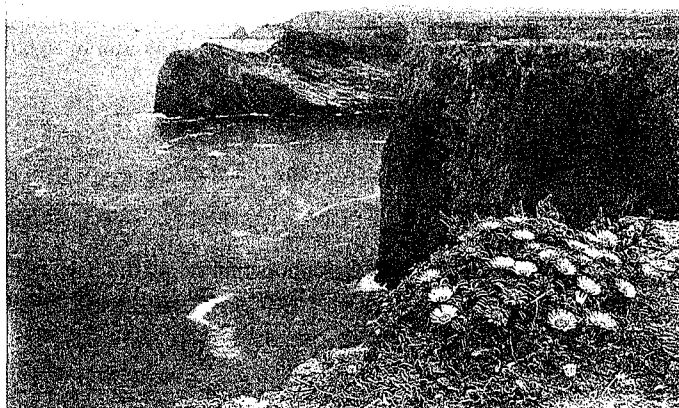

1 Coastal and halophytic communities



11 Ocean and seas

Oceanic and continental shelf waters, their associated open-water and bottom communities, and marine vascular vegetation beds.

- 11.1 OPEN MARINE WATERS**
Pelagic biocenoses. They can be characterized by their planktonic communities and by the composition of their nektonic or surface-feeding faunas of cephalopods, fish, sea mammals and seabirds.
(Nicholson, 1977; Augier, 1985; Fiala-Médione *et al.*, 1987; Wood, 1988)
- 11.11 OCEANIC WATERS**
Waters beyond the continental shelf.
- 11.12 SHELF AND SLOPE WATERS**
Waters of the continental shelf, underwater plateau extending from the coast to a depth of about 100 fathoms, beyond which the continental slope falls steeply toward the ocean bottom.
- 11.121 Inshore waters**
Waters within the strong influence of land masses, both in terms of physical parameters and of fauna, often arbitrarily defined as waters less than 5 km from low-water mark, waters between the continent and islands or islets well in sight of shore, and any seas of depth less than 6 metres.
- 11.122 Offshore waters**
The zone extending from the limits of inshore waters to the continental slope.
- 11.123 Continental slope**
Waters situated over the continental slope, the steep descent from the continental shelf to the ocean bottom, an area where upwellings, water mixing or shearing and other anomalies often develop.
- 11.124 Upwellings**
Zones where the warmer surface water is displaced, allowing cooler water rich in nutrients to rise to the surface, often generating much increased biological productivity.
- 11.125 Shoals**
Shallow waters over permanently submerged elevated features of the sea-floor.
- 11.2 SEABED**
Benthic communities of animals and algae occupying the sea floor in the infralittoral, circalittoral and deeper zones. This unit should be subdivided into a number of habitats characterized by depth, substrate, geographical location, water movement and the distinct biocenoses they support. A basic framework is outlined below; divisions such as those proposed by Augier (1982) for Mediterranean biocenoses can be easily, and without transformation, incorporated in it to provide further divisions.
(Augier, 1982, 1985; Mitchell, 1987; Harmelin *et al.*, 1987; Fiala-Médione *et al.*, 1987; Wood, 1988)
- 11.21 DEEP SEA FLOOR**
Bathyal, abyssal, hadal and hydro-thermal benthic communities, of the continental slope, the abyssal plain and its features, respectively.
- 11.22 SUBLITTORAL SOFT SEABEDS**
Mostly animal communities colonizing soft sediments such as mud, sand or gravel of the infralittoral and circalittoral zones.

- 11.23** **SUBLITTORAL PEBBLY SEABEDS**
Communities of mostly annual algae and invertebrates developing on pebble formations of the infralittoral and circalittoral zones.
- 11.24** **SUBLITTORAL ROCKY SEABEDS**
Varied, strongly stratified communities colonizing underwater cliffs, reefs and rocky continental shelf seabeds.
- 11.25** **SUBLITTORAL ORGANOGENIC CONCRETIONS**
Continental shelf colonies of lower plants or animals resulting in concretions and encrustations.
- 11.251** **Corallogenic concretions**
Communities forming and colonizing corallogenic concretions of calcified red algae in the circalittoral zone of the Mediterranean.
- 11.252** **Encrusting algae pavements**
Mediterranean communities associated with mediolittoral pavements of encrusting algae (*Lithospermum tortuosum*).
- 11.253** **Gastropod and polychaete ledges**
Infralittoral ledges built by gastropods or polychaetes.
- 11.254** **Mussel beds**
Communities of Atlantic and Mediterranean mussel beds.
- 11.26** **UNDERSEA CAVES**
- 11.3** **MARINE VASCULAR VEGETATION**
Zosteretea marinae, *Posidonietea*, *Halodulo-Thalassietea*
Beds of submerged marine vascular vegetation, except those of brackish seas.
- 11.31** **ATLANTIC EELGRASS MEADOWS**
Zosterion marinae: *Zosteretum marinae*
Eelgrass beds dominated by *Zostera marina*, established between the base of the intertidal zone and a depth of about 10 metres in Atlantic and North Sea waters.
(Westhoff and den Held, 1975; Tutin, 1980; Géhu, 1984; Géhu and Géhu-Franck, 1984a; Ellenberg, 1988; Oberdorfer, 1990)
- 11.32** **ATLANTIC DWARF EELGRASS MEADOWS**
Zosterion marinae: *Zosteretum noltii*
Eelgrass beds dominated by *Zostera noltii* or *Z. angustifolia*, mostly characteristic of the low part of the intertidal zone in Atlantic and North Sea waters, sometimes permanently submerged.
(Westhoff and den Held, 1975; Tutin, 1980; Géhu, 1984; Géhu and Géhu-Franck, 1984a; Wildpret de la Torre and del Arco Aguilar, 1987)
- 11.321** **Mainland Atlantic dwarf eelgrass meadows**
Formations of *Zostera noltii* or *Z. angustifolia* of the Atlantic and North Sea shores of continental Europe.
- 11.322** **Macaronesian dwarf eelgrass meadows**
Very local *Zostera noltii* formations of Fuerteventura and Lanzarote, near the southern limit of the Atlantic range of the genus.
- 11.33** **MEDITERRANEAN CYMODOCEA AND ZOSTERA BEDS**
Cymodoceion nodosae p.
Beds of *Cymodocea nodosa* and *Zostera noltii* or *Z. marina*, permanently submerged in waters down to 10 metres deep, often in sheltered areas behind *Posidonia* reefs.
(Campbell, 1976; Molinier and Martin, 1980; Augier, 1982; Géhu and Géhu-Franck, 1984a; Géhu, Costa *et al.*, 1984; Polunin and Walters, 1985)

11 Ocean and seas

- 11.331** **Mediterranean Cymodocea beds**
Cymodoceum nodosae
Cymodocea nodosa formations of muddy sands, monospecific or associated with either the alga *Caulerpa prolifera* or the phanerogam *Halophila stipulacea*.
- 11.332** **Mediterranean Zostera beds**
Giraudyo-Zosteretum noltii
Formations of the upper part of the infralittoral zone with *Zostera noltii* and the alga *Giraudya sphacelarioides*.
- 11.34** **POSIDONIA BEDS**
Posidonium oceanicae
Beds of the Mediterranean and thermo-Atlantic endemic, *Posidonia oceanica*, permanently submerged in waters down to 100 metres deep.
(Campbell, 1976; Molinier and Martin, 1980; Augier, 1982; Géhu and Franck, 1984a; Géhu, Costa *et al.*, 1984; Polunin and Walters, 1985; Harmelin, Vacelet and Pétron, 1987; Fiala-Médione, Pétron and Rives, 1987)
- 11.35** **MACARONESIAN CYMODOCEA BEDS**
Cymodoceion nodosae p.
Formations of *Cymodocea nodosa* or *Cymodocea* and *Caulerpa spp.*, in particular *Caulerpa prolifera*, occupying large surfaces on sandy substrates at depths of 1-15 metres, around the Macaronesian Islands.
(Wildpret de la Torre and del Arco Aguilar, 1987)
- 11.36** **HALOPHILA BEDS**
Deep water colonies of *Halophila spp.*
(Dandy, 1980; Augier, 1982; Wildpret de la Torre and del Arco Aguilar, 1987)
- 11.361** **Canarian Halophila beds**
Halophila decipiens colonies of Tenerife, at depths between 10 and 14 metres.
- 11.362** **Mediterranean Halophila beds**
Colonies of *Halophila stipulacea* invading the Mediterranean as a result of the opening of the Suez Canal; they have been reported from continental Greece, the Cyclades, Crete, Rhodes and Samos.
- 11.4** **BRACKISH SEA VASCULAR VEGETATION**
Ruppiaetea maritimae p.
Submerged or slightly emergent vascular vegetation of open brackish waters. Characteristic of open Baltic waters, *Ruppiaetea* communities may also occur in permanent pools of mud or sand flats (11.4 *p.*), as well as in inlets or estuaries where they should be coded as 12.4 or 13.4, respectively. Similar vegetation in landlocked pools is listed under 23.2.
(Westhoff and den Held, 1975; Nordiska ministerradet, 1984; Ellenberg, 1988; Oberdorfer, 1990)
- 11.41** **MARINE TASSELWEED COMMUNITIES**
Ruppion maritimae p.
Submerged *Ruppia maritima* (or *R. cirrhosa*) beds and *Chara* formations of the open Baltic and of pools on mud flats or sand flats of other seas.
- 11.42** **DWARF SPIKE-RUSH BEDS**
Scirpion parvuli p.
Emergent *Eleocharis parvula* formations of the open Baltic or of tidal flats.

12 Sea inlets

Bays and narrow channels, including sea lochs or loughs, fiords or fiards, rias and straits but excluding estuaries. Detailed habitats can be coded by transposing subdivisions of prefix 11, simply replacing prefix 11 by prefix 12.
(Wood, 1988)

13 Tidal rivers and estuaries

River channels below the tidal limit, including the water and the channel bed but not the fringing vegetation.

- 13.1. **TIDAL RIVERS**
Portions of rivers subject to the tide, upstream from the estuary.
- 13.11 **BRACKISH WATER**
- 13.12 **FRESH WATER**
- 13.2 **ESTUARIES**
Broadening of rivers entering the sea. Detailed habitats can be coded by transposing subdivisions of prefix 11.2, simply replacing prefix 11.2 by prefix 13.2.
- 13.3 **SUBMERGED BEDS OF VASCULAR MARINE VEGETATION**
Subdivisions of 11.3 can be transposed to precise communities (13.31 to 13.36).
- 13.4 **SUBMERGED BEDS OF VASCULAR BRACKISH VEGETATION**
Subdivisions of 11.4 can be transposed to precise communities (13.41 to 13.42).

14 Mud flats and sand flats

Sands and muds, submerged for part of every tide, devoid of vascular plants, but usually coated by blue algae and diatoms. They are of particular importance as feeding grounds for wildfowl and waders. The diverse intertidal communities of invertebrates and algae that occupy them can be used to define subdivisions of 14. Eelgrass communities that may be exposed for a few hours in the course of every tide have been listed under 11.3, 12.3 or 13.3, depending on the physical location of the flats.

15 Salt marshes, salt steppes and gypsum scrubs

Plant communities which are submerged by high tides at some stage of the annual tidal cycle. Also continental and coastal halophile and gypsophile communities.

15.1

SALT PIONEER SWARDS

Thero-Salicornietalia, *Frankenion pulverulentae*, *Saginion maritimae*

Formations of *Salicornia* and other annuals colonizing periodically inundated muds and sands of marine or interior salt marshes.

(Duvigneaud, 1967; Westhoff and den Held, 1975; Castroviejo and Porta, 1975; Rivas-Martinez and Costa, 1975; Géhu, Caron and Bon, 1975; Parent and Burny, 1981; Géhu, 1984; Géhu and Géhu-Franck, 1984a; Géhu, Costa *et al.*, 1984; Ladero *et al.*, 1984; Peinado Lorca *et al.*, 1984; Drachenfels *et al.*, 1984; Dijkema *et al.*, 1984; Peinado Lorca and Rivas-Martinez, 1987; Ellenberg, 1988; Oberdorfer, 1990)

15.11

GLASSWORT SWARDS

Thero-Salicornietalia

Annual glasswort (*Salicornia* spp., *Microcnemum coralloides*) and seablite (*Suaeda maritima*) formations on periodically inundated muds of coastlands and inland salt-basins.

15.111

Atlantic glasswort swards

Annual *Salicornia* and *Suaeda* swards of the coastal saltmarshes of the North Sea, the Baltic and the North Atlantic.

15.1111

Low shore samphire flats

Salicornion dolichostachyo-fragilis

Colonies of non-reddening tetraploid glassworts *Salicornia dolichostachya*, *S. fragilis*, *S. decumbens* and of *Suaeda maritima* ssp. *flexilis*, occupying the lowest, dampest areas of northern and western coastal flats.

15.1112

Seablite-samphire communities

Salicornion europaeo-ramosissimae p. (*Thero-Suaedion* auct.)

Colonies of often much-branched, diploid glassworts *Salicornia ramosissima*, *S. europaea*, *S. obscura* i.a. and/or of *Suaeda maritima*, occupying higher, drier areas of coastal flats.

15.112

Continental glasswort swards

Salicornion europaeo-ramosissimae p.

Glasswort formations of inland saltmarshes of Germany, France and England (15.4).

15.1121

Continental glasswort seeps

Salicornietum vicensis

Colonies of the orange-turning *Salicornia emerici* var. *vicensis*, of unstable, fluid, seeping muds.

15.1122

Continental drier glasswort swards

Salicornietum ramosissimae lotharingiense, *Puccinellio distantis-Salicornietum europaeae* p.

Colonies of the reddening *Salicornia ramosissima* or of *S. europaea*, of firmer ground.

15.113

Mediterranean glasswort swards

Glasswort swards of Mediterranean and thermo-Atlantic coastal saltmarshes.

15.1131

Low-shore Mediterranean glasswort swards

Salicornion emerici p.

Formations dominated by the reddening tetraploid glasswort *Salicornia emerici* occupying long-inundated basins of Mediterranean, south-western French and Iberian coastal saltmarshes.

- 15.1132** **Venetian glasswort swards**
Salicornion emerici p.: Salicornietum veneti
Endemic, threatened *Salicornia veneta* swards of basins of the Venice lagoon.
- 15.1133** **Upper shore Mediterranean glasswort swards**
Salicornion patuli
Formations dominated by the reddening diploid glasswort *Salicornia patula* occupying firmer, drier muds of Mediterranean, south-western French and Iberian coastal saltmarshes.
- 15.114** **Iberian glasswort swards**
Microcnemion
Annual *Salicornia* and *Microcnemum coralloides* formations of interior Iberian salt basins.
- 15.1141** **Microcnemum swards**
Formations of the endemic *Microcnemum coralloides* ssp. *coralloides*, associated or not with *Salicornia europaea s.l.*, of interior salt basins of central and east-central Spain.
- 15.1142** **Iberian interior Salicornia swards**
Formations of *Salicornia europaea s.l.* of interior salt basins of Iberia.
- 15.12** **HALONITROPHILOUS FRANKENIA COMMUNITIES**
Frankenion pulverulentae
Formations of halonitrophilous annuals (*Frankenia pulverulenta*, *Suaeda splendens*, *Salsola soda*, *Cressa cretica*, *Parapholis incurva*, *P. strigosa*, *Hordeum marinum*, *Sphenopus divaricatus*) colonizing salt muds susceptible to temporary inundation and extreme drying, mostly characteristic of the Iberian peninsula, with irradiations notably in the Camargue, Italy, and on the Atlantic coast of France.
- 15.13** **SEA-PEARLWORT COMMUNITIES**
Saginion maritimae
Formations of annual pioneers (*Sagina maritima*, *Cochlearia danica*) of sands subject to variable salinity and humidity, in particular in the zone of contact between dune and salt marsh.
- 15.2** **CORDGRASS SWARDS**
Spartinion maritimae
Perennial pioneer *Spartina* grasslands of coastal salt muds.
(Westhoff and den Held, 1975; Rivas-Martinez *et al.*, 1980; Parent and Burny, 1981; Drachenfels *et al.*, 1984; Géhu and Géhu-Franck, 1984a; Dijkema *et al.*, 1984; Peinado Lorca and Rivas-Martinez, 1987; Alcaraz Ariza and Peinado Lorca, 1987)
- 15.21** **FLAT-LEAVED CORDGRASS SWARDS**
Perennial pioneer grasslands of coastal salt muds, dominated by flat-leaved *Spartina maritima*, *S. townsendii*, *S. anglica*, *S. alterniflora*.
- 15.22** **RUSH-LEAVED CORDGRASS SWARDS**
Perennial pioneer grasslands of southern Iberian coastal salt muds, dominated by the junciform-leaved *Spartina densiflora*.
- 15.3** **ATLANTIC SALT MEADOWS**
Glauco-Puccinellietalia maritimae
Salt meadows of Baltic, North Sea, Channel and Atlantic shores. *Aster tripolium* can be present or abundant in most subdivisions.
(Géhu *et al.*, 1975; Géhu and Delzenne, 1975; Duvigneaud, 1975; Westhoff and den Held, 1975; Parent and Burny, 1981; Dijkema *et al.*, 1984; Drachenfels *et al.*, 1984; Géhu and Géhu-Franck, 1984a; Géhu, 1984, 1986; Noirfalise, 1986; Peinado Lorca and Rivas-Martinez, 1987; Ellenberg, 1988; Oberdorfer, 1990)
- 15.31** **SALTMARSH GRASS MEADOWS**
Puccinellion maritimae
Bright green lawns of *Puccinellia maritima* of the lower and middle schorre.

15 Salt marshes, salt steppes and gypsum scrubs

- 15.32** **SALTMARSH GRASS COMMUNITIES**
Puccinellion maritimae p.
 Facies of the saltmarsh grass meadows, transitional or not to other communities, in which species other than *Puccinellia maritima* take on an important physiognomic role.
- 15.321** **Sea purslane-saltmarsh grass meadows**
 Facies of the saltmarsh grass meadows resulting from their invasion by *Halimione portulacoides*.
- 15.322** **Sea aster-saltmarsh grass meadows**
 Lower schorre communities dominated by the conspicuous *Aster tripolium*.
- 15.323** **Glasswort-saltmarsh grass meadows**
 Transitional communities of the lower schorre, with *Puccinellia maritima*, annual *Salicornia* and *Suaeda maritima*.
- 15.324** **Stalked orache beds**
 Formations dominated by the rare, threatened *Halimione pedunculata*, developing very locally in the *Puccinellion maritimae* of Denmark, Germany, the Netherlands, Belgium and France, extinct in the British Isles.
- 15.33** **UPPER SCHORRE COMMUNITIES**
Armerion maritimae
 Often relatively species-rich, grassy, flowery formations of upper salt meadows, with *Armeria maritima*, *Glaux maritima*, *Plantago maritima*, *Frankenia laevis*, *Artemisia maritima*, *Festuca rubra*, *Agrostis stolonifera*, *Juncus gerardii*, *Carex extensa* and *Blysmus rufus*. The dominance of various species induces distinctive facies, among which:
- 15.331** *Juncus gerardii*-rich or -dominated formations
- 15.332** *Plantago maritima*-dominated formations
- 15.333** *Festuca rubra* or *Agrostis stolonifera* swards
- 15.334** Thrift (*Armeria maritima*) swards
- 15.335** *Carex distans* beds
- 15.336** *Carex extensa*-rich formations
- 15.337** Sea lavender (*Limonium vulgare*) meadows
- 15.338** *Blysmus rufus*-rich formations
- 15.339** *Eleocharis uniglumis* or *E. palustris* beds
- 15.33A** *Juncus maritimus* beds
- 15.33B** Sea wormwood (*Artemisia maritima*) scrub
- 15.33C** *Potentilla anserina* carpets
- 15.33D** Sea-heath (*Frankenia laevis*) mats
- 15.33E** Upper schorre sea aster (*Aster tripolium*) beds
- 15.34** **PEARLWORT-SALTMARSH GRASS SWARDS**
Puccinellio-Spergularion salinae
Puccinellia swards with *Spergularia marina*, *Puccinellia distans*, *P. fasciculata*, *P. retroflexa*, *P. maritima*, *Triglochin maritima*, *Potentilla anserina* and *Halimione portulacoides*, occupying zones of varying salinity and humidity, in particular in estuarine saltmarshes.

- 15.35** **SALTMARSH COUCH BEDS**
Agropyron pungentis
Nitrophilous tall grass communities with *Elymus pycnanthus* (= *Agropyron pungens*) or *E. repens*.
- 15.36** **ATLANTIC SALTMARSH DRIFTLINES**
Annual formations of pioneers colonizing driftlines forming within saltmarshes, with *Atriplex littoralis*, *A. hastata*, *Beta maritima*, *Matricaria maritima*.
- 15.4** **CONTINENTAL SALT MEADOWS**
Puccinellietalia distantis
Salt meadows of salt basins of interior middle Europe. Continental saltmarshes are remarkable, extremely threatened communities occurring in a few isolated stations of Saxony and Lower Saxony, Schleswig-Holstein, Thuringe, Hesse, Lorraine, Auvergne and the Midlands. They comprise this unit and continental glasswort swards (15.112). (Duvigneaud, 1967; Drachenfels *et al.*, 1984; Géhu, 1984; Géhu and Rivas-Martinez, 1984; Géhu and Géhu-Franck, 1984a; Dejou, 1985; Peinado Lorca and Rivas-Martinez, 1987; Ellenberg, 1988; Oberdorfer, 1990)
- 15.41** **INTERIOR SALTMARSH GRASS MEADOWS**
Puccinellion distantis
Meadows of *Puccinellia distans* occupying the lower levels of interior salt basins with fairly extended periods of inundation.
- 15.42** **INTERIOR SALTMARSH RUSH AND COUCH BEDS**
Juncion gerardii p.
Formations dominated by *Juncus gerardii* or *Elymus repens* of the upper levels of interior salt basins on damp, less saline soils.
- 15.43** **INTERIOR STALKED ORACHE BEDS**
Formations dominated by the threatened *Halimione pedunculata* restricted to saltmarshes east and south of the Harz.
- 15.5** **MEDITERRANEAN SALT MEADOWS**
Juncetalia maritimi
Salt meadows of the Mediterranean coasts and of interior Iberian salt basins. (Bolos and Molinier, 1958; De Jong, 1965; Bolos, Molinier and Montserrat, 1970; Guinochet and Vilmorin, 1973; Horvat *et al.*, 1974; Rivas-Martinez, 1975a; Rivas-Martinez and Costa, 1975; Castroviejo and Costa, 1975; Izco and Cirujano, 1975; Lavagne and Moutte, 1977; Molinier and Martin, 1980; Lahondère, 1982; Géhu and Rivas Martinez, 1984; Géhu and Géhu-Franck, 1984a; Géhu, Costa *et al.*, 1984; Chiappini, 1985a; Peinado Lorca and Rivas-Martinez, 1987)
- 15.51** **MEDITERRANEAN TALL RUSH SALTMARSHES**
Juncion maritimi p.
Beds of *Juncus maritimus* or *J. acutus* of periodically inundated depressions, with *Carex extensa*, *Iris spuria*, *Gladiolus communis*, *Aster tripolium*, *Sonchus maritimus*, *S. crassifolius*.
- 15.52** **MEDITERRANEAN SHORT RUSH, SEDGE, BARLEY AND CLOVER SALTMARSHES**
Trifolion maritimi, Juncion maritimi p.
Humid meadows of low vegetation dominated by *Juncus gerardii*, *Carex divisa*, *C. extensa*, *Hordeum marinum* or *Trifolium spp.* and *Lotus spp.* of the edges of brackish lagoons.
- 15.53** **MEDITERRANEAN HALO-PSAMMOPHILE MEADOWS**
Plantaginion crassifoliae
Drier, dense formations of sandy soils at the foot of dunes, or between dunes and lagoons, with *Plantago crassifolia*, *Schoenus nigricans*, *Juncus acutus*, *J. littoralis*, *Spartina versicolor*, all of which may dominate and form physiognomically distinct, sometimes almost monospecific, facies.

- 15.54** INTERIOR IBERIAN SALT PAN MEADOWS
Puccinellion fasciculatae
Salt meadows peculiar to the lowest, wettest parts of interior Iberian depressions, dominated by *Puccinellia fasciculata* or *Aeluropus littoralis* in the very lowest areas, or, slightly higher, by *Juncus gerardii*. The higher, drier ground that surrounds them is occupied either by other salt meadow communities that are less differentiated from the coastal communities (15.51-15.53) or by salt scrubs (15.615).
- 15.55** MEDITERRANEAN SALT MARSH GRASS SWARDS
Puccinellion festuciformis
Dense formations of *Puccinellia festuciformis* and *Aeluropus littoralis* along Mediterranean coasts and coastal lagoons.
- 15.56** MEDITERRANEAN SALT MARSH DRIFTLINES
Thero-Suaedion
Communities of annuals forming on accumulations of organic debris in saltmarshes, with *Atriplex*, *Suaeda*, *Kochia*, *Salsola soda*.
- 15.57** SALT MARSH COUCH-WORMWOOD STANDS
Agropyro-Artemision coerulescentis i.a.
Formations of *Elymus* or *Artemisia* fringing Mediterranean and interior Iberian saline wetlands.
- 15.58** FINE-LEAVED RUSH BEDS
Arthrocnemetalia fruticosi p.
Medium-tall *Juncus subulatus* beds, often forming facies within *Arthrocnemum* scrubs.
- 15.6** SALT MARSH SCRUBS
Arthrocnemetea fruticosi
Scrubby formations of woody glassworts (*Arthrocnemum*), seablites (*Suaeda*), *Halimione*, *Halocnemum* or *Limoniastrum* of saltmarshes and of their immediate vicinity. (Bolos and Molinier, 1960; Bolos *et al.*, 1970; Guinochet and Vilmorin, 1973; Horvat *et al.*, 1974; Géhu and Delzenne, 1975; Géhu *et al.*, 1975; Castroviejo and Porta, 1975; Géhu and Géhu-Franck, 1977; Géhu *et al.*, 1978; Molinier and Martin, 1980; Parent and Burny, 1981; Géhu, 1984, 1986; Géhu and Rivas-Martinez, 1984; Rivas Martinez, Alcaraz *et al.*, 1984; Géhu, Costa *et al.*, 1984; Rivas-Martinez and Costa, 1984; Peinado Lorca *et al.*, 1984; Géhu and Géhu-Franck, 1984a; Chiappini, 1985a; Peinado Lorca and Rivas-Martinez, 1987; Wildpret de la Torre and del Arco Aguilar, 1987)
- 15.61** MEDITERRANEAN SALT SCRUBS
Arthrocnemion fruticosi, *Suaedion brevifoliae*
Low shrubby expanses of woody glassworts, seablites, sea purslanes or *Halocnemum*, characteristic of temporarily inundated salt marshes of Mediterranean coasts, south-western Iberian coasts and interior Iberian basins. They can be further subdivided according to dominant species, generally associated with patterns of inundation. *Cistanche lutea* characterizes many southern formations.
- 15.611** Creeping glasswort mats
Arthrocnemion perennis: *Puccinellio festuciformis*-*Arthrocnemetum perennis*, *Halimion portulacoidis*-*Sarcocornietum alpini*
Prostrate *Arthrocnemum perenne* carpets of wettest areas of coastal marshes.
- 15.612** Shrubby glasswort thickets
Arthrocnemion fruticosi: *Puccinellio festuciformis*-*Arthrocnemetum fruticosi*, *Cistancho luteae*-*Arthrocnemetum fruticosi*
Formations of robust *Arthrocnemum fruticosum*, capable of forming extensive low, dense thickets.
- 15.613** Glaucous glasswort thickets
Arthrocnemion glauci
Shrubby formations of *A. glaucum*, often occupying somewhat drier sites such as shell banks in saline lagoons.

- 15.614** **Shrubby seablite thickets**
Arthrocnemion fruticosi: *Halimiono-Suaedetum verae*
Shrubs of *Suaeda vera* occupying drier elevations of coastal saltmarshes.
- 15.615** **Interior Iberian salt scrubs**
Suaedion brevifoliae
Formations of woody glassworts and seablites of Iberian interior salt basins.
- 15.6151** **Interior woody seablite scrubs**
Suaeda pruinosa (*S. fruticosa* var. *brevifolia*) formations of Iberian interior salt basins.
- 15.6152** **Interior glaucous glasswort scrubs**
Arthrocnemum glaucum formations of Iberian interior salt basins.
- 15.6153** **Interior creeping glasswort scrubs**
Arthrocnemum perenne formations of Iberian interior salt basins.
- 15.616** **Mediterranean sea-purslane-woody glasswort scrubs**
Halimione portulacoides-rich facies within Mediterranean *Arthrocnemum* communities.
- 15.617** **Halocnemum scrub**
Halocnemion strobilaceae
Rare and local formations dominated by the tall, often sparse, clumps of *Halocnemum strobilaceum*, usually associated with *Arthrocnemum glaucum*, sometimes with *A. fruticosum*, of south-eastern Spain, Sardinia, Sicily and Greece.
- 15.62** **ATLANTIC SALT SCRUBS**
Halimionion portulacoidis
Sea purslane, glasswort and seablite scrubs of northern Atlantic and North Sea coasts.
- 15.621** **Silver scrubs**
Halimionetum portulacoidis, *Bostrychio-Halimionetum portulacoidis*
Shrubby *Halimione portulacoides* communities of middle levels of Atlantic scorres.
- 15.622** **Atlantic creeping glasswort mats**
Puccinellio maritimae-Arthrocnemetum perennis p.
Arthrocnemum perenne-dominated formations of the British Isles, the Atlantic coasts of France and of Iberia, except for the extreme south-west of the peninsula.
- 15.623** **Atlantic shrubby seablite scrubs**
Agropyro-Suaedetum verae
Suaeda vera-dominated formations of the British Isles, the Atlantic coasts of France and of Iberia, except for the extreme south-west of the peninsula.
- 15.624** **Atlantic shrubby glasswort scrubs**
Puccinellio maritimae-Arthrocnemetum fruticosi
Arthrocnemum fruticosum-dominated formations of the Atlantic coasts of France and of Iberia, except for the extreme south-west of the peninsula.
- 15.63** **LIMONIASTRUM SCRUBS**
Limoniastrion monopetali i.a.
Formations of often large, silver-glaucous shrubs of *Limoniastrum monopetalum* with showy pink flowers in late spring, of drier parts of Mediterranean and Iberian salt marshes.
- 15.64** **CANARIAN SALT MARSH SCRUBS**
Arthrocnemetalia fruticosi p.
Low shrubby expanses of woody glassworts, seablites, sea purslanes or *Zygophyllum*, characteristic of temporarily inundated salt marshes of Canary Island coasts.
- 15.641** **Canarian creeping glasswort scrubs**
Formations of *Arthrocnemum perenne* occupying the lowest level of the salt marshes of the coasts of Fuerteventura, Lanzarote and Isla de Lobos.

15 Salt marshes, salt steppes and gypsum scrubs

- 15.642** *Zygophyllum saltmarshes*
Zygophyllo fontanesii-Arthrocnemetum macrostachyi
 Formations of the Canario-Saharan halophyte *Zygophyllum fontanesii*, associated with *Arthrocnemum glaucum*, of the higher level of the saltmarshes of the eastern islands and, very locally, of Alegranza and La Graciosa.
- 15.643** **Canarian *Salsola* saltmarshes**
 Formations of *Salsola longifolia*, often dense and sometimes up to 2 metres high, of Canary Island coastal marshes, barranco openings and lagoons.
- 15.7** **SEMI-DESERT SALT SCRUBS**
 Halophile shrub formations of dry ground in low-precipitation areas of the Iberian peninsula, Sicily and the Macaronesian Islands.
- 15.71** **CANARIAN XERO-HALOPHILOUS SCRUBS**
Chenoletalia tomentosae
 Shrubby formations of *Zygophyllum fontanesii*, *Chenoleoides tomentosa*, sea-heath, salt-worts and seabites of the vicinity of the coasts of the Canary Islands.
 (Wildpret de la Torre and del Arco Aguilar, 1987; Serrada *et al.*, 1988)
- 15.711** **Canarian coastal scrub**
Chenoletalia tomentosa: Chenoleion tomentosae
 Formations of *Chenoleoides tomentosa*, *Suaeda vermiculata*, *Frankenia laevis*, *Zygophyllum fontanesii*, *Polycarpaea nivea*, *Atriplex halimus*, *A. glauca* and *Limonium spp.* forming a halophile belt in the littoral zone of the larger Canary Islands and, with somewhat modified composition, of the islets.
- 15.712** ***Zygophyllum* dry scrubs**
 Formations of *Zygophyllum fontanesii* of sandy stone fields and black sands of the coastal zone of the Canary Islands.
- 15.713** ***Salsola longifolia* dry scrubs**
 Formations of *Salsola longifolia* of dry coastal areas of the Canary Islands.
- 15.72** **MEDITERRANEAN HALO-NITROPHILOUS SCRUBS**
Salsolo-Peganetalia
 Nitrophilous scrubby formations typically of dry soils and arid climates, often greyish-white and semi-desert-like, sometimes including taller, denser brushes. They are most frequent in the eastern Iberian peninsula, where characteristic shrubs include *Peganum harmala*, *Artemisia herba-alba*, *Lycium intricatum*, *Capparis ovata* and the Chenopodiaceae *Salsola vermiculata*, *S. genistoides*, *S. verticillata*, *Suaeda pruinosa*, *Atriplex halimus*, *A. glauca*, *Camphorosma monspeliaca*, *Anabasis articulata* and *Haloxylon articulatum*.
 (Braun-Blanquet and Bolos, 1957; Delvosalle and Duvigneaud, 1962; Freitag, 1971; Bolos, 1973; Polunin and Smythies, 1973; Rivas-Martinez, 1977; Bellot, 1979; Brullo *et al.*, 1980; Peinado-Lorca *et al.*, 1984; Peinado and Martinez-Parras, 1984; Géhu, 1984; Géhu and Rivas Martinez, 1984; Peinado Lorca and Rivas-Martinez, 1987)
- 15.721** **Ebro sisallares**
 Interior, extensive and varied, halo-nitrophilous scrubs of the Ebro basin, comprising both dry ground sisallares proper, as well as various more hygrophile communities of edges of salt lagoons.
- 15.722** **Manchegan sisallares**
 Halo-nitrophilous scrubs of La Mancha, in the central Iberian peninsula, formed of communities related to those of the Ebro.
- 15.723** **Catalano-Valencian halo-nitrophilous scrubs**
 Local halo-nitrophilous scrubs of the coasts of Catalonia, Valencia and the Balearics.
- 15.724** **South-eastern Iberian matojares**
 Halo-nitrophilous scrubs, matojares and related communities, of the arid zone of south-eastern Spain, forming, with predesert scrubs (32.25) and localized gypsum scrubs (15.93), the unique vegetation of this highly distinctive region.

- 15.725** **Sicilian halo-nitrophilous scrubs**
Halo-nitrophilous scrubs of south-western Sicily, with *Salsola verticilata*, *Suaeda pruinosa*, *Reaumuria vermiculata*, *Capparis ovata* and the endemics *Limonium opulentum* and *Herniaria fontanesii* ssp. *empedocleana*.
- 15.8.** **MEDITERRANEAN SALT STEPPES**
Limonietalia
Associations rich in perennial, rosette-forming *Limonium* spp. or esparto grass, *Lygeum spartum*, occupying, along Mediterranean coasts and on the fringes of Iberian salt basins, soils temporarily permeated (though not inundated) by saline water and subject to extreme summer drying, with formation of salt efflorescences.
(Braun-Blanquet and Bolos, 1957; Bolos, 1973; Castroviejo and Porta, 1975; Rivas-Martinez and Costa, 1984; Peinado-Lorca *et al.*, 1984; Géhu and Géhu-Franck, 1984a; Géhu, Costa *et al.*, 1984; Géhu, 1984; Rivas-Martinez and Costa, 1985; Peinado Lorca and Rivas-Martinez, 1987)
- 15.81** **SEA-LAVENDER SALT STEPPES**
Limonium-rich facies of the salt steppes.
- 15.82** **ESPARTO SALT STEPPES**
Saltmarsh and saltmarsh fringe formations of *Lygeum spartum* of coastal Crete, coastal and interior Iberia.
- 15.9** **IBERIAN GYPSUM SCRUBS**
Gypsophiletalia
Garrigues occupying gypsum-rich soils of the Iberian peninsula, usually very open and floristically characterized by the presence of numerous gypsophilous species, among which *Gypsophila struthium*, *G. hispanica*, *Centaurea hyssopifolia*, *Teucrium libanitis*, *Ononis tridentata*, *Lepidium subulatum*, *Herniaria fruticosa*, *Reseda stricta*, *Helianthemum squamatum*. They are often rich in thymes (*Thymus*), germanders (*Teucrium*), rockroses (*Helianthemum*), composites (*Centaurea*, *Jurinea*, *Santolina*), *Frankenia*.
(Rivas Goday, 1955; Delvosalle and Duvigneaud, 1962; Rivas Goday and Rivas-Martinez, 1968; Rivas-Martinez and Costa, 1970; Bolos, 1973; Bellot, 1979; Géhu, 1984; Peinado Lorca and Rivas-Martinez, 1987)
- 15.91** **CENTRAL IBERIAN GYPSUM SCRUBS**
Lepidion subulati
Low garrigues dotted with occasional tall bushes, developed on gypseous soils which are often covered by a crust of lichens, generally rich in *Centaurea hyssopifolia* and often in *Gypsophila struthium*, *Lepidium subulatum*, *Thymus zygis* or *Jurinea pinnata*. They are limited to the Meseta and eastern Andalusia.
- 15.911** **Meseta gypsum scrubs**
Formations of the central Meseta dominated by, or rich in, *Centaurea hyssopifolia*.
- 15.912** **Eastern Andalusian gypsum scrubs**
Formations of eastern Andalusia (Armeria, Granada) dominated by, or rich in, *Centaurea hyssopifolia*, *Jurinea pinnata* or *Gypsophila struthium*.
- 15.913** **Dueran gypsum scrubs**
Formations of the central Duero with *Linum suffruticosum* and *Lepidium subulatum*.
- 15.92** **EBRO GYPSUM SCRUBS**
Gypsophilion hispanicae
Open low garrigues of eroded gypsiferous hills of the Ebro basin and of the upper Turia region, with *Gypsophila hispanica*.
- 15.921** ***Gypsophila hispanica* garrigues**
Open formations dominated by, or very rich in, *Gypsophila hispanica*, the most widespread north-eastern gypsum scrub component.
- 15.922** ***Helianthemum squamatum* garrigues**
Formations of *Helianthemum squamatum*, often very homogeneous.

15.923

Ononis tridentata garrigues

Formations of somewhat deeper calcaro-gypsiferous soils, rich in *Ononis tridentata*.

15.93

SOUTH-EASTERN GYPSUM SCRUBS

Thymo-Teucrium verticillati

Low, open thyme, germander and rockrose garrigues colonizing poorly developed gypsiferous soils of the arid south-east of the Iberian peninsula (Alicante and Murcia). Characteristic elements are *Teucrium libanitis* (*T. verticillatum*), *T. polium*, *T. pumilum*, *T. carthaginense*, *Thymus longiflorus*, *T. antoninae*, *Helianthemum lavandulifolium* (*H. racemosum*), *H. squamatum*, *Gypsophila hispanica*, *G. struthium*, *Astragalus alopecuroides*. Grasses (*Lygeum*, *Stipa*, *Brachypodium*), wormwood (*Artemisia*) and Chenopodiaceae may be locally prominent.

16 Coastal sand-dunes and sand beaches

Sand-covered shorelines in general, but in particular, onshore areas of sand created by the action of wind and often colonized and stabilized by communities of coarse maritime grasses.

- 16.1 SAND BEACHES**
Gently sloping sand-covered shorelines fashioned by wave action.
- 16.11 UNVEGETATED SAND BEACHES**
Sandy beaches devoid of phanerogamic vegetation. Mediolittoral (intertidal) and supralittoral invertebrate communities can be used to define subdivisions.
(Augier, 1982)
- 16.12 SAND BEACH ANNUAL COMMUNITIES**
Cakiletea maritima (*Atriplici-Salsolion kali* = *Salsolo-Honkenyion peploidis*, *Thero-Suaedion*, *Euphorbion peplis p.*)
Formations mostly of annuals occupying accumulations of drift material and sands rich in nitrogenous organic matter; characteristic are *Suaeda maritima*, *Bassia hirsuta*, *Cakile maritima*, *Salsola kali*, *Beta maritima*, *Atriplex spp.*, *Glaucium flavum*, *Mertensia maritima*, *Polygonum spp.* and, along Mediterranean coasts, *Euphorbia peplis*, *E. paralias*.
(Guinochet and Vilmorin, 1973; Horvat *et al.*, 1974; Westhoff and den Held, 1975; Molinier and Martin, 1980; Lahondère, 1980; Parent and Burny, 1981; Géhu and Géhu-Franck, 1984a; Géhu, Costa *et al.*, 1984; Nordiska ministerradet, 1984; Géhu, 1984, 1985; Peinado Lorca and Rivas-Martinez, 1987; Ellenberg, 1988; Oberdorfer, 1990)
- 16.13 SAND BEACH PERENNIAL COMMUNITIES**
Honkenyo-Elymion
Boreal halo-nitrophilous perennial vegetation of the upper beach formed by *Leymus (Elymus) arenarius*, *Ammophila arenaria*, *Honkenya peploides*, *Elymus farctus*, *E. repens*, *Mertensia maritima*, accompanied by *Atriplex spp.*, *Cakile maritima*, *Petasites spurius*, limited to the Baltic and the northern North Sea.
(Nordiska ministerradet, 1984; Géhu, 1985; Oberdorfer, 1990)
- 16.2. DUNES**
Onshore wind-carried sand deposits arranged in cordons of ridges parallel to the coast.
- 16.21 SHIFTING DUNES**
Agropyron juncei, *Ammophilon arenariae*, *Zygophyllion fontanesii*
Mobile sands, unvegetated or occupied by open grasslands; they may form tall dune ridges or, particularly along the Mediterranean, be limited to a fairly flat upper beach, still subject in part to inundation.
(Braun-Blanquet *et al.*, 1972; Guinochet and Vilmorin, 1973; Horvat *et al.*, 1974; Diez *et al.*, 1975; Westhoff and den Held, 1975; Lahondère, 1980; Molinier and Martin, 1980; Parent and Burny, 1981; Géhu, Costa *et al.*, 1984; Géhu, 1985, 1986; Peinado Lorca and Rivas-Martinez, 1987; Wildpret de la Torre and del Arco Aguilar, 1987; Serrada *et al.*, 1988; Ellenberg, 1988; Machado, *in litt.*, 1989; Oberdorfer, 1990)
- 16.211 Embryonic dunes**
Agropyron juncei (*Agropyro-Honkenyion*)
The first stages of dune construction, constituted by ripples or raised sand surfaces of the upper beach or by a seaward fringe at the foot of the tall dunes.
- 16.2111 Atlantic embryonic dunes**
Elymo-Agropyretum juncei, *Euphorbio-Agropyretum juncei*
Embryonic dunes of the Atlantic, the North Sea and the Baltic coasts, with *Elymus farctus* (*Agropyron junceum*) accompanied by *Leymus arenarius* in the north, by *Euphorbia paralias* on middle and southern Atlantic shores.

- 16.2112** **Mediterranean embryonic dunes**
Agropyron juncei: *Agropyretum mediterraneum*
 Embryonic dunes of the Mediterranean coasts, on which *Elymus farctus* is accompanied by *Sporobolus pungens*, *Euphorbia peplis*, *Otanthus maritimus*, *Medicago marina*, *Anthemis maritima*, *A. tomentosa*, *Eryngium maritimum*, *Pancratium maritimum*.
- 16.212** **White dunes**
Ammophilion arenariae, *Zygophyllion fontanesii*
 Mobile dunes forming the seaward cordon or cordons of dune systems.
- 16.2121** **Atlantic white dunes**
Ammophilion arenariae: *Elymo-Ammophiletum*, *Euphorbio-Ammophiletum*, *Othanto-Ammophiletum*
 White dunes of the North Sea, the Baltic and the Atlantic coasts, dominated, when vegetated, by marram grass (*Ammophila arenaria*) accompanied by, among others, *Eryngium maritimum*, *Euphorbia paralias*, *Calystegia soldanella*, *Otanthus maritimus*.
- 16.2122** **Mediterranean white dunes**
Ammophilion arenariae: *Echinophoro-Ammophiletum*
 White dunes of the Mediterranean coasts, dominated, when vegetated, by marram grass (*Ammophila arenaria*) accompanied by, among others, *Echinophora spinosa*, *Eryngium maritimum*, *Euphorbia paralias*, *Cutandia maritima*, *Medicago marina*, *Anthemis maritima*.
- 16.2123** **Canarian white dunes**
Zygophyllion fontanesii
 Mobile dunes of the Canary Islands, with *Zygophyllum fontanesii*, *Euphorbia paralias*, *Polycarpea nivea*, *Cyperus capitatus*, *Ononis natrix*, *Convolvulus caput-medusae*, *Polygonum maritimum* and the threatened Lanzarote endemic lily *Androcymbium psammophilum*.
- 16.22** **GREY DUNES**
 Fixed dunes, stabilized and colonized by more or less closed perennial grasslands. (Zarzycki, 1961; Braun-Blanquet *et al.*, 1972; Guinochet and Vilmorin, 1973; Horvat *et al.*, 1974; Westhoff and den Held, 1975; Diez *et al.*, 1975; Géhu and Foucault, 1977; Rivas-Martinez, 1977; Lahondère, 1980; Molinier and Martin, 1980; Parent and Burny, 1981; Géhu, Costa *et al.*, 1984; Chiappini, 1985a; Veri and Pacioni, 1985; Géhu, 1985, 1986; Peinado Lorca and Rivas-Martinez, 1987; Wildpret de la Torre and del Arco Aguilar, 1987; Serrada *et al.*, 1988; Ellenberg, 1988; Machado, *in litt.*, 1989; Oberdorfer, 1990)
- 16.221** **Northern grey dunes**
Galio-Koelerion albescentis (*Koelerion albescentis*), *Corynephorion canescentis* p., *Sileno conicae-Cerastion semidecandri*
 Grasslands of Baltic, North Sea, Channel and northern Atlantic fixed dunes.
- 16.2211** **Tortula moss dune communities**
 Calciphile communities with *Koeleria*, *Galium verum*, *Viola curtisii*, *Ononis repens*, *Festuca rubra*, and moss (e.g. *Tortula ruraliformis*) and lichen carpets.
- 16.2212** **Grey-hairgrass dune communities**
 Communities of less calcareous or decalcified slopes rich in *Corynephorus canescens* and *Viola canina*.
- 16.2213** **Mouse-ear dune communities**
 Short-lived, warmth-loving mouse-ear dune communities with *Cerastium diffusum*, *C. semidecandrum*, *C. subtetrandrum*, *Erodium lebelii*, *Phleum arenarium*, *Silene conica*.
- 16.222** **Biscay grey dunes**
Euphorbio-Helichryson stoechadis
 Fixed dune grasslands infiltrated by dwarf bushes of French Brittany and the coast of the Bay of Biscay, with *Helichrysum stoechas*, *Artemisia campestris*, *Ephedra distachya*.

- 16.223 Ibero-Mediterranean grey dunes**
Crucianellion maritimae
Fixed dunes of the western Mediterranean and of the thermo-Atlantic coasts of Portugal and south-western Spain, with *Crucianella maritima* and *Pancratium maritimum*.
- 16.224 Greek fixed dunes**
Formations of Greece with *Euphorbia terracina* and *Silene nicaeensis* or *Ephedra distachya* and *Silene subconica*.
- 16.225 Dune Mesobromion grasslands**
Dunal grasslands composed of species characteristic of dry calcareous grasslands (34.32), particularly of northern Brittany (*Galio maritimi-Brachypodietum pinnati*).
- 16.226 Dune thermophile fringes**
Trifolio-Geranietea sanguinei: *Galio maritimi-Geranion sanguinei*
Geranium sanguineum formations (34.4) incorporated within grey dune systems of the British Isles and Brittany.
- 16.227 Dune fine-grass annual communities**
Thero-Airion p., *Nardo-Galion saxatile p.* (*Botrychio-Polygaletum*), *Tuberarion guttatae p.*
Sparse pioneer formations (35.2, 35.3) of fine grasses rich in spring-blooming therophytes characteristic of oligotrophic, superficial soils.
- 16.228 Dune malcolmia annual-herb communities**
Malcolmietalia
Associations with many small annuals and often abundant ephemeral spring bloom (35.4), with *Malcolmia lacera*, *M. ramosissima*, *Evax astericiflora*, *E. lusitanica*, *Anthyllis hamosa*, *Linaria pedunculata*, of deep sands in dry interdunal depressions of Iberia, southern France and Italy.
- 16.229 Dune Mediterranean xeric grasslands**
Thero-Brachypodietalia p.
Dunal formations of 34.5.
- 16.22A Canarian fixed dunes**
Traganion moquini
Fixed dunes of the Canary Islands, forming, mostly in the centre and east of the archipelago, extensive systems (jables), with *Traganum moquini*, *Suaeda vera*, *Atriplex halimus*, *A. glauca* var. *ifniensis*, *Salsola longifolia*, *S. vermiculata*.
- 16.23 CROWBERRY BROWN DUNES**
Empetrium nigri
Decalcified dunes colonized by *Empetrum nigrum* heaths, of the Frisian, German, Danish and Scottish coasts.
(Westhoff and den Held, 1975; De Smidt, 1981; Géhu, 1985)
- 16.24 HEATHER BROWN DUNES**
Calluno-Ulicetea p.
Decalcified dunes of France and Britain, colonized by heaths of the *Calluno-Genistion* or the *Ulicion minoris*, and of Iberia, colonized by heaths of the *Ericion umbellatae*.
(Géhu, 1985)
- 16.241 East Anglian ling dunes**
Carici arenariae-Callunetum
Calluna vulgaris-Carex arenaria heaths of East Anglian inner dunes.
- 16.242 French ling dunes**
Carici trinervis-Callunetum
Calluna vulgaris-Carex trinervis heaths of northern French inner dunes.
- 16.243 British bell heather dunes**
Carici arenariae-Ericetum cinereae
Erica cinerea-Carex arenaria heaths of decalcified dunes of the west of the British Isles.

- 16.244** **French bell heather dunes**
Festuco vasconensis-Ericetum cinereae
Erica cinererea-Festuca vasconensis heaths of dry dunes of south-western France.
- 16.245** **French Dorset heath dunes**
Arrhenathero thorei-Ericetum ciliaris
Erica ciliaris-Pseudarrhenatherum longifolium (Arrhenatherum thorei) heaths of more humid dunes of south-western France.
- 16.246** **Iberian green heather dunes**
Erico scopariae-Ulicetum australis
Erica scoparia-Ulex parviflorus ssp. *eriocladus (U. australis)* heaths of south-western Iberian dunes.
- 16.247** **Iberian Dorset heath dunes**
Erico ciliaris-Ulicetum australis
Erica ciliaris-Ulex parviflorus ssp. *eriocladus* heaths of more humid south-western Iberian dunes.
- 16.25** **DUNE THICKETS**
Prunetalia spinosae p. (*Ligustro-Hippophaeion rhamnoidis, Lonicerion periclymeni, Pruno-Rubion ulmifolii* p., *Sam buco-Berberidion*)
Dense formations of large shrubs including sea-buckthorn, privet, elder, willow, gorse or broom, often festooned with creepers such as honeysuckle or white bryony. Codes of 31.8 can be used, in addition to 16.252, to specify the habitat.
(Westhoff and den Held, 1975; Lahondère, 1980; Parent and Burny, 1981; Géhu, 1985)
- 16.251** **Sea-buckthorn dune thickets**
Hippophae rhamnoides formations of forest colonization in both dry and humid dune depressions, mostly in Denmark, Germany, The Netherlands, Belgium and the British Isles.
- 16.252** **Mixed dune thickets**
Pre-forest thickets other than heaths, sea-buckthorn or creeping willow (*Ulex, Sarothamnus, Rubus, Ligustrum, Daphne*).
- 16.26** **CREEPING-WILLOW MATS**
Salicion arenariae
Salix arenaria formations of both dry and humid dune depressions.
(Géhu, 1985)
- 16.27** **DUNE JUNIPER THICKETS AND WOODS**
Juniperion lyciae; Berberidion p.
Juniper formations (*Juniperus phoenicea, J. lycia, J. macrocarpa, J. transtagana*) of dune slacks and slopes in Mediterranean and thermo-Atlantic areas; *J. communis* formations of calcareous Jutland dunes.
(Garcia and Purroy, 1973; Diez *et al.*, 1975; Westhoff and den Held, 1975; Rivas-Martinez *et al.*, 1980; Géhu, 1985; Peinado Lorca and Rivas-Martinez, 1987)
- 16.271** **Dune prickly juniper thickets**
Rhamno-Juniperetum macrocarpae i.a.
Juniperus oxycedrus ssp. *macrocarpa* thickets and low woods of the outer belt of the juniper woods of fixed Mediterranean and Mediterranean-Atlantic dunes.
- 16.272** **Lycian juniper woods**
Rhamno-Juniperetum lyciae i.a.
Juniperus phoenicea ssp. *lycia* thickets and woods of the inner belt of the juniper woods of fixed Mediterranean and Mediterranean-Atlantic dunes.
- 16.273** **Rufescent juniper thickets**
Scrubs of the fastigate *Juniperus oxycedrus* ssp. *transtagana* of the dunes of south-western Portugal.

- 16.274** **Common juniper dune thickets**
Juniperus communis scrubs of the calcareous dunes of Jutland.
- 16.28** **DUNE SCLEROPHYLLOUS SCRUBS**
Ononido-Rosmarinetea p., *Quercetea ilicis p.*, *Cisto-Lavanduletea p.*
Sclerophyllous scrubs established on dunes in the Mediterranean region. Codes of 32 may be used in addition to 16.28 to specify the habitat.
- 16.29** **WOODED DUNES**
Dunes colonized by woodland or riparian thickets. Codes of 41.5, 41.7, 42, 44, 45 can be used, in addition to 16.29, to specify the habitat.
(Diez *et al.*, 1975; Lahondère, 1980; Géhu, 1985)
- 16.3** **HUMID DUNE-SLACKS**
Humid depressions of the dunal systems. The most important habitats are included in the following units. If the divisions proposed are not sufficient, appropriate codes from 22.4, 22.3, 54.2, 54.4, 53 can be used in conjunction with them. Humid dune-slacks are extremely rich and specialized habitats very threatened by the lowering of water tables.
(Duvigneaud, 1947; Lebrun *et al.*, 1949; Herbauts, 1971; Westhoff and den Held, 1975; Lahondère, 1980)
- 16.31** **DUNE-SLACK POOLS**
Fresh-water aquatic communities (see 22.4) of permanent dune-slack water bodies.
- 16.32** **DUNE-SLACK PIONEER SWARDS**
Juncenion bufonii p.: *Gentiano-Erythraetum littoralis*
Pioneer formations of humid sands with *Samolus valerandi*, *Centaurium spp.*, *Blackstonia perfoliata*, *Juncus bufonius* (see 22.322).
- 16.33** **DUNE-SLACK FENS**
Calcareous and, occasionally, acidic fen formations (see 54.2, 54.4, in particular 54.21, 54.2H, 54.49), often invaded by creeping willow, occupying the wettest parts of dune-slacks.
- 16.34** **DUNE-SLACK GRASSLANDS**
Humid grasslands and rushbeds (see 37.31, 37.4) of dune-slacks, also often with creeping willows (*Salix rosmarinifolia*, *S. arenaria*).
- 16.35** **DUNE-SLACK REEDBEDS AND SEDGEBEDS**
Reedbeds and tall-sedge communities (see 53.1, 53.2, 53.3) of dune-slacks.

17 Shingle beaches

Beaches covered by pebbles, or sometimes boulders, usually formed by wave action.

- 17.1 UNVEGETATED SHINGLE BEACHES**
Shingle beaches devoid of phanerogamic vegetation. Mediolittoral (intertidal) and supralittoral invertebrate communities can be used to define subdivisions.
(Augier, 1982)
- 17.2 SHINGLE BEACH DRIFT LINES**
Cakiletea maritima p.
Formations of annuals occupying accumulations of drift material and gravels rich in nitrogenous organic matter; characteristic are *Cakile maritima*, *Salsola kali*, *Atriplex* spp. (particularly *A. glabriuscula*), *Polygonum* spp., *Euphorbia pepelis*, *Mertensia maritima*, *Glaucium flavum*, *Matthiola sinuata*.
(Nordiska ministerradet, 1984; Géhu, 1984, 1985; Costa, 1987)
- 17.3 SEA KALE COMMUNITIES**
Honkenyo-Crambion
Halo-nitrophilous perennial vegetation of the upper beach formed by *Crambe maritima*, *Honkenya peploides* and species characteristic of the regional communities as indicated below.
(Vanden Bergen, 1964; Nordiska ministerradet, 1984; Géhu, 1985, 1986; Oberdorfer, 1990)
- 17.31 BALTIC SEA KALE COMMUNITIES**
Elymo-Crambetum
Crambe-Honkenya formations with *Leymus arenarius* of the coasts of the southern Baltic, the Kattegat and the baelts.
- 17.32 CHANNEL SEA KALE COMMUNITIES**
Lathyro-Crambetum
Crambe-Honkenya formations with *Lathyrus japonicus* of the southern North Sea and Channel coasts of south-western England and, very locally, the Channel coast of France.
- 17.33 ATLANTIC SEA KALE COMMUNITIES**
Crithmo-Crambetum
Crambe-Honkenya formations with *Crithmum maritimum* of Brittany, the Cotentin peninsula and Anglesey.
- 17.4 GRAVEL BANK HEATHS AND GRASSLANDS**
Grasslands and heaths of the landward expanses of large gravel banks.
(Vanden Bergen, 1964; Nordiska ministerradet, 1984; Géhu, 1985, 1986)
- 17.41 GRAVEL BANK FALSE OATGRASS SWARDS**
Swards of *Arrhenatherum elatius* of gravel banks.
- 17.42 GRAVEL BANK BROOM MATS**
Prostrate *Cytisus scoparius* formations of gravel banks.

18 Cliffs and rocky shores

Rock exposures adjacent to the sea or to saline lakes, or separated from them by a narrow shoreline. In addition to their botanical significance, they are often important as nesting sites for sea birds.

- 18.1 BARE CLIFFS**
Cliffs and rocky shores devoid of vascular vegetation. The mediolittoral (intertidal or wave-washed) and supralittoral (spray) zones are inhabited by rich and diverse communities of invertebrates and algae that can be used to define subdivisions. A basic framework is proposed below; further subdivisions, such as the biocenoses and facies listed by Augier (1982) for the Mediterranean, can be easily integrated. (Augier, 1982; Mitchell, 1987; Wood, 1988)
- 18.11 MEDIOLITTORAL FRINGE ROCKS**
Cliffs and rocks of the lowest part of the mediolittoral zone, occupied by communities transitional to those of the infralittoral zone.
- 18.12 LOWER MEDIOLITTORAL ROCKS**
Cliffs and rocks of the lower part of the mediolittoral zone, occupied, in particular, by encrusting algae.
- 18.13 UPPER MEDIOLITTORAL ROCKS**
Cliffs and rocks of the higher part of the mediolittoral zone, occupied by communities characterized, in particular, by cirriped crustaceans and soft algae.
- 18.14 MEDIOLITTORAL CAVES AND OVERHANGS**
Mediolittoral overhangs, crevices and caves.
- 18.15 MEDIOLITTORAL ROCK POOLS**
Permanent saline pools of the mediolittoral zone, fed by flood tides (tide pools).
- 18.16 SUPRALITTORAL ROCKS**
Cliffs and rocks of the supralittoral spray zone, mostly occupied by lichens (*Verrucaria i.a.*).
- 18.17 SUPRALITTORAL ROCK POOLS**
Pools of variable salinity fed by rainwater, spray and occasionally waves.
- 18.2 VEGETATED SEA CLIFFS AND ROCKY SHORES**
Cliffs and rocky shores colonized by disjunct assemblages of aerohaline chasmophytes or by more or less closed aerohaline grasslands.
- 18.21 ATLANTIC CLIFF COMMUNITIES**
Crithmo-Armerietalia
Vegetated cliffs of the Atlantic, Channel, Irish and North Sea coasts with *Crithmum maritimum*, *Armeria maritima*, *Limonium spp.*, *Brassica oleracea*, *Silene maritima*, *Cochlearia officinalis*, *Plantago maritima*, *Festuca rubra ssp. pruinosa*, *Daucus spp.*, *Matricaria maritima*, *Asplenium marinum*, *Spergularia rupicola*, *Inula crithmoides*, *Sedum anglicum*, *Rhodiola rosea*, *Lavatera arborea*.
(Vanden Bergen, 1964; Guinochet and Vilmorin, 1973; Géhu, 1984; Géhu and Géhu-Franck, 1984a, 1984b; Géhu, Franck and Scoppola, 1984; Polunin and Walters, 1985)

18 Cliffs and rocky shores

18.22 MEDITERRANEAN CLIFF COMMUNITIES

Crithmo-Limonietalia

Vegetated cliffs and rocky shores of the Mediterranean and south-western Iberia, with *Crithmum maritimum*, *Plantago subulata*, *Silene sedoides*, *Sedum litoreum*, *Limonium spp.*, *Armeria spp.*, *Euphorbia spp.*, *Daucus spp.*, *Asteriscus maritimus*. Many *Limonium* species, in particular, are endemics of extremely local occurrence.

(Guinochet and Vilmorin, 1973; Horvat *et al.* 1974; Brullo *et al.*, 1977; Molinier and Martin, 1980; Géhu, 1984; Géhu, Franck and Scoppola, 1984; Polunin and Walters, 1985)

18.23 MACARONESIAN CLIFF COMMUNITIES

Frankenio-Astidamietalia latifoliae

Sea-cliffs of the Atlantic islands (Canaries, Madeira), with *Crithmum maritimum*, *Astydamia latifolia*, *Schizogyna sericea*, *Andryala glutinosa*, *Plantago coronopus*, *Tolpis fruticosa*, *Aizoon canariense*, *Campylanthus salsoloides*, *Limonium pectinatum*, *Frankenia ericifolia*, *Reichardia ligulata*, *Argyranthemum frutescens*, *Lotus spp.*, *Asplenium marinum*.

(Delvolsalle, 1964; Duvigneaud, 1977; Bramwell and Bramwell, 1983; Géhu, 1984; Wildpret de la Torre and del Arco Aguilar, 1987)

18.24 AZOREAN CLIFF COMMUNITIES

Festucion petraeae

Communities of the cliffs of the Azores dominated by the endemic *Festuca petraea*.

(Machado, *in litt.*, 1989)

18.3 VEGETATED CLIFFS OF SALINE LAKES

Crithmo-Limonietalia: Limonietum secundiramei

Endemic *Limonium secundirameum*-dominated formations of the cliffs overlooking Bagno dell' Acqua, Pantelleria.

(Brullo *et al.*, 1977)

19 Islets and rock stacks

Small islands in the sea or in large bodies of water, mostly important as sites for water bird colonies. Other codes, in particular those of 18, can be used to indicate the habitats supported.

1A Machair

Plains behind dunes especially characteristic of the western seaboard of the Outer Hebrides. Wind-blown calcareous sands deposited on peat support a flower-rich, and correspondingly insect-rich, dune grassland studded with shallow lochs and cultivated on a strip rotation. The grassland is dominated by *Poa pratensis* and *Festuca rubra*, accompanied by *Thalictrum minus*, *Thymus drucei*, *Bellis perennis*, *Prunella vulgaris*, *Erodium cicutarium*, *Trifolium spp.*, *Euphrasia spp.* and many orchids, among which *Dactylorhiza fuchsii ssp. hebridensis*, *D. purpurella*, *Gymnadenia conopsea*, *Coeloglossum viride*, *Platanthera chlorantha* and *Orchis mascula* are the most prominent. This grassland harbours a plant community of very restricted distribution comprising vulnerable species; *Cochlearia scotica*, *Euphrasia marshallii* and *Dactylorhiza fuchsii ssp. hebridensis* are endemic. Other elements of the ecosystem, such as pools and fallow fields, can be noted by addition of codes from other units (22, 16.2, 34, 37, 53, 54, 82, 87). As a whole, machair is an essential habitat for breeding waders such as *Haematopus ostralegus*, *Vanellus vanellus*, *Charadrius hiaticula*, *Calidris alpina*, *Tringa totanus* and *Gallinago gallinago*; it supports the healthiest European population of the threatened corncrake *Crex crex*.

(Ritchie, 1976, 1979; Glentworth, 1979; Currie, 1979; Dickinson and Randall, 1979; Fuller *et al.*, 1979; Fuller, 1982; P. R. Evans, *in litt.*, 1985)