
Preliminary investigation on the phaeodarians
(Radiolaria) in the Adriatic Sea plankton

Preliminarna istraživanja feodarija (Radiolaria) u planktonu
Jadranskog mora

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INTRODUCTION

Phaeodarians are most uncommon of radiolarians. Our knowledge of these organisms is largely limited to the data collected during the great expeditions of the end of the last and the beginning of this centuries (Haeckel, 1887; Haecker, 1906, 1908; Borgert, 1901 a, b, 1902, 1903, 1906, 1907, 1908, 1909, 1911). For the last few decades, the phaeodarians have been investigated by: Reshetnjak (1966), Björklund (1974), Kling (1976), Takahashi and Honjo (1981) and Xinghui and Zhiyuan (1985). Recently, more attention has been paid to the fossil radiolarian forms as well as to the Recent radiolarians found in the surface sediments, yet phaeodarian skeletons are rarely found in the sediments, (Takahashi *et al.*, 1983), presumably due to their fast dissolution. Björklund and Ruitter (1987) reported only two phaeodarian species in the anoxic sediments of the Tyro and Kretheus basins in the eastern Mediterranean.

No data at all exist on the phaeodarians of the Adriatic Sea. Thus, the present survey represents the first report on the specific makeup, distribution and abundance of phaeodarian assemblages in the plankton of the Adriatic Sea.

MATERIAL AND METHODS

Plankton samples were collected between 1980 and 1987, in the open middle and southern Adriatic and in the Strait of Otranto during the cruises of the RV »Andrija Mohorovičić« in: January 1980, October 1985, April 1986, August 1986 and April 1987 (Fig. 1).

Collecting gear was a 53 μm Nansen net, 45 cm mouth diameter, equipped with a closing mechanism. The vertical hauls covered the following layers: 0–50, 50–100, 100–200, 200–300, 300–400, 400–600, 600–800,

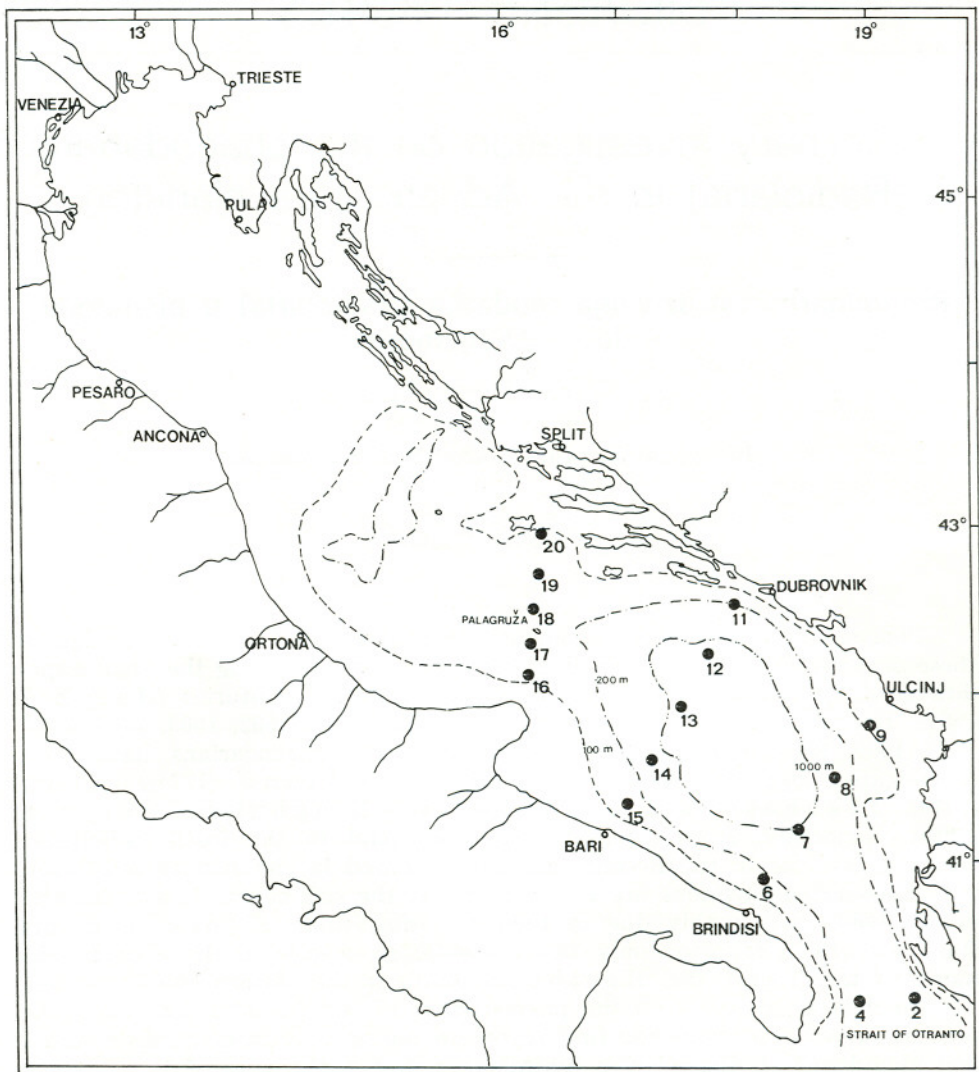


Fig. 1. Map showing the sampling stations in the Adriatic Sea.

800–1000, and occasionally 600–1000 m, depending on the bottom depth. All samples were preserved in 2.5% formaldehyde neutralized by CaCO_3 . Counting of the individuals was performed using a Wild microscope at magnifications of 100 x. Most species were identified using a Cambridge 600 scanning electron microscope in Chemical Research and Development Centre RO Chromos, Zagreb. The R2 Flowmeter, Model 2030, General Oceanics, Inc. was used to estimate the volume of the seawater filtered.

SYSTEMATICS

Suborder *Phaeodaria*, family *Challengeriidae*, genus *Protocystis*

Protocystis xiphodon (Haeckel, 1887)

(Table 1, figures a, b)

This species was constantly present in the south Adriatic plankton. It was found in all the layers below 100 m, evenly distributed throughout the water column, with no marked abundance peaks at any particular depth. Overall population density ranged between 1 and 20 ind. m^{-3} , with a mean of 5.3 ± 4.3 ind. m^{-3} based on 98 samples. Highest values ($n = 15$, range 5—93 ind. m^{-3} , mean 29.2 ± 26.6 ind. m^{-3}) were registered in April, 1987 at stations 2, 4 and 7.

Protocystis tritonis (Haeckel, 1887)

(Table 1, figures c, d)

Only single specimens of this species were found, all below 300 m depth. In October 1985 up to 2 ind. m^{-3} were recorded at station 2 in the Strait of Otranto, in the 400—300 m layer.

Genus *Challengeron*

Challengeron diodon (Haeckel, 1887)

(Table 1, figures e, f)

This species was continuously present in the southern Adriatic plankton. It was found in all the layers below 100 m. In January 1980, April 1986, 1987 and August 1986, the population densities ranged from 1 to 17 ind. m^{-3} , with a mean of 3.4 ± 3.1 ind. m^{-3} , based on 85 samples. Values up to 2—40 ind. m^{-3} were registered only in October 1985 ($n = 18$, mean 16 ± 11.9 ind. m^{-3}).

Challengeron channeri (Murray, 1885)

(Table 1, figure g)

This species was found during all the cruises in the layers below 200 m with the population density of 1 ind. m^{-3} . In August 1986, it was most widespread in the South Adriatic and the Strait of Otranto occurring in densities from 1—5 ind. m^{-3} ($n = 22$, mean 1.9 ± 1.2 ind. m^{-3}).

Challengeron willemoesii (Haeckel, 1887)

(Table 1, figure h)

This species was only found below 100 m. Only single specimens were recorded. Nevertheless, in August 1986, in 29 samples collected from different

depths and at different stations, the population density ranged between 1 and 6 ind. m^{-3} , with a mean of 1.8 ± 1.4 ind. m^{-3} . In October 1985, the population density in 13 samples taken in the southern Adriatic was 1–14 ind.

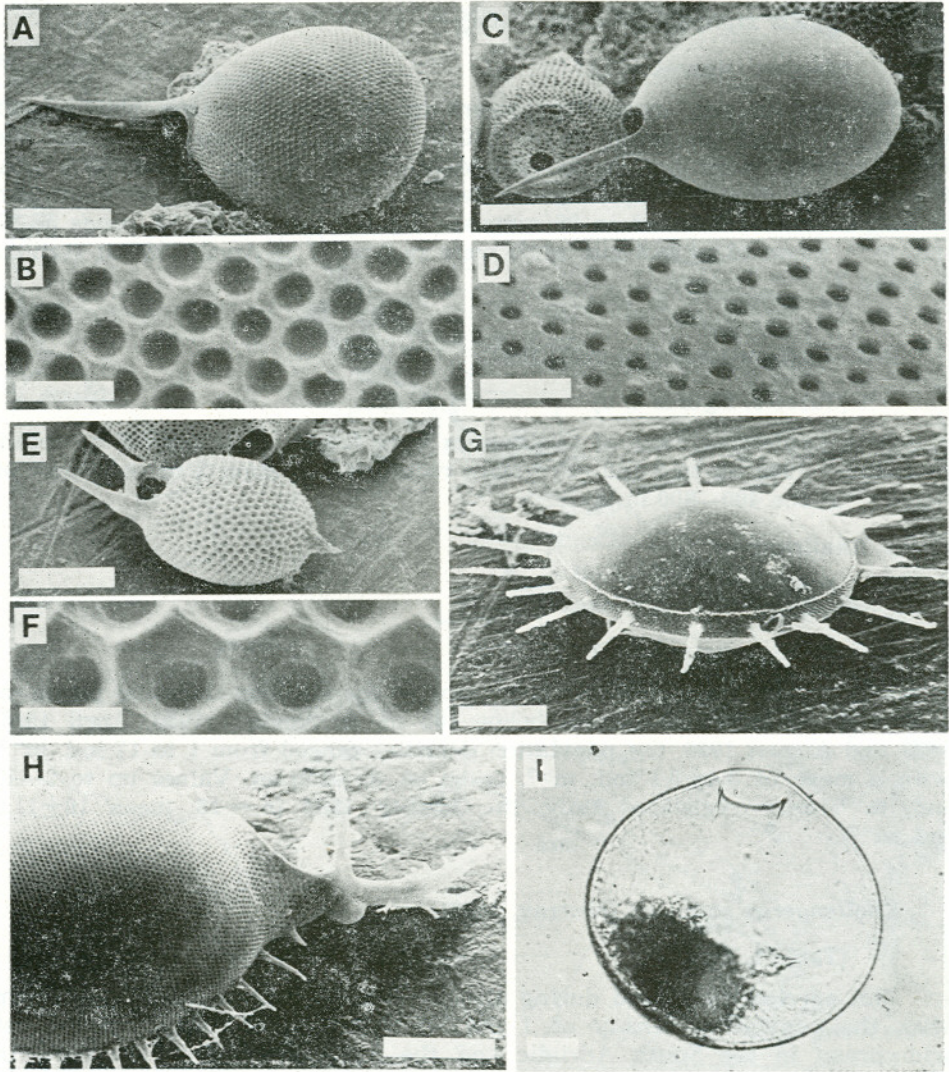


Table 1. (a, b) *Protocystis xiphodon*; (c, d) *Protocystis tritonis*; (e, f) *Challengeron diodon*; (g) *Challengeron channeri*; (h) *Challengeron willemoesii*; (i) *Etnocannula circularis*; (Scale = 4 μm for b, d, f; Scale = 40 μm for a, e, g, h, i; Scale = 100 μm for c).

m^{-3} , with a mean of 3.3 ± 3.6 ind. m^{-3} , whereas at station 2 in the Strait of Otranto 4 ind. m^{-3} were found in the 900–550 m layer, with a maximum of 32 ind. m^{-3} between 300 and 200 m.

Genus *Entocannula*

Entocannula circularis (Haeckel, 1887)

(Table 1, figure i)

This species was rare. In October 1985 only 5 specimens were found in the 550—400 m layer at Station 14 and 12 specimens in August 1986, at station 12 (600—400 m) and at station 13 (800—400 m).

Family *Medusettidae*, genus *Euphysetta*

Euphysetta lucani Borgert, 1892

(Table 2, figure a)

This species was present consistently below 100 m in the southern Adriatic and the Strait of Otranto, where its population density ranged from 1

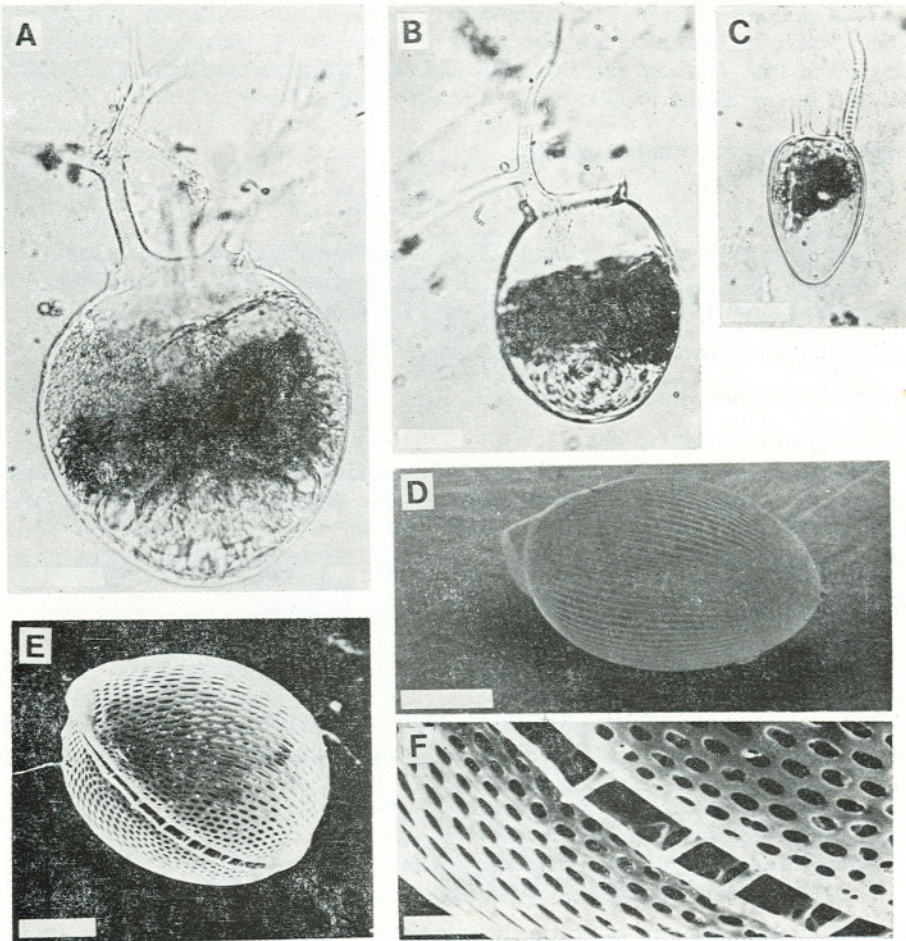


Table 2. (a) *Euphysetta lucani*; (b) *Euphysetta rara*; (c) *Euphysetta pusilla*; (d) *Lirella* sp.; (e, f) *Conchophacus diatomeus* (Scale = 10 μ m for f; Scale = 20 μ m for b, c, d; Scale = 40 μ m for a, e).

to 10 ind. m^{-3} ($n = 71$, mean 1.9 ± 1.7 ind. m^{-3}). Higher values were mostly restricted to the eastern station of the Strait of Otranto. In April 1987 most of the individuals were found in the 800–300 m layer, with a maximum of 25 ind. m^{-3} at 800–600 m.

Euphysetta rara Borgert, 1902

(Table 2, figure b)

This species occurred only in January 1980 and October 1985 in the deeper layers. In the southern Adriatic it was only sporadically present, whereas at station 2 in October, its population density reached 3 ind. m^{-3} .

Euphysetta pusilla Cleve, 1900

(Table 2, figure c)

This species was present constantly, both in the southern Adriatic and in the Strait of Otranto, mainly below 200 m and in densities ranging from 1 to 5 ind. m^{-3} . Highest densities, 18 ind. m^{-3} were recorded in April 1987 at station 2 in the Strait of Otranto in the 400–300 m layer.

Family *Lirellidae*, genus *Lirella*

Lirella sp.

(Table 2, figure d)

This species occurred sporadically, being recorded only in October 1985 and August 1986 at all the stations in the southern Adriatic and the Strait of Otranto below 100 m, with a mean density of 4 ind. m^{-3} .

Family *Conchariidae*, genus *Conchophacus*

Conchophacus diatomeus (Haeckel, 1887)

(Table 2, figures e, f)

This species was found rarely. Only isolated specimens were recorded, always below 200 m. In October 1985 it was registered at station 2 in the Strait of Otranto at all depths below 100 m, within a population density never exceeding 2 ind. m^{-3} .

Family *Aulosphaerida*, genus *Autatractus*

Autatractus fusiformis Haeckel, 1887.

(Table 3, figures a, b, c)

This species is the largest phaeodarian species found in the Adriatic, with some specimens reaching 8 mm. It was found sporadically during the August 1986 cruise, only at the surface.

Family *Aulacanthida*, genus *Aulacantha*

Aulacantha scolymantha Haeckel, 1860

(Table 3, figures d, e)

This species was present in the plankton of the south Adriatic and the Strait of Otranto during summer and autumn in the 400–50 m layer, represented by isolated specimens. Its highest abundances occurred during the August 1986 cruise, when these organisms were most widespread in the

southern Adriatic and the Strait of Otranto. Maximum densities of 5 ind. m^{-3} were registered at stations 7 and 4 in the 100—50 and 300—200 m layer, respectively.

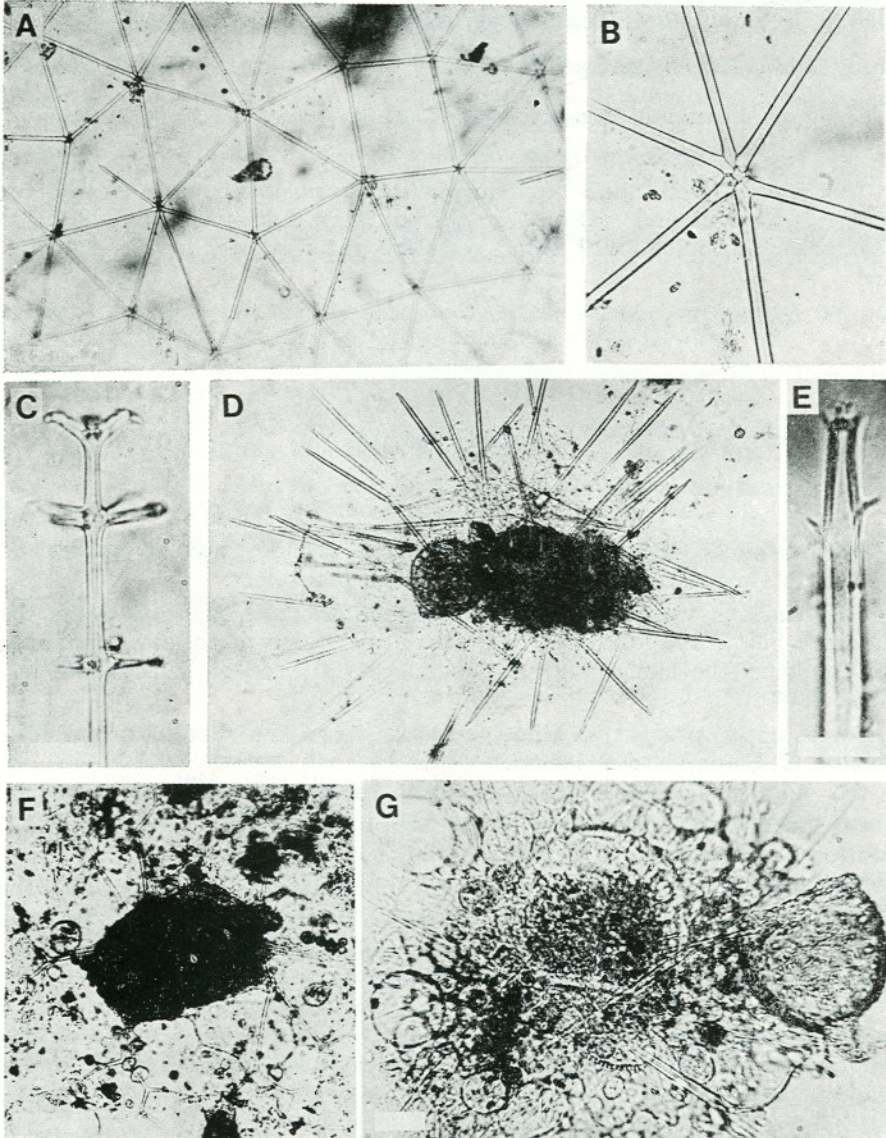


Table 3. (a, b, c) *Autatractus fusiformis*; (d, e) *Aulacantha scolymantha*; (f) *Coelodend ramosissimum*; (g) *Cementella loricata* (Scale = 10 μm for b, c, e; Scale = 20 μm for g; Scale = 100 μm for a; Scale = 200 μm for d, f).

Family *Coelodendridae*, genus *Coelodendrum*

Coelodendrum ramosissimum Haeckel, 1860

(Table 3, figure f)

This species was present in the southern Adriatic and the Strait of Otranto only in the warmer months, and inhabited the surface layer down to 400 m. Its population density never exceeded 1 ind. m^{-3} .

Family *Cementellidae*, genus *Cementella*

Cementella loricata, Borgert, 1901

(Table 3, figure g)

This species was found only during the April 1987 cruise at both Strait of Otranto stations and station 7 in the southern Adriatic below 100 m, with a maximum of 55 ind. m^{-3} being registered at station 7 in the 400–300 m layer.

CONCLUSIONS

Fifteen phaeodarian species, including 8 families and 10 genera, were for the first time recorded in the Adriatic Sea plankton.

Phaeodarians were widespread in the southern Adriatic and the Strait of Otranto below 100 m depth. Only single specimens of the dominant species were found in the surface layers, in the coastal area of Dubrovnik, and in the Jabuka Pit.

Consistently present in the plankton were the dominant species: *P. xiphodon*, *C. diodon* and *E. lucani*.

The highest average phaeodarian density, 32 ind. m^{-3} was recorded in October 1985, with a maximum of 137 ind. m^{-3} being recorded in April 1987 at station 2 in the Strait of Otranto in the 800–600 m layer.

The percentage contribution of the phaeodarians to total radiolarians in the southern Adriatic and the Strait of Otranto was lowest during the January 1980 cruise (30%), whereas in August 1986 these organisms were major contributors to radiolarian assemblages reaching up to 60%.

The highest phaeodarian densities were most frequently recorded at station 2, in the Strait of Otranto, which can be associated with an intensive immigration of these species from the eastern Mediterranean into the Adriatic.

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PRELIMINARNA ISTRAŽIVANJA FEODARIJA (RADIOLARIA)
U PLANKTONU JADRANSKOG MORA

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KRATKI SADRŽAJ

U ovom radu se po prvi put iznose podaci o distribuciji i gustoći populacije za 15 vrsta feodarijskih radiolarija u planktonu Jadranskog mora.