ALGAL CHECK LIST IN ISCA (CALABRIA, ITALY) MARINE RESERVE

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ABSTRACT - The purpose of this study was to carry out a taxonomic analysis of the macrophytobenthonic populations in the marine reserve of Isca. In total, 47 algal species were collected, of which 21 are new to the region. The algae were distribuited as follows: 32 *Rhodophyta (68%)*, 8 *Phaeophyta (17%)* and 7 *Chlorophyta (15%)*. The bathymetric distribuition of the species, their relative abundance and the frequency of the principal ecological groups at the different sampling sites are all reported here.

KEY WORDS - Algal species; bathymetric distribution; vertical zonation.

INTRODUCTION

The Isca Marine Reserve (16°,4' longitude Est – 39°,9' latitude Nord), one of 130 protected areas run by the WWF, is the first reserve of its kind to be established along the Tyrrhenian Sea in Calabria. The protected area exemplifies a marine biotope marked by the presence of animal and plant species of considerable scientific interest. With the exception of a geological study conducted by the University of Cosenza (Lena, 1990), this is the first scientific contribution to the knowledge of this site, the size of which is limited (approx. 6 hectares), roughly circular in shape and encircling two prominent rocks of different dimension. It is located in territorial waters 800 meters from the shore over a sea bed approximately 20 meters deep, between the coastal villages of Amantea and Belmonte Calabro (Cs).

The aim of this work is to determine the nature and the extent of the macrophytobentonic populations in the marine reserve of Isca.

MATERIAL AND METHODS

The research expeditions were organized with the logistics support and direction of the operators of the local WWF chapter in four phases between August 1997 and June 1998, specifically: August 15/16, 1997; Sept. 14/15, 1997; Dec. 7/8, 1997; May 17/18, 1998. Samples were collected in the areas corresponding to the rocky

protuberances: minor and major (named rock n. 1 and n. 2 respectively). The part of each rock facing the shore was denominated by the letter A while the part facing the open sea was labeled with the letter B. The side of the major rock facing the open sea was subdivided into a northerly (1Bn) and a westerly area (1Bo) due to its greater expanse.

The sampling sites were grouped as follows: 1A, 1Bn, and 1Bo for the major rock; 2A and 2B for the minor rock (Fig.1). The macrophytobenthonic samples were obtained at the selected sites by means of auto-respiratory air (ARA). Samples were collected during dives in tightly-stitched underwater nets and subsequently placed in refrigerated recipients containing 5% aqueous formaldehyde solution. The taxonomic identification of the species was conducted on the following texts (Giaccone, 1973; Maggs et Hommersand, 1993) and carried out by the Phycological Laboratory of the University of Rome (La Sapienza) Plant Biology Department, utilizing Zeiss Axiolab optic microscope and Wild Herbrugg stereomicroscope.

The research results were recorded on a series of slides and underwater photographs taken "in situ" at the sampling sites using a Nikonos IV A camera and Nikon SB 101 automatic flash. Microphotographs were also obtained of some of the more interesting algae from a taxonomic and ecologic standpoint.

CHARACTER OF THE BIOTOPE

The two rocks at Isca, situated at the heart of the marine reserve, are both formed of grey sandstone and go back to the Middle Myocene period: they may have constituted the western extremity of an ancient promontory which may have been centered in a deep cove corresponding to the present-day village of Amantea located between the former Capo Verre (Isca rocks) and Capo Tillesio (Capo Corica) (Lena, 1990). The larger northern rock is wider, longer and taller, whereas the southern rock is lower and flatter. Thc contour of the underwater walls of the rocks, though characterized in both cases by typical signs of tidal erosion and leveling near the surface due to hydrodynamic forces, exhibit noteworthy differences; these divergences, in turn, result in qualitative and quantitative variations in the relative penetration of sunlight with corresponding deviations in the distribution and composition of the macrophytobenthonic populations.

The algal flora of the two rocks has been analyzed along 5 profiles from the surface to a depth of about 20 meters. The inner wall of the major rock (profile 1A, fig. 2) begins as two small foothholds connected by a vertical tract of 1,5 m. and is followed by another leveled area at a depth of about two meters. This is followed by a sharp drop until one reaches an isobath at 10 meters depth where an extensive erosion has taken place. Further down, there is a vertical wall, which is interrupted by a short foothold at a depth of 18 meters down to the base of the rock. The rock sits upon a sandy bottom at about 20 meters depth. The outer wall of the major rock has been divided into two areas, each with distinctive morphofologic characteristics.

The upper region (profile 1Bn, fig. 3) shows a gradual levelling at the surface which tapers off at a depth of about 0.5 meters. From a depth of 1 to 8 meters one encounters a tract that curves downward at a sharp slope, delimited below by a rocky protuberance. The latter marks the upper edge of another extensive cavernous area that is characterized by a very uneven and tortuous surface, teeming with cavities

and deep fissures of the substratum. Finally, from the level of the isobath at a depth of 14 meters to the bottom at twenty meters one finds a practically vertical wall that reaches down to a sea bottom composed of sand and pebbles. Profile 1Bo is describing (fig. 4) and results very irregular. Once beyond the typical smooth intertidal surface at a depth of about 1.5 m, one finds a slanted tract followed by another smooth tract, which goes from a depth of 4 m. to 5 m. At this point there is a shark drop until 10 m. depth, characterized by the presence of two small footholds at the isobaths at roughly 6 and 8 m. From 10 to 12 meters the seabed appears irregular with deep hallows, wide depressions and furrowing of the substratum as far down as the zone which marks the beginning of a declivity at 12 meters depth. The final tract from 12 to 20 meters is a vertical escarpment made more prominent in the last 3 meters by a sharp inward curving of the substratum, which ends on the sandy bottom.

The minor rocky protuberance is more regularly shaped. Profile 2A (fig. 5) was carried out on the inner wall from the surface to the base of the rock at a depth of aproximately 20 meters is, in fact, a vertical wall interrupted at the isobath at 6 meters depth by a short foothold. The morphological configuration of the outer wall (profile 2B, fig. 6) appears more uneven and irregular. Below the typical smoothening at the surface one finds, in fact, a sharply downward sloping tract until a depth of 2 meters when a second leveled area appears. This, in turn, is followed by a vertical tract down to the isobath at 5 meters depth, after which the rock drops obliquely to a depth of 16 m: along this tract can be found numerous cavities and gorges. The final tract, from 16 meters to 20 meters depth, is characterized by ample cavitation of the substratum with the final stretch inclined contrariwisc.

RESULTS

CHECK LIST

In the table (table 1) are listed the macrophytobenthonic species found in the Isca marine reserve.

For each species the symbols (+) and (-) refer to presence or absence, respectively; the relative abundance is indicated by a = abundant, m= moderately abundant, and r = rare. Also indicated is the overall quantity at the five sampling sites as a whole. The list includes 47 algal species, of which 32 are *Rhodophyta*, 8 are *Phaeophyta* and 7 *Clorophyta*. A marked prevalence of red algae (68%) was observed with respect to the brown (17%) and to the green (15%). This prevalence is related not only to the larger number of red algal species, but also to the greater adaptability of this group to conditions of sparse sunlight penetration (both quantitative and qualitative).

As far as *Rhodophyta* are concerned, a high percentage of minute epiphyte species was present. A review of the list reveals, in particular, that *Jania rubens, Stypocaulon scoparium* and *Halimeda tuna* are ubiquitous and numerous, present in abundant quantities at all of the sampling sites. Among epiphytes, *Nitophyllum punctatum, Seirospora sphaerospora, Polysiphonia sertularioides, Falkenbergia rufolanosa* and *Sphacelaria cirrosa* are the species most frequently encountered.

ALGAL BATHYMETRIC DISTRIBUTION

At the different sampling sites, a characteristic zonation of species appeared in relation to the depth, though some variation occurred due to changes in topographical features of the substratum. In the Western Mediterranean the sublittoral plane of rocky substratum extends as far as the bathymetric boundary of the *Posidonia oceanica* grasslands (40 – 45 m.) and is composed of several sublevels. In the Isca Marine Reserve the first sublevel (0.3 – 1.5 m.) presents a typical photophile algal belt composed of a monospecies population of *Jania rubens*, a red coralline algae extremely diffuse and abundant in surface waters. The second sublevel (1.5 – 3 m.) is characterized by a marked dominance of the species *Jania rubens* and *Halimeda tuna*, which are closely associated with each other; growth of the two species is particularly noticeable at the outer walls of the sites, whereas the inner walls, in the absence of strong hydrodynamic forces, are populated by extensive growths of *Halimeda tuna*.

The third sublevel (3-4 m.) is characterized by the presence of other types of coralline species, including *Corallina elongata* along the inner wall and *Corallina officinalis* along the outer walls. Along the upper horizontal planes of the sublittoral level one observes numerous calcareous algal species that belong to the coralline and Caulerpali groups consisting of tighly packed conglomerates capable of contributing to the hardening of the substratum and to the growth of extensive organogenic formations. The fourth sublevel, which is more extensive than the preceding ones (4–11 m.) comprises some species with broad bathymetric distribution, including the chlorophyte *Flabellia petiolata* and the pheophytes *Dictyota dichotoma* and *Stypocaulon scoparium*; this latter species is dominant and ubiquitous at all the sampling sites. In the lower horizontal plane of the sublittoral level, some species are spread from the surface itself, including *Stypocaulon scoparium* and *Flabellia petiolata*, while along the vertical walls in the cavities and depressions of the substratum (and, in general, in the zone where light is scarce), a typical sciaphile rhodophyte predominates, namely, *Peyssonnelia squamaria*. The latter species is sometimes found in association with the chlorophyte *Flabellia petiolata* and other secondary species such as *Sphaerococcus coronopifolius* and *Lithophyllum frondosum* in a typical biological association denominated *Flabellia-Peyssonelietum* (Funk, 1927).

Finally, starting at a depth of 10 meters, one observes the characteristic phenomenon of ecologic vicariance, by which *Dictyota dichotoma*, present in the superficial horizzontal planes, is subsituted by the closely related *Dictyota linearis* in deeper waters.

Besides light, another fundamental factor capable of influencing the qualitative and quantitative distribution of the macrophytobenthonic populations is represented by the hydrodynamic nature of the medium. The data, in fact, reveal that the outer sites exhibit a greater proliferation of species compared to the inner zone due to the marked hydrodynamic forces to which the external areas are subjected to, as well as to the more pronounced heterogeneity of the substratum. The marked wave motion at this location results in a distinct vertical zonation of the macrophytobenthonic populations in the upper horizzontal zones of the sublittoral plane: this is evidenced by the formation of surface belts of vegetation composed of *Jania rubens, Halimeda*

tuna and *Corallina officinalis* (particularly profuse along the outer walls of the sampling sites).

In addition, the phenomenon of epiphytism appears rather marked; in fact, 60% of the species present are epiphytes. In general, microscopic algal species predominate and, of these, most are rhodophytes belonging to the order *Ceramiales*, which are capable of safely colonizing the upper surface of macroscopic algae. The degree of epiphytism is, at times, so pronounced that one observes second and third degree epibiosis. Such a situation may derive from the marked competition for existing space on a substratum of limited extension in a semipelagic zone, distant and isolated from the shore. In general, the epiphytic relationships are entirely random, though there are instances of apparent obligate epiphytism, such as that occurring between *Padina pavonica* and *Cladophora lehmanniana*, and that between *Corallina officinalis* and *Hypoglossum hypoglossoides*. From a close examination of the data it appears evident that the more commonly occurring epiphytic species are, in decreasing order of frequency, as follows: *Ceramium diaphanum, Halopteris filicina, Falkenbergia rufolanosa, Aglaothamnion byssoides, Seirospora sphaerospora* and *Chylocladia verticillata*. As far as the relative frequency of sciaphiles and photophiles is concerned, the former were found in greater numbers as figure 7 clearly illustrates; of note is the total absence of Cystoseira species, which are normally a constant component of photophile communities (Giaccone & De Leo, 1966).

Discussion

The flora of the Tyrrhenian Sea of the Calabrian coast is known from only three scientific contributions carried out in the areas of Praia a mare, Tropea and S. Litterata (Tolomio, 1973, 1976; Cantasano, 1995). Tolomio's publications list 97 overall algal species: 58 *Rhodophyta* (60%), 16 *Chlorophyta* (16,5%) and 23 *Phaeophyta* (23,5%). Cantasano's studies, which include a graduate thesis reporting on a series of specimen collections taken from underwater ridges (Cantasano, 1973), list a total of 71 algal species: 43 *Rhodophyta* (60%), 14 *Chlorophyta* (20%) and 14 *Phaeophyta* (20%), of which 39 are recorded by both authors. The present–day floral picture, therefore, includes 129 total species, of which *Rhodophytes* make up 60%, *Pheophytes* 22% and *Chlorophytes* 18%. Nearly all the new algal species are red epiphytes, a finding that differs from the previous studied by Tolomio. This research lists 32 new species in comparison with Tolomio and appears to corroborate that of Tolomio (Tolomio, 1973, 1976), according to which the phytobenthonic species of the Calabrian Tyrrhenian coast include relatively low numbers of macroscopic species but correspondingly high numbers of microscopic and epiphytic algae. Further research is warranted to further elucidate these findings.

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highly professional and gracious help he provided for all the various activities and needs throughout the project. Thanks to these men's dedication, this limited strip of coastal water, unique for its extraordinary biodiversity, is today a protected WWF marine reserve.

Riassunto

Il presente studio analizza la consistenza dei popolamenti fitobentonici nella riserva marina "Scogli di Isca" (Cosenza). Sono state complessivamente rinvenute 47 specie algali, di cui 21 nuove per la regione in esame, appartenenti alle seguenti divisioni: Rhodophyta 32 (68%), Phaeophyta 8 (17%) e Clorophyta 7 (15%). Vengono riportate la distribuzione batimetrica delle specie presenti, il loro grado di abbondanza relativa ed inoltre, per le diverse stazioni di raccolta, la frequenza dei principali gruppi ecologici.

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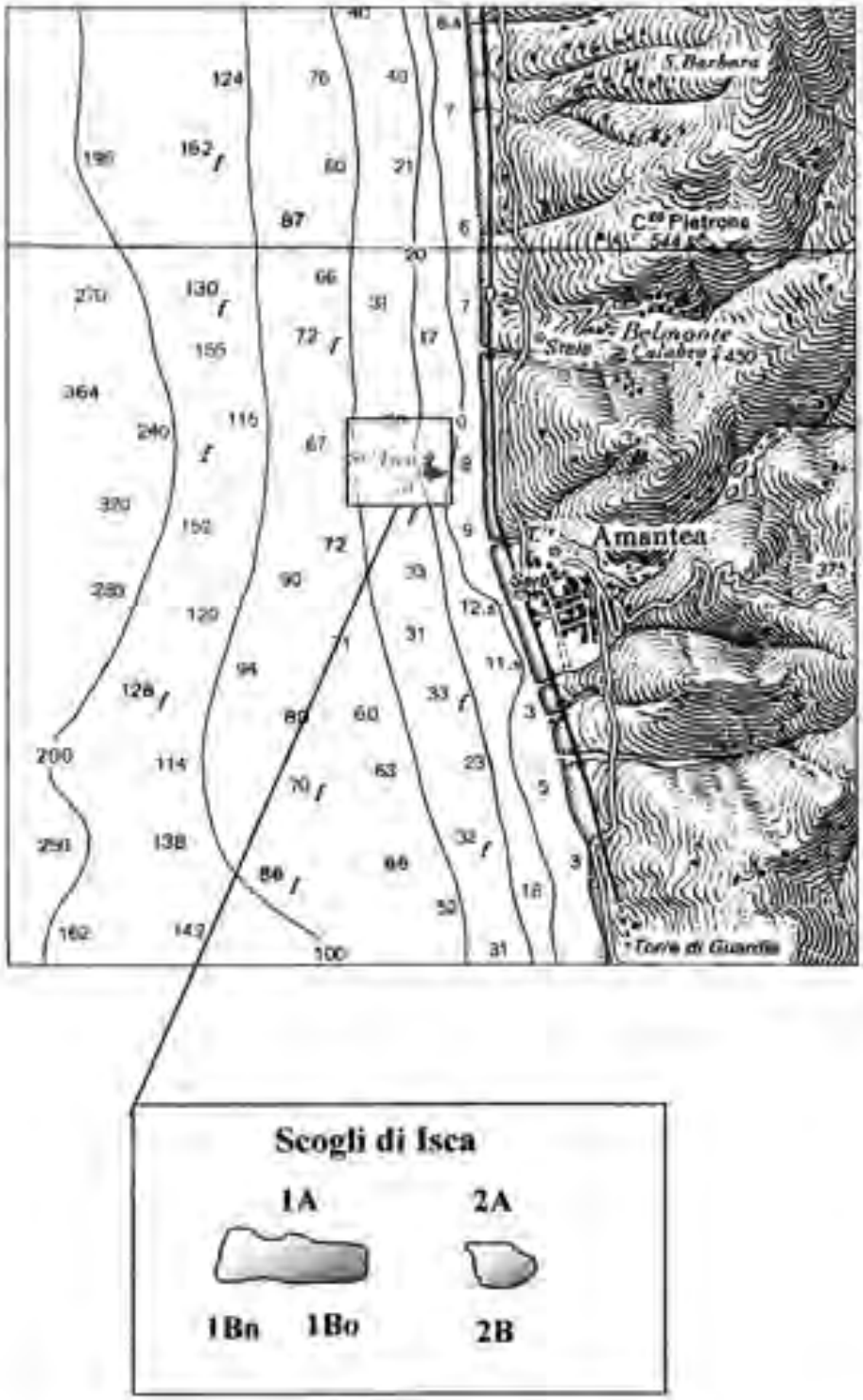

Fig. 1 - "Scogli di Isca" marine reserve. (Carta Istituto idrografico della Marina, 1993 - Scala 1:40.000).
In details: (1A, 2A, 1Bo, 2B: profiles).

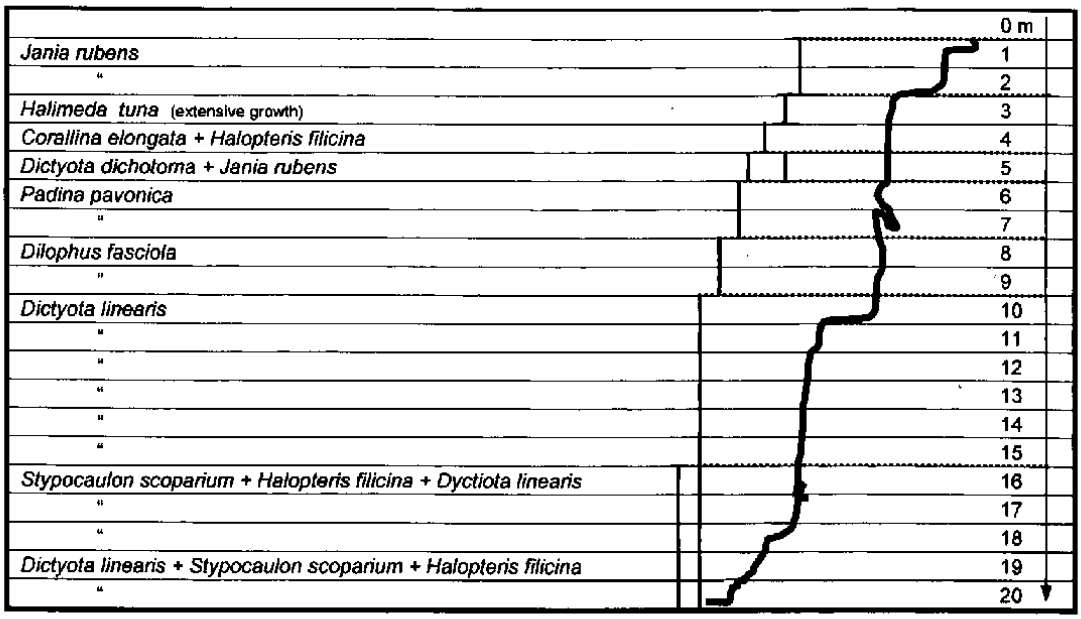

Fig. 2 – Profile 1A: *bathymetric distribution of main algal species*

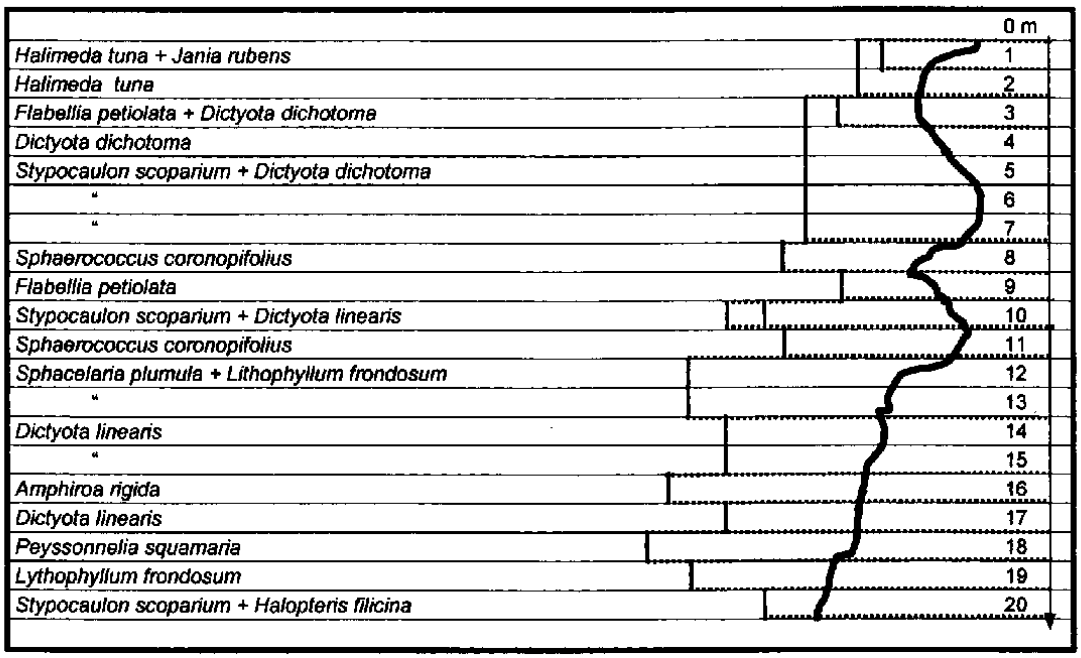

Fig. 3 – Profile 1Bn: *bathymetric distribution of main algal species.*

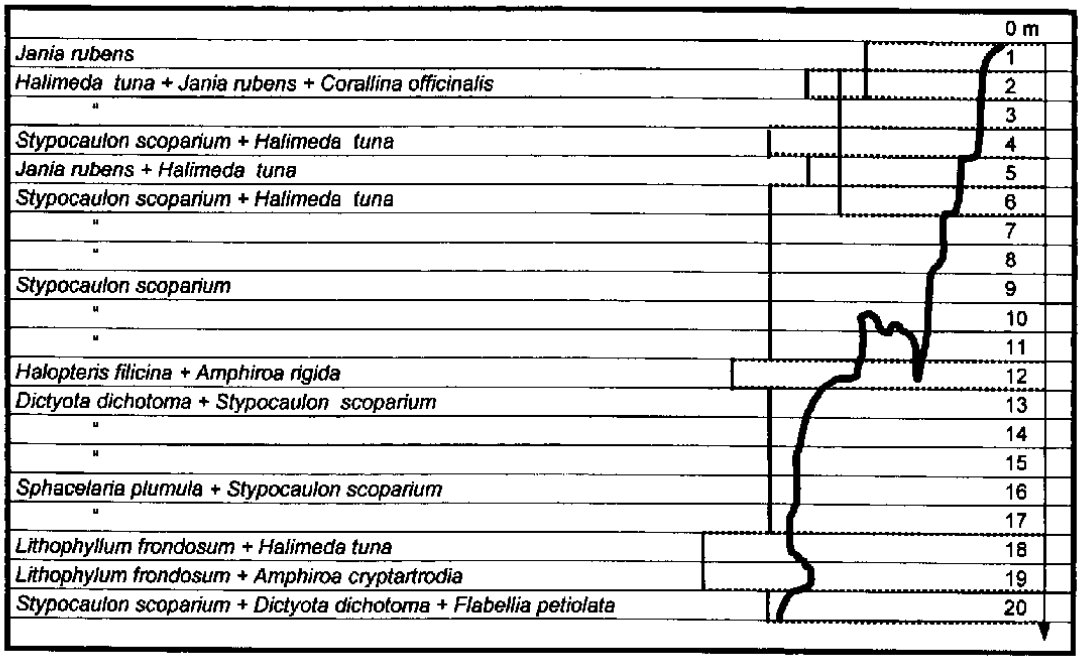

Fig. 4 – Profile 1Bo: *bathymetric distribution of main algal species.*

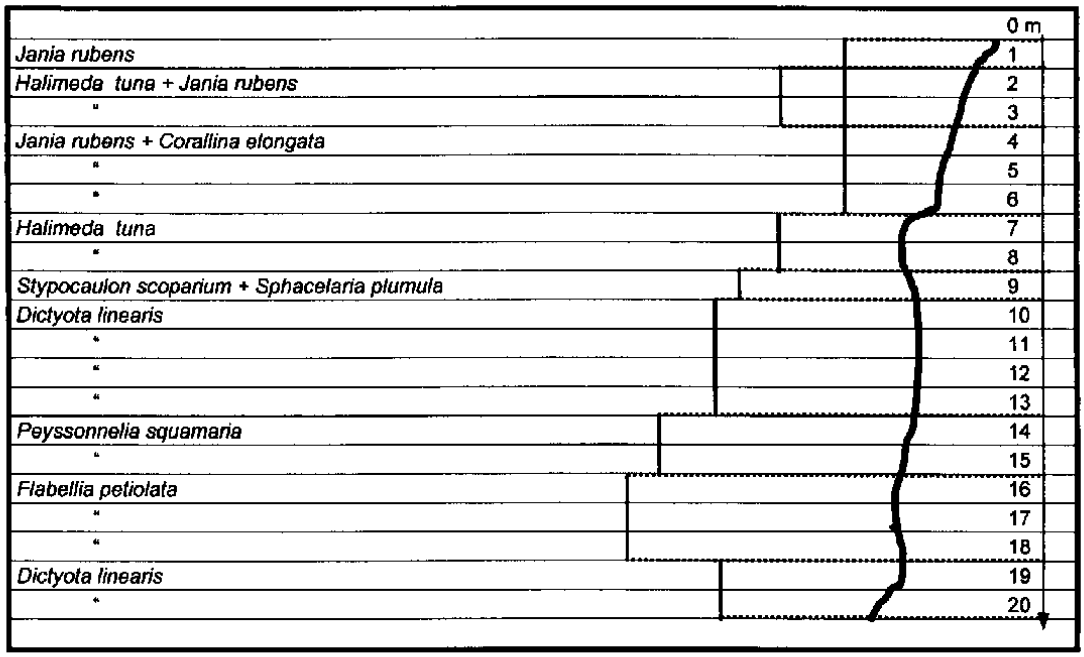

Fig. 5 – Profile 2A: *bathymetric distribution of main algal species.*

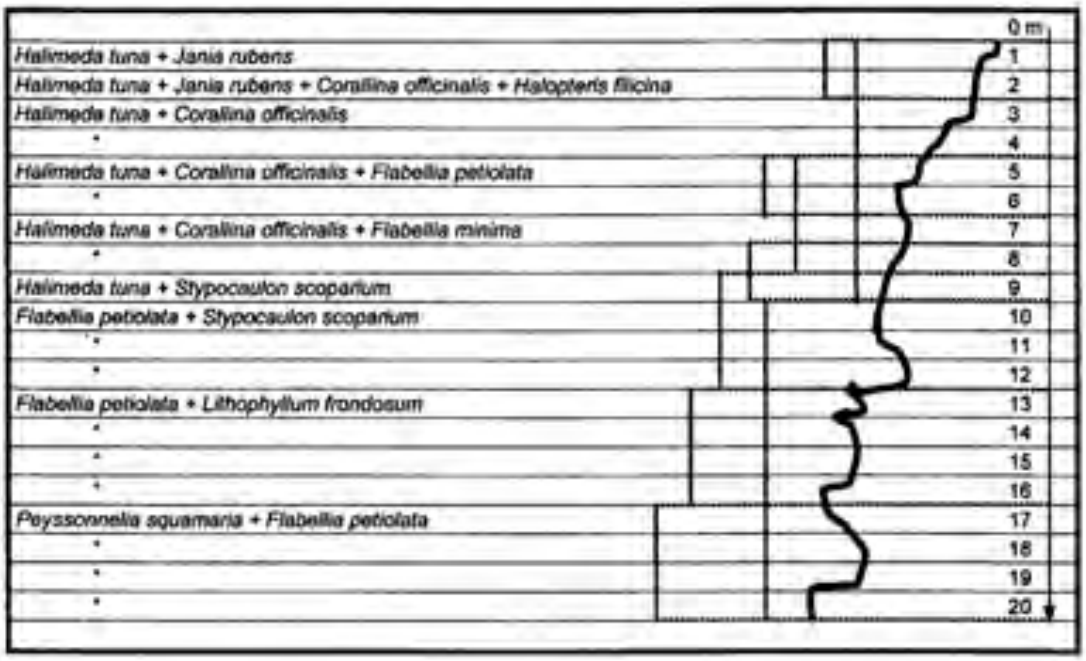

Fig. 6 - Profile 2B: *bathymetric distribution of main algal species.*

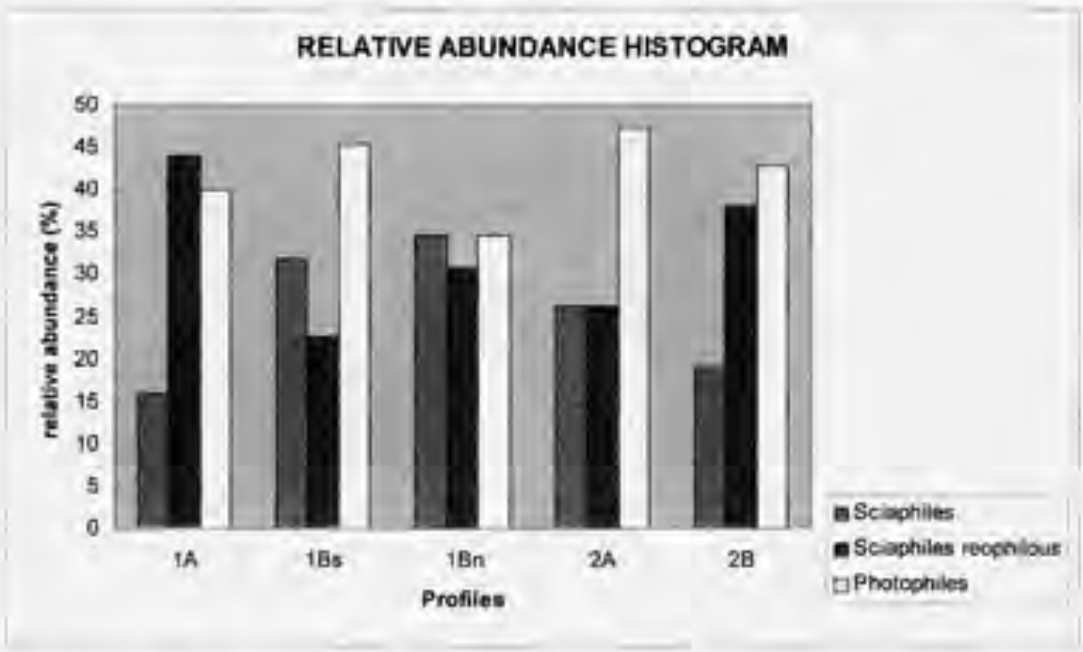

Fig.7 - *Graph showing relative freqency of principal algal groups.*

TAB. I – CHECK LIST OF ALGAL SPECIES OF ISCA MARINE RESERVE.
SYMBOLS: ° SPECIES PRESENT IN S. LITTERATA (CANTASANO N., 1993. GRADUATE THESIS). ' SPECIES EPIPHYTE.

SPECIES	Prof. 1A	1Ba	1Bn	2A	2B	Presence
Rhodophyta						
° *Amphiroa cryptarthrodia* Zanardini (m)	–	+	–	–	–	1
° *Amphiroa rigida* Lamoroux (a)	–	+	+	–	–	2
° *Corallina elongata* Ellis et Solander (a)	+	+	–	+	–	3
° *Corallina officinalis* Linnaeus (a)	–	+	–	–	+	2
Erythroglossum balearicum (Rodriguez) J.Agardh (r)	–	–	+	–	–	1
° *Jania rubens* (Linnaeus) Lamoroux (a)	+	+	+	+	+	5
° *Peyssonnelia squamaria* (S.G.Gmelin) Decaisne (m)	–	–	+	+	+	3
° *Lithophyllum frondosum* (Philipp) Lemoine (m)	–	+	+	–	+	3
° *Sphaerococcus coronopifolius* Stackhouse (r)	–	–	+	–	–	1
° *Aglaothamnion byssoides* (Harriot ex Harvey) L'Hardy Halos et Rue (a)	+	–	+	+	–	3
° *Anotthamnion pilliferum* Connaci et Furnari (r)	+	–	+	–	–	2
° *Asperagopsis armata* Harvey (r)	–	+	+	–	–	2
° *Bolryocladia microphysa* (Hauck) Kylin (r)	–	+	+	–	–	2
° *Ceramium ciliatum* (Ellis) Ducluzeau (r)	+	–	–	–	+	2
° *Ceramium diaphanum* (Lightfoot) Roth (a)	+	+	+	+	+	5
° *Ceramium nodulosum* (Lightfoot) Ducluzeau (a)	+	+	+	–	–	3
° *Chondria dasyphilla* (Woodward) C.Agardh (r)	+	–	+	–	–	2
° *Chondria mairei* G.Feldmann (r)	–	–	+	–	–	1
° *Chylocladia verticillata* (Lightfoot) Bliding (m)	–	+	+	+	+	4
° *Dasya hutchinsiae* Harvey (m)	–	+	+	–	+	3
° *Falkenbergia rufolanosa* (Harvey) Schmitz (a)	+	+	+	+	+	5
° *Griffithsia phyllamphora* J.Agardh (r)	+	–	–	+	–	2
° *Gastroia nodulosa* (Grigovic) J. et G.Feldmann (r)	–	–	–	–	+	1
° *Herposiphonia secunda* (C. Agardh) Ambrom (r)	–	–	–	–	+	1
° *Hypoglossum hypoglossoides* (Stackhouse) F.Collins et Harvey (r)	–	–	–	–	+	1
° *Nitophyllum punctatum* (Stackhouse) Greville (a)	+	+	+	+	+	5
° *Polysiphonia fucoides* (Hudson) Greville (r)	–	–	–	–	+	1
° *Polysiphonia sertularioides* (Grateloup) J.Agardh (d)	+	+	+	+	+	5
° *Polysiphonia subulifera* (C.Agardh) Harvey (r)	–	–	–	–	+	1
° *Sarcospora giraudy* (Kutzing) De Toni (r)	+	–	–	–	–	1
° *Sarcospora sphaerospora* J.Feldmann (a)	+	+	+	+	+	5
° *Wrangelia penicillata* C.Agardh (r)	–	+	+	–	–	2
Phaeophyta						
° *Dictyota dichotoma* (Hudson) Lamoroux (a)	+	+	+	–	–	3
Dictyota linearis (C.Agardh) Greville (a)	+	–	+	+	–	3
Dilophus fasciola (Roth) Howe (m)	+	–	–	–	+	2
° *Stypocaulon scoparium* (Linnaeus) Kutzing (a)	+	+	+	+	+	5
° *Padina pavonica* (Linnaeus) Thivy (r)	+	–	–	–	–	1
° *Halopteris filicina* (Grateloup) Kutzing (m)	+	+	+	+	+	5
° *Sphacelaria cirrosa* (Roth) C.Agardh (a)	+	+	+	+	+	5
° *Sphacelaria plumula* Zanardini (r)	–	+	+	–	–	2
Chlorophyta						
° *Codium bursa* (Linnaeus) C.Agardh (r)	+	–	–	+	–	2
° *Dasycladus vermicularis* (Scopoli) Krasser (r)	+	–	–	+	–	2
° *Flabellia petiolata* (Turra) Nizamuddin (m)	–	+	+	+	+	4
° *Halimeda tuna* (Ellis et Solander) Lamoroux (a)	+	+	+	+	+	5
° *Valonia utricularis* (Roth) Agardh (r)	+	+	+	+	–	4
° *Cladophora lehmanniana* (Lindenberg) Kutzing (r)	+	–	–	–	–	1
° *Flabellia minima* (Ernst) Nizamuddin (r)	+	–	–	+	–	2

TAB.2 - RELATIVE ABUNDANCE (%) OF ALGAL SPECIES

PROFILES	1A	1Bs	1Bn	2A	2B
Sciaphiles	16,0	31,8	34,6	26,3	19,1
Sciaphiles reophilous	44,0	22,7	30,8	26,3	38,1
Photophiles	40,0	45,5	34,6	47,4	42,8
TOTAL stations	100,0	100,0	100,0	100,0	100,0