GFCM Workshop on Algal and Jellyfish blooms

Sub-Committee on Marine Environment and Ecosystems (SCMEE)

6-9 October, Istanbul,Turkey

NATURAL EUTROPHICATION INDUCING PHYTOPLANKTON BLOOM ALONG LEBANESE COASTAL WATER (Levantine Basin)

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Location of Hydrobiologic stations along Lebanese Coastal and offshore waters investigated during 1970-2008.

GENERAL CHARACTERISTICS OF LEBANESE SEAWATER

- LEVANTINE BASIN IS THE MORE OLIGOTROPHIC WATERBODY OF THE MEDITERRANEAN
  - * Little freshwater outflow from runoff and small rivers drying during 6 months)
  - * Low phosphate and Nitrate input
- *SALINITY AND TEMPERATURE AVERAGES THE HIGHEST IN THE WHOLE MEDITERRANEAN

* LITTLE INFLUENCE OF ATLANTIC WATER IN THE EAST MEDITERRANEAN

*INCREASING LESSEPSIAN MIGRATION OF EXOTIC MARINE SPECIES

- « TROPICALIZATION » OF THE LEVANTINE BASIN

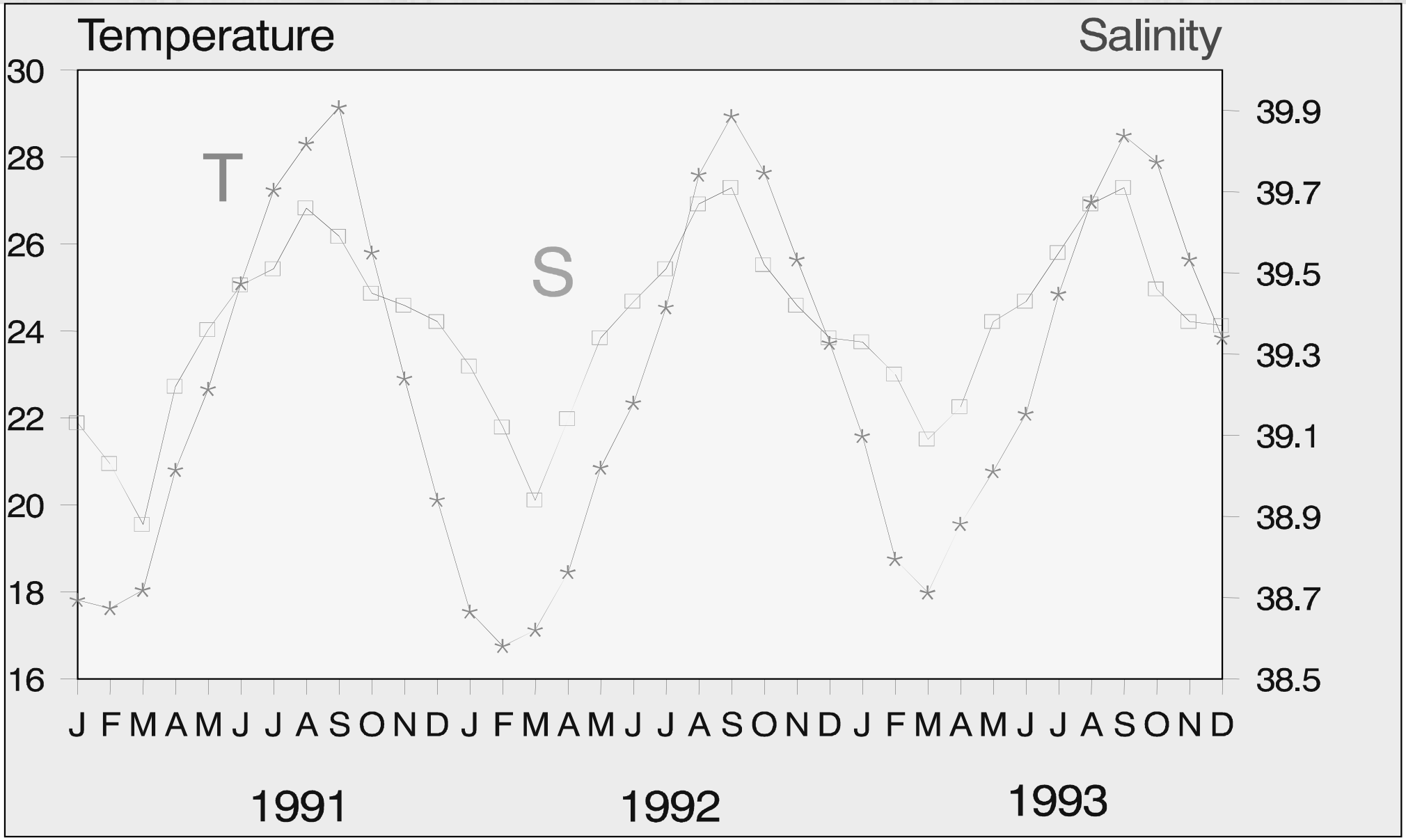
MONTHLY VARIATIONS OF HYDROBIOLOGICAL PARAMETER AT SURFACE SEAWATER AT 5 MILES OFFSHORE STATION DURING 2003.

Month	Temp. oC	S ‰	Diss.O2	NO_3 µM l^{-1}	PO_4 µM l^{-1}	CHL.a mg.m^{-3}	PH	Secchi m.	Phyto cel .l^{-1}
J	17.84	39.39	7.10	0.33	0.25	0.09	8.18	19	25000
F	17.18	39.38	7.21	0.28	0.15	0.09	8.17	15	38000
M	18.35	39.29	7.25	0.25	0.19	0.21	8.16	12	55000
A	21.13	39.39	7.09	0.24	0.09	0.42	8.27	10	120000
M	22.85	39.38	7.00	0.19	0.11	0.39	8.25	9	250000
J	23.75	39.51	6.89	0.28	0.11	0.37	8.31	14	300000
J	26.25	39.49	6.18	0.12	0.07	0.12	8.35	22	200000
A	28.91	39.58	5.22	0.41	0.09	0.11	8.32	25	95000
S	29.58	39.54	6.15	0.28	0.08	0.10	8.30	28	35000
O	28.12	39.51	6.46	0.35	0.12	0.11	8.29	29	41000
N	25.61	39.47	7.00	0.23	0.13	0.18	8.29	30	45000
D	22.74	39.39	7.00	0.31	0.16	0.12	8.29	26	35000

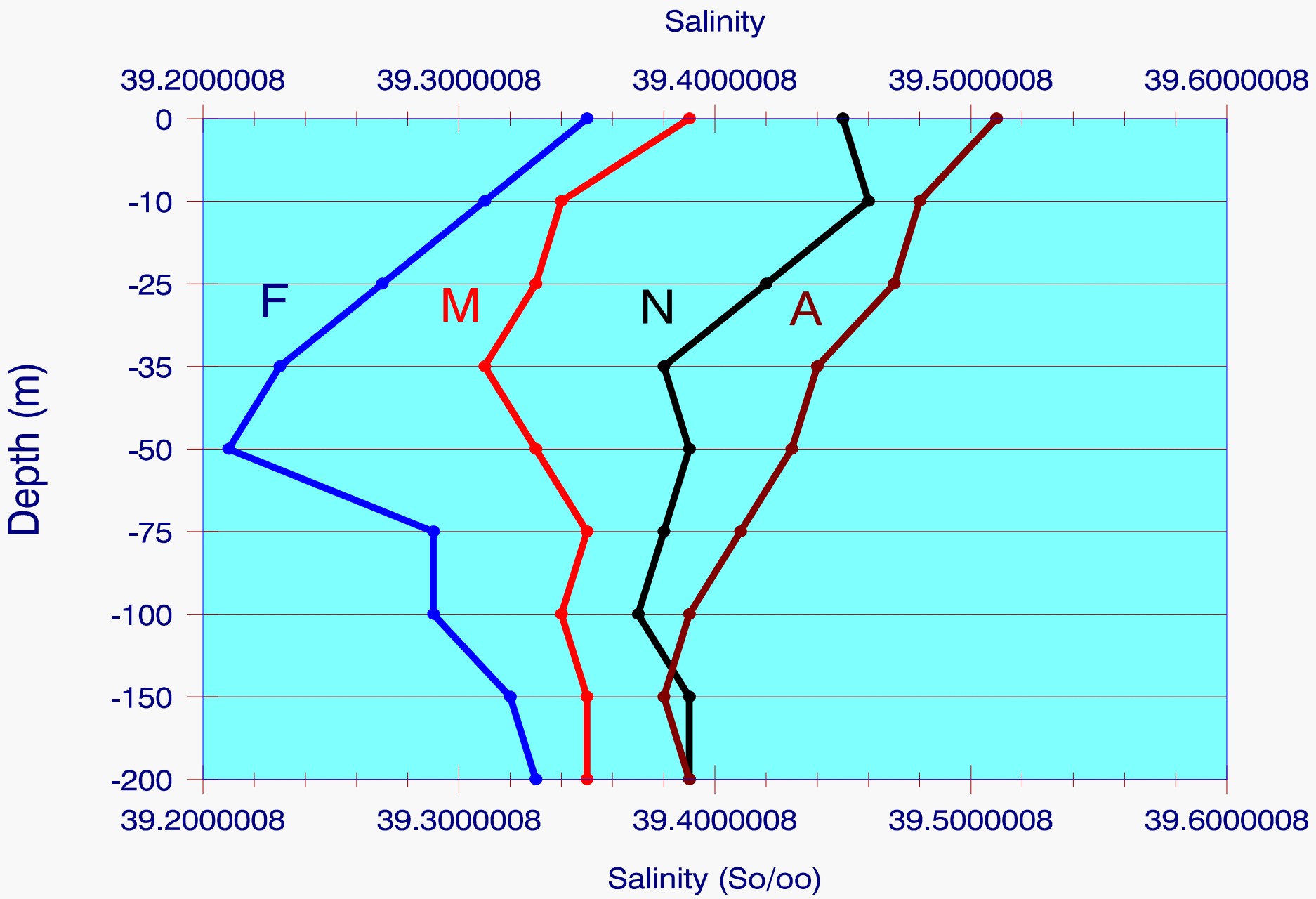
Hydrologic parameters in the profile 0-200 m at an offshore station (By3) in 13 February 2003

DEPTH (m)	Temp. oC	Salinity ‰	Diss.O_2 $mg.l^{-1}$	NO_3 $\mu M.l^{-1}$	PO_4 $\mu M.l^{-1}$	CHL.a $mg.m^{-3}$	Phyto cel $.l^{-1}$	PH
0	16,98	39,34	7,05	0,29	0,18	0,14	40000	8,19
10	16,87	39,32	7,00	0,26	0,15	0,12	25000	8,16
25	16,68	39,28	6,88	0,24	0,14	0,10	20000	8,14
35	16,18	39,21	6,72	0,23	0,09	0,07	15000	8,14
50	16,12	39,19	6,65	0,27	0,11	0,06	5000	8,15
75	15,65	39,26	6,37	0,29	0,13	0,04	4000	8,19
100	15,32	39,29	6,10	0,31	0,18	0,08	1000	8,20
150	15,29	39,30	5,94	0,38	0,19	0,02	0	8,20
200	15,12	39,31	5,75	0,35	0,22	0,00	0	8,20

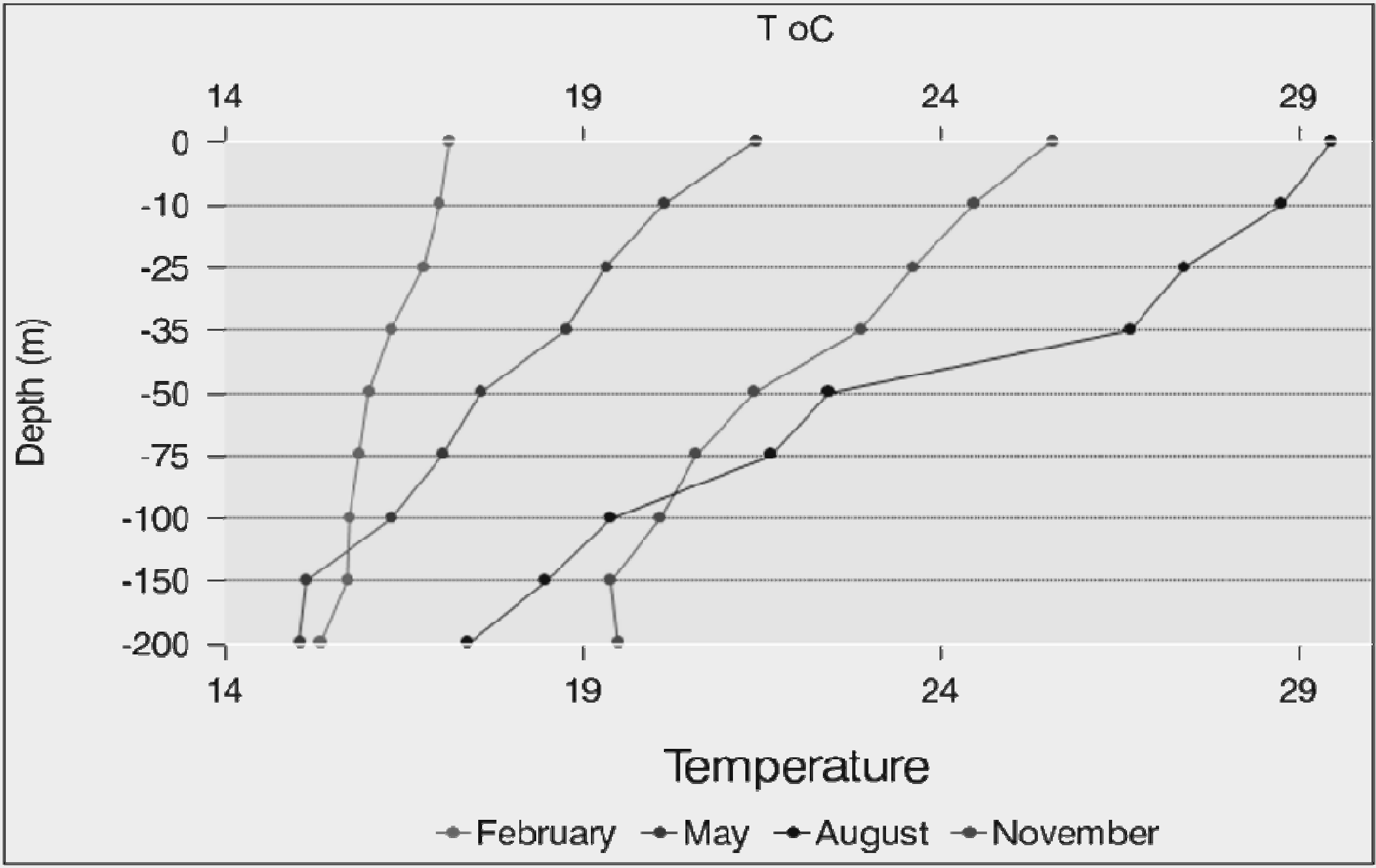
Monthly variations of T/S at surface water during three consecutive year



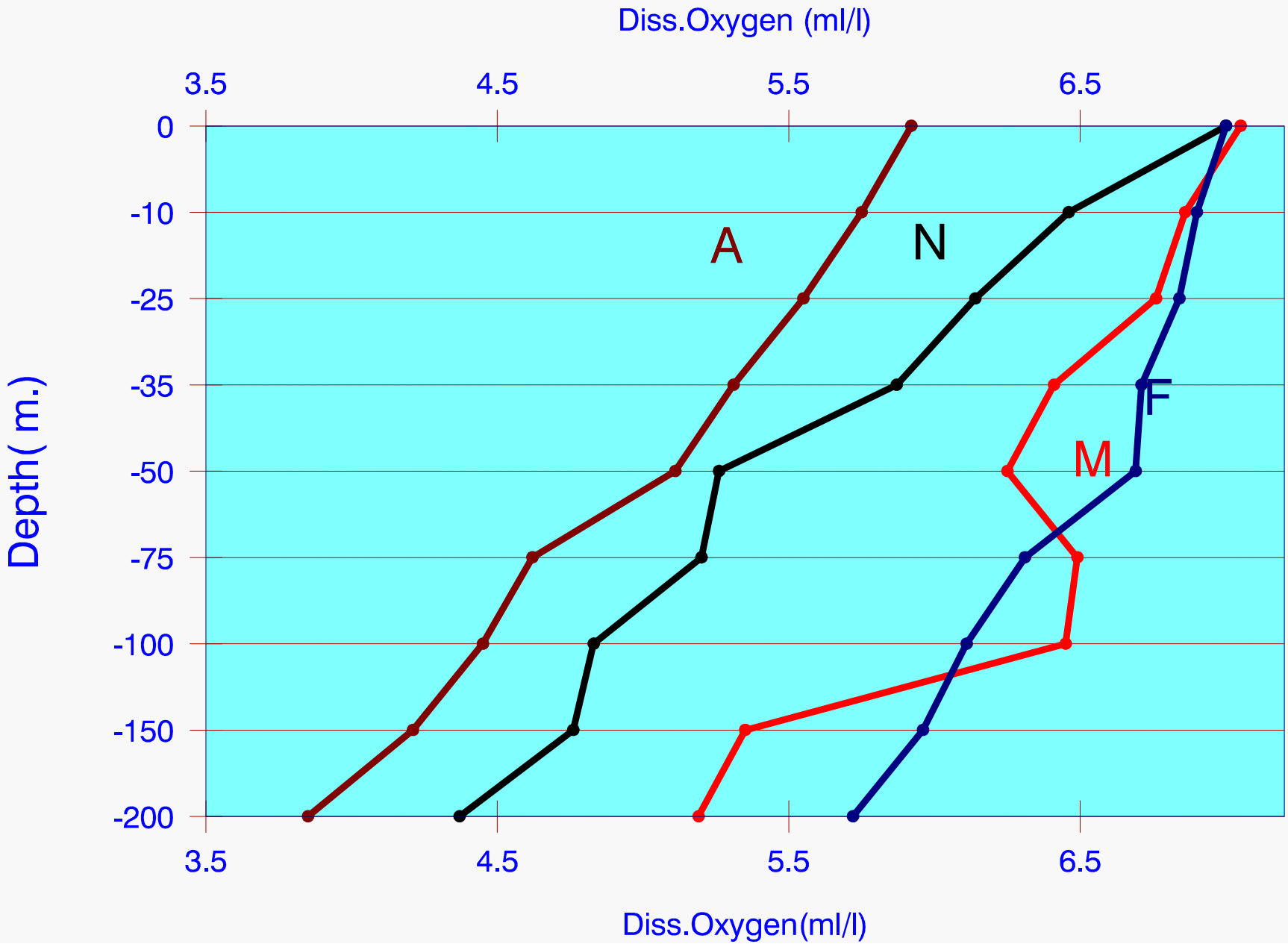
Salinity changes with depth



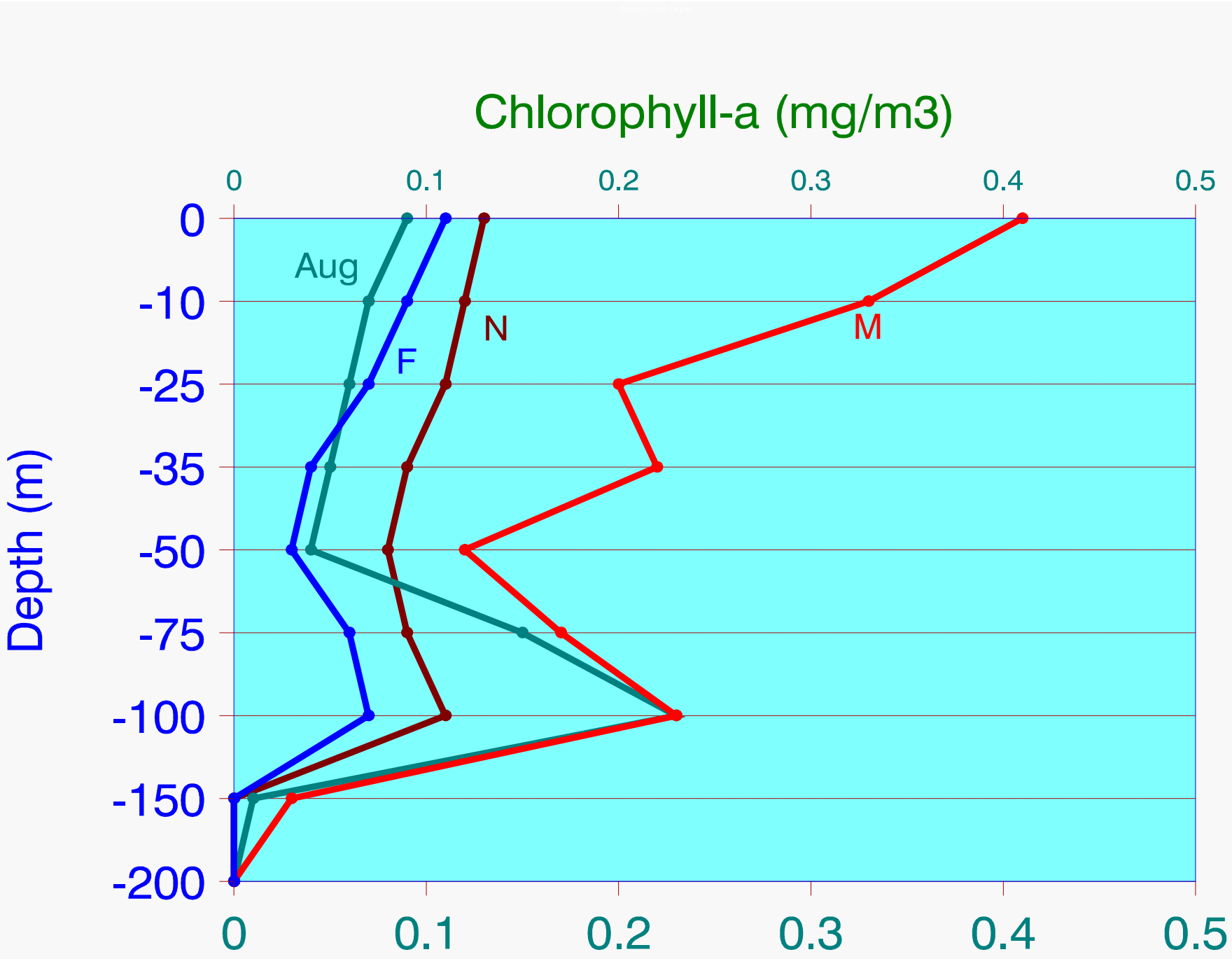
Temperature changes with depth

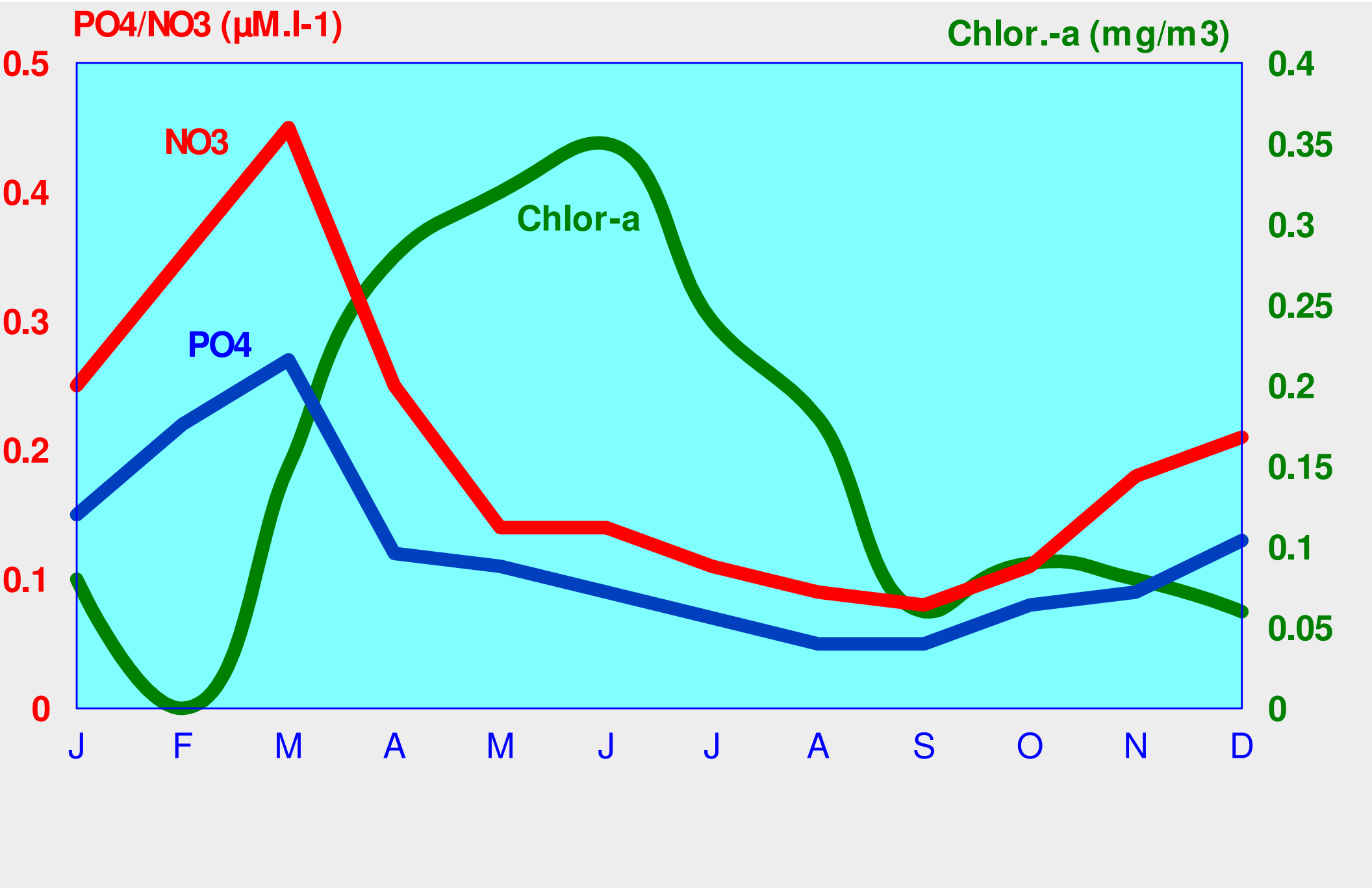


Variations of dissolved O2 With depth

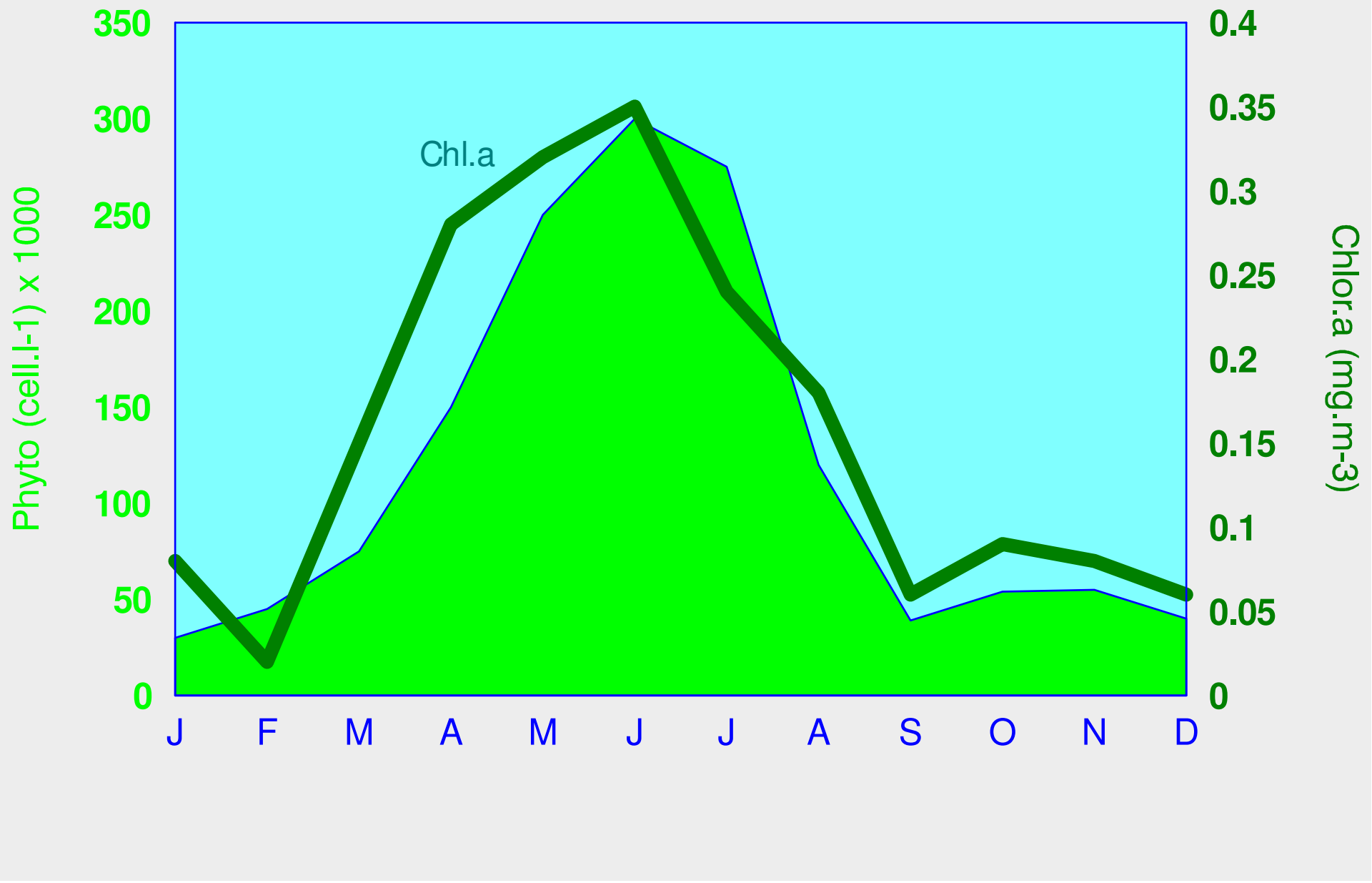


Chlorophyll with depth

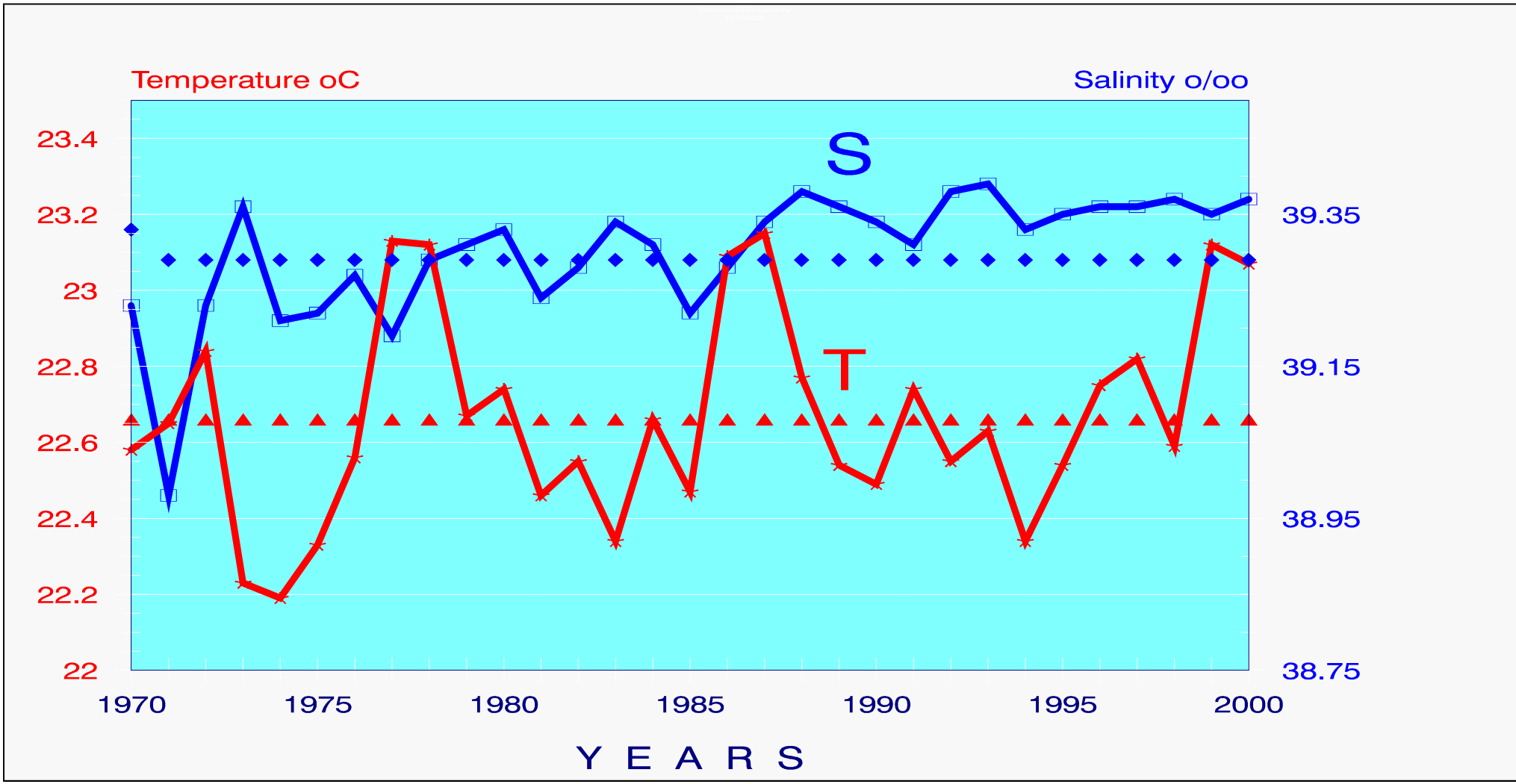



PO4/NO3 (µM.l-1)
Chlor.-a (mg/m3)
0.5
0.4
0.3
0.2
0.1
0
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
NO3
PO4
Chlor-a
J
F
M
A
M
J
J
A
S
O
N
D

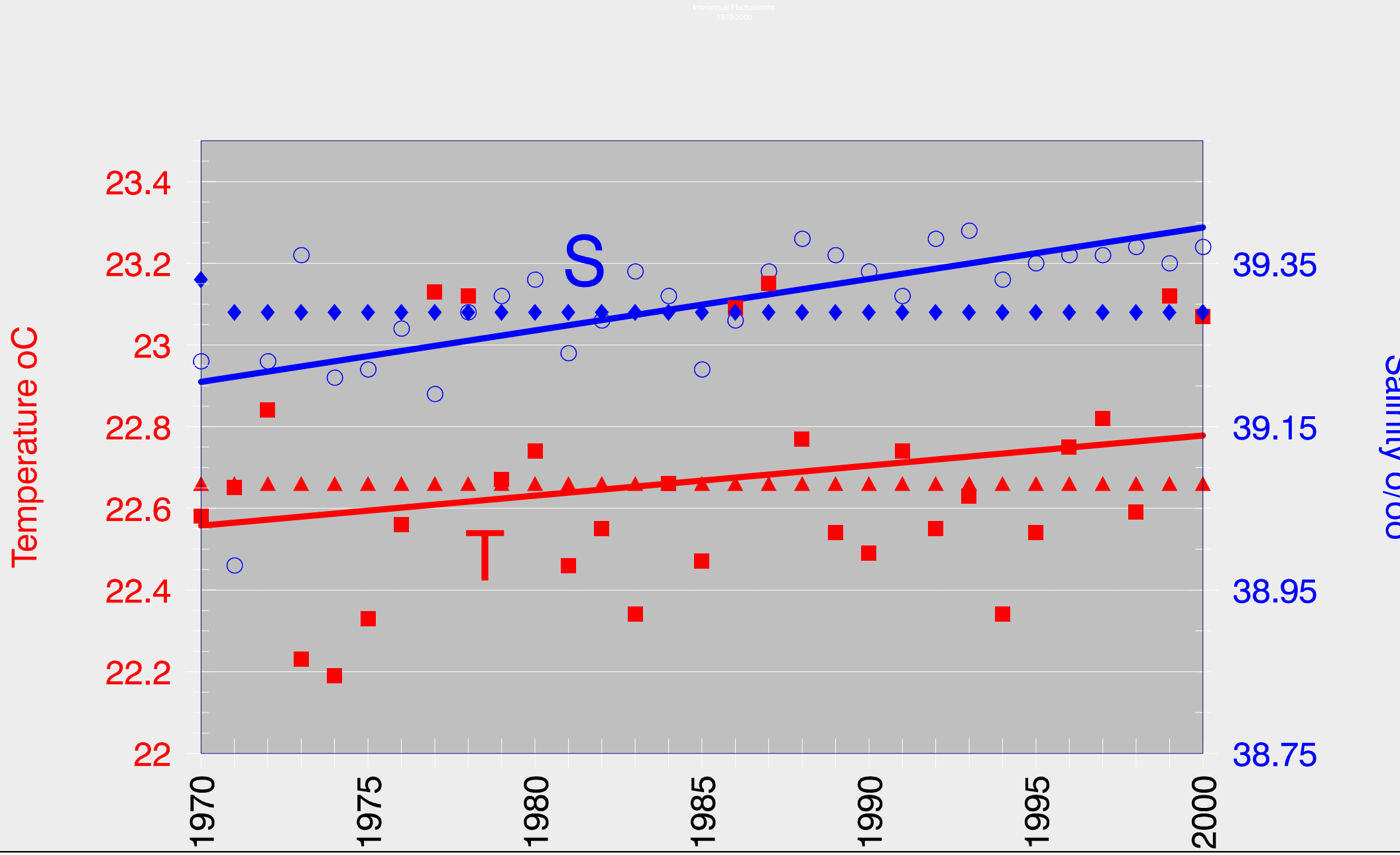
MONTHLY VARIATIONS OF PHYTOPLANKTON CELL DENSITY AND CHL.a SHOW MAXIMUM STANDING CROP IN MAY-JUNE



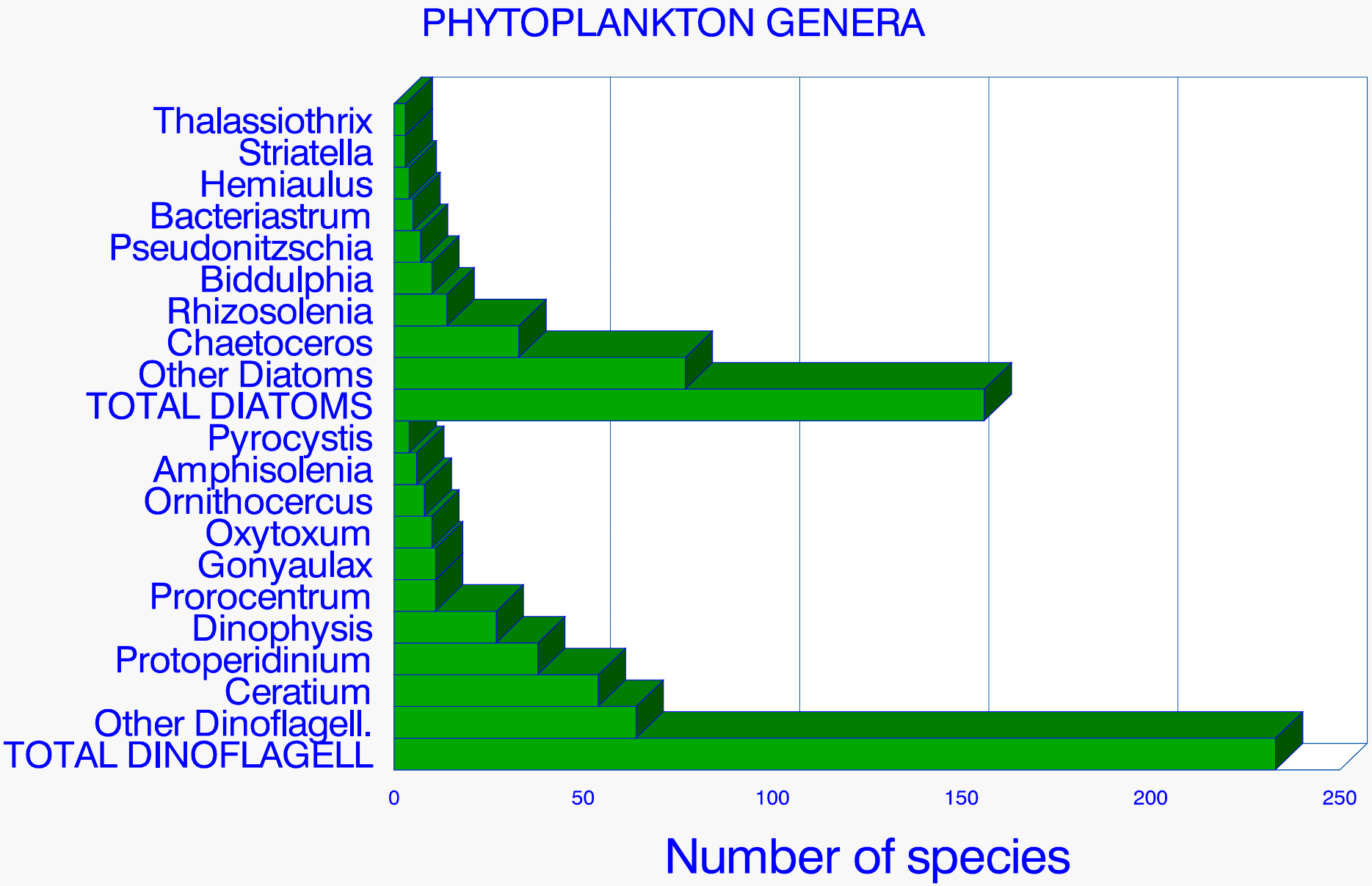
MULTIANNUAL FLUCTUATIONS OF T/S IN LEBANESE SEAWATER between 1970-2000



MULTIDECADAL TREND OF T/S ANNUAL AVERAGES



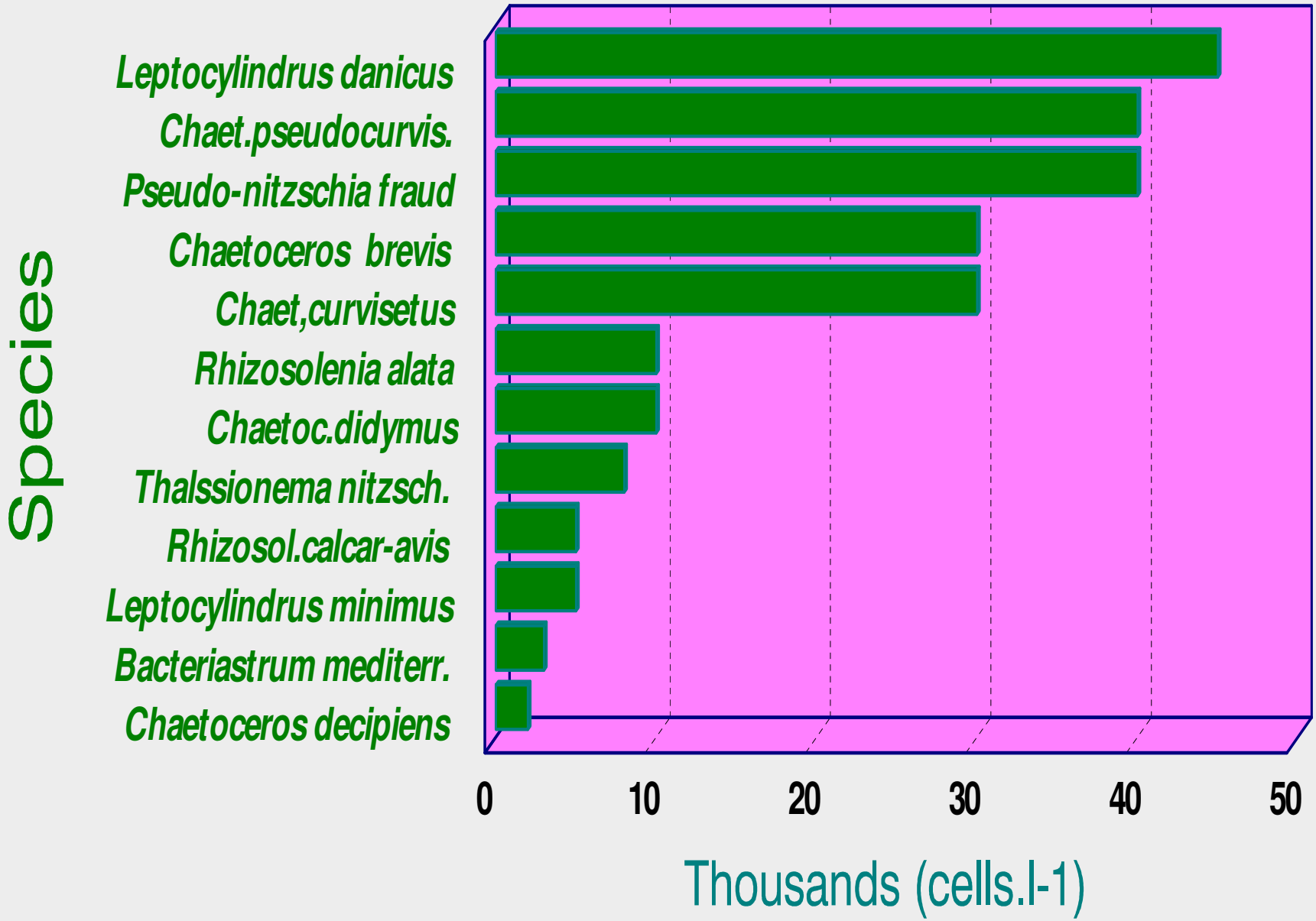
Major genera of Diatoms (150 sp.) and Dinoflagellates (250) found in Lebanese seawater



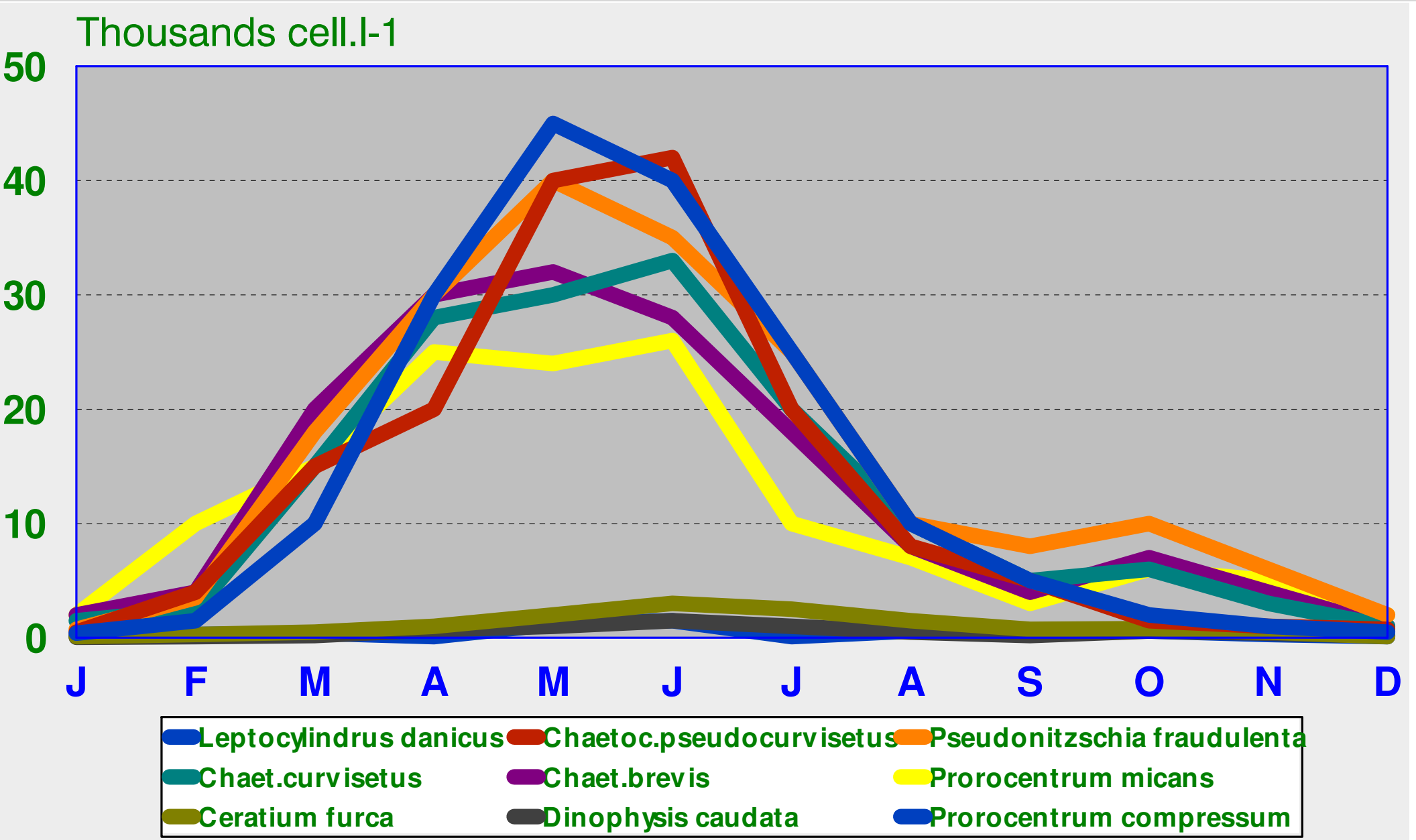
The most abundant Diatoms forming bloom in Lebanese seawater

Species	% Frequency occurrence	Max. cells. l^{-1}	Period bloom	Station
Acnanthes longipes	45	1000	March	coastal
Asterionella japonica	55	300	April	neritic
Bacteriastrum delicatulum	35	1500	May	coastal
Bacteriastrum hyalinum	30	1000	May	coastal
Bacteriastrum mediterraneum	65	3000	June	coastal
Cerataulina pelagica	55	1000	April	neritic
Chaetoceros affinis	40	1000	April	neritic
Chaetoceros brevis	85	30000	April-May	neritic
Chaetoceros curvisetus	85	30000	April-May	neritic
Chaetoceros decipiens	35	2000	April	neritic
Chaetoceros didymus	50	10000	March-April	neritic
Chaetoceros pseudocurvisetus	100	40000	March-May	coast-neritic
Leptocylindrus danicus	100	45000	April-May	neritic
Leptocylindrus minimus	55	5000	May	neritic
Pseudonitzschia fraudulenta	100	40000	April-May	neritic
Rhizosolenia alata f.alata	75	10000	May	neritic
Rhizosolenia calcar-avis	75	5000	May-June	neritic
Skeletonema costatum	80	20000	April	coast.-neritic
Thalassionema nitzschioides	90	8000	April	coast.-neritic

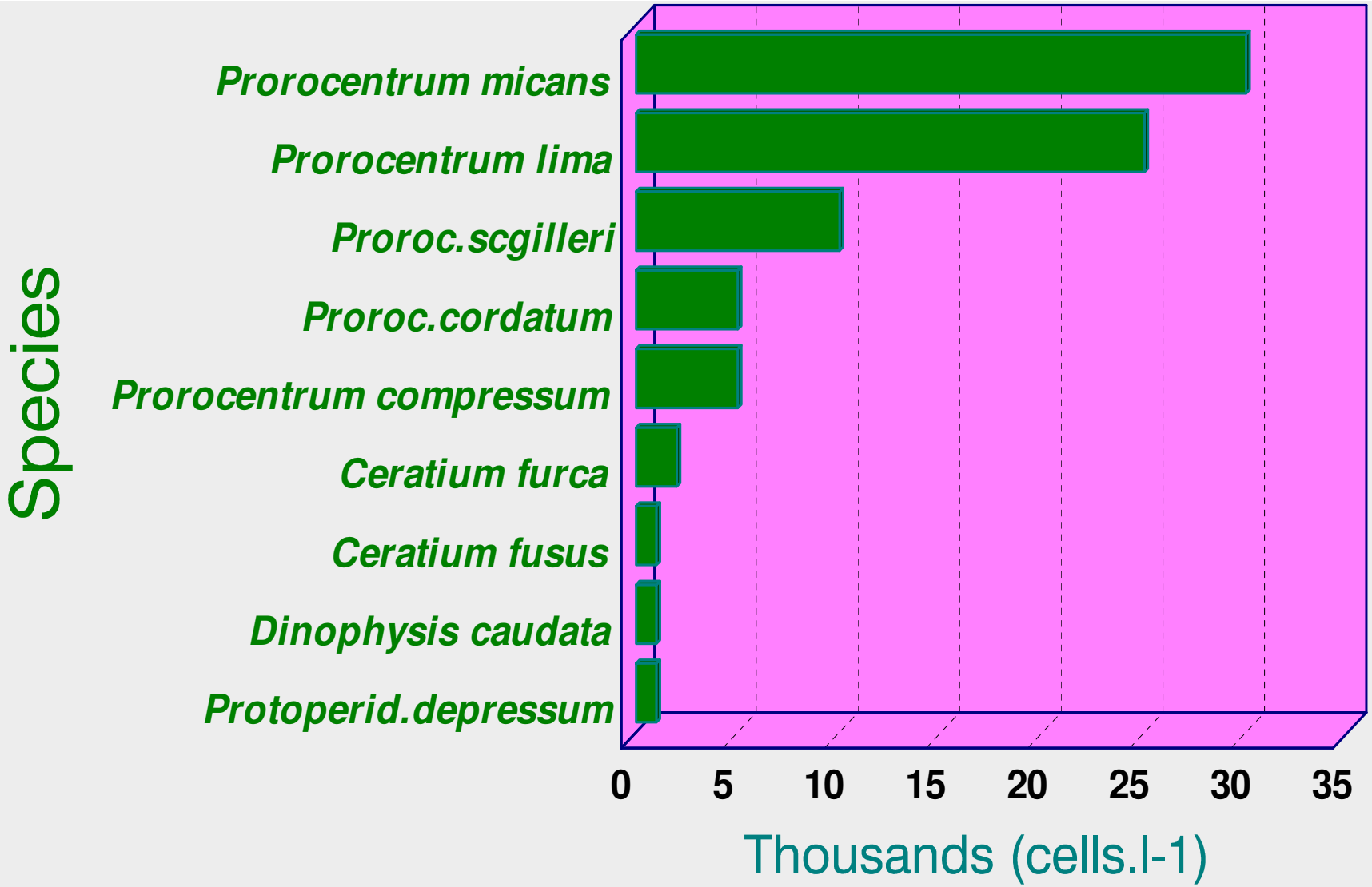
DIATOM SPECIES FORMING BLOOM



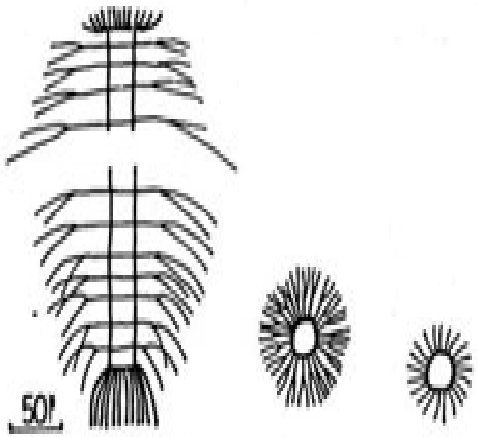
MAJOR DIATOMS CONTRIBUTING TO ALGAL BLOOM



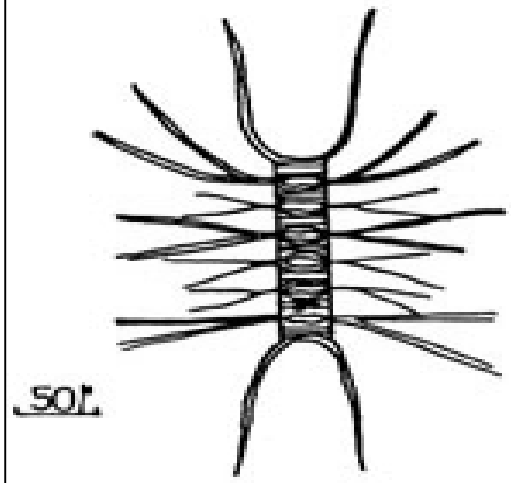
DINOFLAGELLATES CONTRIBUTING TO THE BLOOM FORMATION



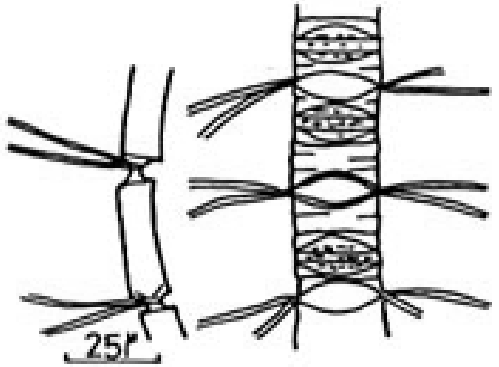
Diatoms contributing to bloom form



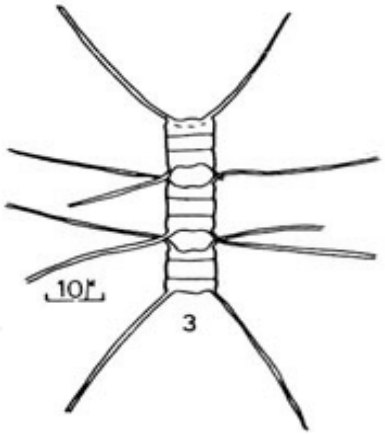
Bacteriastrum mediterraneum



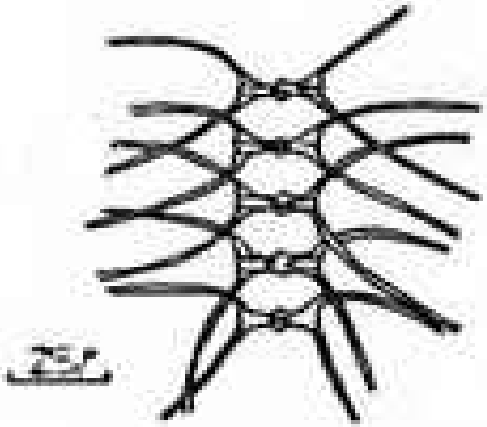
Chaetoceros decipiens



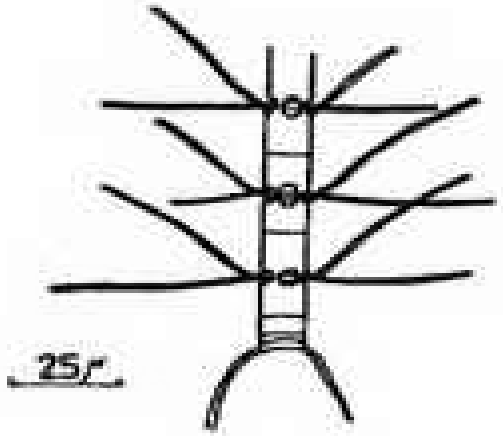
Chaetoceros curvisetus



Chaetoceros brevis

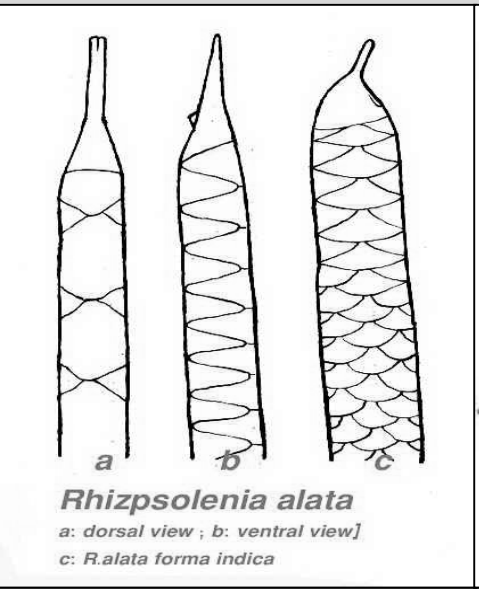


Chaetoceros didymus



Chaetoceros pseudocurvisetus

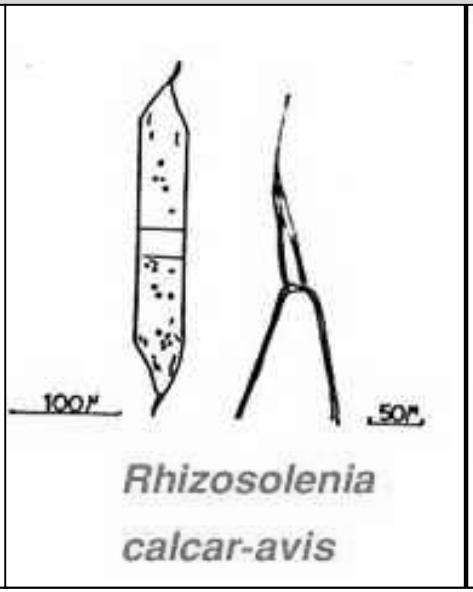
Diatoms contributing to bloom formation



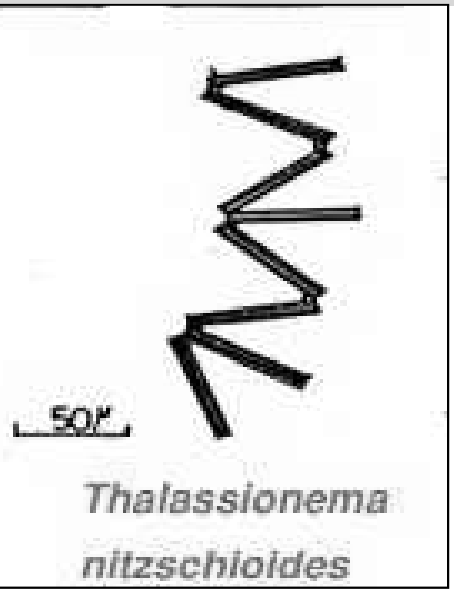
Rhizpsolenia alata

a: dorsal view ; b: ventral view]

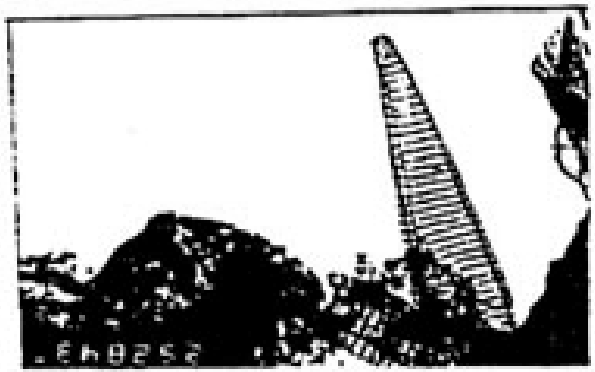
c: R.alata forma indica



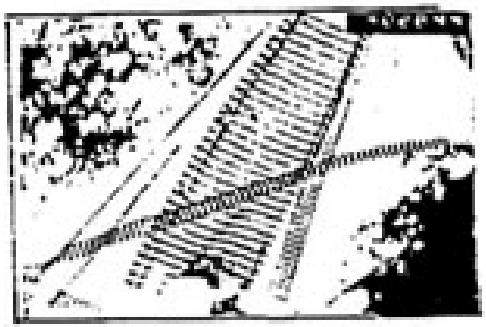
Rhizosolenia calcar-avis



Thalassionema nitzschioides



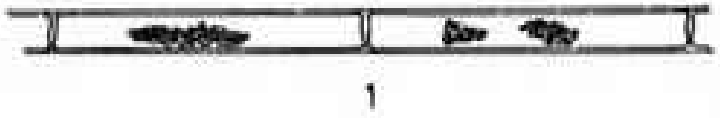
x 4500 (SEM)



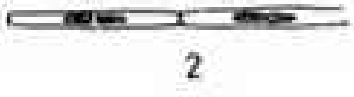
x 12000 (SEM)

Pseudonitzschia fraudulenta

(P.seriata var.fraudulenta)



1:Leptocylindrus danicus

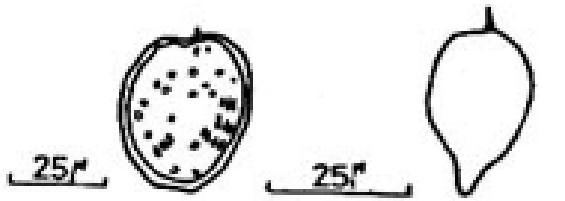


2: Lept. minimus

The most abundant Dinoflagellates forming bloom

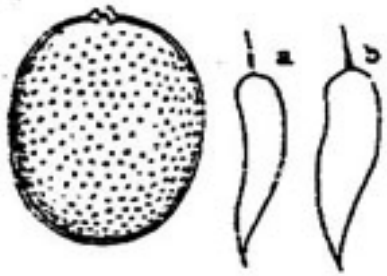
Species	% Frequency occurrence	Max. cells. l^{-1}	Period of bloom	Station
Ceratium furca	85	2000	June-Sept.	Neritic-oceanic
Ceratium fusus	65	1000	May-August	Neritic-oceanic
Ceratium pulchellum	55	500	May-July	Neritic-oceanic
Dinophysis caudata	60	1000	May	Neritic-oceanic
Dinophysis tripos	55	1000	June	Neritic-oceanic
Protoperidinium depressum	55	1000	April	Neritic-oceanic
Protoperidinium globulus	50	1000	April	Neritic-oceanic
Prorocentrum micans	65	20000	April-May	Neritic-oceanic
Prorocentrum cordatum	65	5000	April-May	Neritic-oceanic
Prorocentrum compressum	55	2000	April-May	Neritic-oceanic
Prorocentrum lima	50	10000	MarchApril	Neritic-oceanic
Prorocentrum schilleri	55	5000	MarchApril	Neritic-oceanic

DINOFLAGELLATES CONTRIBUTING TO ALGAL BLOOM



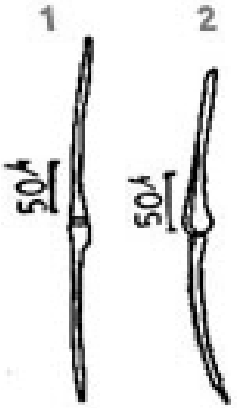
Prorocentrum micans

Prorocentrum schilleri



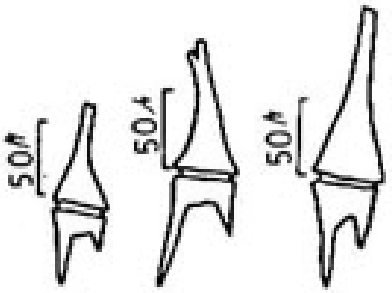
Prorocentrum compressum

q,b= cellules vivantes

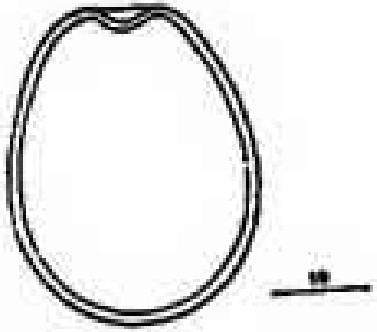


1: *Ceratium fusus var. seta*

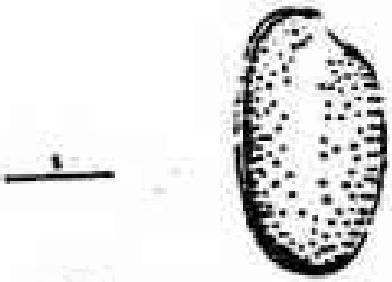
2: *C.fusus v.schuetti*



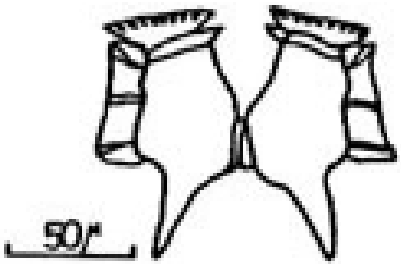
3 varieties of Ceratium furca



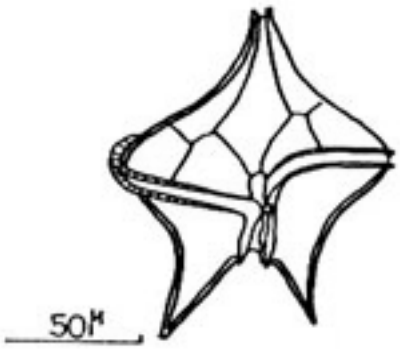
Prorocentrum lima



Proroc.cordatum



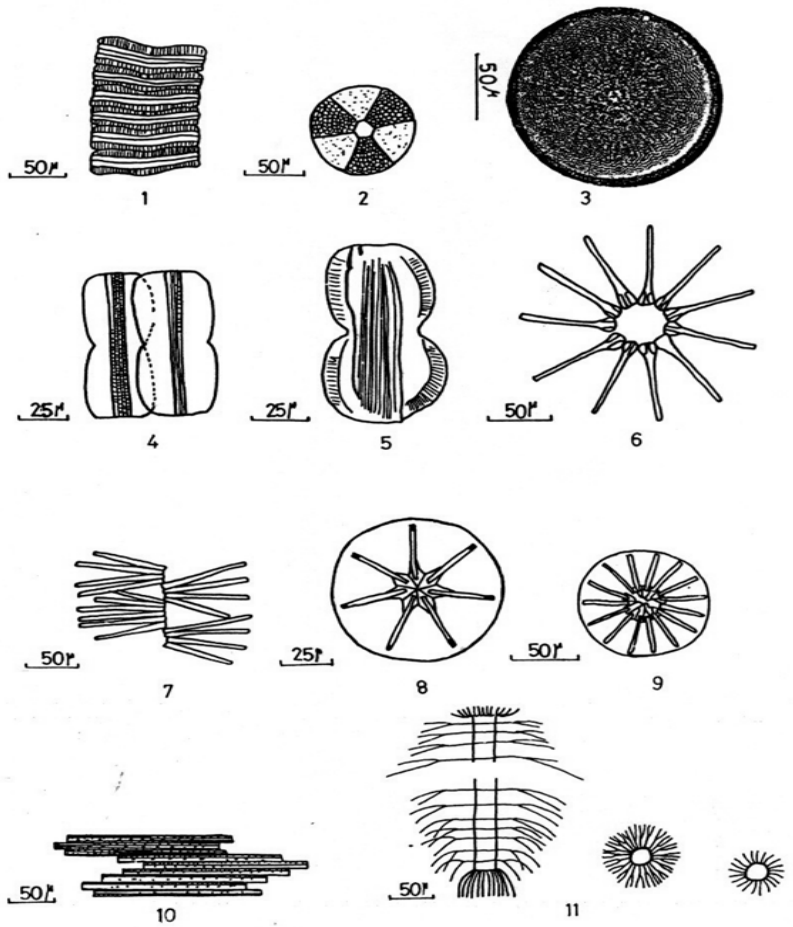
Dinophysis caudata



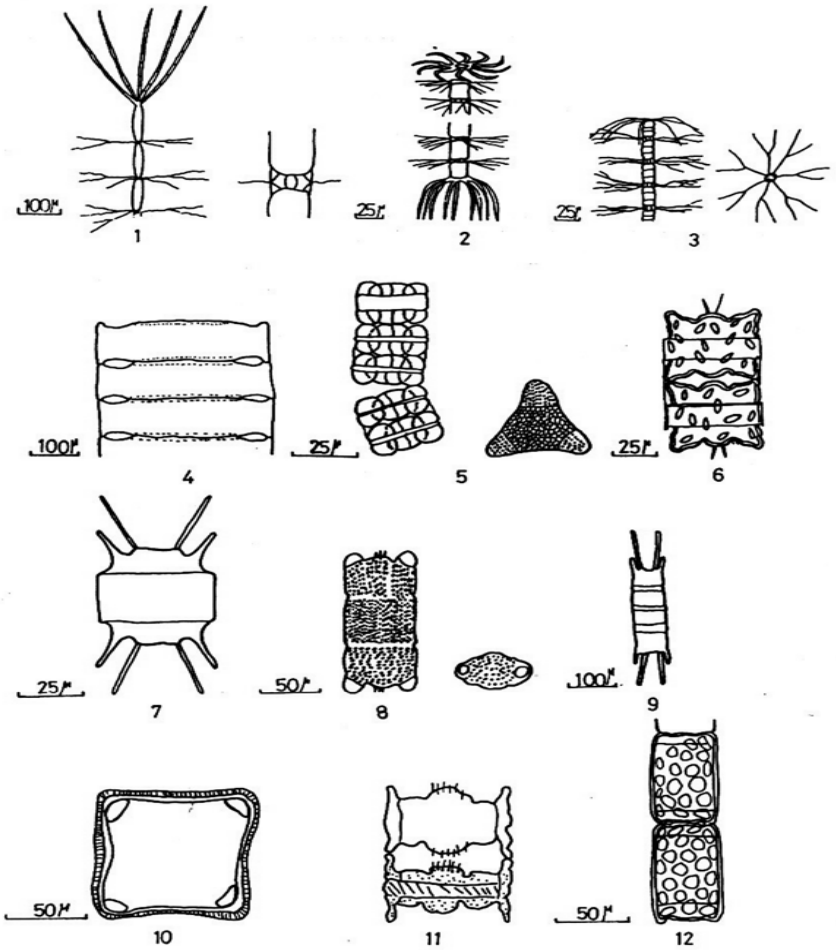
Protoperidinium depressum

Potentially toxic microalgae from coastal and neritic Lebanese water

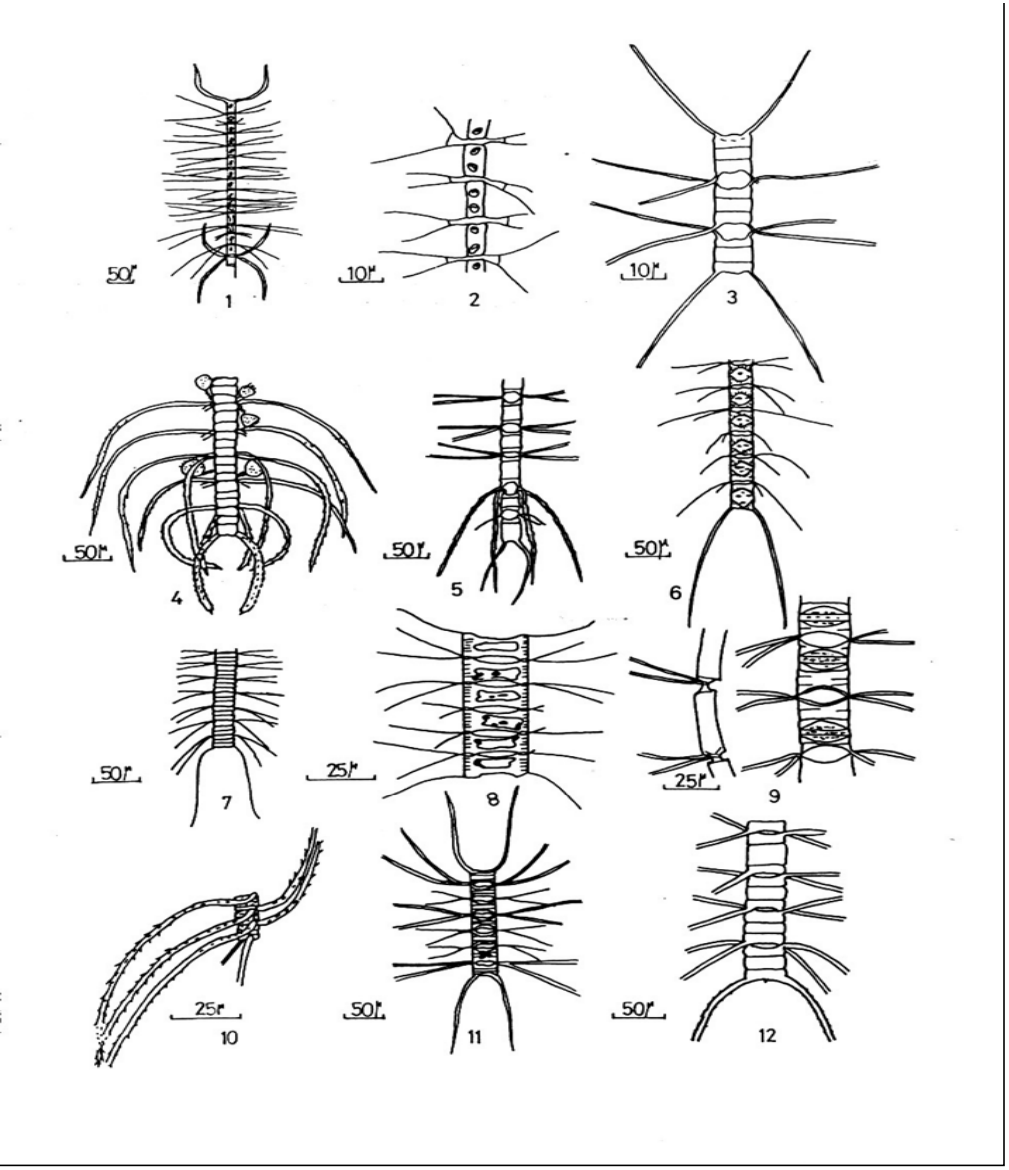
Species	Relative Abundance	Bloom period	Toxicity
Amphora sp.	C	April-May	ASP
Chaetoceros socialis	C	April-May	?
Chaetoceros danicus	C	May	?
Pseudo-nitzschia pungens	C	July-Nov	ASP
Pseudo-nitzschia closterium	A	Apr-June-Nov	?
Pseudo-nitzschia fraudulenta	D	March	?
Pseudo-nitzschia delicatissima	A	May-June	ASP
Alexandrium minutum	R	June-Nov.	PSP
Dinophysis caudata	A	April-Aug.	DSP
Dinophysis acuminata	X	June	DSP
Dinophysis mitra	X	Oct-Nov	DTX1
Dinophysis tripos	C	June-Dec.	DTX1
Gonyaulax polyedra	C	June-August	Hydrolysine toxin
Gymnodinium sp.	C	May-June	NSP-Hemolysine
Gyrodinium contortum	C	April-June	DSP
Prorocentrum lima	C	October	Ciguatera fish p.
Prorocentrum micans	A	Mars-August	Ciguatera fish p.
Distephanus speculum	X	May-June	Toxic to fish



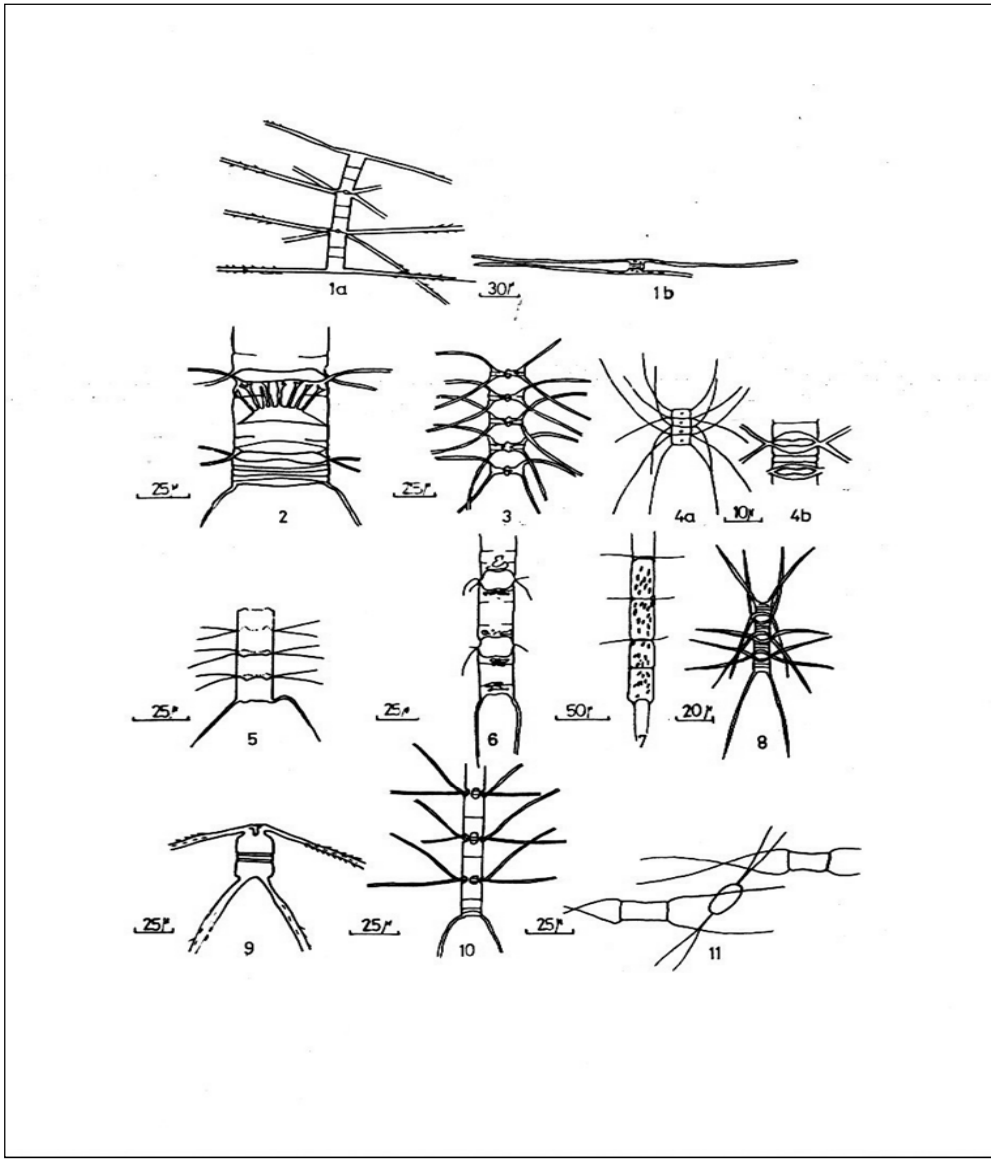
Figs.1:*Achnanthes longipes*, d ; 2:*Actinoptychus senarius*; 3:*Actinocyclus octonarius*, ;4: *Amphiprora* sp.; 5:*Amphiprora alata,* original 6: *Asterionella japonica* ; 7:*Asterionella notata*; 8: *Asterolampra marylandica*,; 9:*Asterolampra grevillei*; 10: *Bacillaria paradoxa*; 11:*Bacteriastrum mediterraneum*



Figs.1: *Bacteriastrum biconicum*;.2: *Bacteriastrum elegans*;3: *Bacteriastrum delicatulum;* 4:*Bellerochea malleus* forma *biangulata*; 5:*Biddulphia alternans*; 6:*Biddulphia aurita*; 7*: Biddulphia mobiliensis*; 8:*Biddulphia pulchella*, 9:*Biddulphia regia*;10:*Biddulphia vesiculosa*; 11:*Biddulphia tridens*; 12- *Cerataulina bergonii*



Figs.1 :*Chaetoceros affinis* ; 2:*Ch. anastomosans*; 3:*Ch. brevis*; 4:*Ch. coarctatus*; 5:*Ch. compressus* ; 6: *Ch. constrictus*; 7:*Ch. costatus*;8: *Ch. crinitus* ; 9:*Ch. curvisetus*; 10: *Ch. dadayi*; 11: *Ch. decipiens* ; 12:*Ch. densus* ,



Figs.1 :*Chaetoceros danicus*, a:chaîne de cellules,b: une cellule avec chromatophores ; 2:*Ch. diadema*; 3 :*Ch. didymus*; 4 :*Ch diversus*, a: chaîne, 4: section de chaîne ; 5 :*Ch. imbricatus*; 6 :*Ch. laciniosus* ; 7 :*Ch. lauderi*; 8 : *Ch. Lorenzianu* ; 9 :*Ch.peruvianus* ; 10: *Ch. pseudocurvisetus*; 11- *Ch. Simplex*

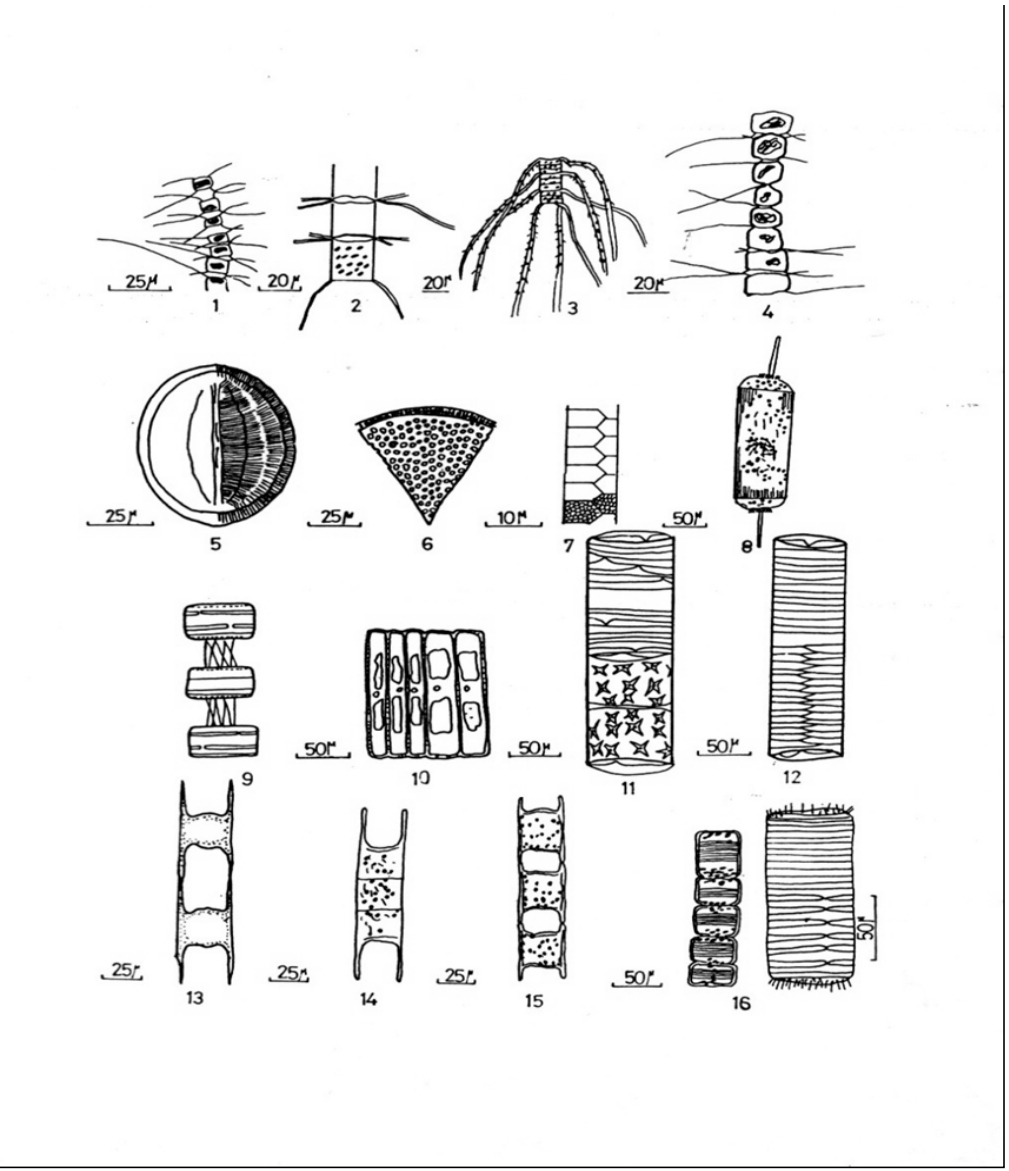


Fig.1:*Chaetoceros socialis; 2: Ch. teres; 3: Ch: tetrastichon ; 4:Ch: tortissimus ; 5 : Cocconeis pseudomarginata ; 6 :Coscinodiscus radiatus; 7 :Dactyliosolen mediterraneus; 8 :Ditylum brightwelli ;9 :Ethmodiscus gazellae ; 10 :Fragilaria cylindrus; 11 :Guinardia flaccida, ; 12 :Guinardia blavyana ; 13 :Hemiaulus heirbergii ; 14 :Hemiaulus haukii ; 15 :Hemiaulus sinensis ; 16 :Lauderia borealis.*

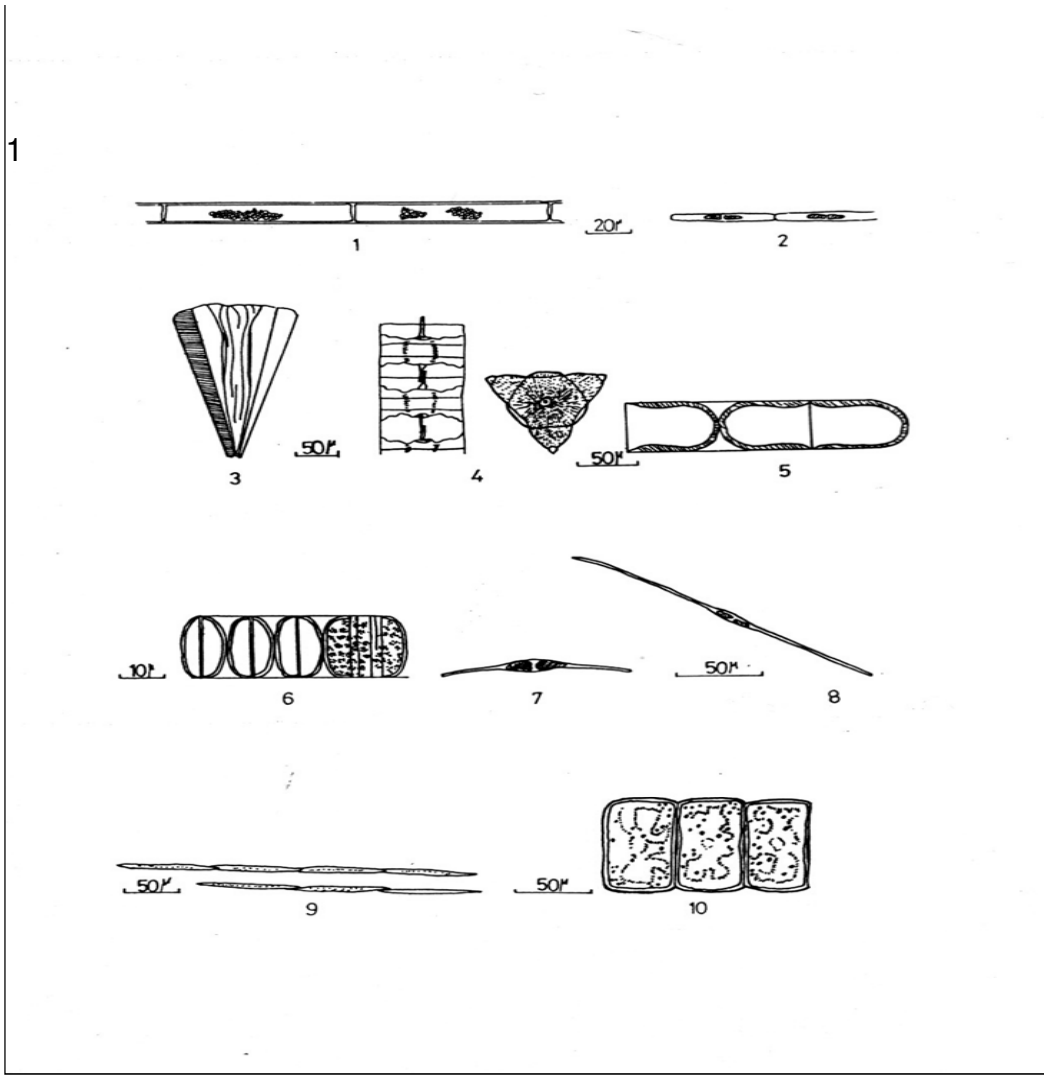


Fig.1:*Leptocylindrus danicus ; 2 :Leptocylindrus minimus ; 3 :Licmophora abbreviata ;4 :Lithodesmium undulatum ; 5 :Melosira juergensii ; 6 :Melosira moniliformis ;7 : Nitzschia closterium; 8:Nitzschia longissima , d'après ; 9 :Pseudonitzschia seriata ; 10 :Navicula membranacea*

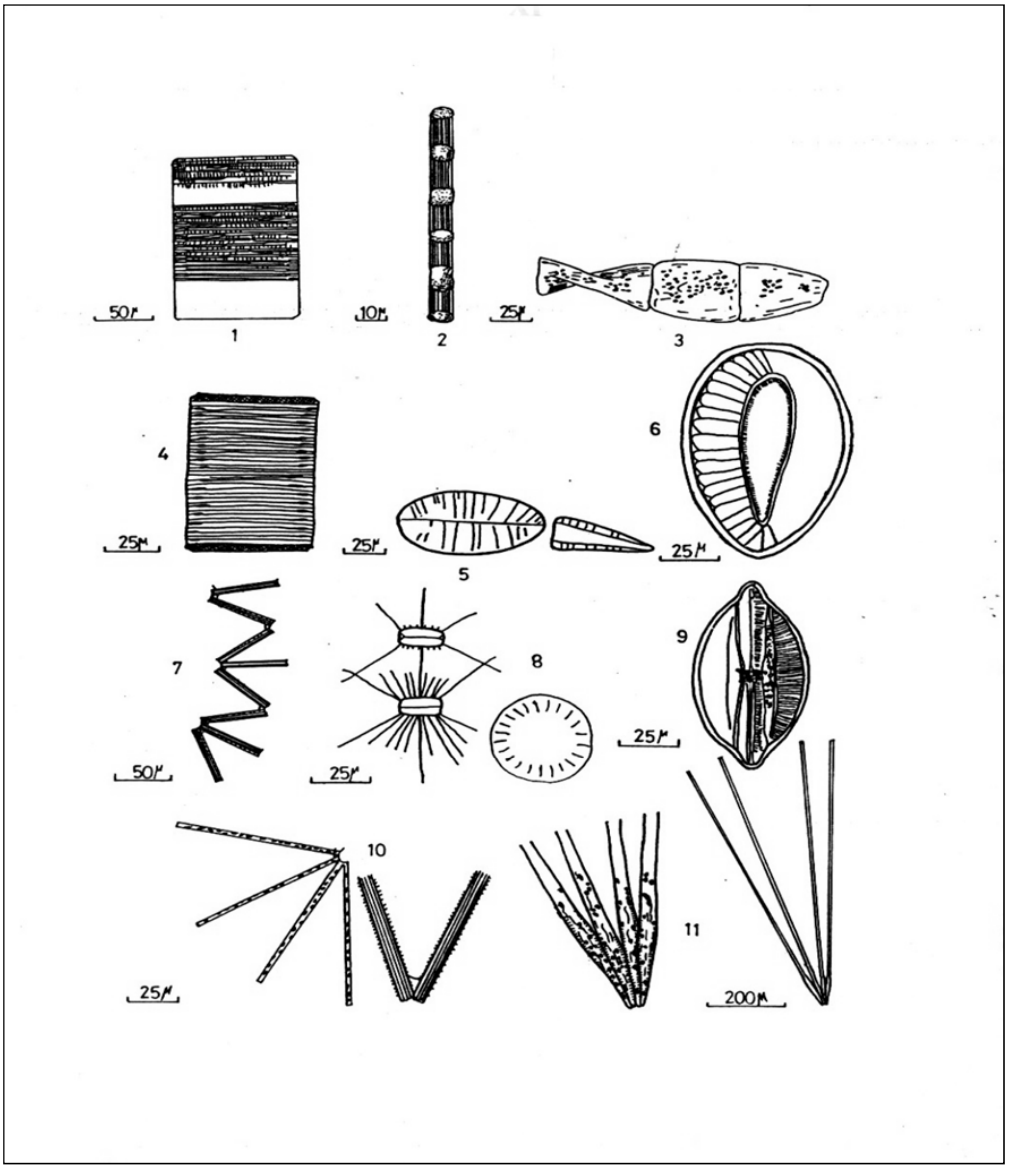


Fig.1:*Rhabdonema adriaticum*; 2:*Skeletonema costatum*; 3:*Streptotheca thamesis*; 4:*Striatella unipunctata*; 5:*Surirella gemma*; 6:*Surirella* sp., original; 7 :*Thalassionema nitzschioides*; 8:*Thalassiosira decipiens;* 9:*Navicula clavata* ; 10 :*Thalassiothrix frauenfeldii* 11 :*Thalassiothrix mediterranea*.

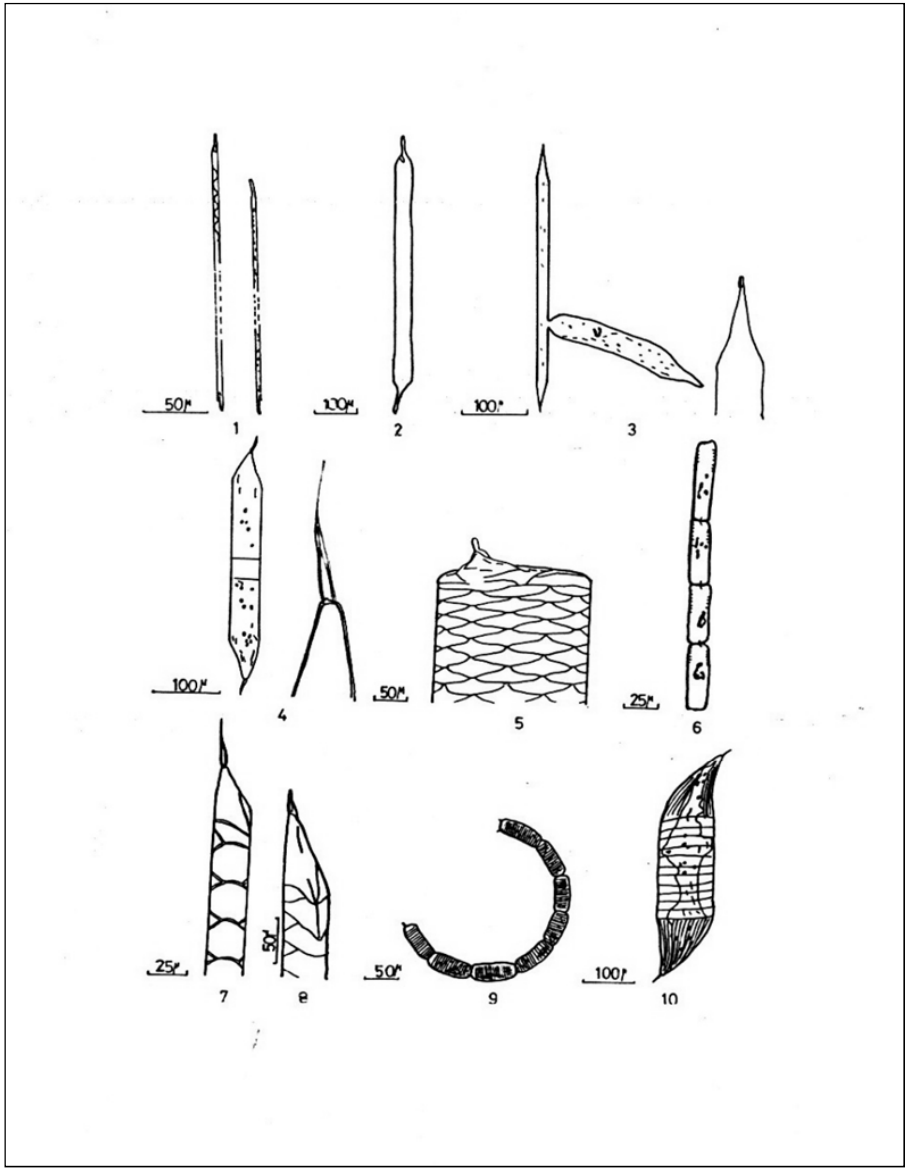


Fig.1 :*Surirella ovata*; 2: *Surirella ovalis*; 3: *Surirella fastuosa*; 4: *Surirella fluminensis*; 5: *Campylodiscus fastuosus*; 6: *C. echeneis*; 7: *C. biangulatus*, axe apical;;8- *Pleurosigma elongata*; 9: *P. normanii*; 10:*Gyrosigma balticum*; 11:*G. hippocampus*;12:*Mastogloia binotata*

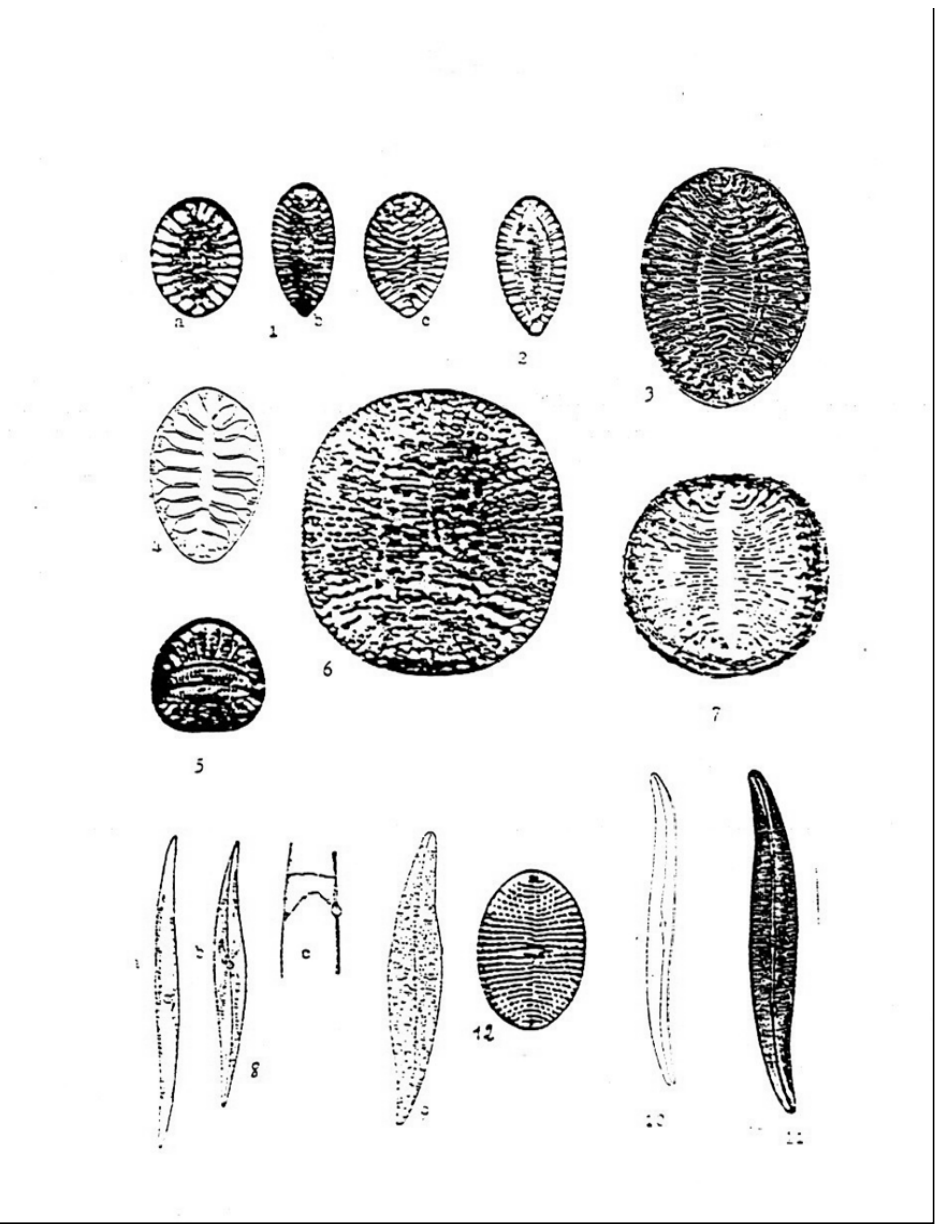


Fig.1:*Rhizosolenia alata* forma *gracillima*; 2:*Rh. alata* forma *indica*; 3:*Rh. bergonii*; 4:*Rh. calcaravis*; 5:*Rh. castracanei*; 6:*Rh delicatula*; 7:*Rh. imbricata* var.*schrubsole*; 8:*Rh. Styliformis* var.*styliformis*; 9:*Rh. stolterforthii* ; 10:*Rh. robusta*,

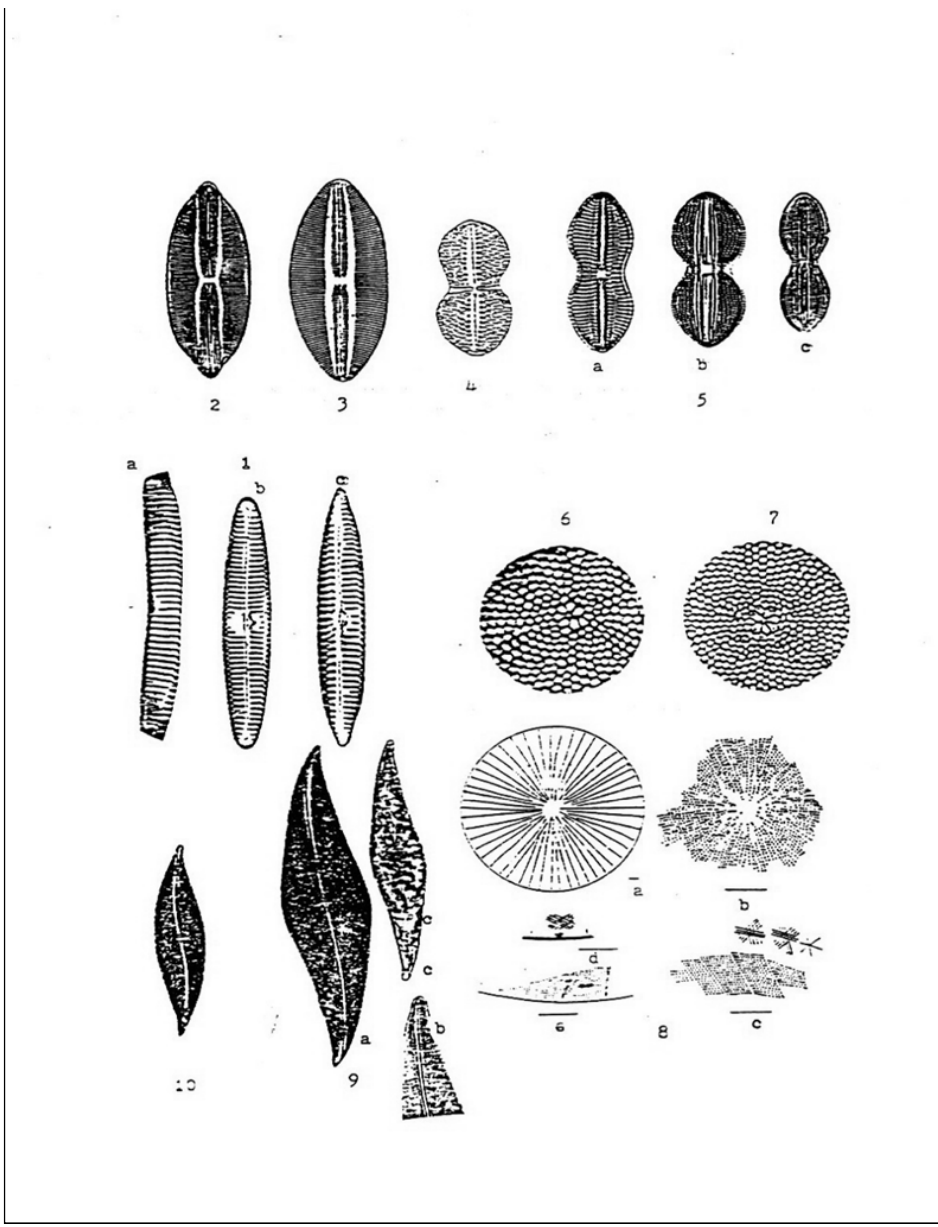


Fig.1- *Navicula cancellata* , a,b: valves; c2 :*Navicula lyra*, ;3 :*Navicula lyroides*; 4 :*Diploneis weissflogii* ; 5 :*Diploneis crabro*; 6 :*Coscinodiscus*; 7 :*C. asteramphalus*, 8 :*C. concinnus* a 9 *:Pleurosigma* c:;10 :*Pleurosigma aestuarii*

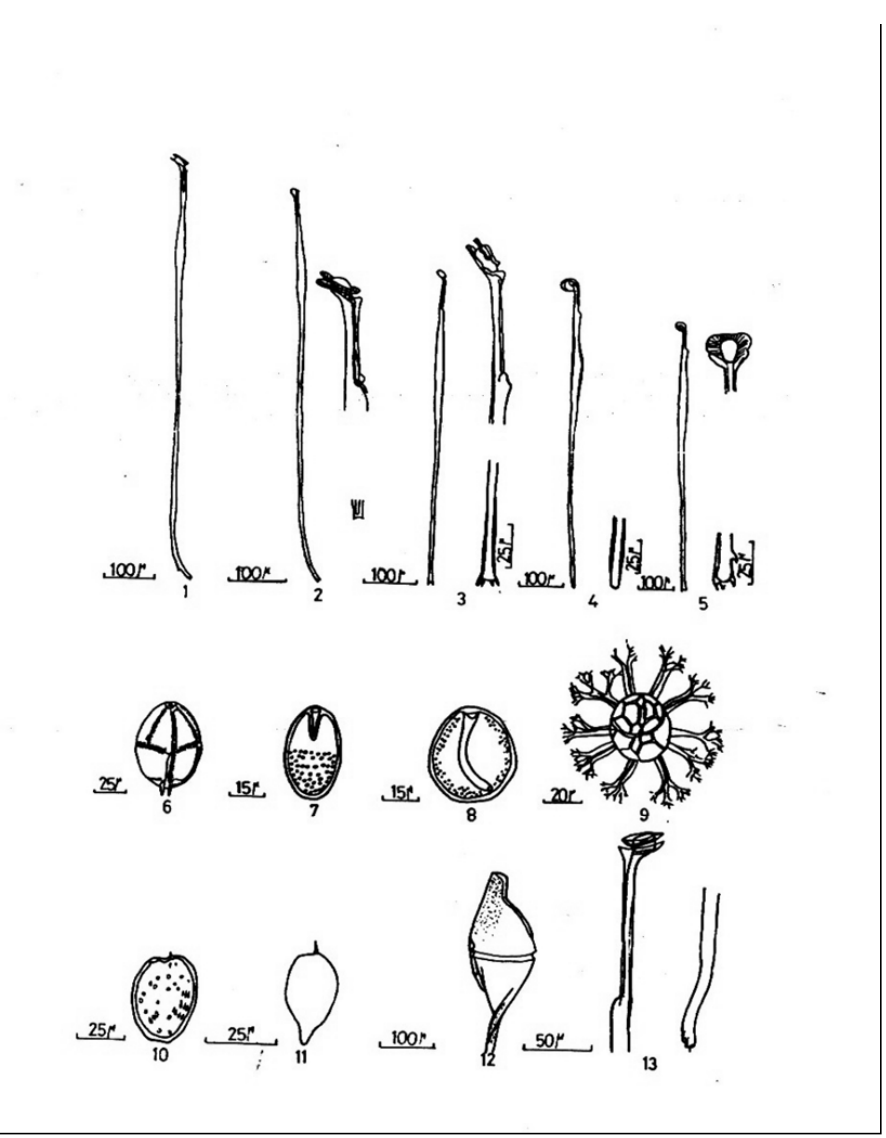
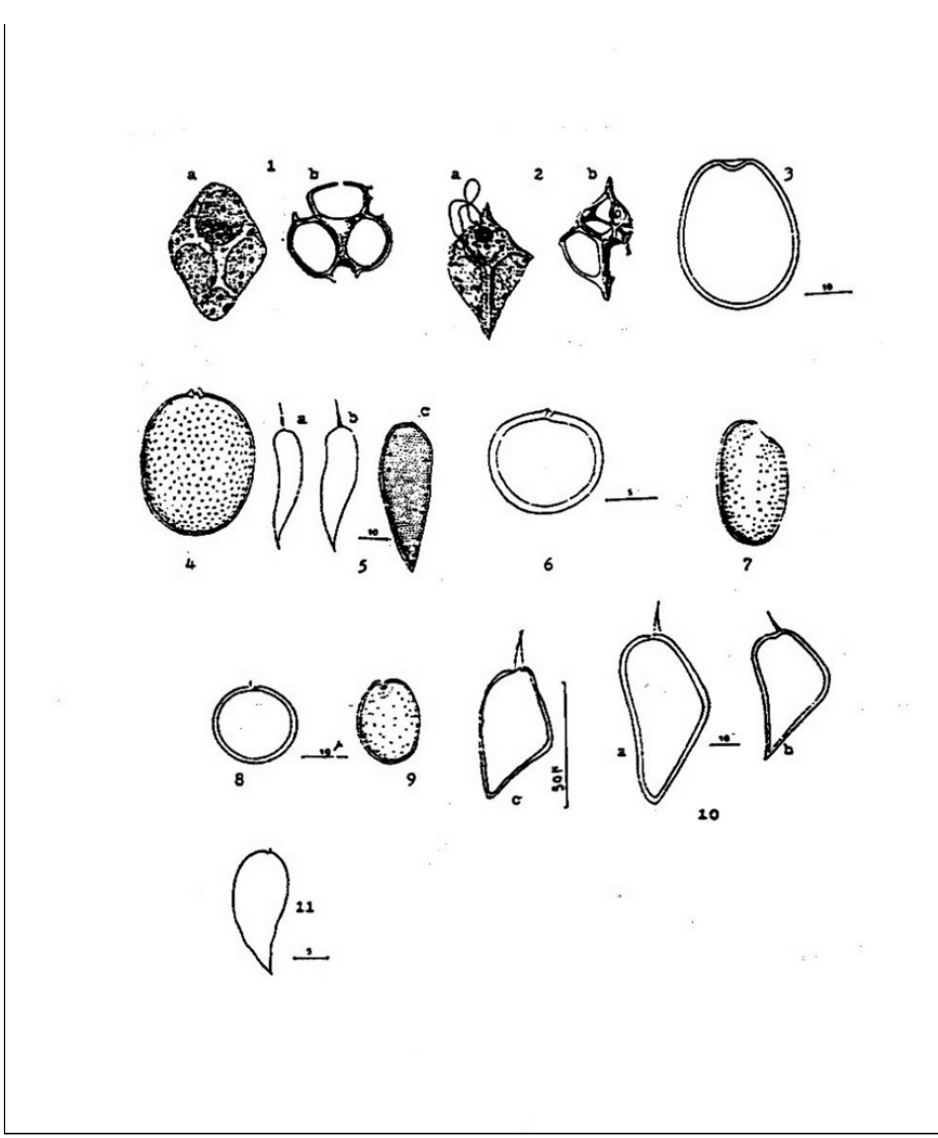


Fig.1:*Amphisolenia bidentata*; 2:*Amphisolenia spinulosa*; 3: *Amphisolenia quadrispina ;* 4:*Triposolenia truncata*; 5:*Amphisolenia palmata* ; 6:*Blepharocysta splendor-maris*; 7 :*Cenchridium globosum*;8:*Cenchridium sphaerula*; 9:*Cladopyxis brachiolata*; 10:*Prorocentrum micans;*11:*Prorocentrum schilleri(dentatum)*;12- *Centrodinium complanatum*; 13 :*Amphisolenia clavipes*



Figs.1:*Ebria tripartita* a: cellule vivante b:squelette interne ; 2 :*Hermesinum adriaticum*; a: cellule vivante, b:squelette interne; 3 :*Prorocentrum lima* ; 4 :*P. compresssum*; 5:*P. gracile*; 6:*P. balticum*; 7:*P. cordatum*;8 : *P. rotundatum*; 9 :*Prorocentrum oblongum*;10 :*P. arcuatum*;11:*P. adriaticum*

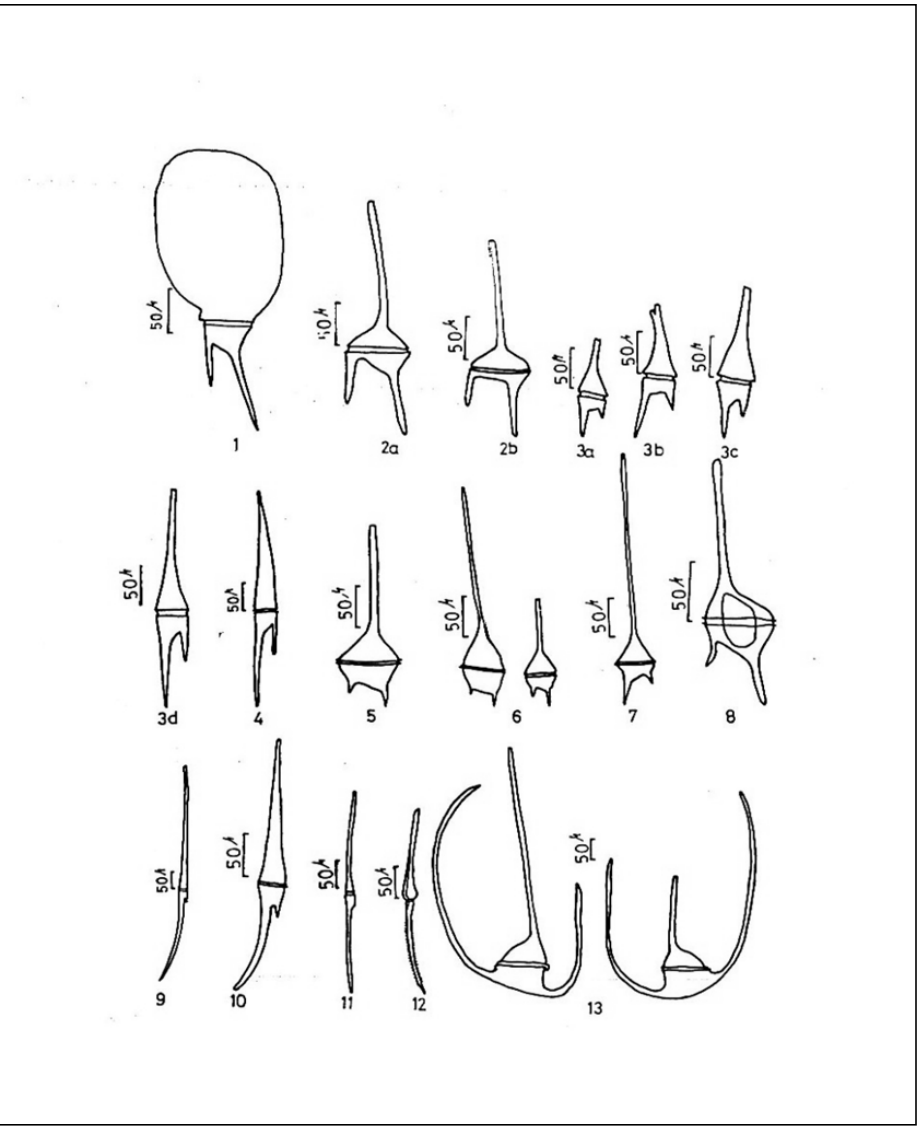


Fig.1:*Ceratium gravidum* **; 2 a: *C. Candelabrum* var.*candelabrum*; 2b:*C. candelabrum* var. *depressum*; 3a,b,c: *C. furca* var.*eugrammum*, d: *C. furca* var. *furca*; 4:*C. incisum*; 5:*C. Pentagonum*; 6:*C. teres* ; 7:*C. setaceum*; 8:*C. ehrenbergii*; 9- *C. longirostrum* ; 10:*C. falcatum*; 11:*C. fusus* var.*seta*; 12:*C. fusus* var.*schuetti*; 13:*C. contortum* var.*karsteni***

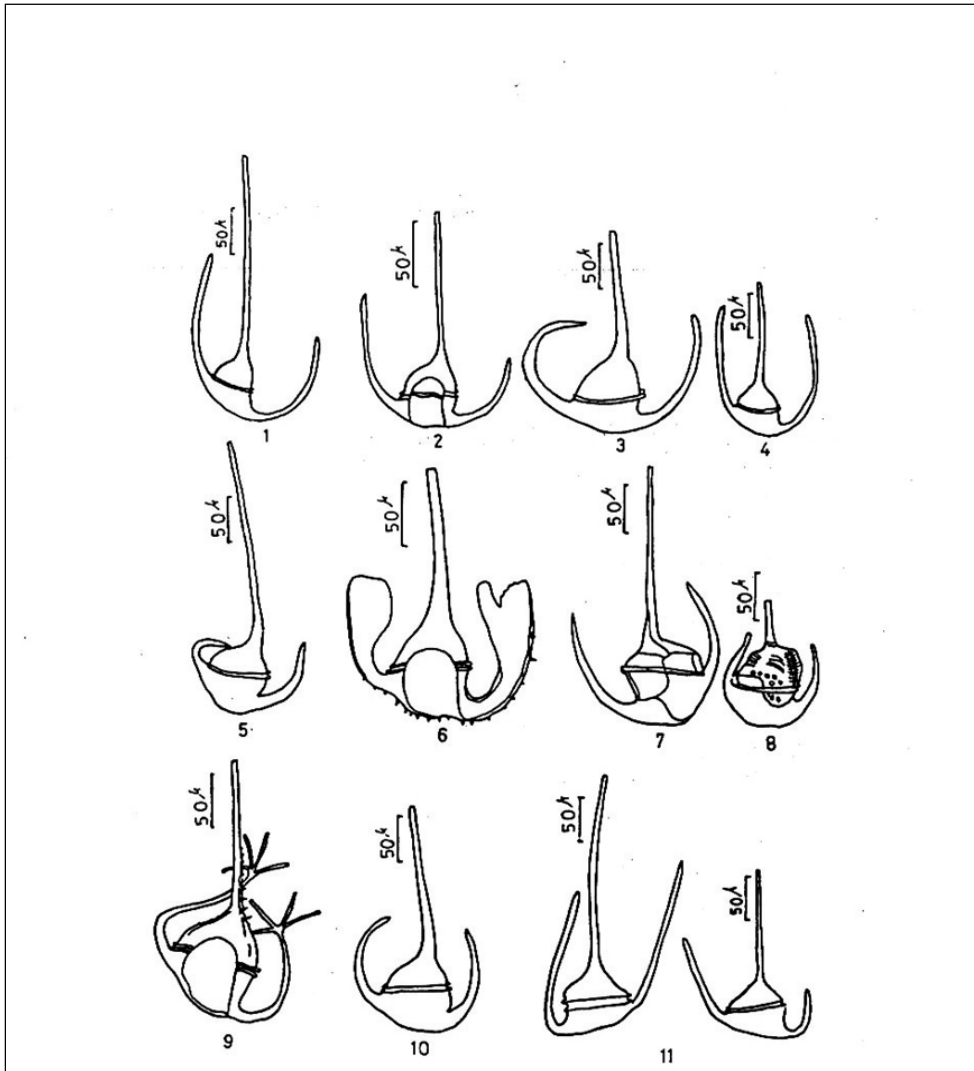


Fig.1:*Ceratium euarcuatum*; 2:*C. declinatum*.f.*declinatum*; 3:*C. arietinum* forma *detortum*; 4: *C. symetricum* ; 5:*C. concilians*; 6: *platycorne* var.*platycorne*; 7: *C. gibberum* var*. gibberum*; 8:*C. paradoxides*; 9:*C. ranipes* forma *palmata*; 10: *C. schmidti*; 11:*C. egyptiacum* forma *suezensis*

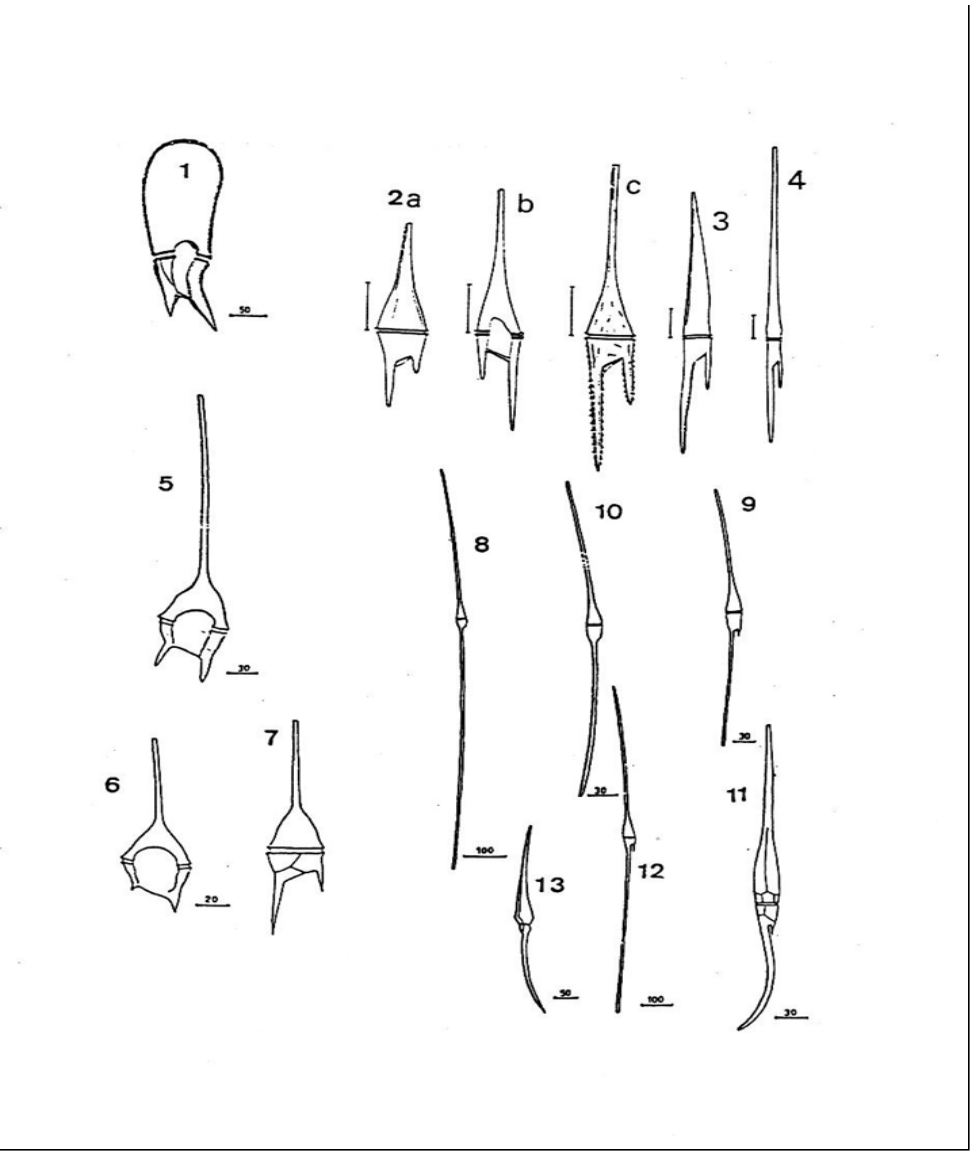


Fig.1:*Ceratium praelongum*; 2a:*C. furca* var.*eugrammum*; 2b:*C. furca*; 2c:*C. furca*var.*furca* ; 3:*C. incisum*; 4:*C. belone*, ; 5 :*C : pentagonum* f. *turgidum*; 6 :*C. minutum*; 7:*C. Kofoidii* ; 8 :*C. extensum*; 9 :*C. fusus* var.*fusu* ;10 :*C. fusus* var.*seta*;11:*C. falcatum*;12:*C. strictum*; 13 :*C. fusus* var.*shuettii*

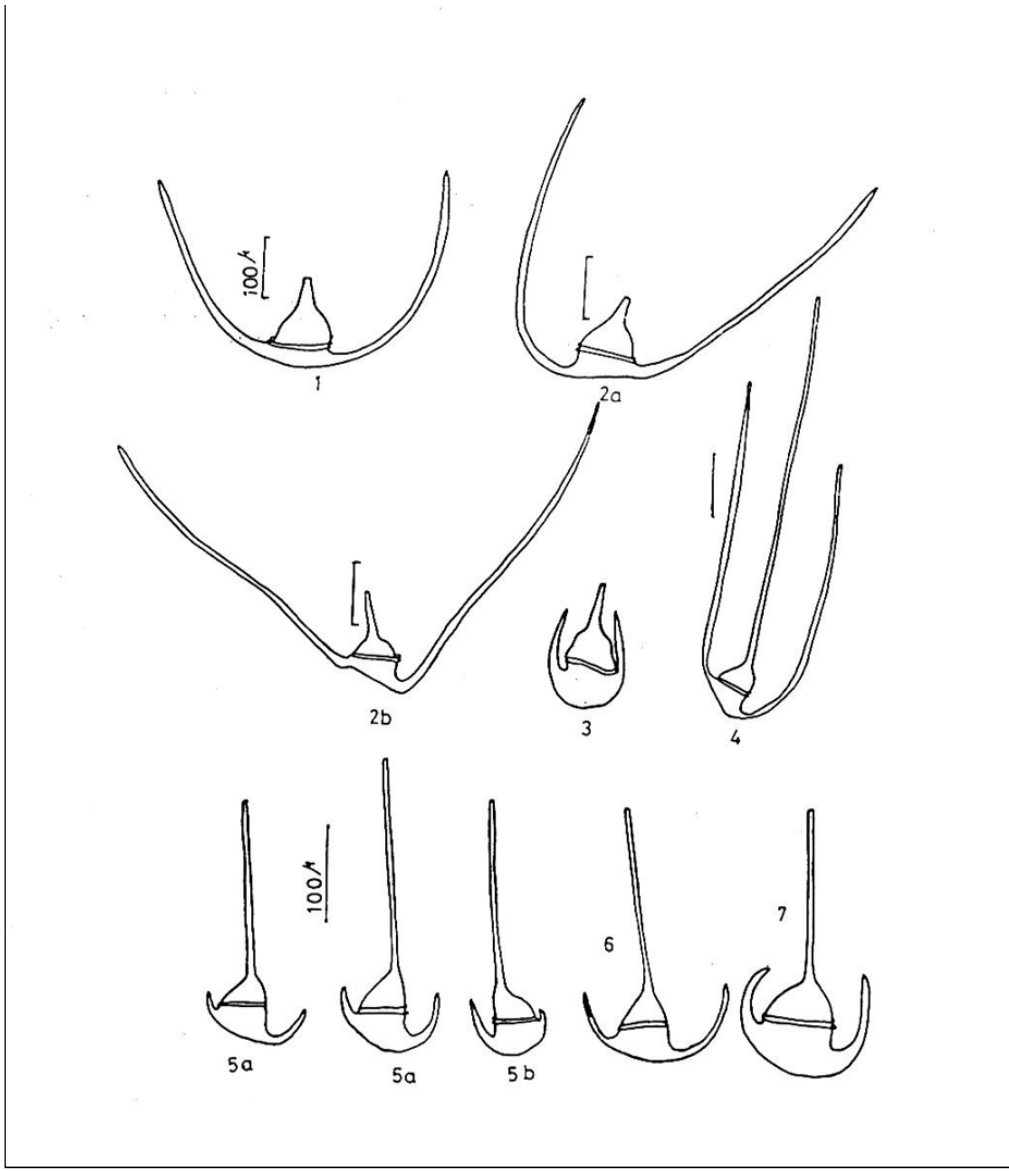


Fig.1:*Ceratium lunula*; 2a,2b:*C. vultur* f. *vultur*; 3:*C. limulus*, d'après Böhm ; 4:*C. longissimum*, d'après Jörg.; 5:*C. pulchellum* forma *semipulchellum*; 6: *C. pulchellum* ,original; 7: *C. tripos* forma *ponticum*

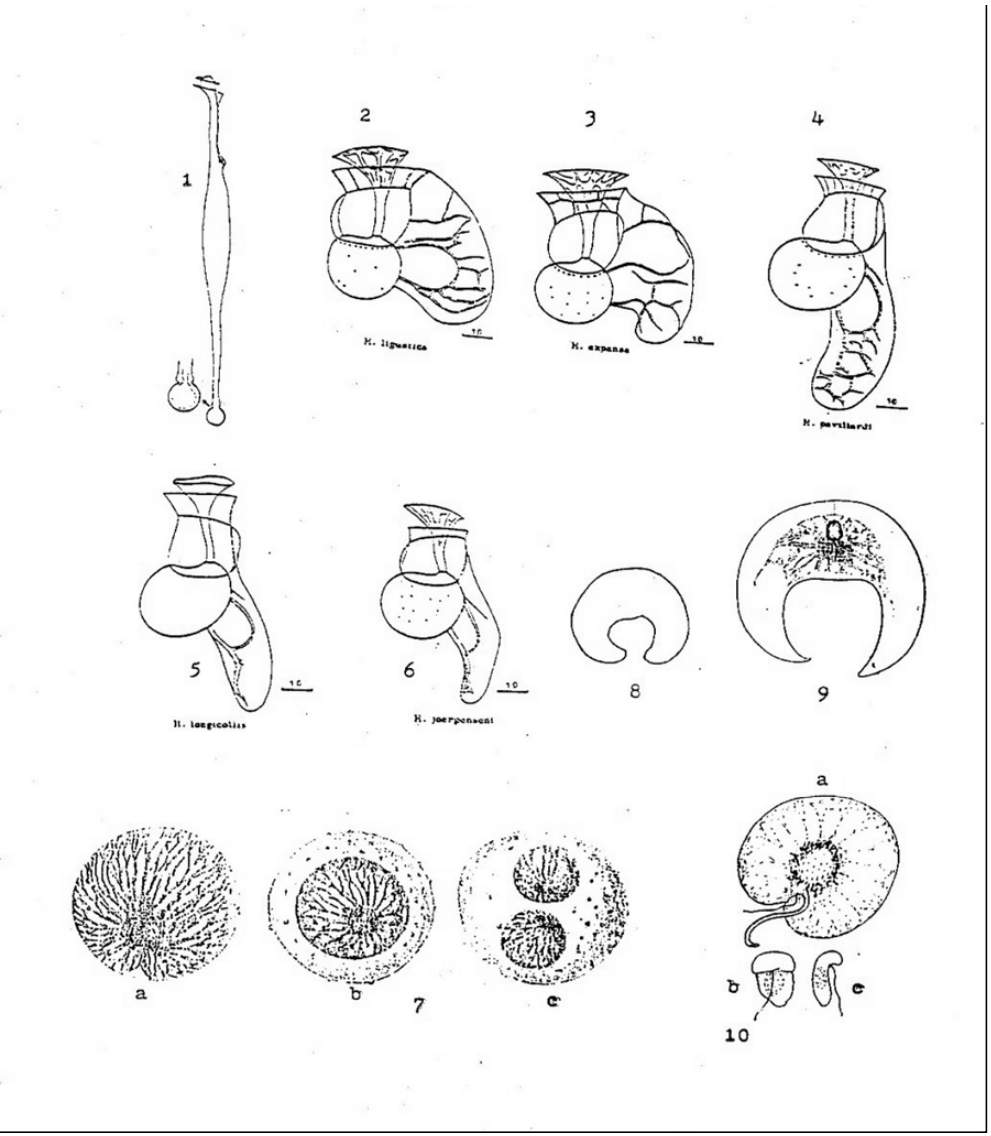


Fig.1 :*Amphisolenia globifera* ; 2 :*Histioneis ligustica*; 3:*H. expansa*; 4 :*H. pavillardi*; 5 :*H. longicollis* ; 6:*H. joergensi*; 7 :*Pyrocystis pseudonoctiluca* a:cellule entière, b,c, d: 800µ cellule en division;; 8 :*P.s obtusa,* ; 9: *P. robusta* ; 10:*Noctiluca miliaris* (=*N.scintillans*),

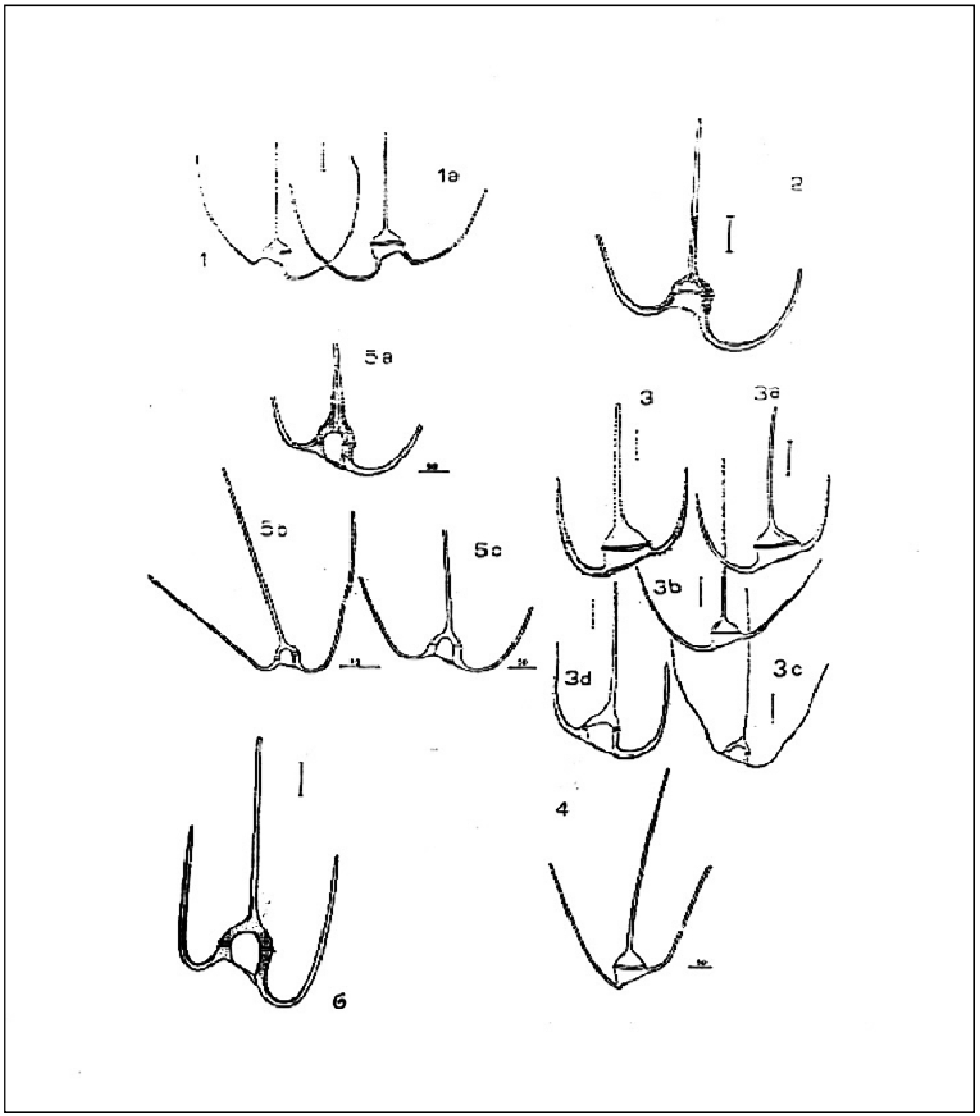


Fig.1:*Ceratium macroceros* var. *gallicum*; 2 :*C. macroceros*; 3:*Ceratium horridum* var.*horridum* ; 3 a:*C. horridum* ;3b:*C. horridum*; 3c:*C. horridum*; 3d:*C. horridum* var.*buceros*f.*tenue*; 4 :*C. pavillardii* ; 5a :*C.massiliense* f. *armatum*,d'après; 5b :*C. massiliense* var. *massiliense* ; 5c :*C. massiliense* var.*protuberans*

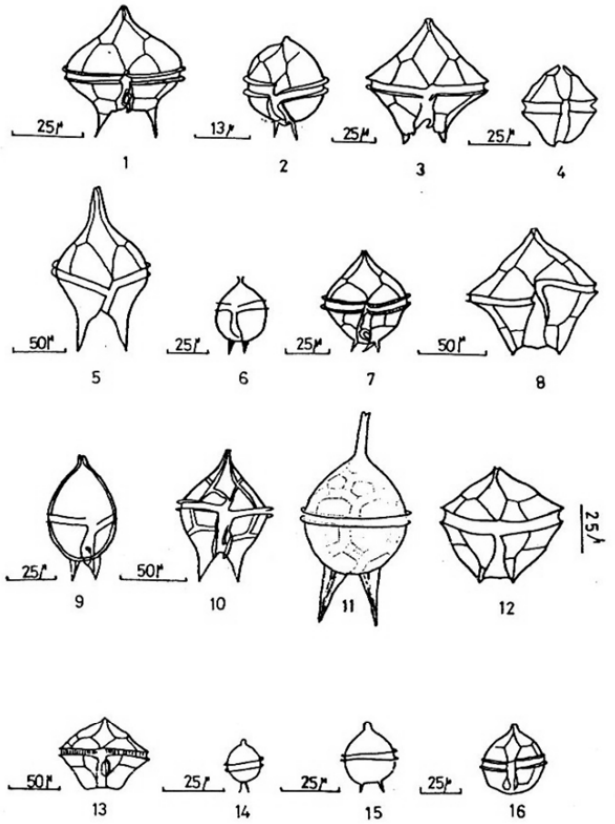


Fig.1:*Protoperidinium granii*; 2*:P. hirobis* , d'après Abé *in* Schiller;3:*P.leonis* ; 4:*P. nux* ; 5:*P. oceanicum*; 6:*P. pedunculatum*; 7:*P. pellucidum*, d'après Lebour; 8:*P. pentagonum*; 9 :*P. pyriforme*; 10:*P. solidicorne*; 11: *P. steinii* var. *mediterraneum*; 12:*P.subinerme,*;13:*P.subinerme* var.*punctulatum* ; 14:*Protoperidinium* sp1.;15:*Protoperidinium* sp2.;16 :*P. minutum*

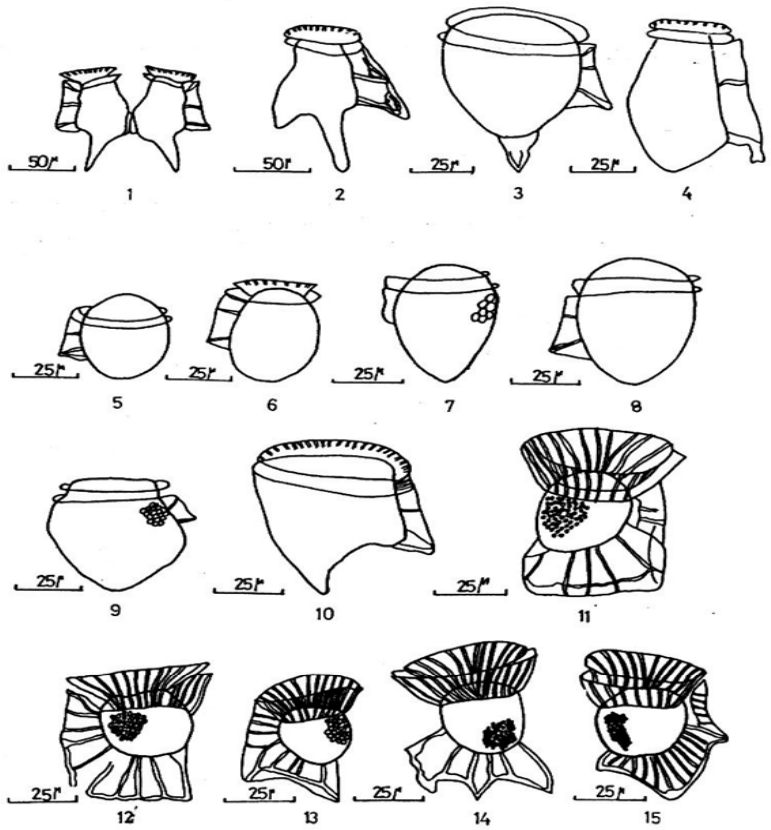


Fig.1:*Dinophysis caudata*; 2:*D.tripos*; 3:*D. doryphorum*; 4:*D. schroederi*; 5:*Phalacroma parvulum*; 6: *Dinophysis sphaerica*; 7:*Dinophysis* sp1; 8:*Dinophysis* sp2; 9:*Dinophysis* sp3; 10:*Phalacroma mitra*; 11*:Ornithocercus quadratus* var.*assimilis*; 12: *O.quadratus* var.*schuetti;* 13:*O.heteroporus*,original;14:*O.magnificus*; 15:*O.carolinae*

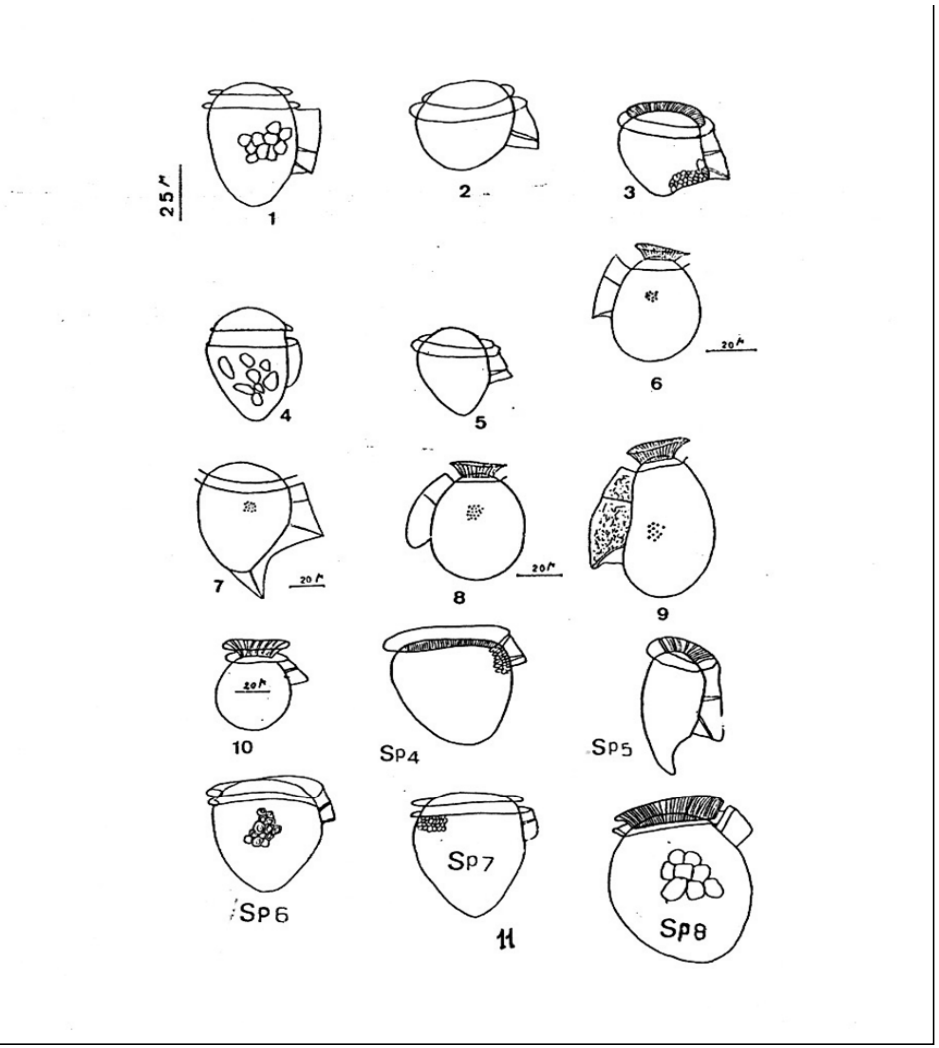


Fig.1:*Dinophysis acuminata* **; 2:*Dinophysis rotundata*** **; 3:*Dinophysis acutoides*** **; 4 :*Dinophysis elongata*** **5:*Dinophysis amandula*** **; 6:*Dinophysis ovum;* 7:*Dinophysis circumsuta*;8:*Dinophysis similis*; 9:*Dinophysis schroderi*; 10:*Dinophysis infundibulus*; 11:*Dinophysis* sp4, sp5,sp6,sp7,sp8.**

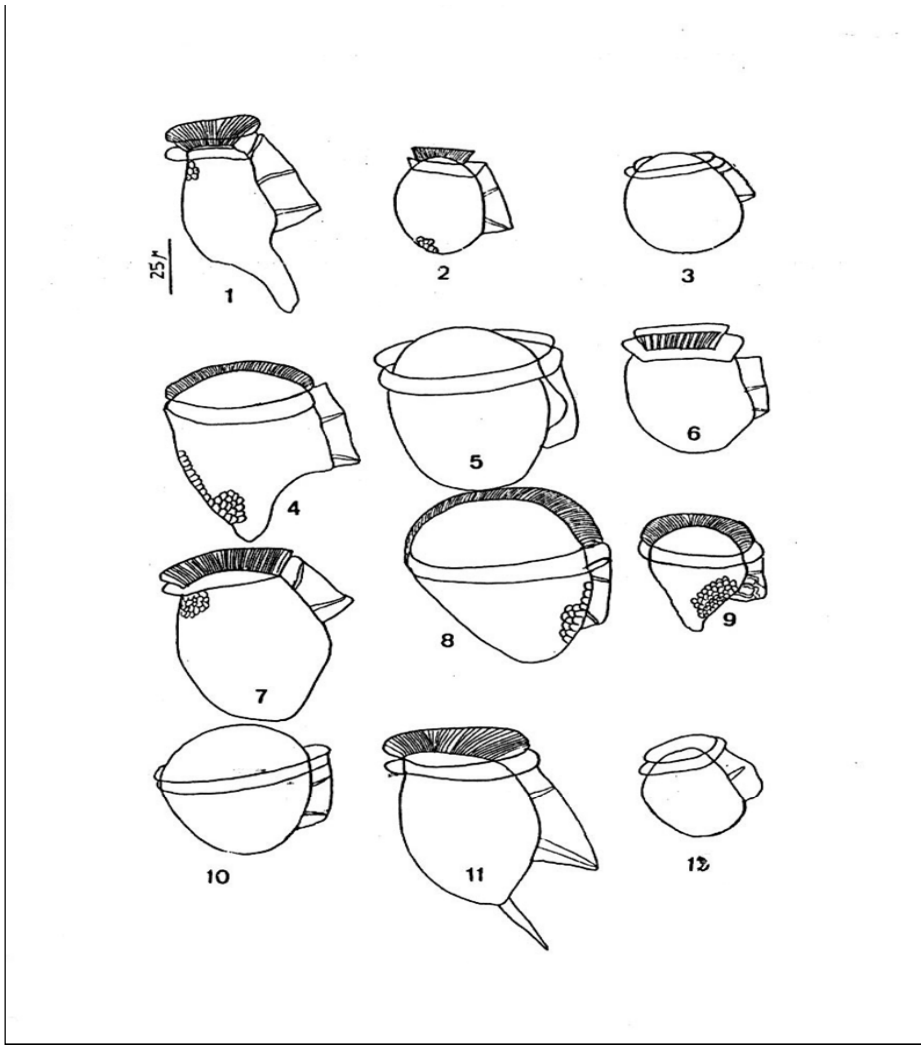


Fig.1:Dinophysis caudata*; 2: *Dinophysis recurva* ; 3:*Dinophysis umbosa ;* 4:*Dinophysis rapa*; 5:*Dinophysis argus*; 6:*Dinophysis operculata*; 7:*Dinophysis acuta*; 8:*Dinophysis cuneus.*;9:*Dinophysis hindmarchi*; 10:*Dinophysis porodictyum*;11:*Dinophysis odiosum; 12:D inophysis expulsa.

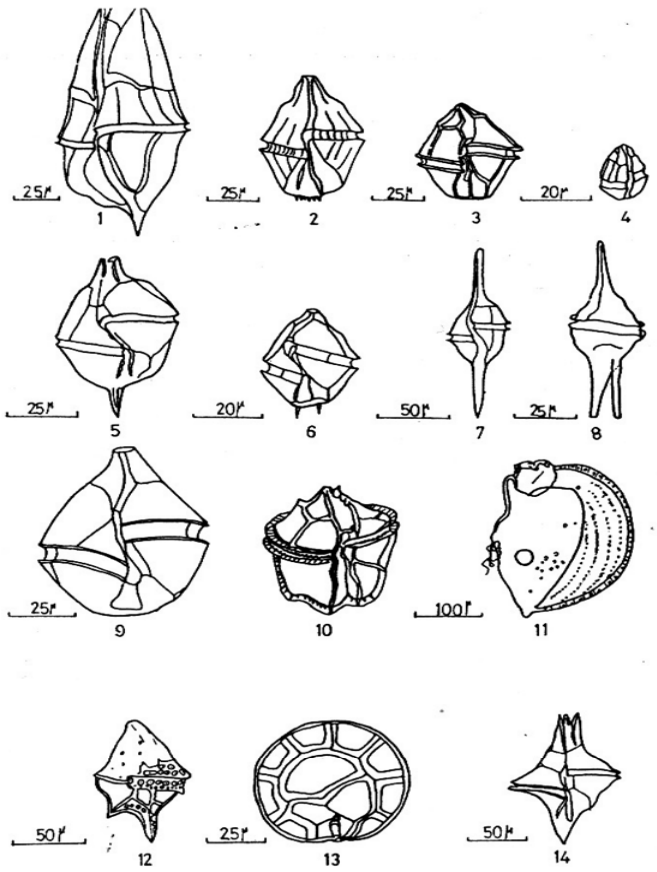


Fig.1:*Gonyaulax pacifica* ; 2:*Gonyaulax polygramma*; 3:*Gonyaulax polyedra*; 4:*Gonyaulax minima*;5:*Gonyaulax monacantha*; 6:*Gonyaulax spinifera*; 7:*Gonyaulax birostris*; 8:*Gonyaulax* sp.; 9 :*Gonyaulax digitale*; 10:*Gonyaulax milner;* 11 :*Kofoidinium velelloides*; 12 :*Heterodinium leiorhynchum*; 13 :*Pyrophacus horologium*, vue latérale; 14:*Spiraulax Jollifei*

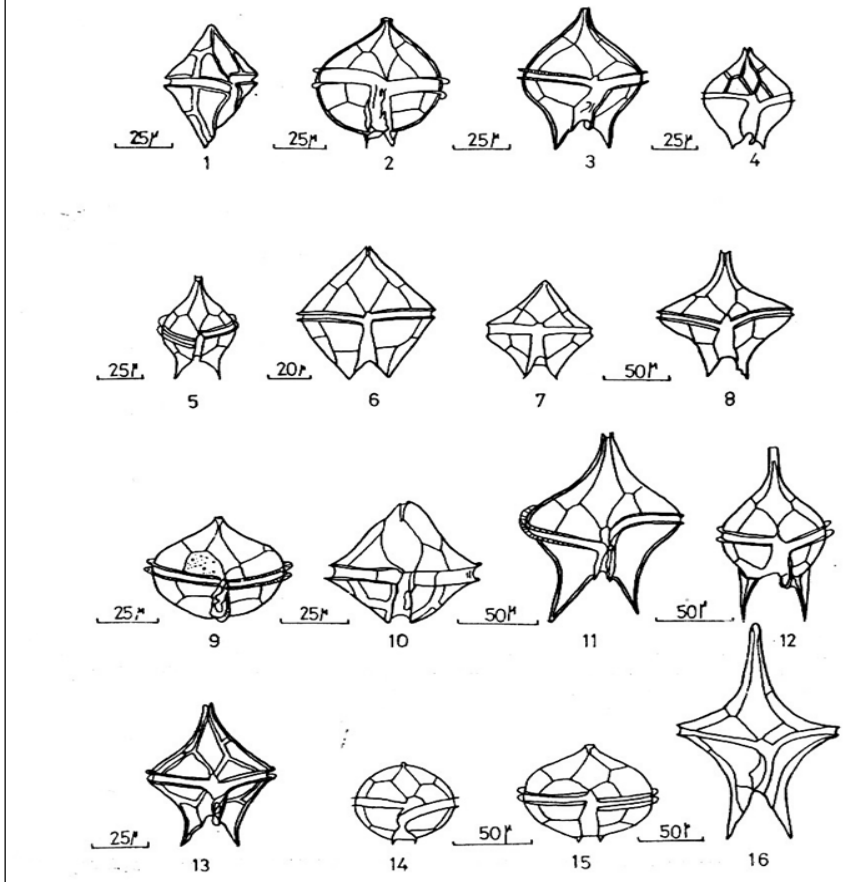


Fig.1:*Protoperidinium abei*; 2:*P. breve*; 3:*P. brochi* ; 4:*P. brochi* forma *inflatum*; 5:*P. Claudicans*; 6:*P. conicum* ; 7:*P.conicum* forma *concava*; 8:*P. crassipes*; 9:*P. curvipes*; 10:*Protoperidinium deficiens*;11:*P. depressum*; 12:*P. diabolus*;13:*P. divergens*;14:*P. globulus* var.*quarnerense*; 15:*P. globulum* var. *ovatum*;16 :*P. grande*

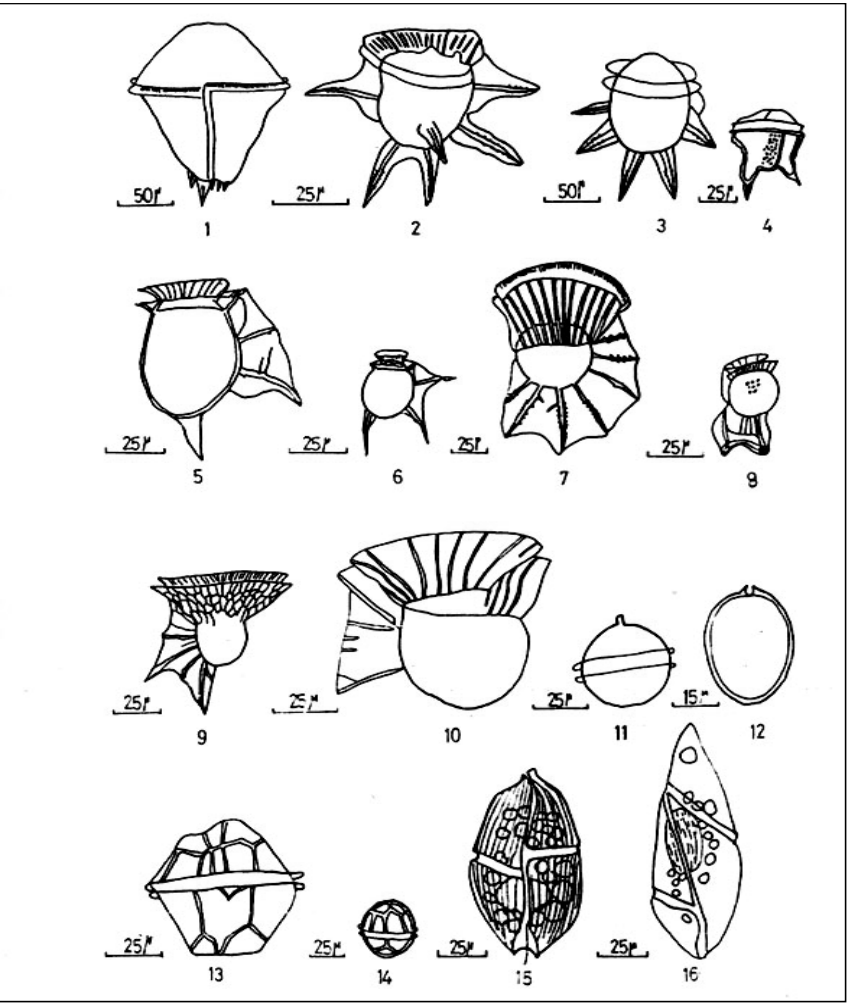


Fig.1: ***Ceratocorys armata*****; 2:** ***C. horrida*****; 3:*****C. gourreti*****; 4:*****C. bipes*****; 5:*****Dinophysis hastata*** **forma** ***hastata*****;6 :*****Dinophysis schuetti*****; 7:*****Ornithocercus steinii*****; 8:*****O. geniculatus*****; 9:*****O. splendidus*****,; 10:*****Ornithocercus*** **sp.; 11:*****Glenodinium lenticula*****; 12:*****Exuviella compressa*****; 13:*****Heteraulacus polyedricus*****; 14:*****Goniodomasphaericum*****; 15:*****Gymnodinium canus*****;16:*****Gyrodinium contortum***

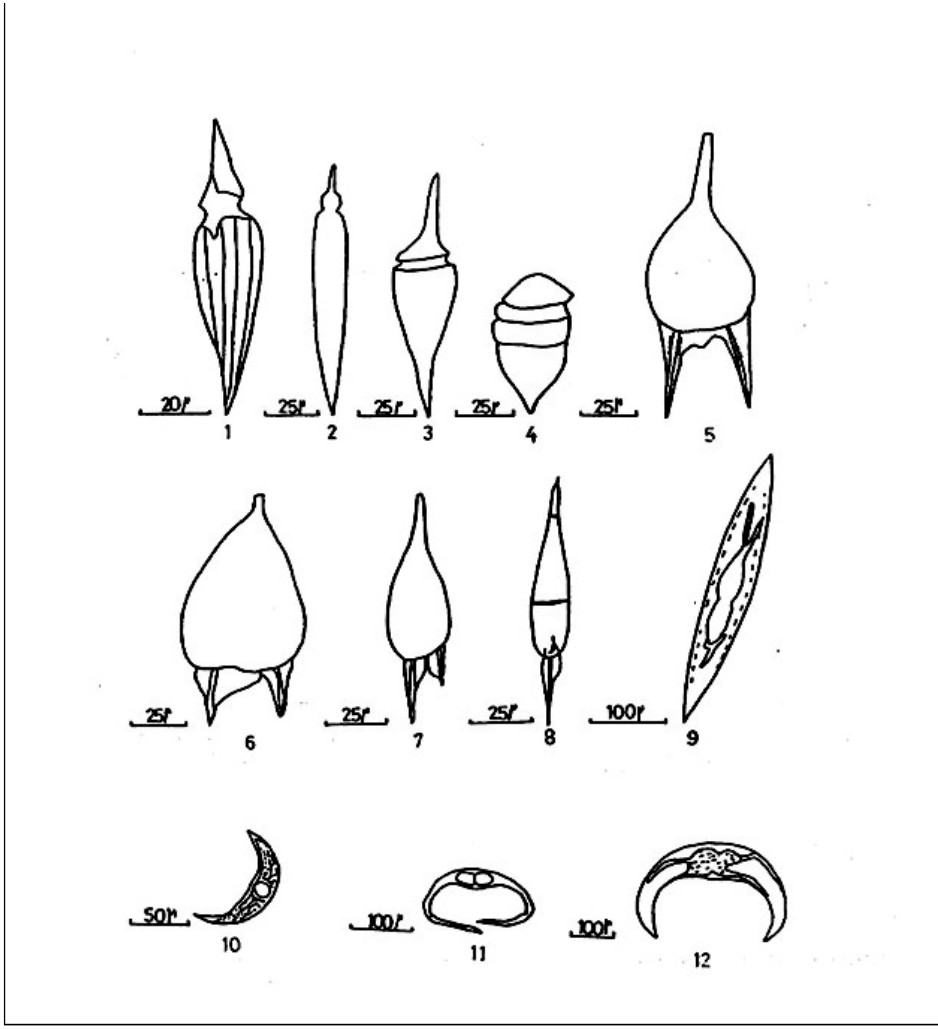


Fig.1:***Oxytoxum longiceps,*****; 2:*****Oxytoxum scolopax*****; 3:*****Oxytoxum Milneri*****; 4:*****Oxytoxum constrictum*****;5:*****Podolampas elegans*** **; 6:*****Podolampas bipes*** **;7:*****Podolampas palmipes*****; 8:*****Podolampas spinifera*****;9 :*****Pyrocystis fusiformis*** **; 10 :*****Pyrocystis lunula;*** **11 :*****Pyrocystis hamulus*** **;12 :*****Pyrocystis elegans***

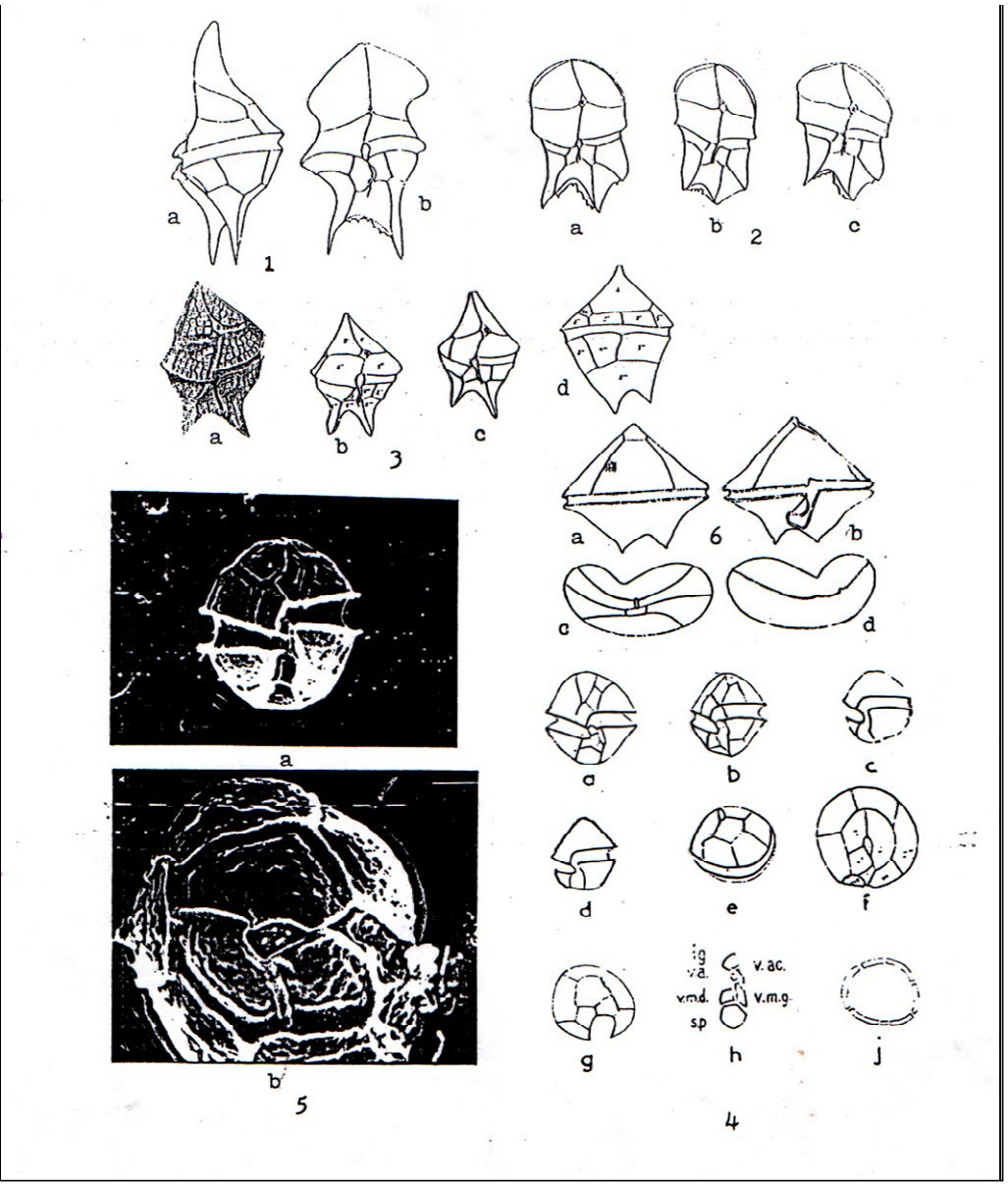


Fig.1- *Heterodiunium fides* 2:*H. mediocre* e ; 3 :*H. rigdenae*); 4 :*Alexandrium minutum* ; 5 : *A. minutum* microphoto au MEB , x 3000 ; 6 :*Peridinium pentagonum var.latissimum* ,

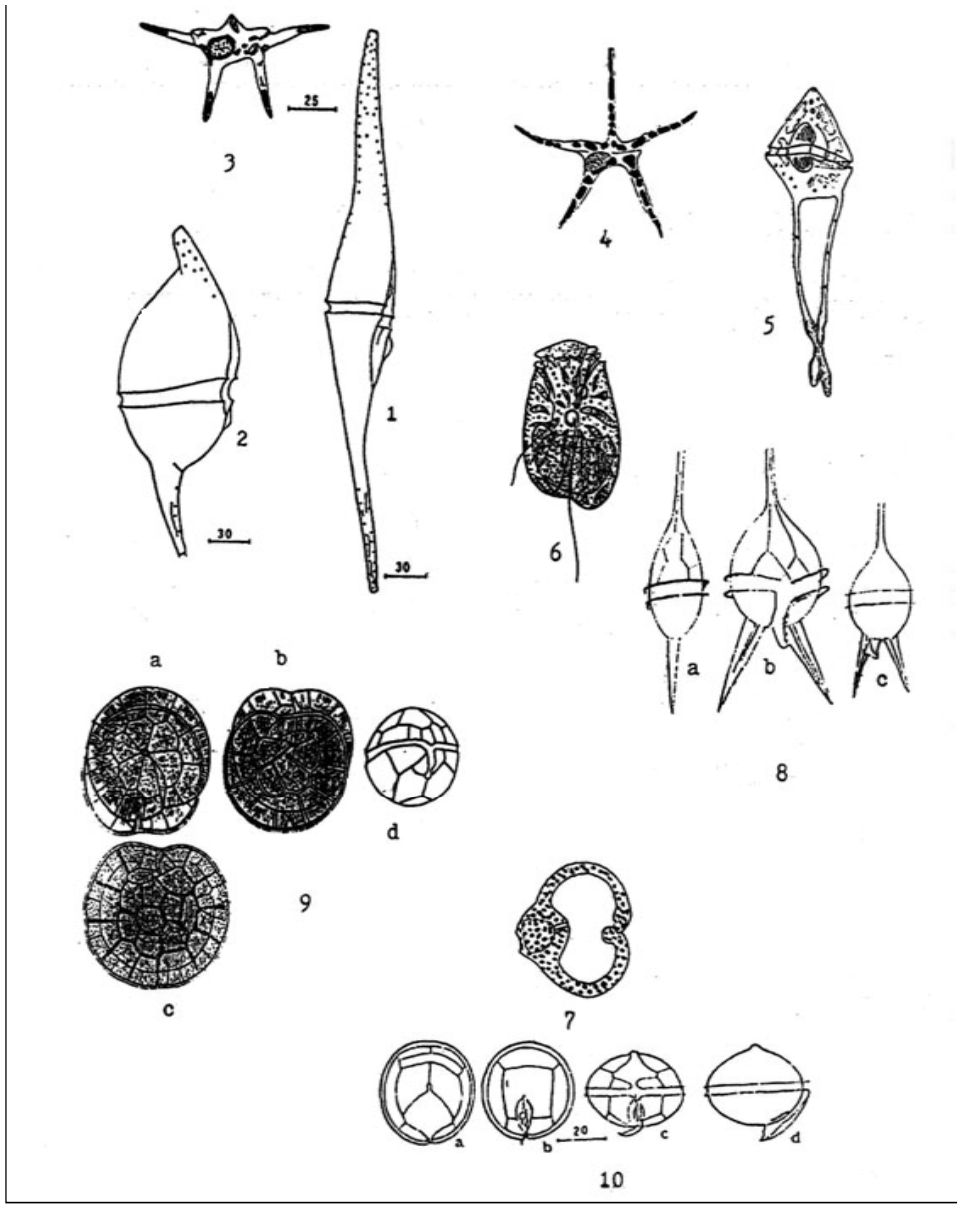


Fig.1:*Centrodinium maximum* ;2:*C. intermedium* ; 3:*Brachydinium capitatum*; 4 :*Asterodinium gracile* 5:*Ceratoperidinium* 6:*Amphidinium* ; 7:*Pseliodinium* ; (d'après Sournia); 8 :*Peridinium tenuissimum* ; 9 :*Pyrophacus horologium* var.*Steinii*,) ;10 :*Diplopsalis (Dissodium) lenticulum*.

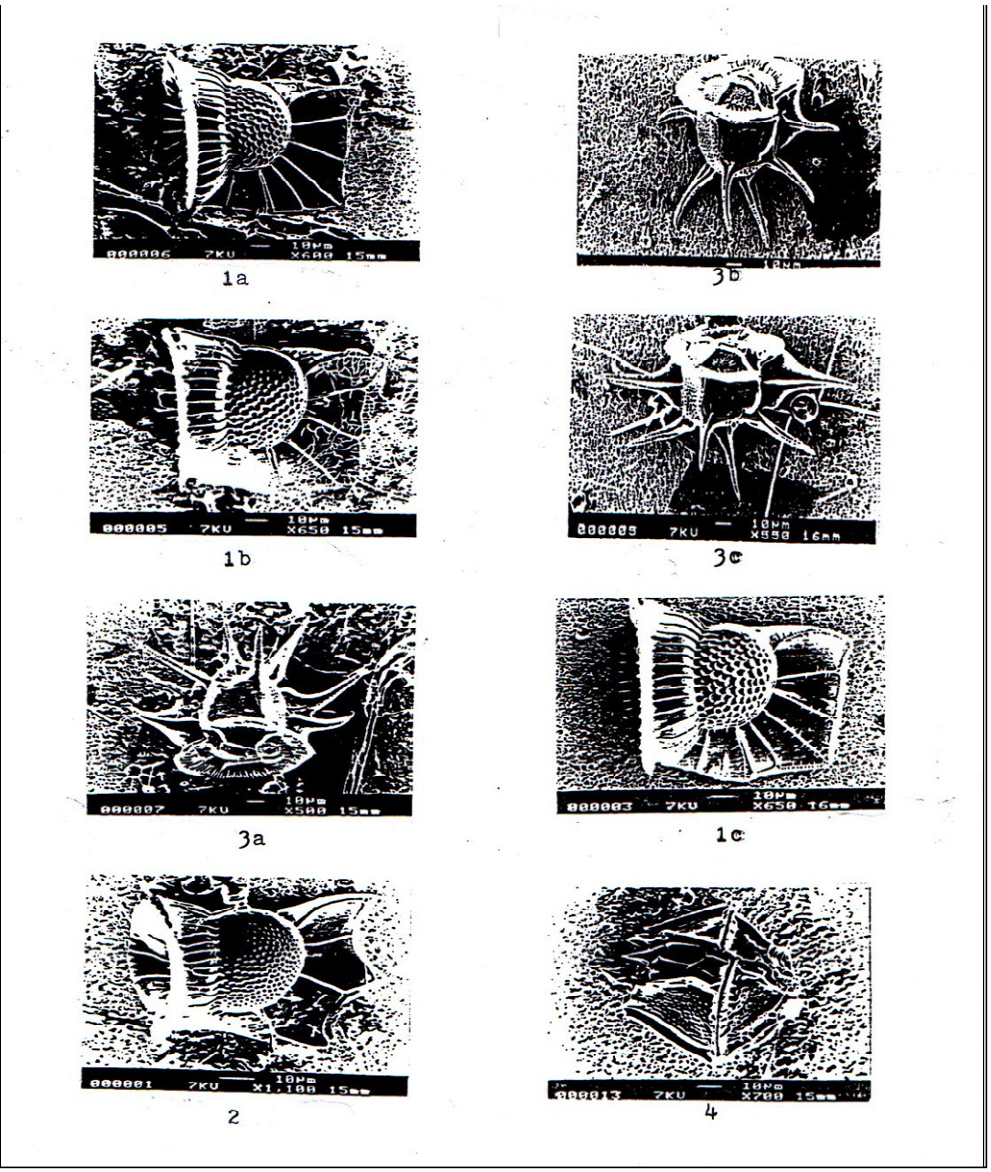


Fig.1a :*Ornithocercus quadratus* f.*assimilis* x 600,; 1b :*O. quadratus* f.*assimilis* x 650; 1c :*O. quadratus* x 650 ; 2 : *O. magnificus* x 1100 ; 3a:*Ceratocorys horrida* var. *horrida* x 500 ;3b- *C. horrida* var.*horrida* x 550; 3c:*C. horrida* x 550; 4 : *C. armata* x700 .

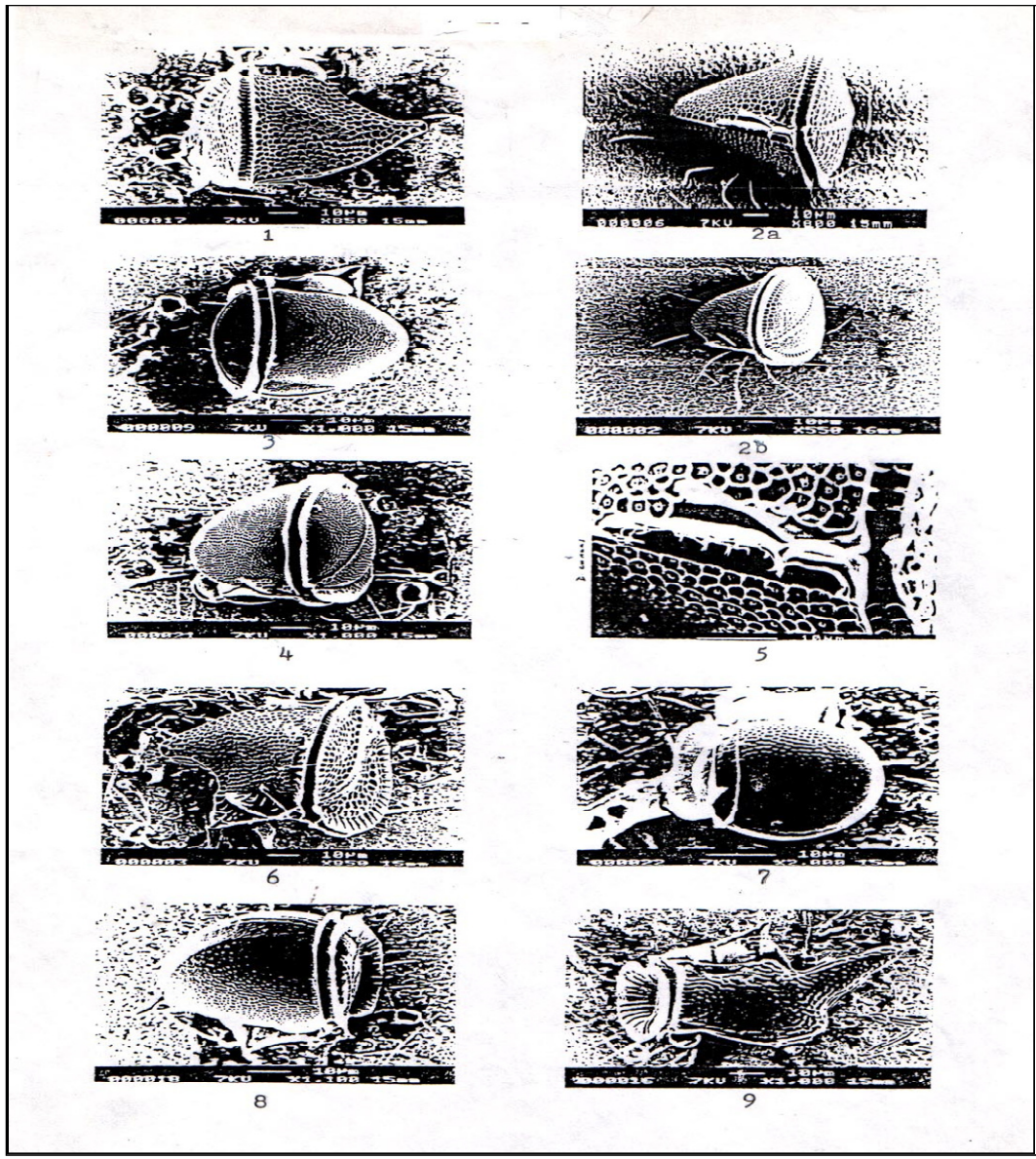
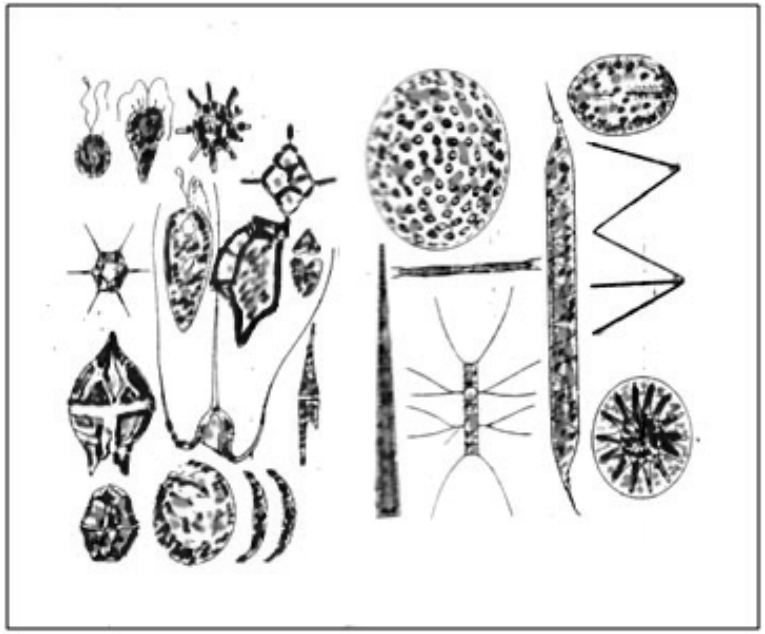


Fig.1 :*Dinophysis rapa* x 850 ;.2 a:*D. cuneus* x 800 ; 2b:*D. cuneus* x 550 ;3:*D. amandula* x1000; 4:*D. cuneus* x 550; 5:*D. porodictyum* x1000;6 :*D. cuneus*, pore apical x 2700 ; 7:*D. rapa* x 850; 8 :*D. Parvula* x 2000; 9:*Dinophysis hastata* forma *hastata* x1100,

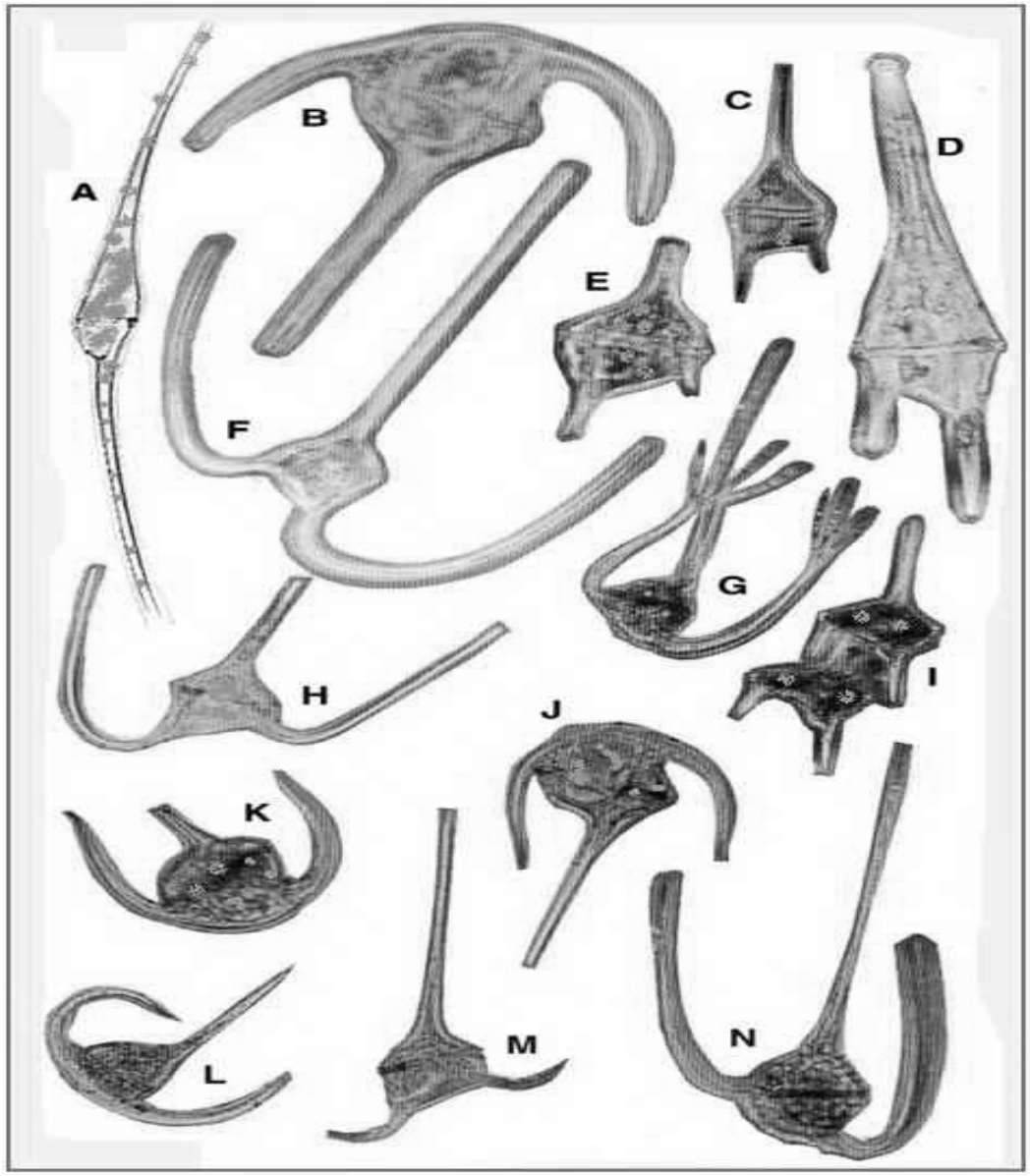
LE PLANCTON MARIN DU LIBAN
ET DU BASSIN LEVANTIN
Biologie, Biodiversité, Biogéographie
I. LE PHYTOPLANCTON

Sami Lakkis

Professeur à l'Université Libanaise



Beyrouth, Liban



Très diversifié, le groupe du genre *Ceratium* (Péridiniens) avec 54 espèces et variétés constitue un des composants importants du phytoplancton des eaux marines libanaises et levantines

THANK YOU FOR

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ATTENTION