

The Eastern Mediterranean as a Laboratory Basin for the Assessment of Contrasting Ecosystems

edited by

Paola Malanotte-Rizzoli

Massachusetts Institute of Technology,
Cambridge, MA, U.S.A.

and

Valery N. Eremeev

Marine Hydrophysical Institute,
Sevastopol, Ukraine



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FLORA AND BOTTOM VEGETATION ON THE DEEP-WATER BANKS OF THE MEDITERRANEAN SEA

N.A.Milchakova, I.K.Evstigneeva, I.N.Tankovskaya
Institute of Biology of the Southern Seas (IBSS), Sevastopol
335011, Crimea, Ukraine. Phone: (0692)52-41-10, Fax: (0692)
59 28 13, E-mail: milcha @ibss.iuf.net

Abstract

177 species of algae and 1 seagrass were identified for ten deep-sea banks in the Mediterranean Sea (Aegean Sea, Tunisian Strait and Strait of Malta), red algae making up more than half of the number. Bottom vegetation includes nine types of communities which occupy depths from 20 down to 115 m, and have polydominant, mosaic, multistratum structure. Algae flora of the banks is temperate to warm-water, while half of the species are common to both the Mediterranean and the Black Sea.

Introduction

Conservation of the existing biodiversity is of high priority for modern science. Algal flora of the Mediterranean Sea numbers about 1200 species (Boudouresque et Verlaque, 1978; Kalugina-Gutnik, 1981; Riedl, 1983). Some localities display remarkably high floristic diversity, among them are deep-sea banks. However, until recently the knowledge about algal flora of the banks was regrettably scarce (Furnari, 1984). We endeavoured to fill this gap by making a description of the species and phytogeographical composition and the occurrence of algae on some banks of the Mediterranean Sea.

Material and methods

Preparing this report, we used materials collected during research cruises

to the Mediterranean in 1979-1986 (property of IBSS). Algae for the collections were taken in the during the 87, 88, 89 and 90-th research cruises of the R/V Academician Kovalevsky (spring and autumn time). Collection sites were the banks of Pantelleria, Lampedusa, Avventura, Tolbot and Herd (Tunisian Strait and Strait of Malta) and Johnston, Mancell, Seaney, Stocks and Brooker (Aegean Sea). The description of bottom vegetation and flora is based on the analysis of data collected at 88 stations (22 in the Aegean Sea, 56 in the Tunisian Strait and 10 in the Strait of Malta). Phytobenthos of deep-water banks of the Aegean Sea and of the Tunisian Strait has been described in details also. Samplings were made with the bottom grab "Okean-50", a beam trawl and Seegsby trawl.

Total number of algal species found there are 177; of them 34 green, 47 brown, 96 red, and one seagrass. All areas rich with bottom vegetation are very similar in the amount of species (73-109) that 41-62% of the total number of described algae.

Prof. A.A. Kalugina-Gutnik headed the work during the cruises to the Mediterranean Sea; we dedicate this paper to her blessed memory.

Description of the taxonomic composition.

Aegean Sea.

115 species of algae were described: 21 green, 32 brown and 62 red. Bottom vegetation of the banks occupies depths from 37 down to 115. Owing to high water transparency red algae occur even 195 m deep (*Palmophyllum crassum*, *Peyssonnelia rubra* and *Pseudolithophyllum expansum*).

There dominant associations were identified and described in the vegetation cover. All investigated phytocenoses had polydominant structure and distributed in a mosaic pattern. Compared with sandy and sandy-silty areas of the sea floor, hard substratum displayed the greatest species richness, especially at Johnston bank. Seasonal variations in the structure of phytocenoses are the most pronounced down to 50 m depth, being smoother at the lower boundary of occurrence.

In spring the prevailing component are perennial brown and red algae like *Sargassum hornschurchii*, *Codium bursa*, *Cystoseira corniculata*, *Phyllophora nervosa* and *Vidalia volubilis*. In summer, annual brown algae, in particular *Arthrocladia villosa*, become dominant. On the banks of Brooker, Stocks and Seaney *Phyllophora nervosa* and *Peyssonnelia squamaria* are the

basic component of vegetation cover.

Association of Cystoseira - Phyllophora nervosa - Vidalia volubilis. The incorporated communities inhabit the depths 37 down to 50 m and concentrate mostly on hard bottom substratum. The association comprises 64 algal species; in addition to the three basic algae typical representatives are genera Sargassum, Dictyopteris, Nereia and Fauchea.

Association Phyllophora nervosa - Peyssonnelia squamaria occupies sandy substrate at 50-90 m depth. The species composition is represented by 32 species, most typical are Palmophyllum crassum, Udotea petiolata, Acrodiscus vidovichii, Schysimenia dubyi. In late summer brown algae (Striaria attenuata, Nereia filiformis, Dictyota dichotoma) dominate.

Association Halopteris filicina - Callymenia microphylla grows on sandy-silty substrate at 100-195 m depths. It includes 9 species. In addition to the main algal species, also numerous are Zonaria tournifortii, Phyllophora nervosa and Schysimenia dubyi.

Special features of the communities were the multistratum polydominant structure and the lack of epiphytic synusiae.

Over 50% of algae are common for the Black and Aegean seas (Kalugina-Gutnik, 1975). However, the immigration of species has been reported: Phyllophora brodiae, Laurencia paniculata and L. parvipapillosa have been identified in the Mediterranean first, while the overuse of rivers may cause euryhaline and stenothermic algae to migrate into the Black Sea where they would occupy vacant environmental niches identical to Mediterranean. The most probable environmental niches for the coming aliens are deep-water areas near the Crimean and Caucasian shores. In these circumstances, studies of bottom plants of the eastern and central Mediterranean acquire special significance (Kalugina-Gutnik, 1981).

Tunisian Strait

Prof. Kalugina-Gutnik identified 159 algal species in the study area: 28 green, 45 brown and 85 red algae (Table 1). Flora of the deep-water banks differs considerably from that of near-shore waters of the Tunisian-Sicillian region (Kalugina-Gutnik, 1981, 1983).

Lampedusa bank is a vast submarine plato with flat bottom and insignificantly varying depths. Algal species numbered 109 (23 green, 35 brown and 51 red algae). The vegetation cover is relatively uniform, being composed of three associations. Brown and red algae prevail. Spring is the season of the dominance of perennial algae like *Cystoseira fucoides*, *Vidalia volubilis*, *Gracilaria verrucosa*. In late summer large brown algae *Arthrocladia villosa*, *Dictyota dichotoma*, *Dictyopteris polypodioides*, *Sporochnus pedunculatus* grow high above the thicket of perennials contributing to the multistratum structure of polydominant communities.

TABLE 1. The number of algal species collected in the Mediterranean Sea (numerator – numbers, denominator - %) in 1979-1980 (R/V 87, 89, 90 cruises Ak. Kovalevsky)

Phylum	Aegean Sea	Banks				Total
		Lampedusa	Pantelleria	Avventura and Tolbot	Herd	
Chlorophyta	<u>21</u> 64.7	<u>22</u> 64.7	<u>14</u> 41.2	<u>13</u> 38.2	<u>5</u> 14.7	<u>34</u> 19.2
Phaeophyta	<u>32</u> 68.1	<u>35</u> 74.5	<u>31</u> 65.9	<u>28</u> 59.6	<u>4</u> 8.5	<u>47</u> 26.6
Rhodophyta	<u>62</u> 65.6	<u>52</u> 54.2	<u>53</u> 55.2	<u>67</u> 69.8	<u>5</u> 5.2	<u>96</u> 54.2
Total	<u>115</u> 66.1	<u>109</u> 61.6	<u>98</u> 55.3	<u>108</u> 61.0	<u>14</u> 7.9	<u>177</u> 100
R P	2.0	1.5	1.7	2.4	—	2.0

Cystoseira fucoides + C. corniculata - Vidalia volubilis - Gracilaria verrucosa dominate the associations, its phytocenoses occupy 50 to 70 m depths. The frequency of occurrence of *Halimeda tuna*, *Udotea petiolata*, *Polysiphonia squamaria* and *Rytiphlaea tinctoria* is about 100%. In this association was found to include 89 species of algae altogether.

Association of Arthrocladia villosa - Udotea petiolata + Zonaria tournefortii were found down to 70 m depth and comprised 36 species, constant species were *Caulerpa prolifera*, *Acetabularia mediterranea*,

Schizymenia dubyi. Vegetative cover was poor at that locality.

Association of *Halopteris filicina* + *Callymenia microphylla* + *Peyssonnelia squamaria* inhabit the depth from 70 down to 115 m. Seven species were identified as composing the algal communities. In addition to dominant species, *Valonia macrophyza*, *Rytiphlaea tinctoria* were occasionally seen.

Pantelleria bank. Algal species found in the locality numbered 98: 15 green, 32 brown and 51 red algae. The thicket of macrophytes concentrated mostly in the depths from 20 to 115 m. Local vegetation cover displays a multistratum structure, the lower stratum being composed of *Peyssonnelia squamaria* and *Zanardinia prototypus*. At the depth of 20 m the dense thicket of *Posidonia oceanica* with occasional *Vidalia volubilis*, *Sphaerococcus coronopifolius*, *Sargassum hornschurchii* and *Cystoseira discors* grow. In spring large and small varieties of red algae prevail and in autumn brown. The abundance of both attached and non-attached varieties of *Ulva rigida*, thallomes of which are found as deep as 105 m depths, is a special feature of the bank. Algal flora develops the greatest richness at the depth 20 to 65 m.

Five algal associations were defined. At the 20-30 m depths the community of *Laminaria rodriguezi* - *Sargassum linifolium* - *Cystoseira*, which includes 54 species is located. Some bottom sites shelter phytocenoses of *Posidonia oceanica* - *Vidalia volubilis*, the number of contributing species being 11. 47 algal species form the community of *Arthrocladia villosa* - *Cystoseira* at the depths 45-60 m; there are multistratum, mosaic and polydominant in structure.

The communities of *Cystoseira* - *Polysiphonia elongata* - *Ulva rigida* grow deeper (60-80 m), comprise 51 species, the vegetation cover is thin and patchy. The deepest (80-115 m) site of *Pantelleria bank* is where phytocenoses composing *Halopteris filicina* + *Callymenia microphylla* grow; 14 species of algae make poorly developed cover.

Avventura bank is an extensive plateau with flat seafloor and the depth varying from 40 to 85 m. Vegetation cover is thick and diverse, and composed of 14 green, 28 brown and 65 red algae, 107 species altogether. Phytocenoses are polydominant and multistratum. Three algal associations are

similar to those on Pantelleria bank; red and brown algae *Cystoseira*, *Sargassum*, *Arthrocladia*, *Sporochnus*, *Halopteris* and *Callymenia* dominate, showing a remarkable diversity of size and the shape of thallomes.

Association of *Laminaria rodriguezi* - *Sargassum linifolium* - *Cystoseira* display the greatest species diversity. Local algal flora manifests distinct seasonal changes.

Phytogeographical composition of algal flora

Mediterranean algal flora contributes notably to the species composition of adjacent seas. The Adriatic Sea is the centre of speciation. Algal flora on the investigated deep-water banks of the Aegean Sea and Tunisian Strait is much like that of the Black Sea (Kalugina-Gutnik, 1981).

Correlation between the aforementioned algal groups (phytogeographical division) as specified for the all deep-water banks of is shown in Table 2. Lower boreal species dominate algal flora of the deep-water banks of the Aegean Sea. The share of subarctic to boreal and boreal to tropical species is also significant. Arctic to boreal, cosmopolitan and tropical algae are only minor (Table 2).

Lower boreal species dominate algal flora of the banks Pantelleria and Avventura; subarctic to boreal are prevailing in waters of Lampedusa bank (Tunisian Strait). The share of endemic algae varies insignificantly, and is the largest on Avventura bank where endemic and arctic-to-boreal species are more abundant in comparison with other banks under study.

Conclusions

1. 177 algal species and one seagrass were collected and described on 10 deep-water banks of Aegean and Mediterranean Seas. The greatest species diversity was found on the banks of Johnston, Avventura and Lampedusa. Floristic composition does not vary considerably between the banks.
2. Maximums of algal species concentrate at the depth 20 to 70 m. The vegetation is represented by phytocenoses of ten types, their structure is polydominant, multistratum and mosaic. Deep-water brown and red algae

TABLE 2. Phytogeographical composition of the algal flora in deep-water banks of Mediterranean Sea (numerator – numbers , denominator - %).

Phytogeographical division (algal group)	Location					Total
	Aegean Sea	Tunisian and Malta Strait, banks				
		Lampedusa	Pantelleria	Avventura and Tolbot	Herd	
Arctic to boreal	$\frac{3}{2.6}$	$\frac{1}{0.9}$	$\frac{2}{2.0}$	$\frac{3}{2.8}$	—	$\frac{4}{2.3}$
Subarctic to boreal	$\frac{23}{20.0}$	$\frac{30}{27.5}$	$\frac{21}{21.2}$	$\frac{22}{20.4}$	$\frac{3}{21.4}$	$\frac{43}{24.3}$
Lower boreal	$\frac{30}{26.1}$	$\frac{25}{22.9}$	$\frac{30}{30.3}$	$\frac{34}{31.4}$	$\frac{3}{21.4}$	$\frac{43}{24.3}$
Boreal to tropical	$\frac{25}{21.7}$	$\frac{24}{22.0}$	$\frac{19}{19.2}$	$\frac{21}{19.4}$	$\frac{4}{28.6}$	$\frac{33}{18.6}$
Subtropical	$\frac{18}{15.6}$	$\frac{14}{12.8}$	$\frac{12}{12.1}$	$\frac{12}{11.1}$	$\frac{3}{21.4}$	$\frac{22}{12.4}$
Tropical	$\frac{4}{3.5}$	$\frac{4}{3.7}$	$\frac{5}{5.0}$	$\frac{6}{5.5}$	—	$\frac{7}{4.0}$
Cosmopolitans	$\frac{3}{2.6}$	$\frac{4}{3.7}$	$\frac{2}{2.0}$	$\frac{2}{1.8}$	$\frac{1}{7.1}$	$\frac{5}{2.8}$
Endemics	$\frac{9}{7.8}$	$\frac{7}{6.4}$	$\frac{7}{7.1}$	$\frac{8}{8.3}$	—	$\frac{16}{9.0}$
Total	$\frac{115}{65.0}$	$\frac{109}{61.6}$	$\frac{98}{55.9}$	$\frac{108}{61.0}$	$\frac{14}{7.9}$	$\frac{177}{100.0}$

prevail, among green algae Siphonales spp. were the most abundant.

3. The algal flora is temperate to warm-water. Taxonomic composition is special, with over half of the algal species being from the Black Sea.

4. Conservation of the biodiversity in unpolluted model areas of the Mediterranean is an essential element at conserving the marine plants richness in the adjacent seas and water areas.

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