Col.Vol.Sci.Pap. ICCAT, 46 (2) : 215-218 (1997)

SUMMER PHYTOPLANKTON IN MEDITERRANEAN SPAWNING AREAS OF TUNA FISHES

Rizzi[1], E., C. Piccinetti[2], G. Marano[1], G. Bello[1]

SUMMARY

In the summer of 1994, sixty-three (63) samples of surface phytoplankton were collected during a cruise to survey the Mediterranean spawning areas of tuna fishes. Phytoplankton densities were very low; they ranged from 160 to 9,500 cells/liter; the lowest values were attained in the Levant Basin. The diversity was also quite low. Small-sized species, i.e. microflagellates and coccolithophorids, predominated. The second most abundance taxon was Dinophyceae. Only few diatoms were found. The overall phytoplankton distribution is in agreement with data reported in the literature.

RESUME

Pendant l'été 1994, 63 échantillons de phytoplankton de surface ont été prélevés pendant une campagne de prospection dans les zones de frai des thons en Méditerranée. Le phytoplankton montrait une faible densité, qui allait de 160 à 9.500 cellules par litre ; les valeurs les plus faibles correspondaient au Bassin Levantin. La diversité était également assez médiocre. Les espèces de petite taille, comme les microflagellés et les coccolithophoridés, prédominaient. Seuls quelques diatomées ont été observées. La distribution globale du phytoplankton correspond aux données qui figurent dans les travaux publiés.

RESUMEN

En el verano de 1994, se recogieron 63 muestras de fitoplancton de superficie durante una prospección realizada en el Mediterráneo en las zonas de desove de los túnidos. Las densidades de fitoplancton eran muy bajas, entre 160 y 9500 células/litro, con los valores mas bajos en la Cuenca de Levante. También la diversidad era bastante baja. Predominaban las pequeñas especies, por ejemplo, microflagelados y cocolitofóridos, siendo los Dinofíceas el taxón mas abundante. Tan sólo se encontraron algunos diatomeas. La distribución global del fitoplancton concuerda con los datos presentados en el texto.

[1] Laboratorio di Biologia Marina, Molo Pizzoli, 70123 Bari, Italy.
[2] Laboratorio di Biologia Marina e Pesca, Viale Adriatico 1/N, 61032 Fano, Italy.

INTRODUCTION

From the 17th of June to the 5h of August 1994 a cruise to survey the distribution and ecology of larvae of tuna fishes was carried out in the Mediterranean Sea (Piccinetti *et al.*, this volume). During the cruise, 63 samples of phytoplankton were taken from selected areas in the whole Mediterranean Sea. The distribution of the sampling stations is reported in Fig. 1. In addition, temperature, salinity and oxygen concentration were surveyed by a multiparametric probe and water samples were taken to study the concentration of nutrients (Marano *et al.*, this volume).

MATERIALS AND METHODS

Each phytoplankton sample consisted of 1 liter of water taken form the sea surface, preserved in 4% formalin and saved in dark bottle. The samples were examined by an inverted microscope "Axiovert 100 Zeiss", using the method described by Zingone *et al.* (1990) for quantitative study. The following taxonomic works were used to identify the species: Trégouboff & Rose (1957), Rampi & Bernhard (1978-81), Vinyard (1979), Sournia (1986), Ricard (1987), Chrétiennot-Dinet (1990), Round *et al.* (1990), Delgado & Fortuño (1991), and Trondsen & Heimdal (1993).

RESULTS

In all, 19 species of diatoms (Bacillariophyceae), 41 dinoflagellates (Dinophyceae), and 3 coccolithophorids (Prymnesiophyceae) were found (Table 1).

The overall phytoplankton density was quite low. Biomass ranged from 160 to 9500 cells/liter (Table 2). The low values of cell concentration were most probably due to the persistent stratification of the water column occurring in the summertime, which is known to control phytoplankton diversity. The observed composition is the one typical of this season: small-sized species predominated; the presence of diatoms was reduced, whereas dinoflagellates were slightly more frequent; microflagellates and coccolithophorids were comparatively abundant (Fig. 2).

Margalef's index of specific diversity ranged from 0.394 to 2.116, its mean value was 0.950; Shannon-Weaver's index of general diversity ranged from 0.585 to 3.384, mean value 1.969.

As regards the regional phytoplankton distribution, the Levant Basin differed somewhat from the rest of the Mediterranean Sea. Samples from this area presented the lowest values of phytoplankton density (range: 160-2500 cells/liter). Both diversity indices displayed quite low values, which corroborates the hypothesis that this is the poorest Mediterranean area, as shown also by the low concentration of nutrients (Marano *et al.*, this volume). Abboud-Abi Saab (1985) found similar results studying phytoplankton samples collected in August off the coast of Lebanon, i.e. 120-420 cells/liter. According to this author, the waters of the eastern basin are the most oligotrophic of the whole Mediterranean Sea.

The situation in the Ionian Sea was comparatively more diverse. The biomass values ranged from 480 to 9600 cells/liter and the indices of Shannon-Weaver were higher than in the Levant Basin. Very few diatoms were found. The most common dinoflagellates belonged to the genera *Cachonina, Gymnodinium,* and *Scrippsiella*. The phytoplankton composition indicates an overall oligotrophic condition, as reported also by Pagou & Gotsis-Skretas (1990).

The phytoplankton samples collected in the stations off the Sicilian coasts contained very few diatoms and many coccolithophorids. The most frequent dinoflagellate was *Mesoporos globulus*.

The Tyrrhenian Sea and the Algerian-Provençal Basin appeared to have fairly similar phytoplankton conditions. Coccolithophorids were most abundant. The most frequent dinofalgellates were *Cachonina* sp. and *Mesoporos globulus*.

To sum up, the most important component of all examined phytoplankton samples was made of microflagellates and coccolithophorids. The distribution of dinoflagellates was comparatively uniform all over the Mediterranean Sea; the genera *Cachonina* and *Scrippsiella* occurred in all stations. On the contrary, few diatoms were counted, mainly belonging to the genera *Thalassionema, Rhizosolenia, Navicula,* and *Nitzschia*. Both diversity indices, i.e. Margalef's and Shannon-Weaver's, substantiate the modest biodiversity as well as the low biomass values observed in these summer samples of phytoplankton.

REFERENCES CITED

Abboud-Abi Saab, M. 1985. Etude quantitative et qualitative du phytoplancton des eaux côtières libanaises. Lebanese Sci. Bull. 1(2): 197-222.

Chrétiennot-Dinet, H.-J. 1990. Chlorarachniophycées, Chlorophycées, Chrysophycées, Cryptophycées, Euglénophycées, Eustigmatophycées, Prasinophycées, Prymnésiophycées, Rhodophycées et Tribophycées. In A. Sournia (ed.), Atlas du Phytoplancton Marin, 3. Edition du CNRS, Paris: 261 pp.

Delgado, M. and J.M. Fortuño. 1991. Atlas de Fitoplancton del Mar Mediterraneo. Sci. Mar. 55 (suppl. 1): 1-133.

Trondsen, J. and Heimdal, B.R. 1993. Marine Phytoplankton. A Guide to Naked Flagellates and Coccolithophorids. Academic Press, San Diego: 263 pp.

Marano, G., G. Martino, C. Piccinetti and S. Lo Caputo. This volume. Summer distribution of nitrogen and phosphorus in Mediterranean spawning areas of tuna fishes.

Pagou, K. and O. Gotsis-Skretas. 1990. A comparative study of phytoplankton in S. Aegean, Levantine and Ionian Seas during March-April 1986. Thalassographica 13 (suppl. 1): 13-18.

Piccinetti, C., G. Piccinetti Manfrin and S. Soro. This volume. Risultati di una campagna di ricerca sulle larve di tunnidi in Mediterraneo.

Rampi, L. and M. Bernhard. 1978. Key for the determination of Mediterranean pelagic diatoms. RT/BIO (78)1. C.N.E.N., Roma: 71 pp.

Rampi, L. and M. Bernhard. 1980. Chiave per la determinazione delle peridinee pelagiche mediterranee. RT/BIO (80)8. C.N.E.N., Roma: 193 pp.

Rampi, L. and M. Bernhard. 1981. Chiave per la determinazione delle coccolitoforidee mediterranee. RT/BIO (81)13. C.N.E.N., Roma: 98 pp.

Ricard, M. 1987. Diatomophycées. In A. Sournia (ed.), Atlas du Phytoplancton Marin, 2. Edition du CNRS, Paris: 297 pp.

Round, F.E., R.M. Crawford and D.G. Mann. 1990. The Diatoms. Cambridge University Press: 747 pp.

Sournia, A. 1986. Cyanophycées, Dictyochophycées, Dinophycées Raphydophycées. In A. Sournia (ed.), Atlas du Phytoplancton Marin, 1. Edition du CNRS, Paris: 219 pp.

Trégouboff, G. and M. Rose. 1957. Manuel de planctologie Mediterranéenne. CNRS, Paris: 587 pp. + 207 plts.

Vinyard, W.C. 1979. Diatoms of north America. Mad River Press, Eureka (Calif.): 120 pp.

Zingone, A., G. Honsell, D. Marino, M. Montresor and G. Socal. 1990. Fitoplancton. In M. Innamorati, I. Ferrari, D. Marino and M. Ribera d'Alcalà (eds.), Metodi nell'ecologia del plancton marino. Nova Thalassia 11: 183-198.

BACILLARIOPHYCEAE

Chaetoceros gracilis Schutt
Climacosphaenia elongata Bailey
Climacosphaenia moniligera Ehrenberg
Cylindrotheca closterium (Ehrenberg) W. Smith
Cymatopleura solea W. Smith
Cocconeis sp.
Coscinodiscus sp.
Guinardia striata (Stolterforth) Hasle
Hemiaulus hauckii Grunow
Leptocilindrus mediterraneus (Peragallo) Hasle
Lioloma elongatum (Grunow) Hasle
Navicula spp.
Nitzschia spp.
Proboscia alata (Brightwell) Sundstrom
Pseudonitzschia pseudodelicatissima (Cleve) Heiden
Rhizosolenia setigera Brightwell
Rhizosolenia sp.
Thalassionema frauenfeldii (Grunow) Hallegraeff
Thalassionema nitzschioides Grunow

DINOPHYCEAE

Achradina sp.
Alexandrium sp.
Cachonina A.R. Loeblich III sp.
Ceratium candelabrum Ehrenberg
Ceratium carriense volans (Cleve) Sournia
Ceratium concilians Jorgensen
Ceratium furca var. *eugrammum* (Ehr.) Schiller
Ceratium fusus var. *seta* (Ehr.) Sournia
Ceratium massiliense var. *massiliense* Sournia
Ceratium teres Kofoid
Cladopyxys caryophyllum (Kof.) Pavillard
Dinophysis fortii Pavillard
Dinophysis parvula (Schutt) Balech
Gymnodinium sp.
Heterodinium sp.
Mesoporos globulus (Schiller) Lillick
Oxytoxum adriaticum Stein
Oxytoxum coronatum Schiller
Oxytoxun milneri Murr. a. Whitt.
Oxytoxum minutum Rampi
Oxytoxum mitra Stein
Oxytoxum ovale Schiller
Oxytoxum rampii Sournia
Oxytoxum scolopax Stein
Oxytoxum variabilis Schiller
Oxytoxum sp.
Pyrocystis sp.
Pronoctiluca sp.
Prorocentrum aporum (Schiller) Dodge
Prorocentrum compressum (Bailey) Dodge
Prorocentrum micans Ehrenberg
Prorocentrum triestinum Schiller
Prorocentrum rotundatum Schiller
Prorocentrum sp.
Protoperidinium brochii (Kofiid a. Swezy) Balech
Protoperidinium mite (Pavillard) Balech
Protoperidinium sp.
Scrippsiella sp.
Unidentified thecate dinoflagellates
Unidentified naked dinoflagellates
Hermesinum adriaticum Zacarias

PRYMNESIOPHYCEAE

Rhabdosphaera tignifer Schiller
Syracosphaera pulchra Lohmann
Unidentified coccolithophorids

Other taxa

Phytoflagellate < 10 µ
Phytoflagellate > 10 µ

Table 1 - List of phytoplankton taxa.

	Sample no.	Phytoplankton (cells/liter)	Diversity indices Shannon-Weaver	Margalef
Levant Basin	58	480	1.793	0.648
	66	1900	1.429	0.530
	74	1300	1.145	0.558
	78	2300	1.595	0.646
	81	1300	1.352	0.558
	84	2500	1.539	0.639
	85	280	1.842	0.710
	86	320	1.906	0.693
	87	240	0.000	0.000
	89	440	2.118	0.822
	90	560	1.292	0.632
	92	760	1.930	0.905
	93	440	1.972	0.822
	94	160	1.500	0.394
	102	2200	1.085	0.520
Ionian Sea	10	3100	1.618	0.622
	18	4160	2.242	1.200
	26	3920	1.261	1.088
	30	4480	1.860	1.784
	34	9100	0.585	0.768
	38	4100	1.801	0.842
	46	9600	1.191	0.982
	50	1500	1.640	0.547
	114	1000	2.259	1.013
	117	900	2.419	0.735
	122	1600	2.350	0.949
	127	1200	2.434	1.128
	135	480	1.781	0.810
Sicilian channel	154	1160	2.160	1.276
	156	600	1.370	0.782
	157	2520	2.455	1.405
	158	200	1.922	0.755
	159	400	1.961	0.835
	263	2900	1.716	0.627
	275	7400	2.924	1.122
	283	880	2.111	1.033
	287	600	1.793	0.625
	291	1160	2.412	0.850
	299	3500	2.357	0.980

	Sample no.	Phytoplankton (cells/liter)	Diversity indices Shannon-Weaver	Margalef
Tyrrhenian Sea	2	1400	2.692	1.104
	140	2880	1.548	1.130
	141	1400	2.935	1.657
	142	4320	2.670	1.314
	143	2000	3.223	1.579
	144	1600	1.424	0.542
	145	320	2.156	0.867
	146	2040	2.627	1.312
	147	1920	3.384	2.116
	148	1120	2.402	1.424
	149	6000	2.658	1.264
	150	880	2.332	1.180
	151	1400	1.753	0.690
	152	500	1.522	0.483
	163	1300	2.035	0.837
	175	9500	2.507	1.201
	183	6040	2.981	2.297
	199	9200	2.607	1.205
Algerian-Provençal Basin	211	3520	2.789	1.714
	215	1100	0.866	0.428
	223	2200	2.207	0.910
	227	6200	2.511	1.374
	239	2300	1.086	0.517
	251	1120	2.030	0.855

Table 2 - Phytoplankton densites and diversity indices.

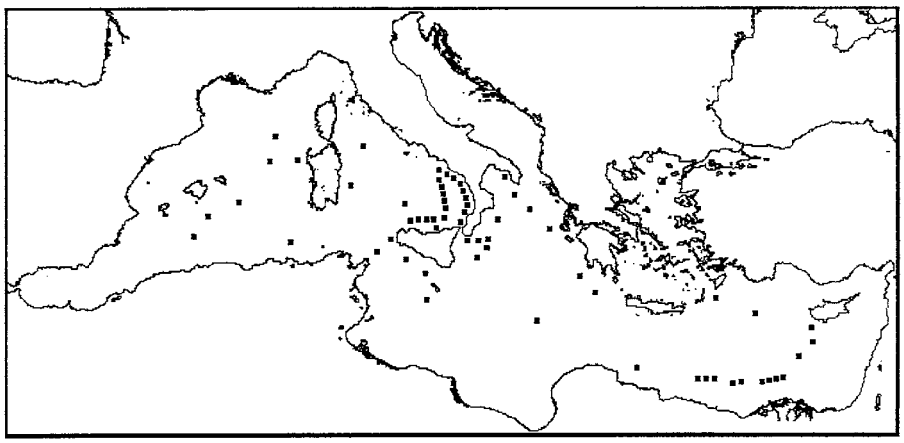

Fig. 1 - Sampling stations for phytoplankton.

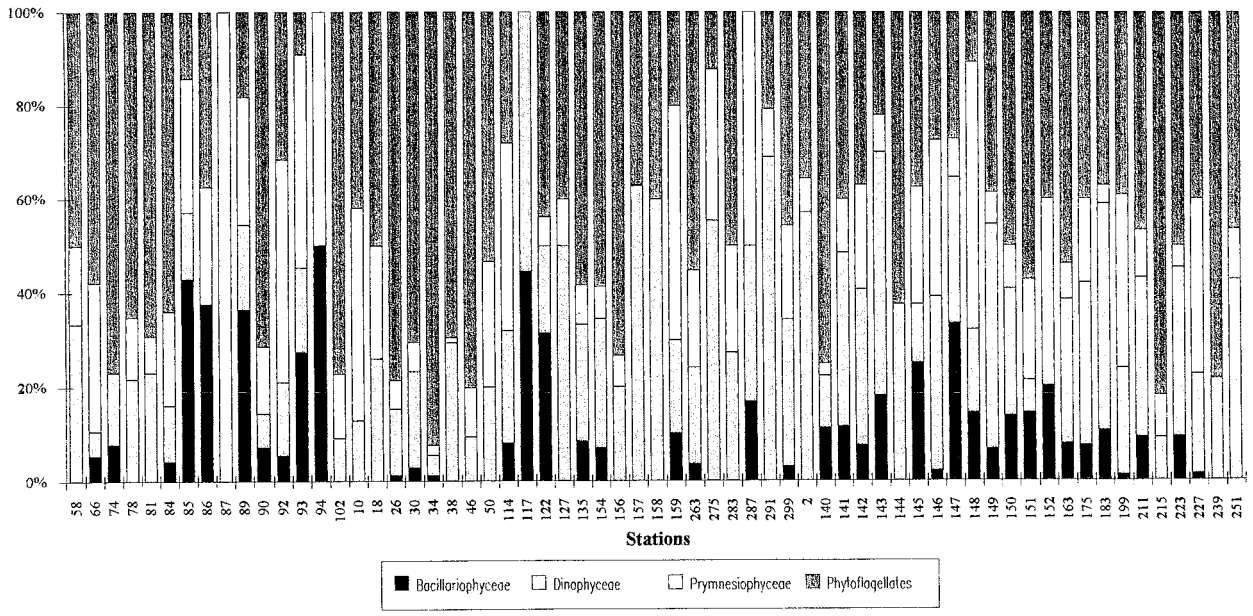

Fig. 2 - Percent composition of phytoplankton.