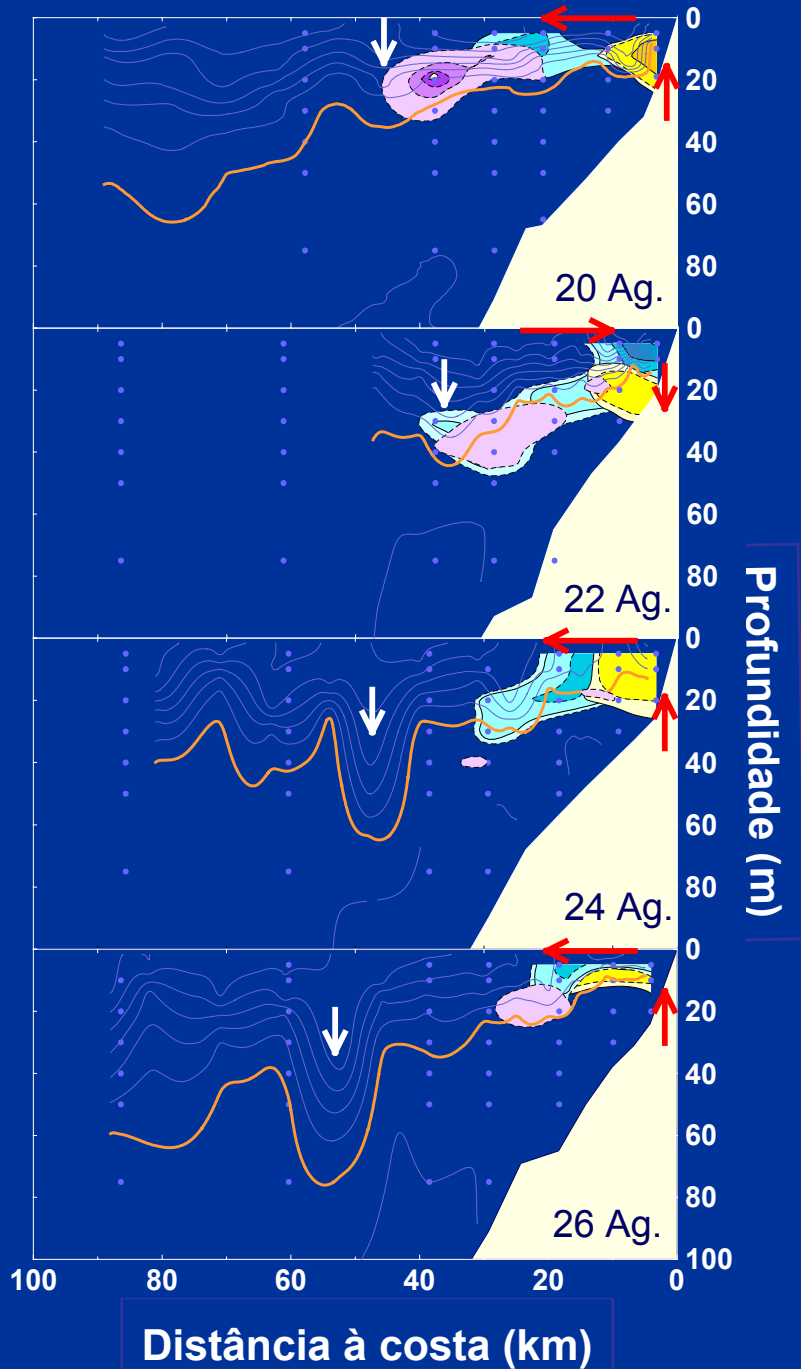





D. acuta 1992



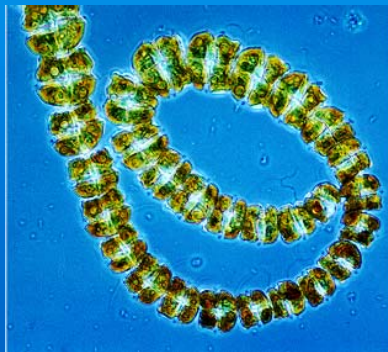
D. acuminata



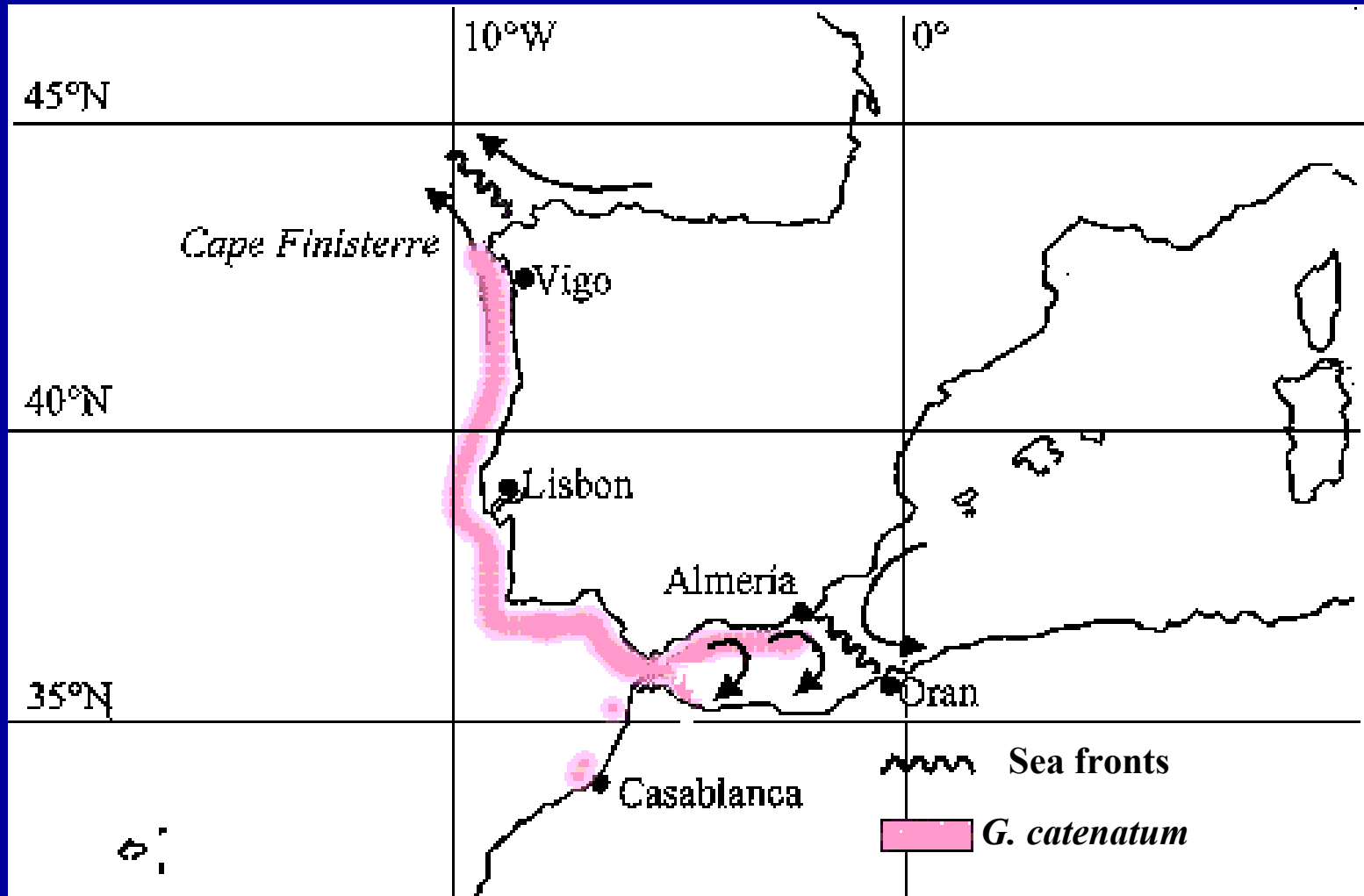


-  *G. catenatum*
-  *D. acuta*
-  *D. tripos*

Blooms de
***Gymnodinium catenatum*,**
espécie produtora de toxinas
paralisantes



Distribuição geográfica de *G. catenatum* na Europa

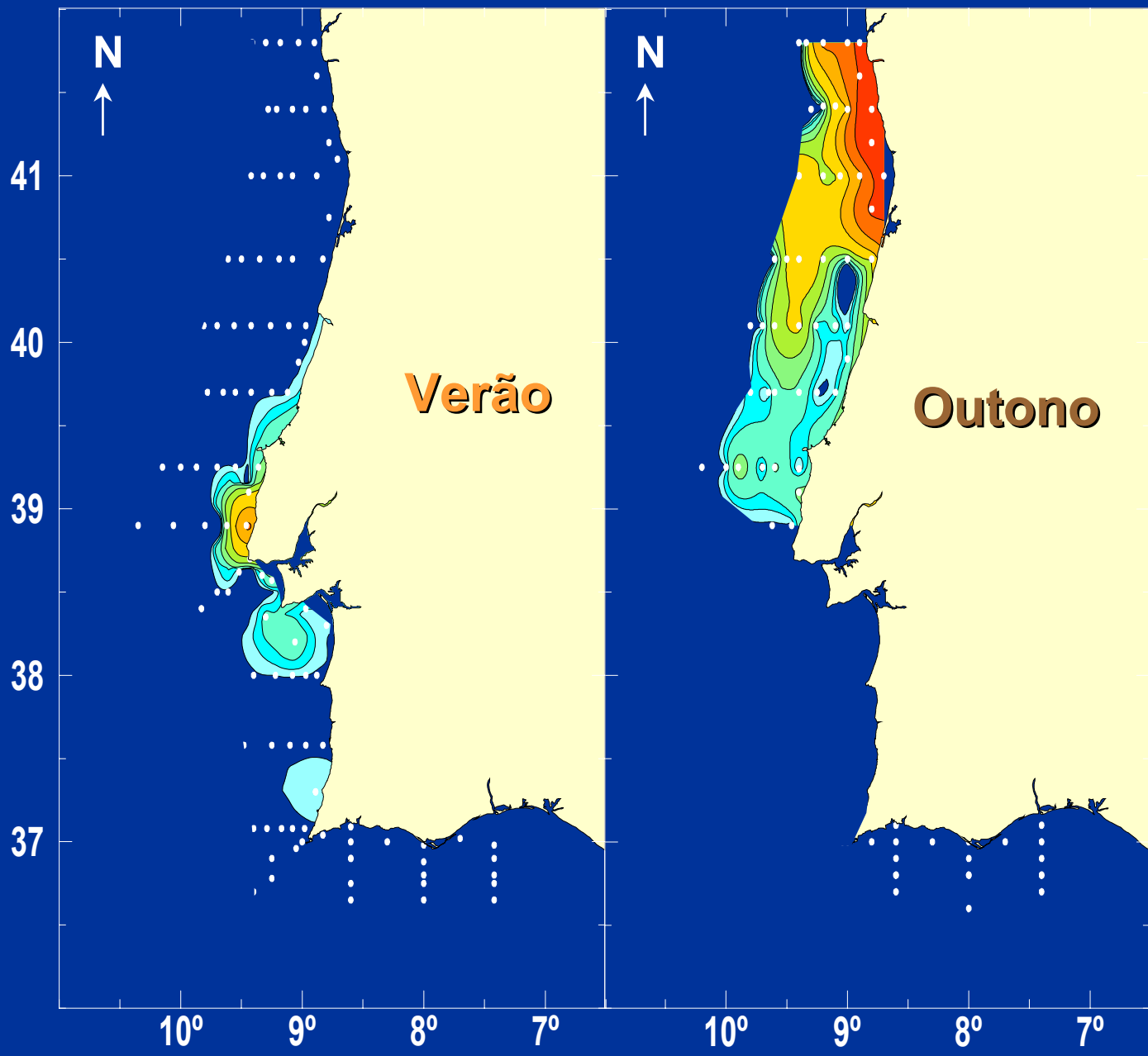


From Fraga, 1996

1985



Gymnodinium catenatum

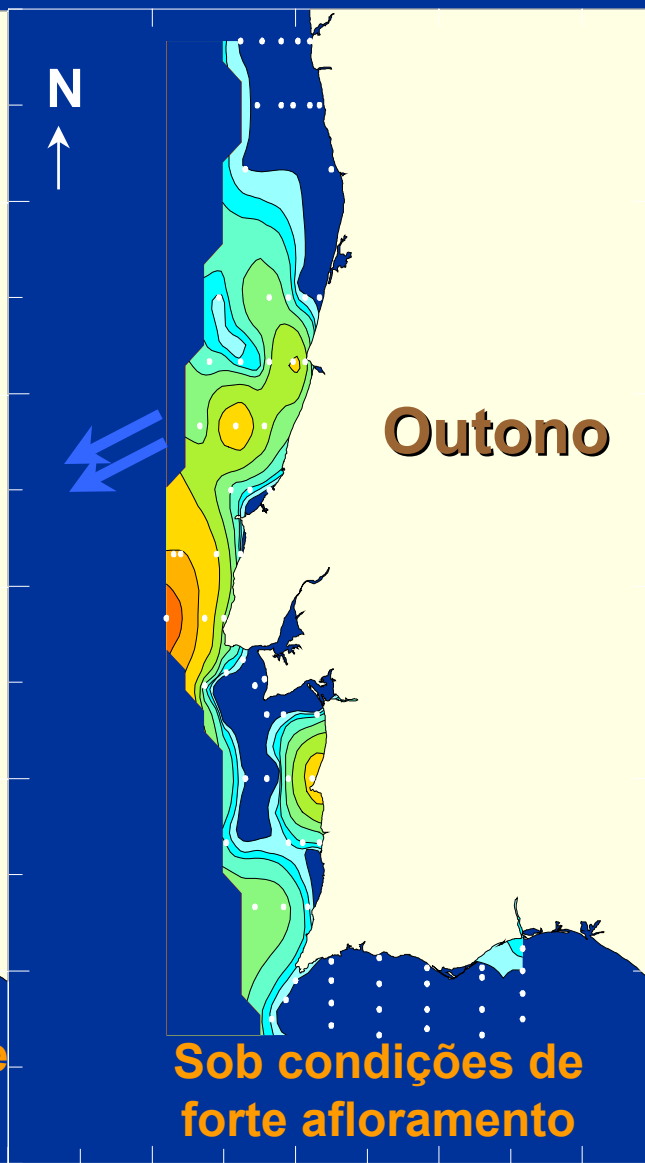
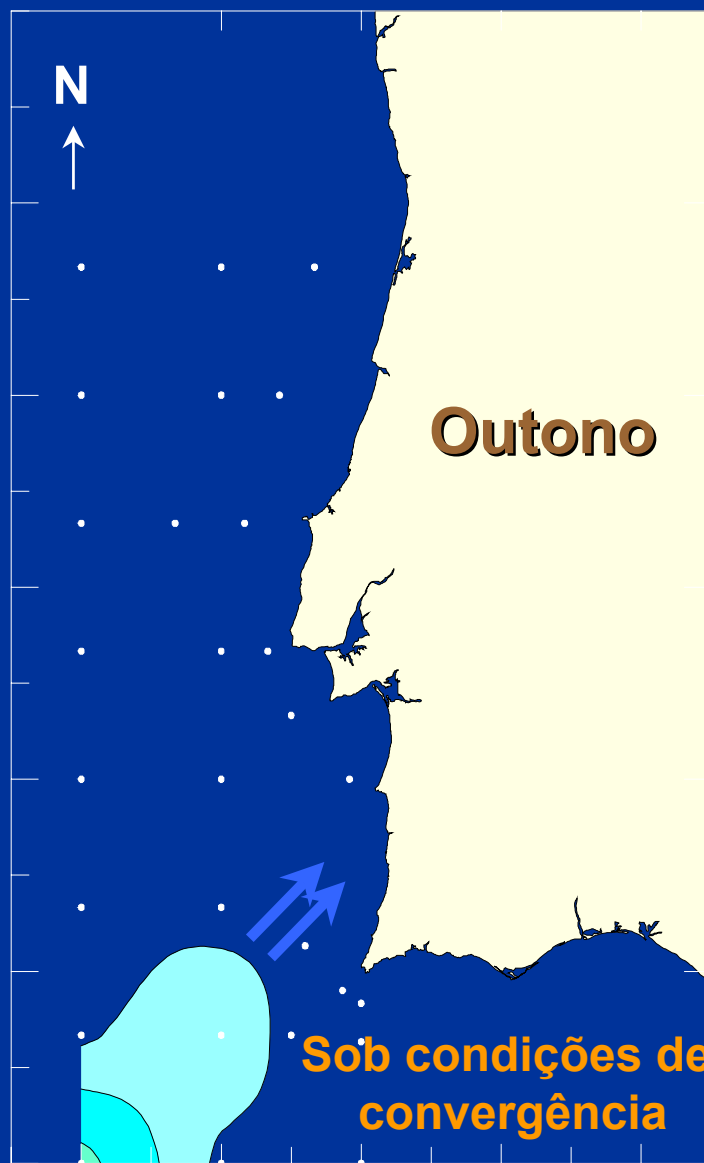
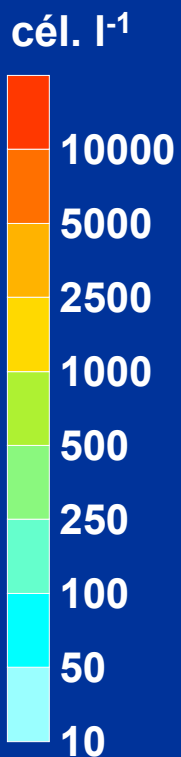




*Gymnodinium
catenatum*

1991

1993

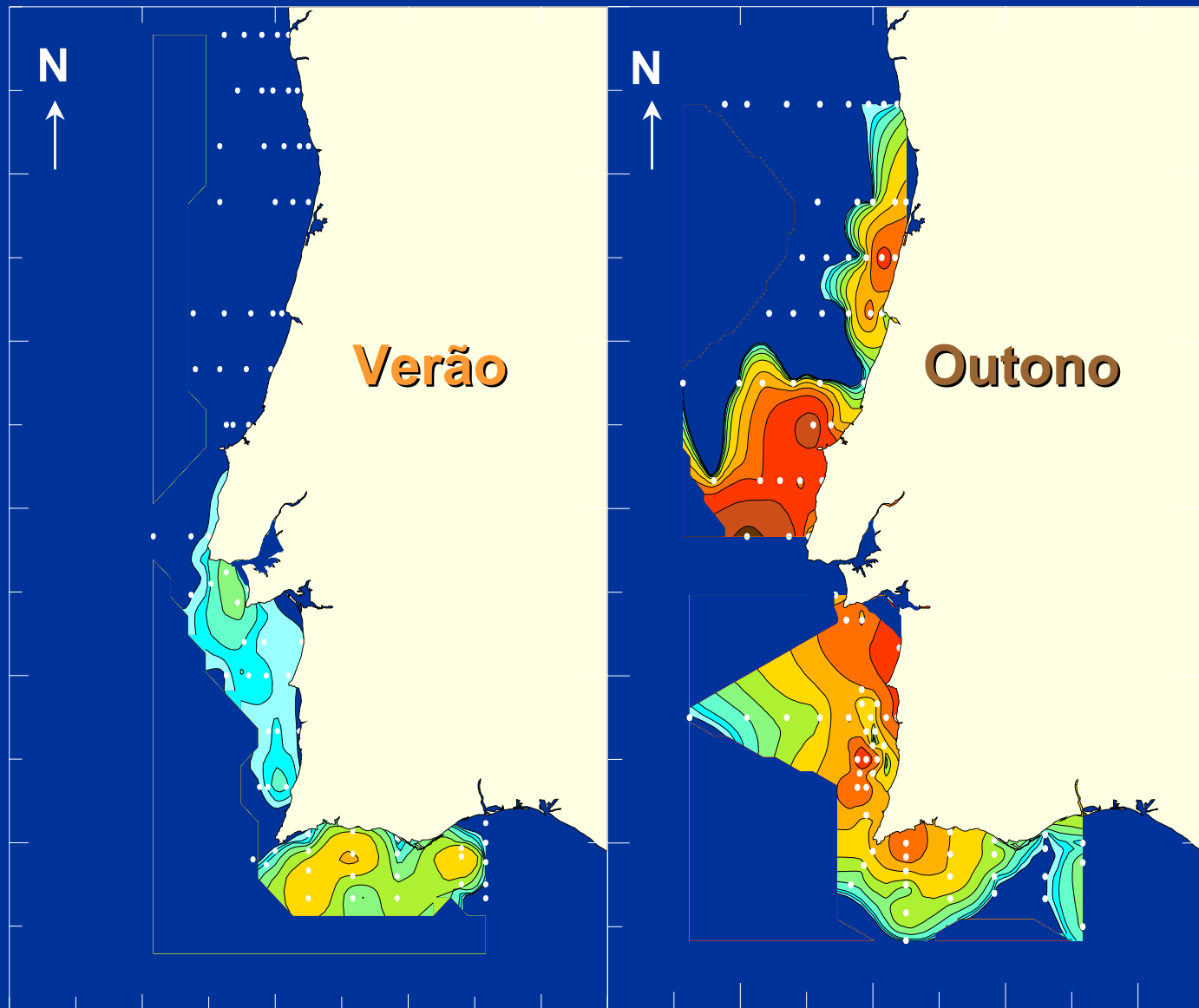
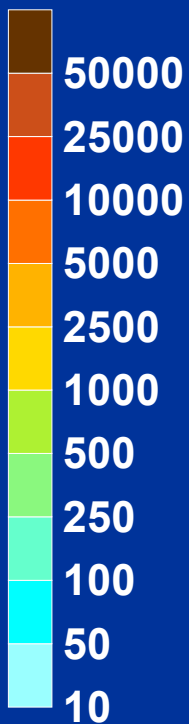


1994



*Gymnodinium
catenatum*

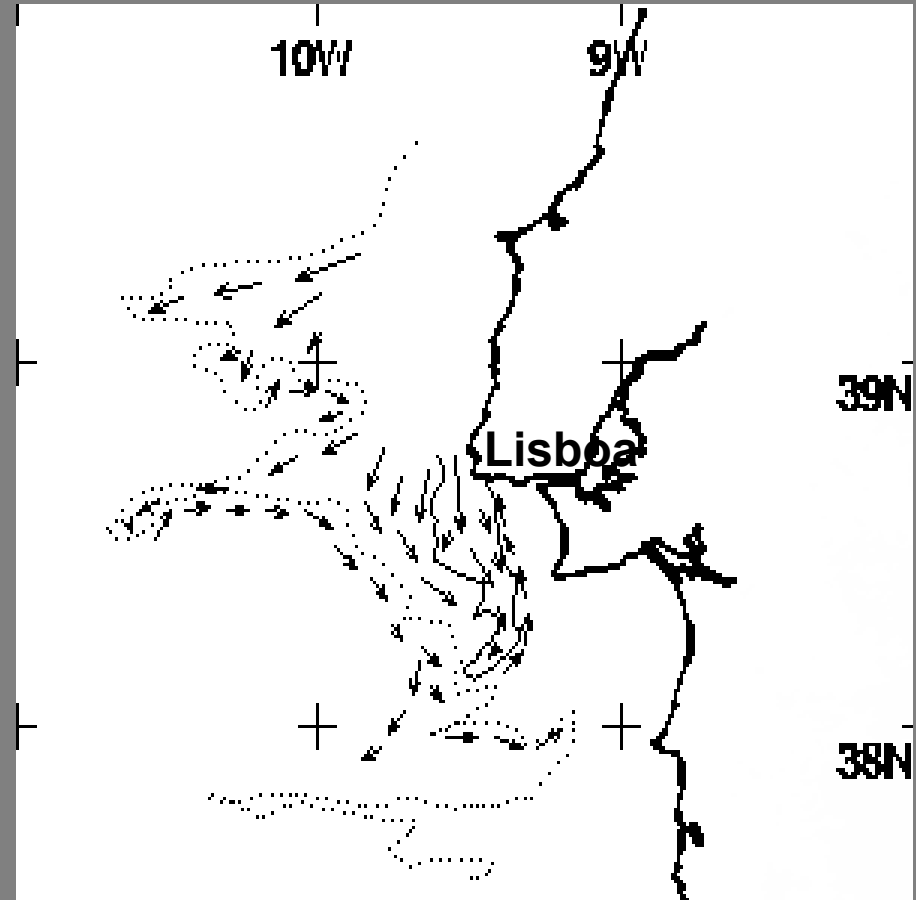
cél. l⁻¹



t superfície(satélite NOAA-9)



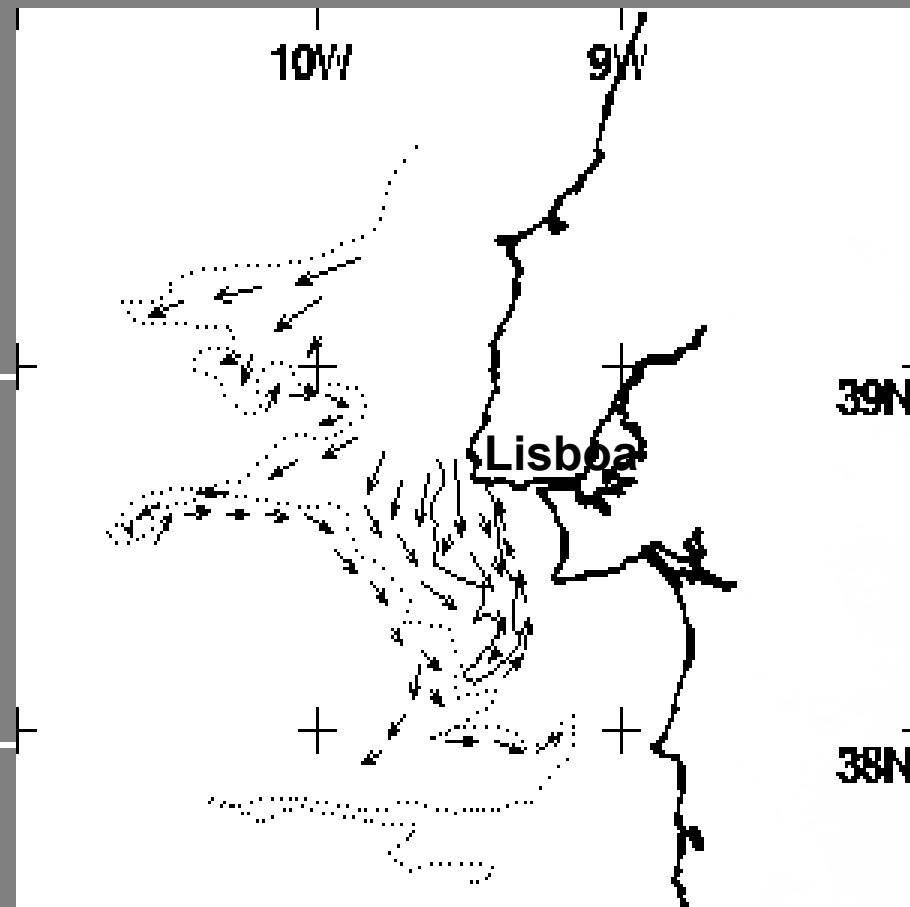
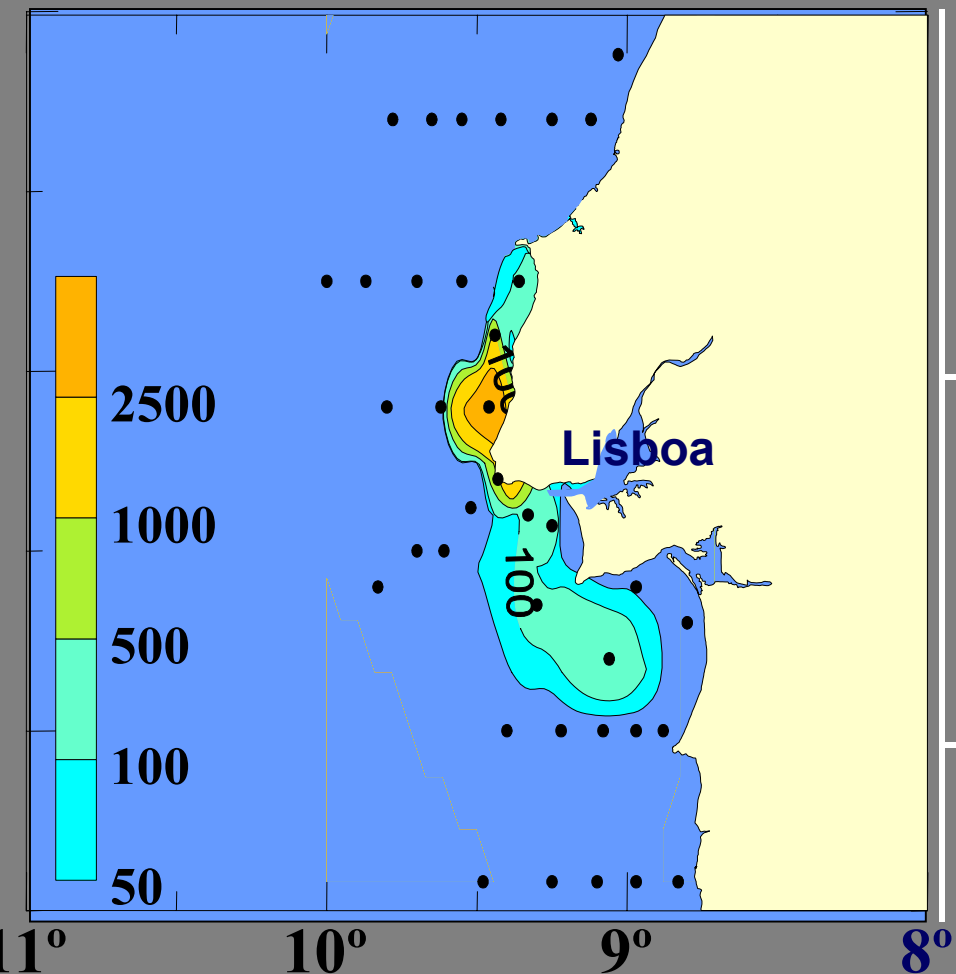
Campo de correntes deduzido



Fim do Verão 1985

G. catenatum (cells.L⁻¹)

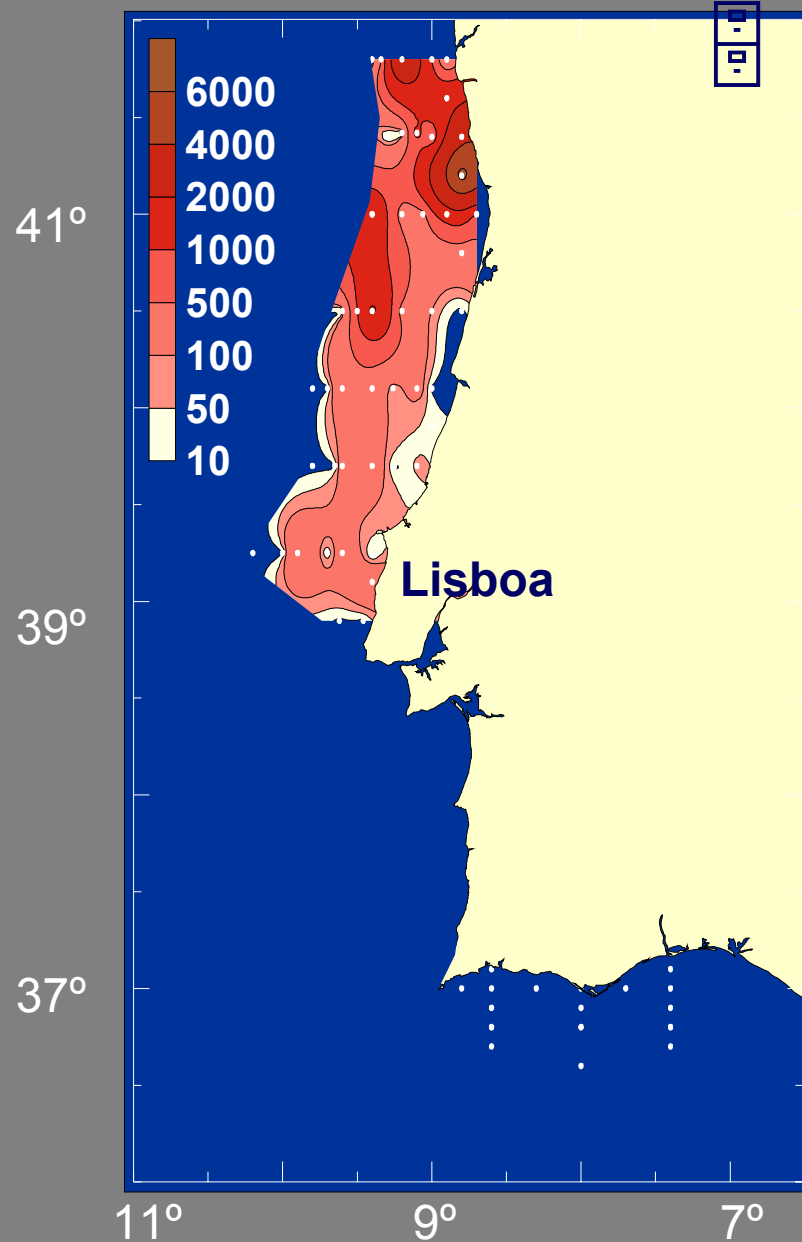
Campo de correntes deduzido



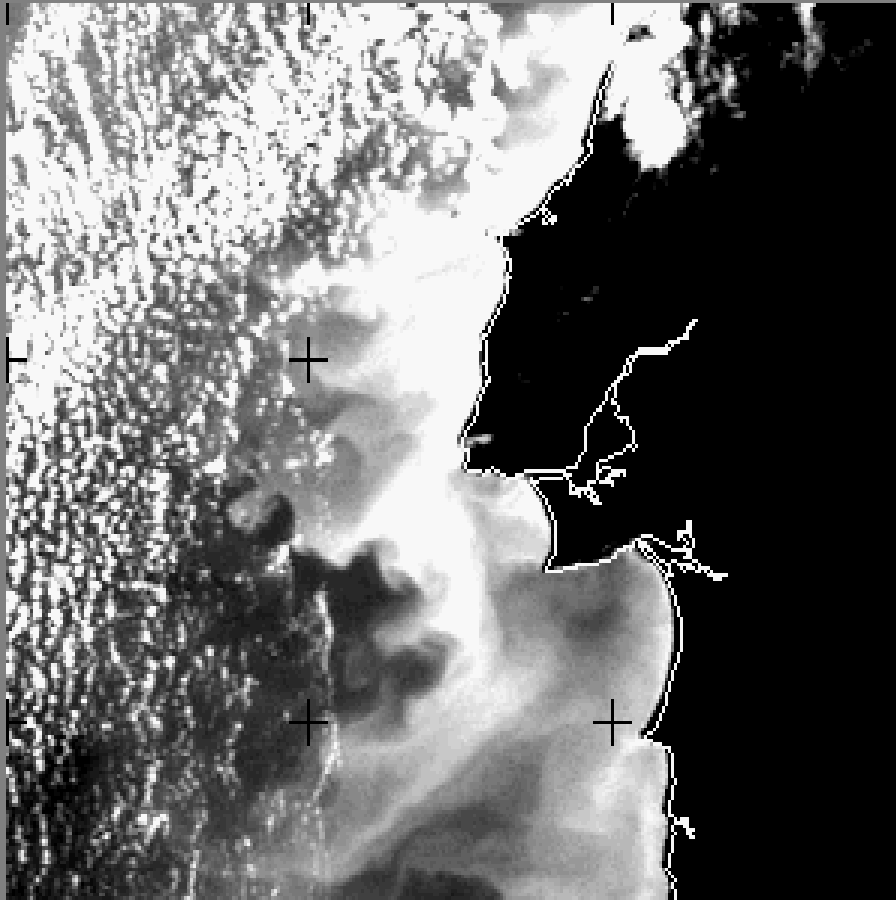
Fim do Verão 1985

G. catenatum (cél.L⁻¹)

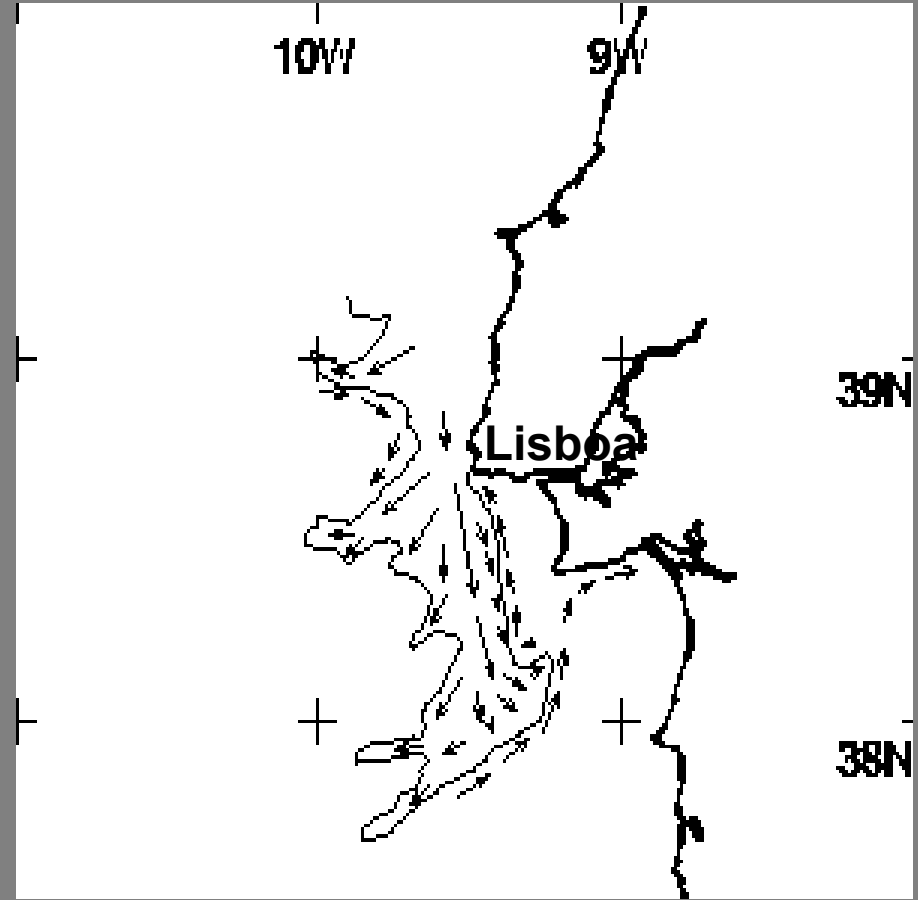
Outono 1985



t superfície(satélite NOAA-9)



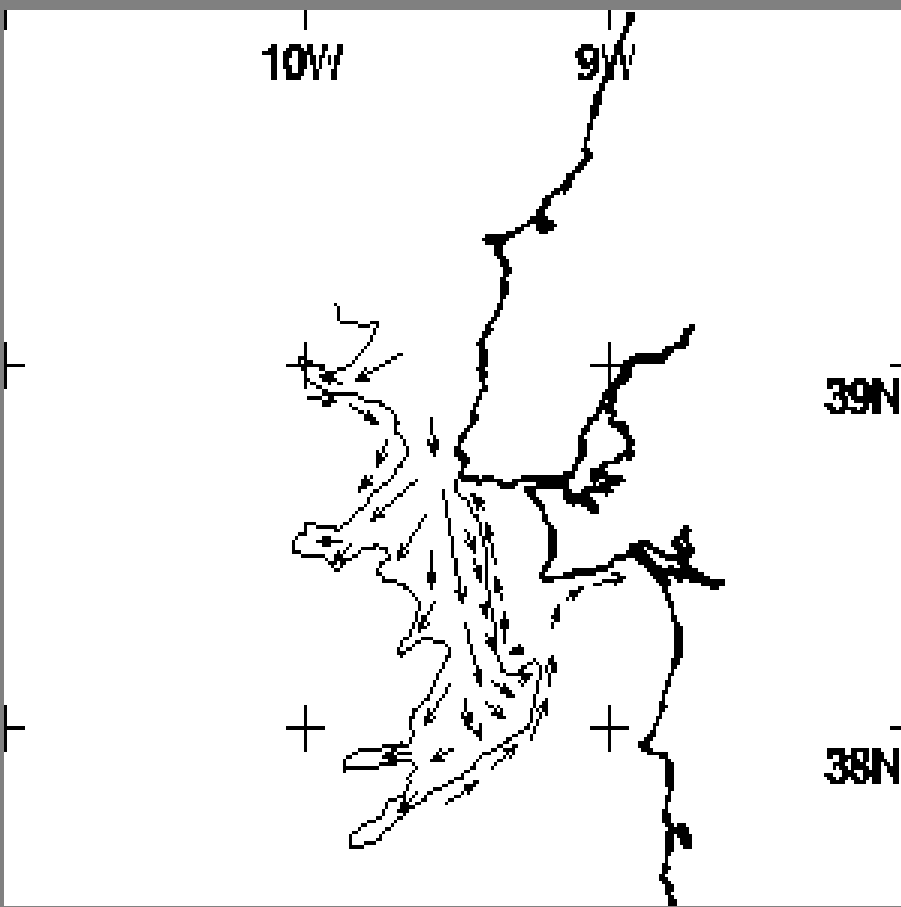
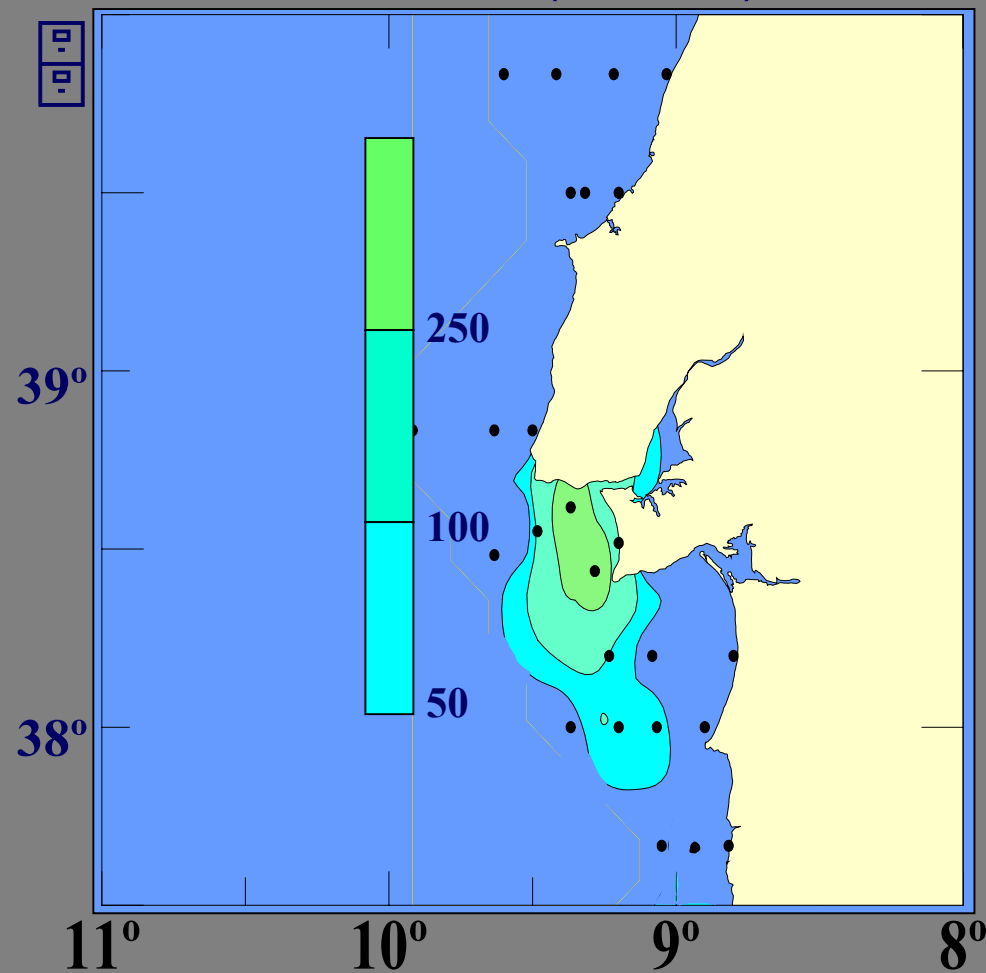
Campo de correntes deduzido



Verão de 1994

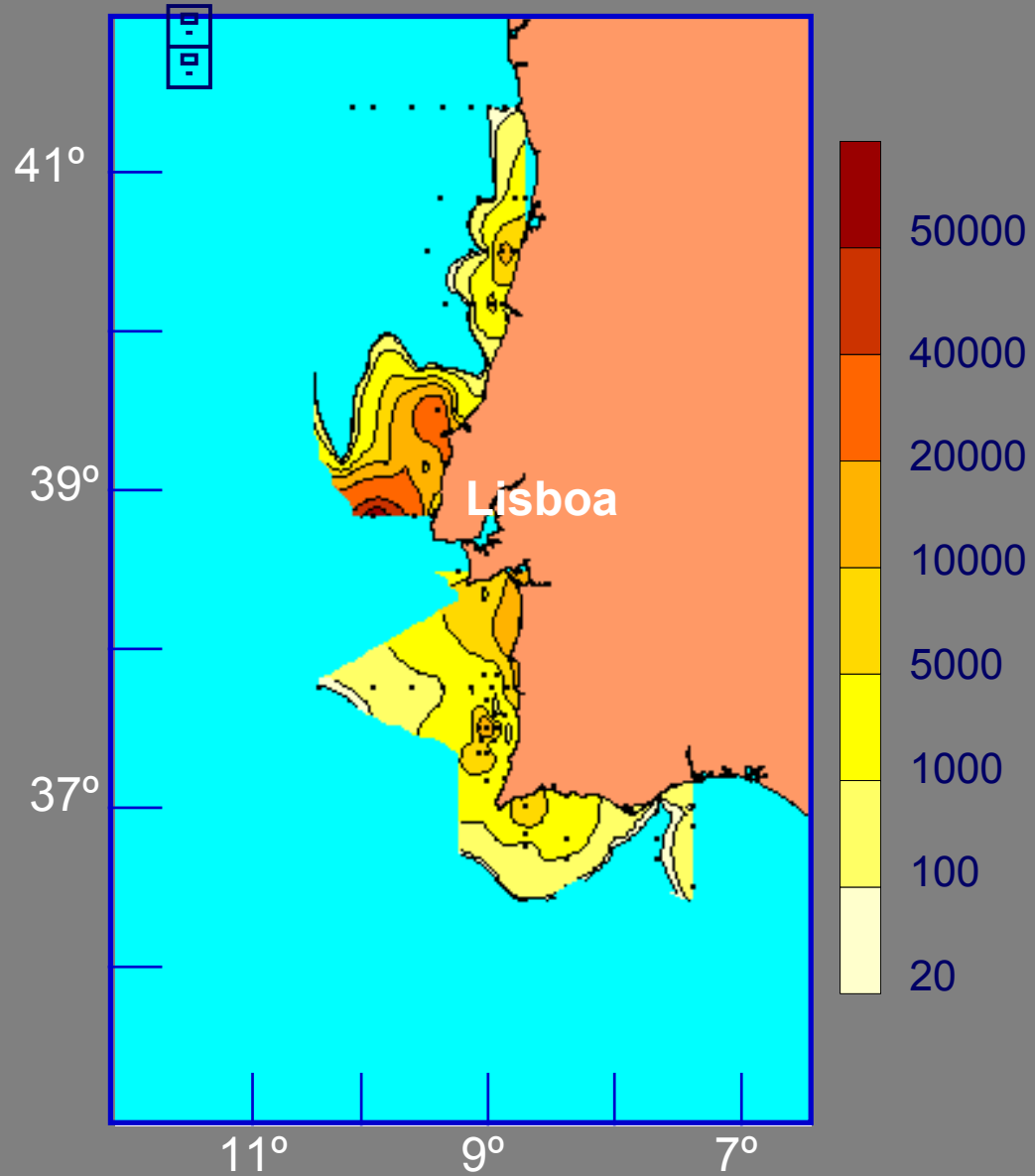
G.catenatum (cells.L⁻¹)

Campo de correntes deduzido

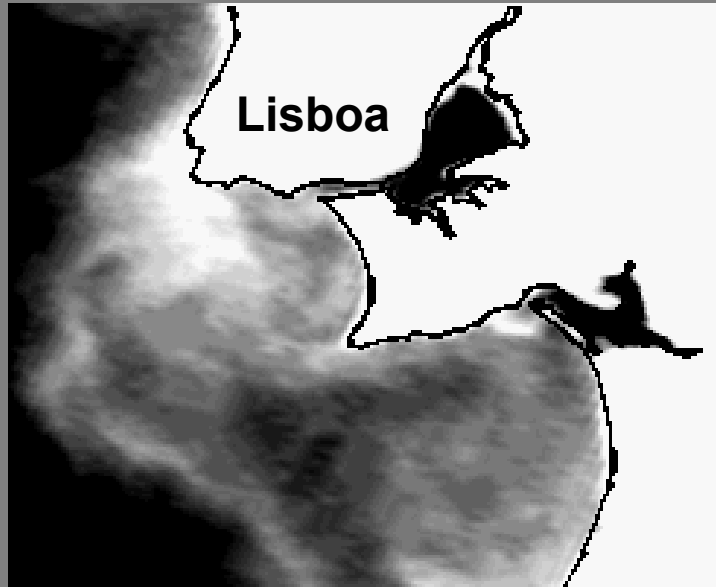


Verão 1994

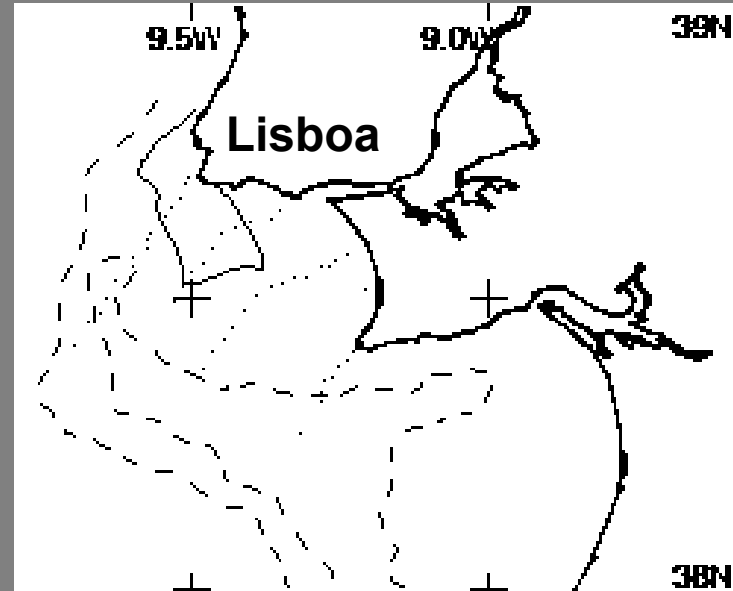
Outono 1994



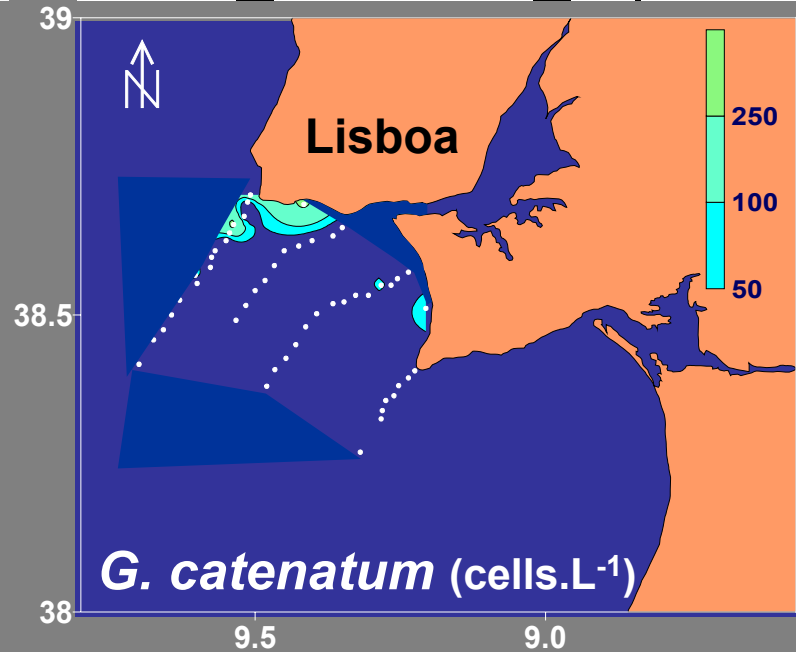
t superfície(satélite NOAA-9)



Campo de correntes deduzido

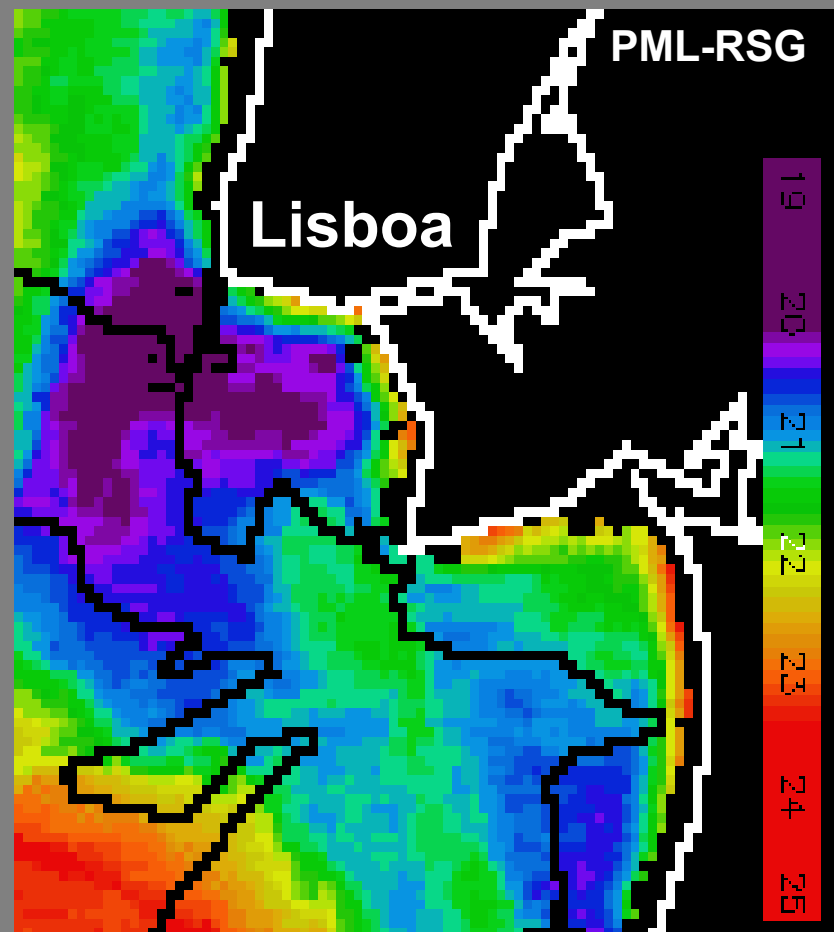
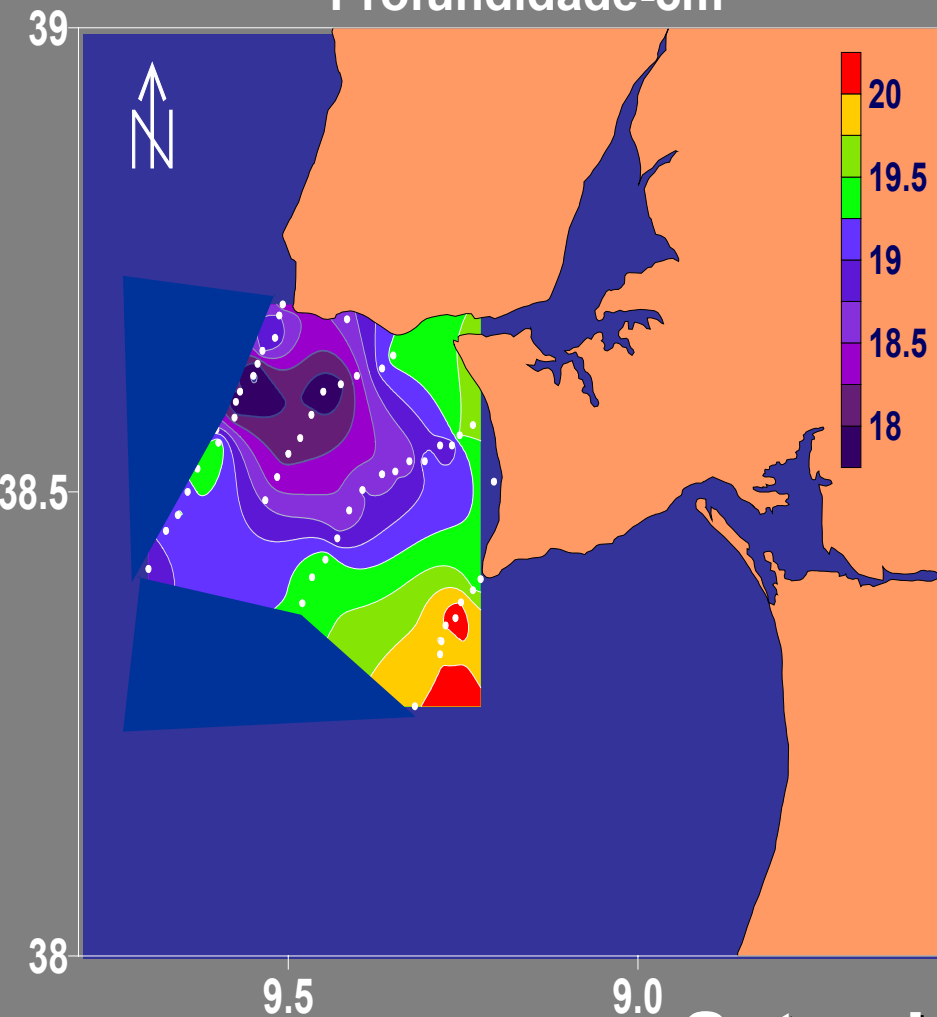


Fim do Verão de 1999



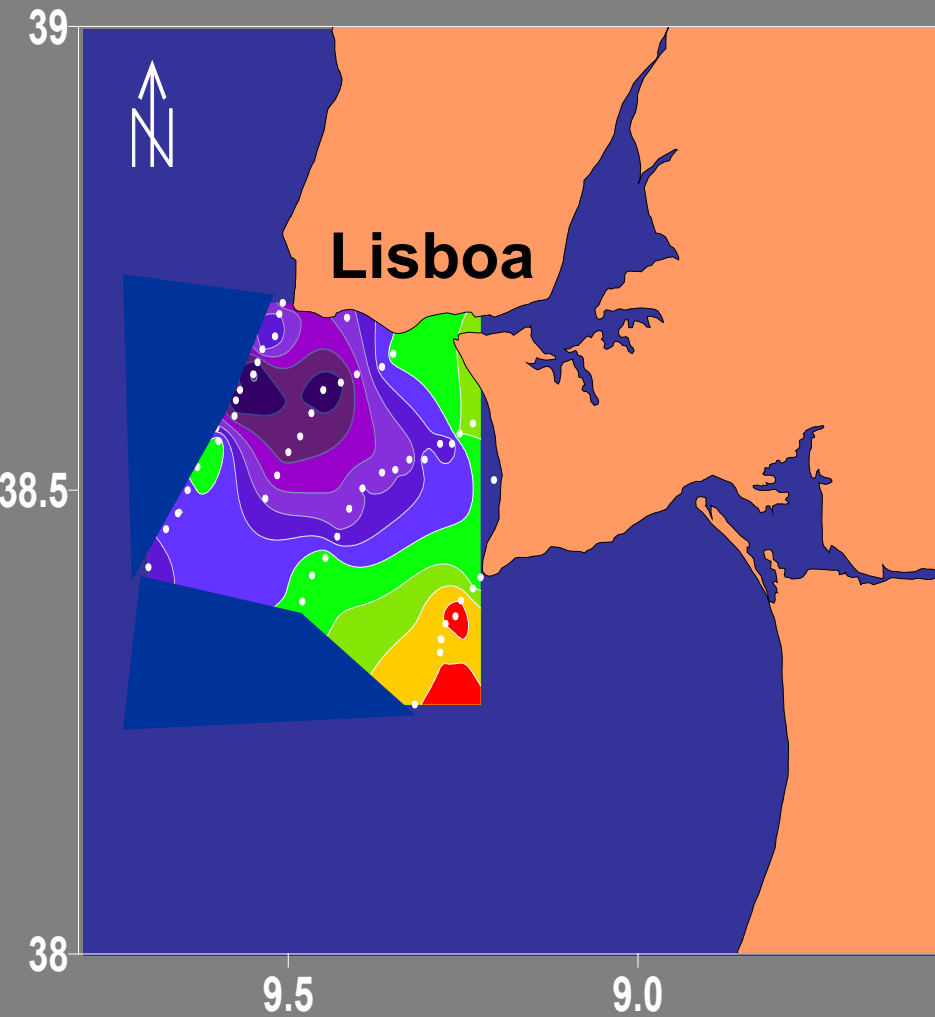
Temperatura de superfície (°C)

Profundidade-5m

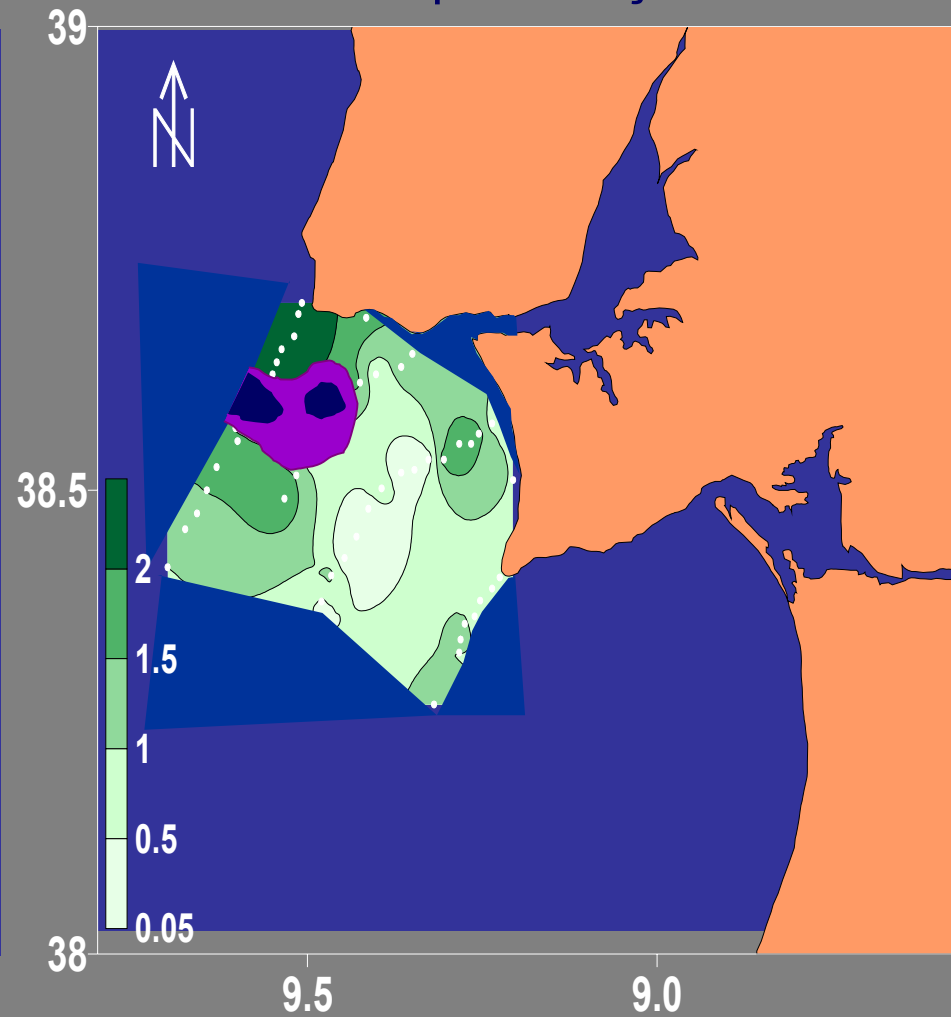


Setembro, 1999

T superfície (5m)



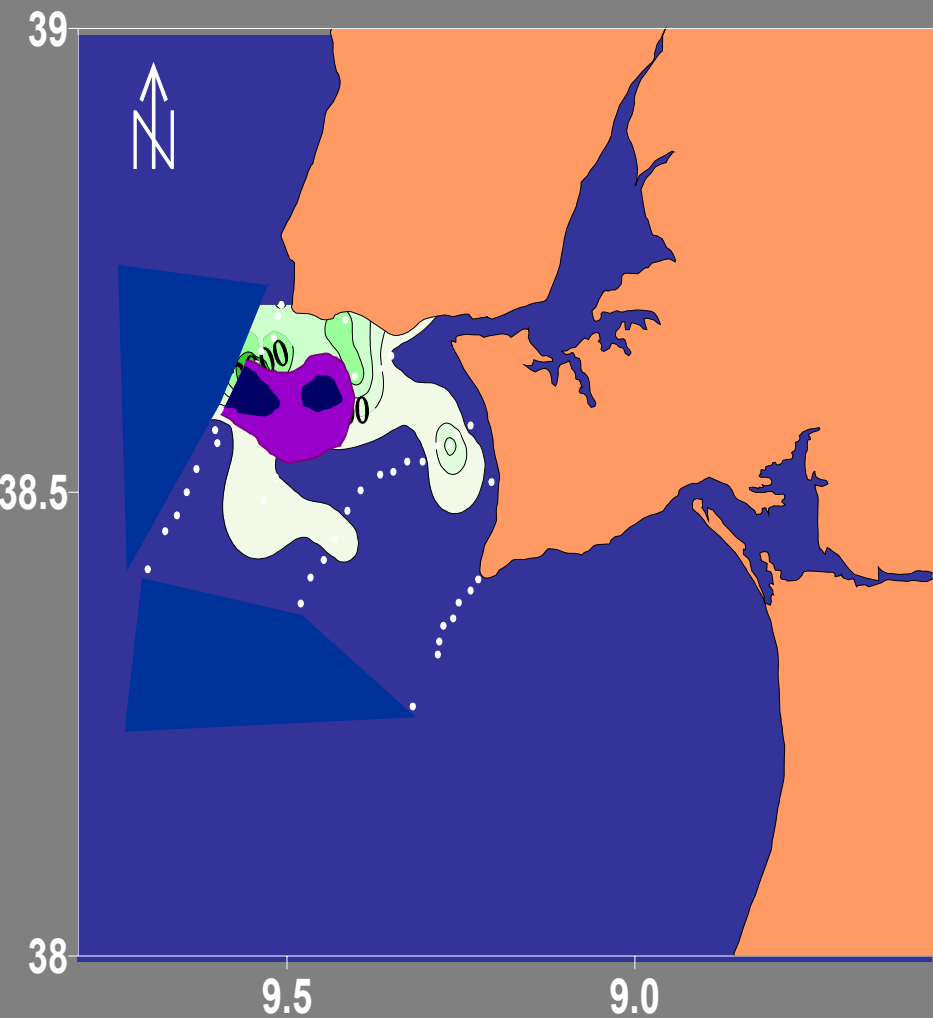
Clorofila *a* (mg/m³)
Max. por estação



Setembro, 1999

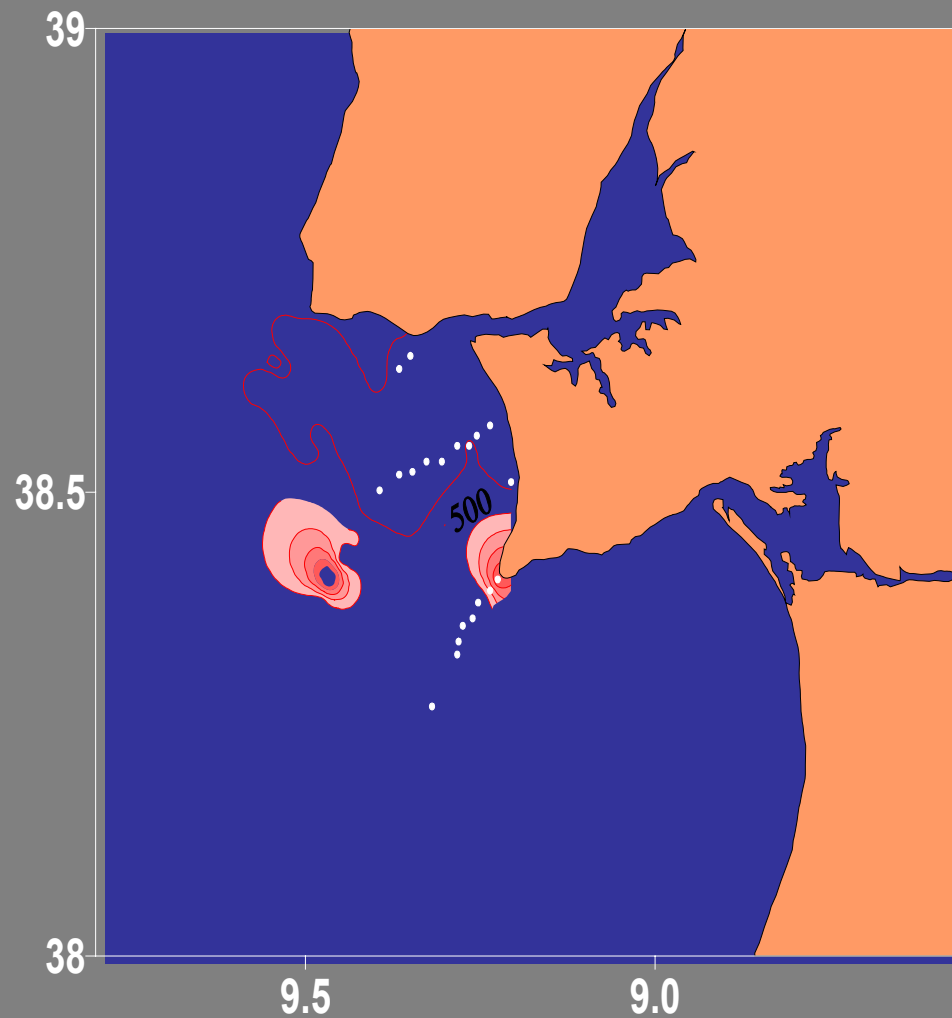
Cylindrotheca closterium (cél./l)

Max. por estação



Pseudo-nitzschia spp. (cél. l⁻¹)

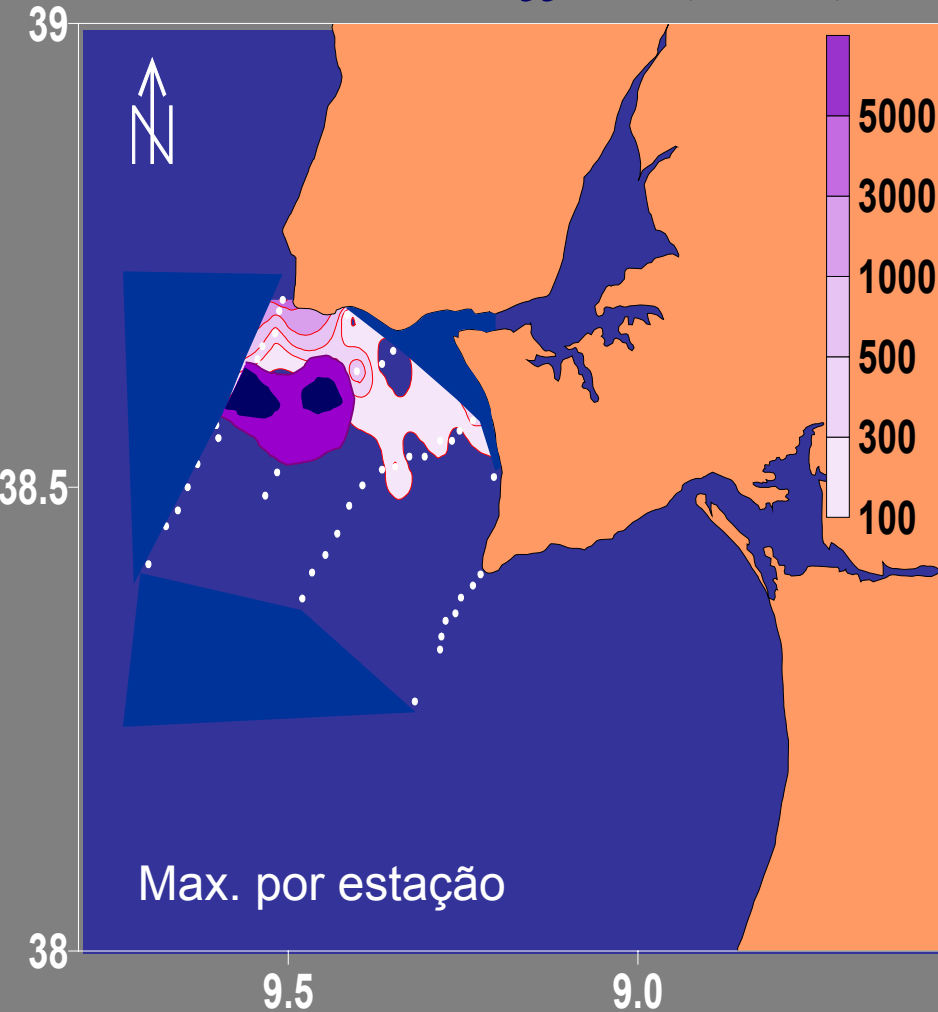
Max. por estação



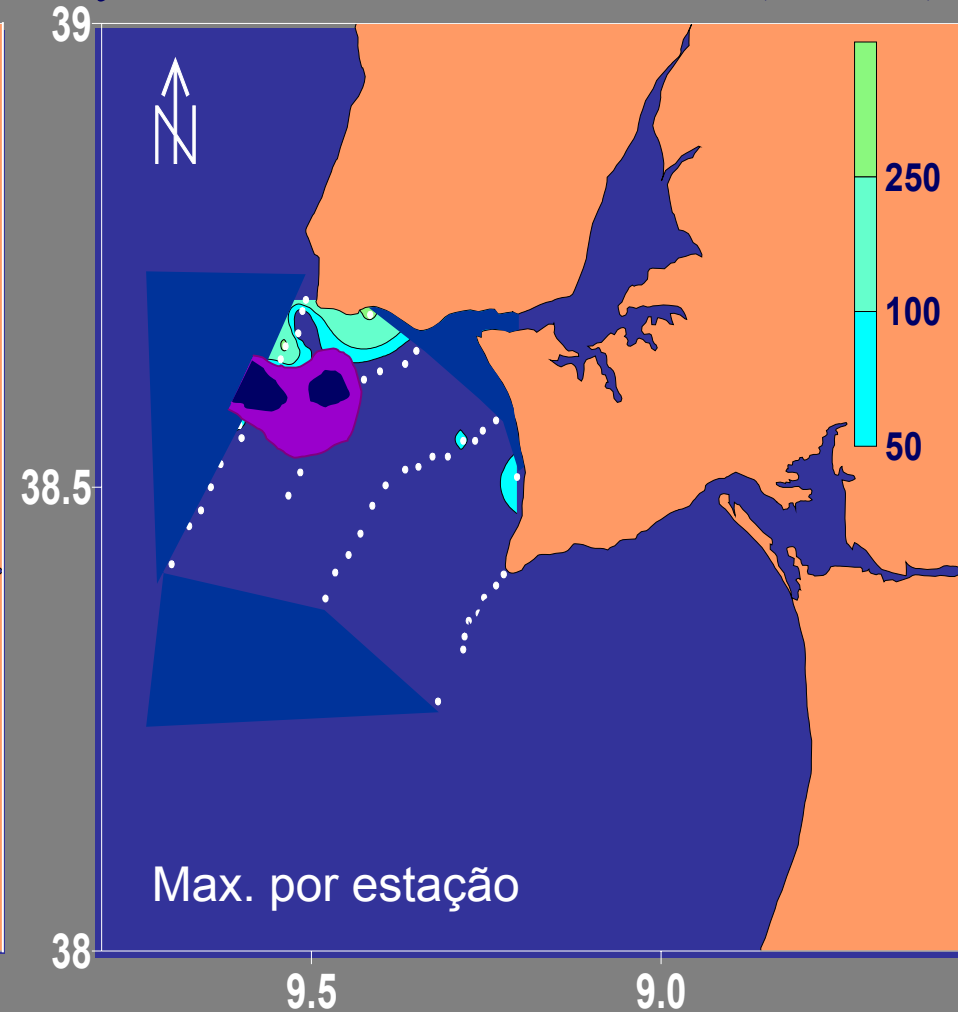
Setembro, 1999

Dinoflagelados que formam cadeias

Alexandrium affine (cél.l⁻¹)



Gymnodinium catenatum (cél. l⁻¹)



Setembro, 1999

Onde está o inoculum para a iniciação dos blooms?



São as Baías associadas a cabos pronunciados zonas particulares de sombra onde a acumulação e/ou retenção de *G. catenatum* são decisivas para a dinâmica dos blooms?

Amostragem do plâncton





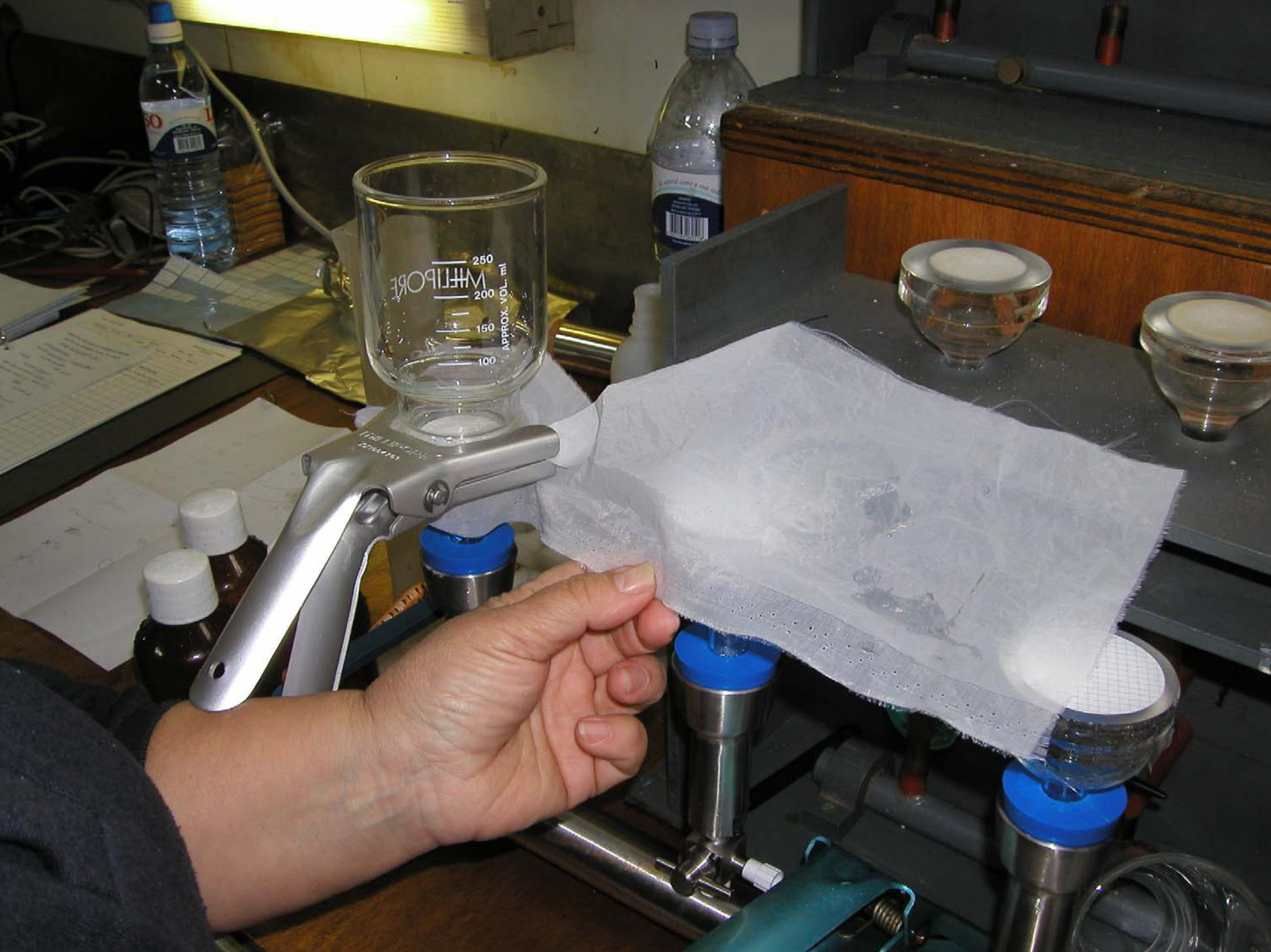






ÁGUA SALGADA

4x
0 - 200 FANAL 602
1 - 50









01120702
#FF6
10mm

01120202
#FF4
50mm

01120702
#FF6
10mm

01120702
#FF6
5mm

01120702
#FF4
5mm

01120702
#FF6
10mm

01120702
#FF2
38mm

01120702
#FF4
20mm

01120702
#FF2
20mm

