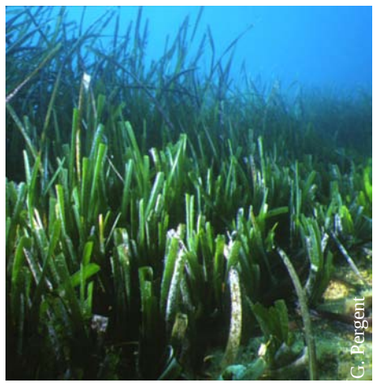
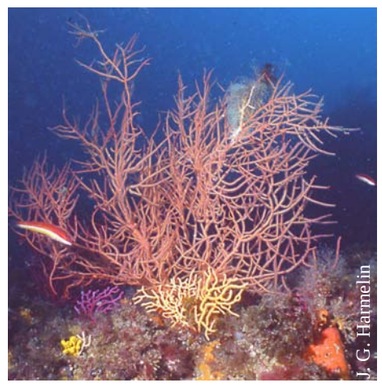
CLASSIFICATION OF BENTHIC MARINE HABITAT TYPES FOR THE MEDITERRANEAN REGION





Juin 2006

Forward[•]

At their 10th Ordinary Meeting (Tunis, 18-21 November 1998), the Contracting Parties to the Convention for the Protection of the Mediterranean Sea against Pollution adopted common criteria for the preparation of national inventories of natural sites of conservation interest. The criteria provided for the establishment of a reference list of marine and coastal natural habitat types, to be drafted on the basis of a model classification. At the same Meeting the Contracting Parties invited the Regional Activity Centre for Specially Protected Areas (SPA/RAC) to work on the elaboration of a model classification of marine habitat types for the Mediterranean region, as well as a reference list of habitat types. France offered to finance the organization of a meeting of experts devoted to these topics.

Accordingly, a Meeting of Experts was convened in Hyères (France), from 18 to 20 November 1998. The main objectives was to establish a classification of the various marine habitats types for the Mediterranean region, that could serve as a common reference for the establishment of national inventories of natural sites of conservation interest. This inventory must take into account the different schemes, established by the various national and international bodies for the same purpose. The specificity of the Mediterranean Sea, its high level of diversity, and the density of the knowledge already acquired called for harmonisation and for a specific study to be carried out.

Numerous initiatives, meetings, and reports enabled hierarchical lists of European marine habitats to be established. The main purpose of these initiatives (CORINE-biotopes ; EEC Habitat Directive 92/43 – Anonymous, 1992 ; Palaeartic Classification - Devilliers & Devilliers-Terschuren, 1996 ; EUNIS habitat classification – Davies & Moss, 1997) was to establish valid lists of all the habitats in Europe.

As early as 1988, France published a zoning scheme covering the whole of the land and part of the coastal areas as Natural Zones of Fauna, Flora and Ecological Interest (ZNIEFF). The classification of the biocenosis, established by Pérès and Picard (1964), was used for determining the sea-ZNIEFF (Anonymous, 1988) and was taken into account not only for the French coasts but also for the whole of the Mediterranean basin. For the Provence-Alpes-Cote d'Azur Region 107 Sea-ZNIEFF have been created, the main objective of which was to present a synthesis of the scientific data available on this environment to optimise its management.

The inventory of the ZNIEFFs concerns knowledge and is considered as a scientific instrument and not as a legal tool although it is used as a protection and management administrative decision making support tool. It is of primary importance for the French state as a basis for international programmes and obligations (inventory of Important

[•] From UNEP(OCA)/MED WG.149/5 – Appendix III

Bird Areas, Special Protection Areas in keeping with the EEC ‘’Bird’’ Directive, inventory as a prerequisite for the designation of Special Conservation Areas in keeping with the EEC ‘’Habitats, Fauna, Flora’’ Directive, Alpine Convention, Statistics for the European Environment Agency, etc...).

As early as 1991, when the inventory of ZNIEFFs was widely used, a reflection process took place that involved the real estate developers, the users and the scientists in order to :

- learn from the utilisation of the existing inventory,
- improve the legibility of the forms established,
- include new data,
- harmonise and standardise information at national level and with foreign partners.

In 1993, a first list of Parameters and Biocenosis of the metropolitan French coasts (Dauvin *et al*., 1993) was established by a working group composed of French Mediterranean and Atlantic experts on the benthos.

In 1994, a second updated and completed edition (Dauvin *et al*., 1994) provided a detailed typology based on the CORINE-biotopes list for the metropolitan French coast.

At the European level, the document ‘CORINE biotopes manual’ (1988), updated in 1989 and edited in 1991 (Anonymous, 1991) and which is a reference for the EEC Directive 92/43 EEC (Anonymous, 1992), proved to be of difficult use for maritime purpose and more so in the Mediterranean zone. Not only it was too schematic but it also contained several errors and some misleading information.

For the north-east part of the Atlantic coast, Connor *et al*. (1995), taking as a model the typology of the ZNIEFFs and after several meetings of European experts, could establish a classification of the benthic marine biotopes of the United Kingdom and of the Republic of Ireland. This activity was carried out within the BIOMAR programme.

The classification of Palaearctic habitats (Devilliers and Devilliers-Terschuren, 1996) is a development and a geographical extension of the CORINE biotopes which does not provide significantly more information for the Mediterranean Sea.

For the Mediterranean Sea several more or less complete documents, suited to the problem, can be used for the demarcation of zones of heritage or ecological interest, zones that require a certain level of protection or for which sensible management is sought :

- the definition of benthic biocenosis resulting from the works in the line of Pérès and Picard (1964) and for which there are only few syntheses available (Gamulin Brida, 1967 ; Augier, 1982 ; Pérès, 1982 ; Ros *et al*., 1985 ; Bellan-Santini *et al*., 1994) ;
- the CORINE biotopes classification which is too succinct ;
- the classifications of Palaearctic (Devilliers and Devilliers-Terschuren, 1996) and BIOMAR (Connor *et al*., 1995) habitats, unsuitable for the Mediterranean Sea ;

- the list of marine biocenosis for the French metropolitan coasts (Dauvin *et al*. 1994) which has been validated for France but which must be completed and reviewed for the Mediterranean Sea.

This list of marine biocenosis of the French metropolitan coasts (Dauvin *et al*., 1994) is the result of a compilation made by scientists who worked on benthic populations (communities or biocenosis ; habitats as defined by the EEC Directive) in the Mediterranean Sea and on the Atlantic and Channel coasts, followed by a common reflection of these scientists.
Biocenosis have been classified as a function of the zonation and granulometric nature of the sediment. Priority environments are those that contribute to the identification of the zone, either for their own value or for that of the species that dwell in them, leaving aside any consideration about the surface. Most assemblages of plants and animals (biocenosis, facies) are fairly easy to identify but the sole mention of the biocenosis can justify the creation of a ZNIEFF in as much as it is sufficiently determinant and most of all accompanied with a list of significant priority species.

This document, which focuses on the Mediterranean Sea only, is based on the document written by Dauvin *et al*. (1994). It has been completely revised and adapted to the specificities of the Mediterranean zone for the French coastlines (ZNIEFFs re-actualisation programme), and then extended to the whole of the Mediterranean Sea to meet the needs of RAC/SPA.

The typology proposed for the Mediterranean Sea, elaborated from the CORINE biotopes nomenclature, is hierarchical, phytosociological and uses the following as bases of references :

- the zonation as defined by Pérès and Picard (1964 ; Appendix I),
- the granulometric nature of the sea beds classified as per the model adopted by Dauvin *et al*. (1994 ; Appendix II).

The levels of the facies and sub-facies are mainly limited to those most widely distributed, because they most often constitute a strictly local datum. The facies mentionned have indicative value only and environments, highly affected by human activity (polluted environments and harbours), are not considered in the text.
The terms used may have appeared with rather different meanings in referenced documents, so a lexicon (Appendix III) gives the meaning adopted herein.

I. SUPRALITTORAL

I. 1. MUDS

I. 1. 1. Biocenosis of beaches with slowly-drying wracks under glassworts

I. 2. SANDS

I. 2. 1. Biocenosis of supralittoral sands

I. 2. 1. 1. Facies of sands without vegetation, with scattered debris
I. 2. 1. 2. Facies of depressions with residual humidity
I. 2. 1. 3. Facies of quickly-drying wracks
I. 2. 1. 4. Facies of tre truncks which have been washed ashore
I. 2. 1. 5. Facies of phanerogams which have been washed ashore (upper part)

I. 3. STONES AND PEBBLES

I. 3. 1. Biocenosis of slowly drying wracks

I. 4. HARD BEDS AND ROCKS

I. 4. 1. Biocenosis of supralittoral rock

I.4.1.1. Association with *Entophysalis deusta* and *Verrucaria amphibia*
I.4.1.2. Pools with variable salinity (mediolittoral enclave)

II. MEDIOLITTORAL

II. 1. MUDS, SANDY MUDS AND SANDS

II. 1. 1. Biocenosis of muddy sands and muds

II. 1. 1. 1. Association with halophytes
II. 1. 1. 2. Facies of saltworks

II. 2. SANDS

II. 2. 1. Biocenosis of mediolittoral sands

II. 2. 1. 1. Facies with *Ophelia bicornis*

II. 3. STONES AND PEBBLES

II. 3. 1. Biocenosis of mediolittoral coarse detritic bottoms

II. 3. 1. 1. Facies of banks of dead leaves of *Posidonia oceanica* and other phanerogams

II. 4. HARD BEDS AND ROCKS

II. 4. 1. Biocenosis of the upper mediolittoral rock

II. 4. 1. 1. Association with *Bangia atropurpurea*
II. 4. 1. 2. Association with *Porphyra leucosticta*
II. 4. 1. 3. Association with *Nemalion helminthoiof* and *Rissoella verruculosa*
II. 4. 1. 4. Association with *Lithophyllum papillosum* and *Polysiphonia* spp.

II. 4. 2. Biocenosis of the lower mediolittoral rock

II. 4. 2. 1. Association with *Lithophyllum lichenoides* (= Entablure with *L. tortuosum*)
II. 4. 2. 2. Association with *Lithophyllum byssoides*
II. 4. 2. 3. Association with *Tenarea undulosa*
II. 4. 2. 4. Association with *Ceramium ciliatum* and *Corallina elongata*.
II. 4. 2. 5. Facies with *Pollicipes cornucopiae*
II. 4. 2. 6. Association with *Enteromorpha compressa*
II. 4. 2. 7. Association with *Fucus virsoides*
II. 4. 2. 8. *Neogoniolithon brassica-florida* concretion
II. 4. 2. 9. Association with *Gelidium* spp
II. 4. 2. 10. Pools and lagons sometimes associated with vermetids (infralittoral enclave)

II. 4. 3. Mediolittoral caves

II. 4. 3. 1. Association with *Phymatolithon lenormandii* and *Hildenbrandia rubra*

III. INFRALITTORAL

III. 1. SANDY MUDS, SANDS, GRAVELS AND ROCKS IN EURYHALINE AND EURYTHERMAL ENVIRONMENT

III. 1. 1. Euryhaline and eurythermal biocenosis

III. 1. 1. 1. Association with *Ruppia cirrhosa* and/or *Ruppia maritima*
III. 1. 1. 2. Facies with *Ficopomatus enigmaticus*
III. 1. 1. 3. Association with *Potamogeton pectinatus*
III. 1. 1. 4. Association with *Zostera noltii* in euryhaline and eurythermal environment
III. 1. 1. 5. Association with *Zostera marina* in euryhaline and eurythermal environment
III. 1. 1. 6. Association with *Gracilaria* spp.
III. 1. 1. 7. Association with *Chaetomorpha linum* and *Valonia aegagropila*
III. 1. 1. 8. Association with *Halopithys incurva*
III. 1. 1. 9. Association with *Ulva laetevirens* and *Enteromorpha linza*
III. 1. 1. 10. Association with *Cystoseira barbata*
III. 1. 1. 11. Association with *Lamprothamnium papulosum*
III. 1. 1. 12. Association with *Cladophora echinus* and *Rytiphloea tinctoria*

III. 2. FINE SANDS WITH MORE OR LESS MUD

III. 2. 1. Biocenosis of fine sands in very shallow waters

III. 2. 1. 1. Facies with *Lentidium mediterraneum*

III. 2. 2. Biocenosis of well sorted fine sands

III. 2. 2. 1. Association with *Cymodocea nodosa* on well sorted fine sands
III. 2. 2. 2. Association with *Halophila stipulacea*

III. 2. 3. Biocenosis of superficial muddy sands in sheltered waters

III. 2. 3. 1. Facies with *Callianassa tyrrhena* and *Kellia corbuloides*
III. 2. 3. 2. Facies with fresh water resurgences with *Cerastoderma glaucum*, and *Cyathura carinata*
III. 2. 3. 3. Facies with *Loripes lacteus* and *Tapes* spp.
III. 2. 3. 4. Association with *Cymodocea nodosa* on superficial muddy sands in sheltered waters
III. 2. 3. 5. Association with *Zostera noltii* on superficial muddy sands in sheltered waters
III. 2. 3. 6. Association with *Caulerpa prolifera* on superficial muddy sands in sheltered waters
III. 2. 3. 7. Facies of hydrothermal oozes with *Cyclope neritea* and nematodes

III. 3. COARSE SANDS WITH MORE OR LESS MUD

III. 3. 1. Biocenosis of coarse sands and fine gravels mixed by the waves

III. 3. 1. 1. Association with rhodolithes

III. 3. 2. Biocenosis of coarse sands and fine gravels under the influence of bottom currents (also found in the Circalittoral)

III. 3. 2. 1. Maërl facies (= Association with *Lithothamnion corallioides* and *Phymatolithon calcareum*) (can also be found as facies of the biocenosis of coastal detritic)
III. 3. 2. 2. Association with rhodolithes

III. 4. STONES AND PEBBLES

III. 4. 1. Biocenosis of infralittoral pebbles

III. 4. 1. 1. Facies with *Gouania wildenowi*

III. 5. *POSIDONIA OCEANICA* MEADOWS

III. 5. 1. *Posidonia oceanica* meadows (= Association with *Posidonia oceanica*)

III. 5. 1. 1. Ecomorphosis of stripped meadows
III. 5. 1. 2. Ecomorphosis of « barrier reef » meadows
III. 5. 1. 3. Facies of dead « mattes » of *Posidonia oceanica* without much epiflora
III. 5. 1. 4. Association with *Caulerpa prolifera*.

III. 6. HARD BEDS AND ROCKS

III. 6. 1. Biocenosis of infralittoral algae :

III. 6. 1. 1. Overgrazed facies with encrusting algae and sea urchins
III. 6. 1. 2. Association with *Cystoseira amentacea* (var. *amentacea*, var. *stricta*, var. *spicata*)
III. 6. 1. 3. Facies with Vermetids
III. 6. 1. 4. Facies with *Mytilus galloprovincialis*
III. 6. 1. 5. Association with *Corallina elongata* and *Herposiphonia secunda*
III. 6. 1. 6. Association with *Corallina officinalis*
III. 6. 1. 7. Association with *Codium vermilara* and *Rhodymenia ardissonei*
III. 6. 1. 8. Association with *Dasycladus vermicularis*
III. 6. 1. 9. Association with *Alsidium helminthochorton*
III. 6. 1. 10. Association with *Cystoseira tamariscifolia* and *Saccorhiza polyschides*
III. 6. 1. 11. Association with *Gelidium spinosum* v. *hystrix*
III. 6. 1. 12. Association with *Lobophora variegata*
III. 6. 1. 13. Association with *Ceramium rubrum*
III. 6. 1. 14. Facies with *Cladocora caespitosa*
III. 6. 1. 15. Association with *Cystoseira brachycarpa*
III. 6. 1. 16. Association with *Cystoseira crinita*
III. 6. 1. 17. Association with *Cystoseira crinitophylla*
III. 6. 1. 18. Association with *Cystoseira sauvageauana*
III. 6. 1. 19. Association with *Cystoseira spinosa*
III. 6. 1. 20. Association with *Sargassum vulgare*
III. 6. 1. 21. Association with *Dictyopteris polypodioides*
III. 6. 1. 22. Association with *Calpomenia sinuosa*
III. 6. 1. 23. Association with *Stypocaulon scoparium* (=*Halopteris scoparia*)
III. 6. 1. 24. Association with *Trichosolen myura* and *Liagora farinosa*
III. 6. 1. 25. Association with *Cystoseira compressa*
III. 6. 1. 26. Association with *Pterocladiella capillacea* and *Ulva laetevirens*
III. 6. 1. 27. Facies with large hydrozoa
III. 6. 1. 28. Association with *Pterothamnion crispum* and *Compsothamnion thuyoides*
III. 6. 1. 29. Association with *Schottera nicaeensis*
III. 6. 1. 30. Association with *Rhodymenia ardissonei* and *Rhodophyllis divaricata*
III. 6. 1. 31. Facies with *Astroides calycularis*
III. 6. 1. 32. Association with *Flabellia petiolata* and *Peyssonnelia squamaria*
III. 6. 1. 33. Association with *Halymenia floresia* and *Halarachnion ligulatum*
III. 6. 1. 34. Association with *Peyssonnelia rubra* and Peyssonnelia spp.
III. 6. 1. 35. Facies and association of Coralligenous biocenosis (in enclave)

IV. CIRCALITTORAL

IV. 1. MUDS

IV. 1. 1. Biocenosis of coastal terrigenous muds

IV. 1. 1. 1. Facies of soft muds with *Turritella tricarinata communis*
IV. 1. 1. 2. Facies of sticky muds with *Virgularia mirabilis* and *Pennatula phosphorea*
IV. 1. 1. 3. Facies of sticky muds with *Alcyonium palmatum* and *Stichopus regalis*

IV. 2. SANDS

IV. 2. 1. Biocenosis of the muddy detritic bottom

IV. 2. 1. 1. Facies with *Ophiothrix quinquemaculata*

IV. 2. 2 Biocenosis the coastal detritic bottom

IV. 2. 2. 1. Association with rhodolithes
IV. 2. 2. 2. Maerl facies (*Lithothamnion corallioides* and *Phymatholithon calcareum*)
IV. 2. 2. 3. Association with *Peyssonnelia rosa-marina*
IV. 2. 2. 4. Association with *Arthrocladia villosa*
IV. 2. 2. 5. Association with *Osmundaria volubilis*
IV. 2. 2. 6. Association with *Kallymenia patens*
IV. 2. 2. 7. Association with *Laminaria rodriguezii* on detritic
IV. 2. 2. 8. Facies with *Ophiura texturata*
IV. 2. 2. 9. Facies with Synascidies
V. 2. 2. 10. Facies with large Bryozoa

IV. 2. 3. Biocenosis of shelf-edge detritic bottom

IV. 2. 3. 1. Facies with *Neolampas rostellata*
IV. 2. 3. 2. Facies with *Leptometra phalangium*

IV. 2. 4. Biocenosis of coarse sands and fine gravels under the influence of bottom currents (biocenosis found in areas under specific hydrodynamic conditions – straits ; also found in the Infralittoral)

IV. 3. HARD BEDS AND ROCKS

IV. 3. 1. Coralligenous biocenosis

IV. 3. 1. 1. Association with *Cystoseira zosteroides*
IV. 3. 1. 2. Association with *Cystoseira usneoides*
IV. 3. 1. 3. Association with *Cystoseira dubia*
IV. 3. 1. 4. Association with *Cystoseira corniculata*
IV. 3. 1. 5. Association with *Sargassum* spp (indigènes).
IV. 3. 1. 6. Association with *Mesophyllum lichenoides*
IV. 3. 1. 7. Association with *Lithophyllum frondosum* and *Halimeda tuna*
IV. 3. 1. 8. Association with *Laminaria ochroleuca*
IV. 3. 1. 9. Association with *Rodriguezella strafforelli*
IV. 3. 1. 10. Facies with *Eunicella cavolinii*
IV. 3. 1. 11. Facies with *Eunicella singularis*
IV. 3. 1. 12. Facies with *Lophogorgia sarmentosa*

IV. 3. 1. 13. Facies with *Paramuricea clavata*
IV. 3. 1. 14. Facies with *Parazoanthus axinellae*
IV. 3. 1. 15. Coralligenous plateforms

IV.3. 2. Semi-dark caves (also in enclave in upper stages)

IV. 3. 2. 1. Facies with *Parazoanthus axinellae*
IV. 3. 2. 2. Facies with *Corallium rubrum*
IV. 3. 2. 3. Facies with *Leptosammia pruvoti*

IV. 3. 3. Biocenosis of shelf-edge rock

V. BATHYAL

V. 1. MUDS

V. 1. 1. Biocenosis of bathyal muds

V. 1. 1. 1. Facies of sandy muds with *Thenea muricata*
V. 1. 1. 2. Facies of fluid muds with *Brissopsis lyrifera*
V. 1. 1. 3. Facies soft muds with *Funiculina quadrangularis* and *Apporhais seressianus*
V. 1. 1. 4. Facies of compact muds with *Isidella elongata*
V. 1. 1. 5. Facies with *Pheronema grayi*

V. 2. SANDS

V. 2. 1. Biocenosis of bathyal detritic sands with *Grypheus vitreus*

V. 3. HARD BEDS AND ROCKS

V. 3. 1. Biocenosis of deep sea corals

V. 3. 2. Caves and ducts in total darkness (in enclave in the upper stages)

VI. ABYSSAL

VI. 1. MUDS

VI. 1. 1. Biocenosis of abyssal muds

Bibliographical references

Anonymous 1988 - Inventaire du Patrimoine Naturel. Programme National d'Inventaire des Zones Naturelles d'Intérêt Ecologique Faunistique et Floristique. Zones Marines. Région Provence-Alpes-Côte d'Azur, Ministère de l'Environnement. Tomes 1 et 2.

Anonymous 1991 - Commission of the European Communities. - CORINE biotopes. 1st ed. - Office for Official Publications of the European Communities for Commission of the European Communities, Luxembourg : 300p.

Anonymous 1992 - Directive 92/43/CEE du Conseil du 21 mai 1992. Journal des Communautés européennes, 22. 7. 92 N°L 206/7-N° L 206/50.

Augier A. 1982 - Inventaire et classification des biocénoses marines benthiques de la Méditerranée. Conseil de l'Europe Collection sauvegarde de la nature 29 : 59p.

Bellan-Santini D., 1985 - The Mediterranean benthos : reflexions and problems raised by a classification of the benthic assemblages : 19-48 *in* Moraitou-Apostolopoulou M. et Kiortsis V., "*Mediterranean marine ecosystems*", Nato Conference series 1, Ecology : 407 p.

Bellan-Santini D., Lacaze J.C. & Poizat C., 1994 - Les biocénoses marines et littorales de Méditerranée, Synthèse, menaces et perspectives. Collection Patrimoines naturels, Museum National d'Histoire Naturelle publ., 19 : 246p.

Connor D., Hiscock K., Foster-Smith R. & Covey R., 1995 - A classification system for benthic marine biotopes. *In*:"*Biology and Ecology of shallow coastal waters*", Eleftheriou, Ansell, Smith edits. : 155-159.

Dauvin J.C., Bellan G., Bellan-Santini D., Castric A., Comolet-Tirman J., Francour F., Gentil F., Girard A., Gofas S., Mahé C., Noël P. & de Reviers B., 1993 - Typologie des Znieff-Mer. Liste des paramètres et des biocénoses de côtes françaises metropolitaines. Museum National d'Histoire Naturelle, Paris : 44p.

Dauvin J.C., Bellan G., Bellan-Santini D., Castric A., Comolet-Tirman J., Francour F., Gentil F., Girard A., Gofas S., Mahé C., Noël P. & de Reviers B., 1994 - Typologie des Znieff-Mer. Liste des paramètres et des biocénoses de côtes françaises metropolitaines. 2ème édition. Museum National d'Histoire Naturelle, Paris : 64p.

Davies C. & Moss D., 1997 - EUNIS habitat classification. European Environment Agency.

Devilliers P. & Devilliers-Terschuren J. 1996 - A classification of Palaearctic habitats. Conseil de l'Europe, Nature et environnement, 78 : 194p.

Gamulin-Brida H., 1967 - The benthic fauna of the Adriatic sea. *Oceanogr. Mar. Biol. Ann. Rev*., 5 : 535-568.

Laubier L. & Emig C., 1993 - La faune benthique profonde de méditerranée. Symposium mediterranean seas 2000. N. F. R., Della Croce ed. Università di Genova : 397-424.

Pérès J.M., 1982 - Major benthic assemblages : 373-522, *in* Kinne O. ed., Marine Ecology, 5(1), London, John-Wiley publ. : 642p.

Pérès J.M., 1984 - History of the Mediterranean Biota and the colonisation of the depth. *In* : "*Western Mediterranean*", Margalef R. ed., Oxford, Pergamon Press : 198-232.

Pérès J.M. & Picard J., 1964 - Nouveau manuel de bionomie benthique de la Méditerranée. *Rec. Trav. Stat. mar. Endoume*, 31(47) : 1-37.

Ross J.D., Romero J., Ballesteros E. & Gili J.M., 1984 - Diving in blue water .The benthos. *In "Western Mediterranean*", Margalef R. ed., Oxford, Pergamon Press : 233-295.

APPENDIX I

Zonation of Biocenosis in the Mediterranean Region (Bellan-Santini *et al*. 1994)

Two main systems can be distinguished as a function of the vertical light gradient :

- the phytal system which is the habitat of all types of flora ;
- the aphytal system which is not the habitat of autotrophic flora except for certain algae in conditions still unclear.

Each of the two main systems comprises subdivisions or stages.

The phytal system comprises :

- the Supralittoral stage where organisms that require a high level of humidifying but that are never immersed are present. The upper limit corresponds to the zone splashed by the waves (including the spray of the waves) ;
- the Mediolittoral stage which corresponds to the zone affected by waves, submitted to sea level variations caused by wind, atmospheric pressure and tides ;
- the Infralittoral stage which is the immersed zone compatible with the life of the marine phanerogams and photophilous algae ;
- the Circalittoral stage which stretches up to the survival boundary of autotrophic pluricellular algae (general case).

The aphytal system comprises :

- the Bathyal stage which stretches up to the boundary of the continental slope ;
- the Abyssal stage, the presence of which is acknowledged in the Mediterranean sea (Pérès, 1984 ; Bellan-Santini, 1985 ; Laubier & Emig, 1993) and which corresponds to the plain that would start at about 2,000 m. A faunistic renewal is noticed there, the reasons of which are still unclear, and a high endemism rate.

  The boundary between the last two stages is still insufficiently defined in the Mediterranean sea.

APPENDIX II

Types of Sediments Selected (Dauvin *et al*., 1993, modified)

- Mud : more than 75 % of fine particles < 63 µm
- Sandy mud : 25 to 75 % fine particles < 63 µm
- Fine sand with more or less mud : 5 to 25 % of fine particles < 63 µm
- Fine sand : less than 5 % of fine particles, fraction larger than 2 mm < 15 %, median smaller than 250 µm
- Dune medium sand : about 0% of fine particles, fraction larger than 2 mm < 15%, median between 315 and 800 µm
- Heterogeneous muddy sand : fine particles between 10 and 30 %, sand, coarse sand and gravel between 50 and 80 %
- Coarse sand : less than 5 % of fine particles, more than 50% of sand + fine particles, median smaller than 2 mm
- Muddy heterogeneous sediment : more than 5 % of fine, median larger than 500 µm, high percentage of pebbles or shells
- Gravel : less than 5 % of fine particles, less than 50 % of pebbles + shells, median larger than 2 mm
- Small stones : less than 5 % of fine particles, more than 50% of pebbles + shells.

Granulometry (Larsonneur, 1977, modified)

- Rock chaos ;
- Blocks : larger than 10 cm ;
- Pebbles and shells : elements larger than 2 cm ;
- Coarse gravel : elements between 1 and 2 cm ;
- Medium gravel : elements between 5 and 10 mm ;
- Small gravel and particles : elements between 2 and 5 mm ;
- Coarse sand : elements between 1 and 2 mm ;
- Medium sand : elements between 0.5 and 1 mm ;
- Fine sand : elements between 0.2 and 0.5 mm ;
- Finer sand : elements between 0.1 and 0.2 mm ;
- Finest sand : elements between 0.063 and 0.1 mm ;
- Fine particles : mud + clay : fraction smaller than 0.063 mm.
- Well sorted sediment ;
- Poorly sorted sediment, heterogeneous.

APPENDIX III

Lexicon

Association : permanent aspect of a biocenosis with a vegetal physionomic dominance where the species are linked by an ecological compatibility and a chorological affinity.
Biocenosis : grouping of living organisms, linked by relationships of interdependence within a biotope with relatively homogenous major characteristics ; each biocenosis comprises mainly the phytocenosis, which includes flora, and the zoocenosis, which includes fauna. The notions of community or association in the phytosociological sense of the word are very close to the notion of biocenosis although they cannot exactly replace it.
Biotope : geographical area with variable surface or volume submitted to ecological conditions where the dominant elements are homogenous.
Characteristics : a species is considered as characteristic when it is exclusive or preferential for the biotope considered, whether it is represented widely or not, sporadic or not.
Community : grouping of living organisms linked by interdependence relationships within a biotope, typically characterized with respect to one or several dominant species.
Ecomorphosis : a particular morphology linked to local ecological conditions.
Enclave : local existence for microclimatic reasons of a habitat within a surface normally occupied by another habitat or another stage.
Euryhaline : which exhibits a large range of variation of the salinity.
*Eurytherm*al : which exhibits a large range of variation of the temperature
Facies : aspect exhibited by a biocenosis when the local predominance of certain factors causes the prevalence of either one or a very small number of species, essentially animal ones.
Habitat : area distinguished by geographic, abiotic and biotic features (definition of EEC Directive 92/43). the definition of the habitat can be compared herein to that of a biocenosis, facies and association.
Stage : vertical space of the marine benthic domain where the ecological conditions, as a function of its situation with respect to the sea level, are notably constant or fluctuate regularly between the two critical levels which indicate its boundaries.