Notas do Herbário da Estação Florestal Nacional (LISFA): Fasc. XVII

XXXVI: The vegetation of Madeira: IV - Coastal Vegetation of Porto Santo Island (Archipelag of Madeira)

The littoral geomorphology of the Porto Santo Island is of paramount importance in the coastal phytocoenosis assemblage: the southern part of the island has an 8 km long sand beach with littoral sandstone platforms in its eastern extreme; sandstone or volcanic (mostly trachits) sea cliffs predominate in the rest of the island; in the northern part of the island, near the airport, there is an elevated dune (more than 150 m above sea level), related to an ancient island tilt. In the Porto Santo' s beach and cliff ecosystems, we found four new associations. All of them are finicolous associations in the context of their alliances, with low floristic diversity and presided by small area endemics.

1. ***Senecio incrassati-Mesembryanthe-metum crystallini*** Jardim, Sequeira, Capelo, Aguiar, J.C. Costa, Espírito-Santo & Lousã associatio nova hoc loco [*typus*: table 1, relevé #3] –

it is a halonitrophylous succulent annual pros-trate plant com-munity associated with dune systems disturbed by trampling or by the input of nitrogen compounds, either of natural or artificial origin. It is very similar to the canarian *Mesembryanthemetum cristalini* and is characterized by the two nominal plants together with *M. nodiflorum* and *Beta procumbens*. The *Senecio incrassati - Mesembryanthemetum cristalini* is not exclusive of mobile substrata: was also observed in Ponta de S. Lourenço (Madeira) in compact soils (variant with *Aizoon canariensis*).

Table 1 – *Senecio incrassati -Mesembryanthemetum crystallini*

# of relevé	3	4	6	7
m.s.m.	ca. 2	ca.2	ca.3	ca.5
Area	4	4	16	12
Cover	60	60	90	70
Characteristic combination				
Mesembryanthemum crystallinum	4	4	3	2
Senecio incrassatus	1	1	2	+
Beta procumbens	1	2	3	1
Mesembryanthemum nodiflorum	.	.	.	4
Characteristic of higher syntaxa				
Brachypodium distachyon	.	.	+	.
Bromus rigidus	.	.	1	.
Chenopodium murale	.	.	+	.
Asphodelus fistulosus	.	.	1	.
Emex spinosa	.	.	1	1
Euphorbia terracina	.	.	+	.
Lavatera cretica	.	.	1	+
Lolium rigidum	.	.	2	.
Medicago polymorpha	.	.	1	.
Scorpiurus muricatus	.	.	.	+
Sonchus tenerrimus	.	.	+	.
Spergularia marina	.	.	+	.
Companions				
Salsola kali	+	+	.	.
Hedypnois cretica	.	.	1	.
Cynodon dactylon	.	.	+	.
Cyperus rotundus	.	.	+	.

Porto Santo, Vila Baleira: 3 and 4: near the harbour, 6, 7 fallow ground on sandy soil. Contact with Salsolo-Cakiletum.

[taxonomical nomenclature follows: PRESS & SHORT (1994) *Flora of Madeira*. BM. London. Sometimes names are shortened to the last infra-specific rank].

2. Euphorbio paraliae-Lotetum glauci Jardim, Sequeira, Capelo, Aguiar, J.C. Costa, Espírito-Santo & Lousã associatio nova hoc loco [*typus*: table 2, relevé #9] – this association stands mostly for the chamaephytic communities of secondary fixed "grey" dunes of southern Porto Santo and its dominated by the Madeira and Canaries Islands endemic *Lotus glaucus*. The *Euphorbio-Lotetum glauci* was also identified in the elevated dunes of northern Porto Santo [subass. *plantaginetosum maderensis;* typus subass. table 2, relevé #53] and in Ponta de S. Lourenço (Madeira).

Table 2 - *Euphorbio paraliae-Lotetum glauci*

# of relevé	8	9	53	54	55	3	4
m.s.m.	ca. 2	ca. 2	ca. 40	ca. 40	ca. 40	140	145
Area	4	8	10	8	12	10	16
Cover	90	80	70	60	30	80	90
Slope	.	.	10	20	10	10	10
Aspect	.	.	W	W	W	E	SE
Characteristic combination							
Crepis divaricata	2	2	.	.	.	.	1
Euphorbia paralias	+	1	+	+	1		
Lotus glaucus	3	4	2	2	2	3	4
Polygonum maritimum	+	1	+	1	1	2	1
Lotus loweanus	2	.	.	.	.	.	.
Matthiola maderensis	.	.	.	+	+	.	.
Phyllis nobla	.	.	1	1	+	.	.
Plantago maderensis	.	.	3	3	2	.	.
Satureja thymoides	.	.	+	+	.	.	.
Senecio incrassatus	.	+	+	1	+	2	+
Companions							
Asphodelus fistulosus	.	1	.	.	.	.	.
Carpobrotus edulis	.	.	+	.	+	.	.
Cynodon dactylon	2	.	.	.	.	.	.
Euphorbia terracina	.	1	.	.	+	.	.
Hedypnois cretica	1	1	.	.	.	+	1
Lolium rigidum	.	+	.	.	.	.	.
Scorpiurus muricatus	1	+	+	.	.	.	.
Sonchus oleraceus	+	+	.	.	.	.	+
Calendula maderensis	.	.	.	.	.	2	+

8. Porto Santo: Calheta. Secondary dune. Contact with *Euphorbia paralias*. Transitional facies to *Lotetum loweani*.
9. Porto Santo: Calheta. Secondary dune. Contact with *Euphorbia paralias*. Transitional facies to *Senecio-Mesembrianthemetum*.
53, 54, 55. Porto Santo: Fonte da Areia. Elevated dunes [subass. *plantaginetosum maderensis*].
3 and 4: Madeira, Ponta de S. Lourenço, Dunas da Piedade.

3. ***Polygono maritimi-Euphorbietum paraliae*** Jardim, Sequeira, Capelo, Aguiar, J.C. Costa, Espírito-Santo & Lousã associatio nova hoc loco [*typus*: table 3, relevé #15] – primary dune community. This species-poor community stands for one of the southernmost extremes of *Ammophiletea* vegetation in the Mediterranean Region. Although only higher rank characteristic *taxa* are present, the uniqueness of its biogeographical context allows recognizing it as an autonomous association. The absence of *Ammophila arenaria* subsp. *australis* is a noteworthy feature of the floristic combination.

Table 3 - *Polygono maritimi-Euphorbietum paraliae*

# of relevé	10	13	15	16
m.s.m	ca. 1	ca. 1	ca. 1	ca. 2
Area	6	8	3	2
Cover	20	15	60	50
Polygonum maritimum	2	1	2	.
Euphorbia paralias	1	2	3	3
Calystegia soldanela	.	.	.	3
Plantago coronopus	.	+	.	.
Sonchus oleraceus	.	.	+	.

10. Porto Santo: Calheta, beach. Primary (front) dune.
13, 15, 16. Porto Santo: a W da Calheta, beach. Primary (front) dune.

4. ***Lotetum loweani*** Jardim, Sequeira, Capelo, Aguiar, J.C. Costa, Espírito-Santo & Lousã associatio nova hoc loco – [typus: table 4 relevé #14] is a phytocoenosis only known from the Porto Santo's beach in elevated compact sandstone platforms. It is characterized by the Porto Santo endemics *Lotus loweanus*.

5. ***Limonietum pyramidati*** Jardim, Sequeira, Capelo, Aguiar, J.C. Costa, Espírito-Santo & Lousã associatio nova hoc loco [typus: table 5 relevé #51] - this chasmophytic phytocoenosis is found under the influence of the sea salt spray in the Porto Santo's northern arenitic cliffs. The *Limonietum pyramidati* characteristic combination is constituded by a small number of species among of wich stands out the microendemic *Limonium pyramidatum* (Lowe) Brullo & Erben**.**

Table 4 - *Lotetum loweani*

# of relevé	11	12	14
m.s.m.	ca. 5	ca. 5	ca. 5
Area	6	6	8
Cover	50	50	25
Characteristic combination			
Lotus loweanus	3	3	3
Crithmum maritimum	.	(+)	2
Frankenia laevis	1	+	.
Senecio incrassatus	1	.	.
Companions			
Gastridium ventricosum	1	+	.
Euphorbia paralias	.	.	+
Hedypnois cretica	.	.	+
Mesembrianthemum crystallinum	+	1	.
Plantago coronopus	.	+	.
Polygonum maritimum	.	+	.
Sonchus tenerrimus	+	.	.
Sonchus oleraceus	+	.	.

11. Porto Santo: Calheta. Flat sandstone platform, a cliff 4m high , with lime-rich evaporites.
12. Porto Santo: a W da Calheta. Flat sandstone platform. Partially covered my mobile sand.
14. Porto Santo: a W da Calheta. Flat sandstone platform. Partially covered my mobile sand.

6. ***Euphorbio paraliae-Lotion glauci*** Jardim, Sequeira, Capelo, Aguiar, J.C. Costa, Espírito-Santo & Lousã alliancia nova hoc loco - [typus alliancia: *Euphorbio paraliae-Lotetum glauci* Jardim, Sequeira, Capelo, Aguiar, J.C. Costa, Espírito-Santo & Lousã ass. nova; characteristic species: *Lotus glaucus, Crepis divaricata*]. Morover, we propose that the few *Crucianelletalia* [*AMMOPHILETEA*] communities of secondary dunes in the Canarian Sub-Region to be grouped in a particular alliance. *Nota bene:* Ecological affinities with *PEGANO-SALSOLETEA (Forskaleo-Rumicetalia lunariae*) and *POPLYCARPO-TRAGANETEA MOQUINII* (*Traganion moquinii*) could be taken on account, but *Lotus glaucus* communities have their main phytosociological optimum in secondary dune systems].

Table 5 – *Limonietum pyramidati*

# of relevé	50	51	52
m.s.m.	ca. 25	ca. 15	ca. 15
Area	4	10	15
Cover	20	10	40
Slope	15	30	30
Aspect	N	N	N
Characteristic combination			
Crithmum maritimum	2	1	1
Limonium pyramidatum	1	2	2
Frankenia laevis	3	1	2
Crepis divaricata	.	.	.
Lotus glaucus	1	.	.
Matthiola maderensis	.	.	1
Senecio incrassatus	+	+	+
Tolpis suculenta	.	+	+
Companions			
Anagallis arvensis	.	.	.
Carpobrotus edulis	.	.	3
Herniaria cinerea	+	.	.
Leontodon taraxacoides	+	.	.
Melilotus indica	+	1	+
Mesembryanthemum nodiflorun	.	.	+
Mesembryanthmeum crystallinum	.	.	+
Phagnalon hansenii	+	.	.
Plantago coronopus	+	+	+
Scorpiurus muricatus	2	.	.
Sonchus tenerrimus	+	.	.

50, 51, 52: Porto Santo: Fonte da Areia, sea cliff.

Table 6 - *Salsolo kali-Cakiletum aegyptiacae* Costa & Mansanet 1981

# of relevé	5
m.s.m.	1
Area	4
Cover	30
Cakile maritima	2
Salsola kali	2

5. Porto Santo: Vila Baleira, beach

Contact with *Senecio-Mesembryanthemetum crystallini*.

[taxonomical nomenclature follows: PRESS & SHORT (1994) *Flora of Madeira*. BM. London; and also the checklist of taxa of RIVAS-MARTÍNEZ, DÍAZ, F. DEZ-GONZÁLEZ, IZCO, LOIDI, LOUSA & PENAS (2002) - *Itinera Geobotanica* 15(2) : 697-813. Sometimes names are shortened to the last infra-specific rank].

7. ***Salsolo kali - Cakiletum aegyptiacae*** Costa & Mansanet 1981 [table 6] The first band of terrestrial vascular vegetation, where tidal organic debris acumulate, is represented by this annual community.

Sintaxonomy

STELLARIETEA MEDIAE Tüxen, Lohmeyer & Preising ex von Rochow 1951

Chenopodio-Stellarienea Rivas Goday 1956

Chenopodietalia muralis Br.-Bl. in Br.-Bl., Gajewski, Wraber & Walas 1936 em. Rivas-Martínez 1977

Mesembryanthemion crystallini Rivas-Martínez, Wildpret, Del Arco, O. Rodríguez, Pérez de Paz, García Gallo, Acebes, T.E. Díaz & Fernández-González 1993

Senecio incrassati-Mesembryanthemetum cristalini Jardim, Sequeira, Capelo, Aguiar, J.C. Costa, Espírito-Santo & Lousã & Lousã ass. nova

CRITHMO-STATICETEA Br.-Bl. in Br.-Bl., Roussine & Nègre 1952

Crithmo-Staticetalia Molinier 1934

Helichrysion obconico-devium Rivas-Martínez, Capelo, J.C. Costa, Lousã, Fontinha, Jardim & Sequeira 2002

Lotetum loweani Jardim, Sequeira, Capelo, Aguiar, J.C. Costa, Espírito-Santo & Lousã ass. nova
Limonietum pyramidati Jardim, Sequeira, Capelo, Aguiar, J.C. Costa, Espírito-Santo & Lousã ass. nova
AMMOPHILETEA Br.-Bl. & Tüxen *ex* Westhoff, Dijk & Passchier 1946
Ammophiletalia Br.-Bl. 1933
Ammophilion australis Br.-Bl. 1921 *corr*. Rivas-Martínez, Costa & Izco *in* Rivas-Martínez, Lousã. T.E. Diáz, Fernánez-González & J.C. Costa 1990
Polygono maritimi-Euphorbietum paraliae Jardim, Sequeira, Capelo, Aguiar, J.C. Costa, Espírito-Santo & Lousã ass. nova
Crucianelletalia Sissingh 1974
Euphorbio paraliae-Lotion glauci Jardim, Sequeira, Capelo, Aguiar, J.C. Costa, Espírito-Santo & Lousã all. nova
Euphorbio paraliae-Lotetum glauci Jardim, Sequeira, Capelo, Aguiar, J.C. Costa, Espírito-Santo & Lousã ass. nova
lotetosum glauci
plantaginetosum maderensis Jardim, Sequeira, Capelo, Aguiar, J.C. Costa, Espírito-Santo & Lousã subass. nova.
CAKILETEA MARITIMAE Tüxen & Presing ex Br.-Bl. & Tüxen 1952
Cakilion maritimae Pignatti 1953
Salsolo kali-Cakiletum aegyptiacae Costa & Mansanet 1981

Aknowledgment: the authors would like to thank the most valuable support of the *Direcção Regional de Florestas da Secretaria Regional do Ambiente e Recursos Naturais da Região Autónoma da Madeira*.

Roberto Jardim; Jardim Botânico da Madeira, Funchal, robertojardim.sra@ gov-madeira.pt. **Miguel Sequeira**; Depto. Biologia, Universidade da Madeira, Funchal, sequeira@uma.pt. **Jorge Capelo**; Depto. de Ecologia, Recursos Naturais e Ambiente. Estação Florestal Nacional, jorge.capelo@efn. com.pt. **Carlos Aguiar**; Escola Superior Agrária de Bragança; cfaguiar@ipb.pt. **José C. Costa**; Depto. Protecção de Plantas e Fitoecologia, Instituto Superior de Agronomia, Lisboa, jccosta@isa.utl.pt. **Dalila Espírito-Santo**; Depto. Protecção de Plantas e Fitoecologia, Instituto Superior de Agronomia, dalilaesanto@ isa.utl.pt. **Mário Lousã;** Depto. Protecção de Plantas e Fitoecologia, Instituto Superior de Agronomia, Lisboa, marioIousa@isa.utl.pt