

## Geobotanical survey of Cabo Verde Islands (West Africa)

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### Abstract:

The results of the study of the bioclimate, biogeography, flora and vegetation of Cabo Verde Islands, after seven years of field works in all inhabited isles are presented in this paper. Tropical hyperdesertic to pluviseasonal, upper infra- to low supratropical and upper ultrahyperarid to upper dry, and occasionally lower subhumid (short period years), are the bioclimates in these archipelago. Biogeographically they are situated in the Paleotropical Kingdom, Afrotropical Sub-kingdom, Tropical Saharan Region, and Cabo Verde Province. Eight new species are described: *Acacia caboverdeana*, *Asphodelus marioi*lousae, *Frankenia pseudoericifolia*, *Hyparrhenia caboverdeana*, *Lotus chevalieri*, *Polycarpaea caboverdeana*, *Suaeda caboverdeana* and *Tetraena vicentina*, and also fifteen new combinations are proposed. In taxonomic phytosociology, five new classis: *Coccido penduli-Sarcostemmetea daltonii*, *Heteropogonetea contorti*, *Tetraenetea simplicis*, *Frankenio pseudoericifoliae-Suaedetea caboverdeanae* and *Arthrocnemetea franzii*; nine new orders: *Euphorbio tuckeyanae-Sarcostemmetalia daltonii*, *Dichrostachyo platycarpae-Acacieta*lia *caboverdeanae*, *Melinio grandiflorae-Heteropogonetalia contorti*, *Aristido cardosoi-Tetraenetalia simplicis*, *Frankenio pseudoericifoliae-Suaedetalia caboverdeanae*, *Arthrocnemetalia franzii*, *Sesuvietalia sesuviodis*, *Kickxietalia elegantis* and *Euphorbieta*lia *prostrato-hirtae*; fourteen new alliances: *Asparago squarrosi-Sarcostemmion daltonii*, *Globulario amygdalifoliae-Periplocion chevalieri*, *Fico gnaphalocarpace-Acacion caboverdeanae*, *Phoenicion atlanticae*, *Tamaricion senegalensis*, *Heteropogonion melanocarpo-contorti*, *Aristido cardosoi-Tetraenion simplicis*, *Polycarpaceo caboverdeanae-Tetraenion waterlotii*, *Arthrocnemion franzii*, *Sesuvion sesuviodis*, *Adiantion trifidi*, *Kickxion elegantis*, *Adiantion inciso-philippensis* and *Trianthemion portulacastri* and, finally, fifty two new associations: *Coccido penduli-Sarcostemmetum daltonii*, *Campylanthe spathulati-Sarcostemmetum daltonii*, *Frankenio caboverdeanae-Asparageto*rum *squarrosi*, *Aeonio gogonei-Sarcostemmetum daltonii*, *Echio stenosiphonis-Euphorbieta*um *tuckeyanae*, *Suaedo caboverdeanae-Aspara-*getum *squarrosii*, *Tetraeno waterlotii-Sarcostemmetum daltonii*, *Erysimo caboverdeanae-Periplocetum chevalieri*, *Echietum vulcanori*, *Actinopterido radiatae-Sarcostemmetum daltonii*, *Echio hypertropici-Euphorbieta*um *tuckeyanae*, *Launaeo thalassicae-Euphorbieta*um *tuckeyanae*, *Loto latifolii-Artemisietum gogonei*, *Melanoselino bischoffii-Globularietum amygdalifoliae*, *Asterisco smithii-Euphorbieta*um *tuckeyanae*, *Dichrostachyo platycarpae-Acacieta*um *caboverdeanae*, *Coccido penduli-Acacieta*um *caboverdeanae*, *Forskaoleo procridisfoliae-Acacieta*um *caboverdeanae*, *Coccido penduli-Ficetum gnaphalocarpace*, *Forsskaoleo procridisfoliae-Ficetum gnaphalocarpace*, *Dichrostachyo platycarpae-Ficetum sur*, *Euphorbio tuckeyanae-Ficetum sur*, *Sideroxyletum marginati*, *Dracaeneta*um *caboverdeanae*, *Coccido penduli-Phoenicetum atlanticae*, *Coccido penduli-Tamaricetum senegalensis*, *Dichanthio foveolati-Heteropogonetum contorti*, *Heteropogonetum melanocarpi*, *Bothriochloo bladhii-Enneapogonetum desvauxii*, *Aristido cardosoi-Tetraenetalum simplicis*, *Asphodelo marioi*lousae-Aristidetum *cardosoi*, *Sehimatetum ischaemoidis*, *Polycarpeo caboverdeanae-Tetraenetalum waterlotii*, *Tetraenetalum vicentinae*, *Sporobolo spicati-Cyperetum crassipedis*, *Loto brunneri-Pulicarietum diffusae*, *Arthrocnemetum franzii*, *Cressetum salinae*, *Sesuvietum sesuviodis*, *Sesuvietum portulacastri*, *Blutaparonetum vermicularis*, *Adiantetum trifidi*, *Hypodemiatum crenati-Campanuletum bravensis*, *Kickxietum webbianae*, *Diplotaxio hirtae-Kickxietum elegantis*, *Umbilico schmidii-Cheilanthesetum acrosticace*, *Campanuletum jacobaeae*, *Campanulo bravensis-Launaetum thalassicae*, *Adiantetum inciso-philippensis*, *Trianthemetum portulacastri*, *Euphorbio hirtae-Boerhavietum repentis* and *Oldenlandietum corymbosae* are proposed and described.

### Resumen:

Se presentan los resultados del estudio del bioclima, biogeografía, flora y vegetación de las Islas de Cabo Verde. El bioclima varía del tropical hiperdésertico al tropical xérico, del infratropical superior al supratropical inferior y del ultrahiperárido superior al seco superior. Biogeográficamente las islas de Cabo Verde están en el Reino Paleotropical, Subreino Afrotropical, Región Tropical-Sahariana, Provincia Caboverdeana. Se proponen nueve nuevas especies: *Aca-*

*cia caboverdeana, Asphodelus marioioides, Frankenia pseudoericifolia, Hyparrhenia caboverdeana, Lotus chevalieri, Polycarpaea caboverdeana, Suaeda caboverdeana y Tetraena vicentina; así como quince nuevas combinaciones. Se describen cinco nuevas clases fitosociológicas: Coccido penduli-Sarcostemmetea daltonii, Heteropogonetea contorti, Tetraenetea simplicis, Frankenio pseudoericifoliae-Suaedetea caboverdeanae y Arthrocnemetea franzii, nueve nuevos órdenes: Euphorbia tuckeyanae-Sarcostemmetalia daltonii, Dichrostachyo platycarpae-Acacietales caboverdeanae, Melinio grandiflorae-Heteropogonetalia contorti, Aristido cardosoi-Tetraeneta simplicis, Frankenio pseudoericifoliae-Suaedetalia caboverdeanae, Artrocnetalia franzii, Sesuvietalia sesuviodis, Kickxietalia elegantis y Euphorbieta prostrato-hirtae; también catorce nuevas alianzas: Asparago squarroso-Sarcostemminon daltonii, Globulario amygdalifoliae-Periplocion chevalieri, Fico gnaphalocarpeo-Acacion caboverdeanae, Phoenicion atlanticae, Tamaricion senegalensis, Heteropogonion melanocarpo-contorti, Aristido cardosoi-Tetraenion simplicis, Polycarpaeo caboverdeanae-Tetraenion waterlotii, Arthrocnemion franzii, Sesuvion sesuviodis, Adiantion trifidi, Kickxion elegantis, Adiantion inciso-philippensis y Trianthemion portulacastri, así como cincuenta y dos nuevas asociaciones: Coccido penduli-Sarcostemmetum daltonii, Campylantho spathulati-Sarcostemmetum daltonii, Frankenio caboverdeanae-Asparageto squarroso, Aeonio gogonei-Sarcostemmetum daltonii, Echo stenosiphonis-Euphorbieta tuckeyanae, Suaedo caboverdeanae-Asparageto squarroso, Tetraeno waterlotii-Sarcostemmetum daltonii, Erysimo caboverdeanae-Periplocetum chevalieri, Echietum vulcanori, Actinopterido radiatae-Sarcostemmetum daltonii, Echo hypertropici-Euphorbieta tuckeyanae, Launaeo thalassicae-Euphorbieta tuckeyanae, Loto latifolii-Artemisietum gogonei, Melanoselino bischoffii-Globularietum amygdalifoliae, Asterisco smithii-Euphorbieta tuckeyanae, Dichrostachyo platycarpae-Acacietales caboverdeanae, Coccido penduli-Acacietales caboverdeanae, Forsskaoleo procrisifoliae-Acacietales caboverdeanae, Coccido penduli-Ficetum gnaphalocarpeo, Forsskaoleo procrisifoliae-Ficetum gnaphalocarpeo, Dichrostachyo platycarpae-Ficetum sur, Euphorbia tuckeyanae-Ficetum sur, Sideroxyletum marginati, Dracaenetae caboverdeanae, Coccido penduli-Phoenicetum atlanticae, Coccido penduli-Tamaricetum senegalensis, Dichanthio foveolati-Heteropogonetum contorti, Heteropogonetum melanocarpi, Bothriochloa bladhii-Enneapogonetum desvauxii, Aristido cardosoi-Tetraenetum simplicis, Asphodelo marioioides-Aristidetum cardosoi, Sehimatetum ischaemoidis, Polycarpaeo caboverdeanae-Tetraenetum waterlotii, Tetraenetum vicentinae, Sporobolo spicati-Cyperetum crassipedis, Loto brunneri-Pulicarietum diffusae, Arthrocnemetum franzii, Cressetum salinae, Sesuvietum sesuviodis, Sesuvietum portulacastri, Blutaparonetum vermicularis, Adiantetum trifidi, Hypodematio crenati-Campanuletum bravensis, Kickxietum webbiana, Diplotaxio hirtae-Kickxietum elegantis, Umbilico schmidii-Cheilanthes acrosticae, Campanuletum jacobaeae, Campanulo bravensis-Launaetum thalassicae, Adiantetum inciso-philippensis, Trianthemetum portulacastri, Euphorbia hirtae-Boerhavietum repens y Oldenlandietum corymbosae.*

**Keywords:** Cabo Verde, Bioclimatology, Biogeography, Phytosociology, Vascular Flora.

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### Introduction

The archipelago of Cabo Verde, 14°45'-17°10'N and 22°40'-25°20'W, is located in the Atlantic Ocean mostly in the high eutropical north latitudinal band (table 2), about 700 km from Mauritania and Senegal coasts. It has 4033 km<sup>2</sup> and includes nine major islands and several islets, going from the “Barlavento” to “Sotavento”: Santo Antão (779 km<sup>2</sup>), São Vicente (227 km<sup>2</sup>) (with Santa Luzia (35 km<sup>2</sup>), Branco and Raso Islets (10 km<sup>2</sup>)), São Nicolau (388 km<sup>2</sup>), Sal (261 km<sup>2</sup>), Boavista (620 km<sup>2</sup>), Maio (269 km<sup>2</sup>), Santiago (991 km<sup>2</sup>), Fogo (476 km<sup>2</sup>), and Brava (67 km<sup>2</sup>) (with Rombo Islets); the abbreviations used in this paper are respectively: A, V, N, SL, BO, M, SN, F, BR. The archipelago constitutes a particular biogeographic unit: Cabo Verde Province, included in the Saharan Tropical Region (Paleotropical Kingdom). Globally the Cabo Verde Islands has serotropical bioclimate, mostly infra-thermotropical aridic and strong eu-hyperoceanic (Ic 4.0-6), with torrential rains and strong interannual variations. This severe bioclimate, the high population and hard erosion in agroforestral activities, increase every year the desertification and a correlate extension of the hyperdesertic landscape.

## 1. Bioclimatology

### 1a. Bioclimatic notions

Bioclimatology is a geobotanical science that studies the reciprocity between the climate data and the distribution of living plants and their communities on the Earth. This discipline, which might also be called Phytoclimatology, for the weight of the phytoindicators, began to be structured as result of connecting numeric climate values (mainly temperature and rainfall) with the distribution of plants areas, plant communities and other bioindicators, adding at a later stage information of biogeocenosis and knowledge from dynamic-catenal phytosociology (vegetation series, geoseries and geopermaseries) (Rivas-Martínez, 2005, Géhu, 2006).

For more than two decades, we have try improve the bioclimatic classification system of the Earth that cover the whole geobiosphere. The reasons for doing so are to have an easily quantifiable bioclimatic typology that show the close relationship between the vegetational components and climate index values, and which, at the same time, considering the high predictive value of the bioclimatic units, could be used in other sciences and conservation programmes. The increasingly detailed knowledge of the distribution of plants and vegetation on Earth, as well as the modifications in the appearance and composition of the potential natural vegetation and its substitution stages caused by climatic, edaphic, geographic and anthropic factors, makes possible to recognize the bioclimatic and vegetational boundaries with greater precision and objectivity. Once the bounds of the vegetation series, geoseries, geopermaseries and bioindicators are known, located, and mapped, it is possible to calculate the numerical bioclimatic threshold values. These territories corresponding to the bioclimatic units (bioclimates, isobioclimates, variants, thermotypes and ombrotypes), have been progressively delimited and adjusted. The resulting biophysical models have demonstrated a high level of reciprocity in the relationship between climate and flora-vegetation, and allow to produce bioclimatic and biogeographical maps and data in any part of the world that could be increasingly accurate. One practical consequence is to have achieved a reciprocal predictive value, all over the Earth, only knowing the climate data or, reciprocally, the flora, formations and vegetation types.

The global bioclimatic classification we use are based on the axioms and reasoning principles of reciprocity, photoperiods, continentality, seasonality of the rains, mediterraneity, deserts, orobioclimates and orogeny. This classification (Rivas-Martínez, Rivas-Sáenz & Penas, 2011) recognize five macrobioclimates, twenty-eight bioclimates, eight bioclimatic variants and about four hundred isobioclimates. The macrobioclimate is the supreme typological unit in the bioclimatic classification system. It is an eclectic biophysical model, delimited by specific climatic, floristic, formations and vegetational types, which covers a wide territorial range and which are related with the main types of climates, biomes, bio-regions, ecosystems and biogeographical regions nowadays accepted on the Earth. There are five macrobioclimates: tropical, mediterranean, temperate, boreal and polar. Each of them, and each of their 28 respective sub-

ordinate units or bioclimates, are represented by a group of vegetation and formations types, bioindicators and plant communities. In the bioclimates, apart from their ombro-thermoclimatic variations or bioclimatic stages – thermotypes and ombrotypes – a certain number of units have been identified depending on the seasonal temperature and rainfall seasonally rhythms (table 1).

### 1b. Bioclimatic classification system

For the bioclimatic analysis and bioclimatic classification of Cabo Verde Island and surrounding territories we use the more recent criteria and models exposed in “Worldwide bioclimatic classification system” in Rivas-Martínez, Rivas-Sáenz & Penas with colls., (Glob. Geobot. 1: 1-634+ 4 maps. 2011) and also in Rivas-Martínez & Rivas-Sáenz (2009, website:

<http://www.globalbioclimatic.org>,

the climatic data of our data bank. As well as the updated approach proposed by Rivas-Martínez, Rivas-Sáenz, Penas & del Río (30-08-2017).

#### 1ba. Parameters and bioclimatic indexes

T: Mean annual temperature in centigrades.

Tmin: Mean temperature of coldest month in C°.

Tmax: Mean temperature of warmest month in C°.

Tamax: Mean annual of monthly maxima.  $\Sigma T_{i,\text{max}}/12$  in C°.

T<sub>i</sub>: Mean monthly temperature in C°, where i: 1 = January, ..., 12 = December.

Tp: Positive annual temperature: Sum in tenths of C° of the mean monthly higher than 0°C.  $\Sigma T_{i,1-12} > 0^\circ\text{C}$ .

Tps: Positive summer temperature: Sum in tenths of C° of the mean monthly summer higher than 0°C.  $\Sigma T_{i,\text{sum}} > 0^\circ\text{C}$ .

Tp<sub>i</sub>: Positive mean monthly temperature in tenths of degrees centigrade, where i: 1 = January, ..., 12 = December

Tp<sub>i,max</sub>: Positive annual maxima monthly temperature. Sum in tenths of centigrades of the monthly maxima higher 0°C. ( $\Sigma T_{i,\text{max}}/12 > 0^\circ \times 10$ ).

Ic: Simple continentality index or annual range temperature Thermic interval value (range) in °C between the mean of the warmest and coldest month of the year (Ic=Tmax-Tmin).

P: Mean annual precipitation in millimeters (litres per square meter).

Pp: Positive annual precipitation of the months with T<sub>i</sub> higher than 0°C ( $\Sigma P_{T_i > 0^\circ\text{C}}$ ) in mm.

Pp<sub>i</sub>: Positive monthly precipitation in mm, where i: 1 = January, ..., 12 = December

Pcm<sub>1</sub>: Precipitation of the warmest four months of the year in mm.

Pcm<sub>2</sub>: Precipitation of the four months following the warmest of the year in mm.

Pcm<sub>3</sub>: Precipitation of the four months before the warmest of the year in mm.

Ps: Precipitation of summer quarter in mm.

Pss: Precipitation of the warmest consecutive six months of the year in mm.

Psw: Precipitation of the coldest consecutive six months of the year in mm.

Macrobioclimates <sup>(1)</sup>	Bioclimates <sup>(5)</sup>	Abbr.	Bioclimatic ranges	Thermoclimatic types		Abbr.	Ombroclimatic types (Io)	Abb.			
Tropical Zone warm: equatorial, eutropical and subtropical (0° to 36° N & S). In subtropical (23° to 35° N & S) at < 200 m two values: T ≥ 25°, m ≥ 10°, Itc ≥ 580. If Pcm <sub>2</sub> < Pcm <sub>1</sub> > Pcm <sub>3</sub> y Pss > Psw, two values: T ≥ 21°, M ≥ 18°, It ≥ 470, Eurasia and Africa: 25° to 35° N > 2000 m is not tropical.	<b>Tr. Pluvial</b> <b>Tr. Pluviseasonal</b> <b>Tr. Xeric</b> <b>Tr. Desertic</b> <b>Tr. Hyperdesertic</b>	trpl trps trxe trde trhd	Ic - ≥ 3.6 - ≤ 2.5 - 1.0-3.6 - 0.2-1.0 - < 0.2	Io ≥ 2.5 - - - - -	Iod2 - - - - - -	It (Itc) 670 - 890 490 - 670 320 - 490 160 - 320 < 160 - 7. Gelid <sup>(3)</sup> - 0	Tp <sup>(2)</sup> > 2860 > 2300 > 1700 > 1000 600-1000 1-600 gtr - 0	itr trr mtr str otr ctr humid gtr - 0	1. Ultrahyperarid < 0.2 2. Hyperarid 0.2-0.4 3. Arid 0.4-1.0 4. Semiarid 1.0-2.0 5. Dry 2.0-3.6 6. Subhumid 3.6-6.0 7. Humid 6.0-12.0 8. Hyperhumid 12.0-24.0 9. Ultrahyperhumid 24.0-48.0 10. Extreme hyperhumid >48.0	aha har ari sar dry shu hum hhu uhh ehh	
Mediterranean Zone warm: subtropical and temperate eutemperate (23° to 52° N & S), with aridity P < 2T, at least two months in summer: Ios <sub>2</sub> ≤ 2, Ios <sub>3</sub> ≤ 2. In subtropical (23° to 36° N & S) at least two values: T < 25°, m < 10°, Itc < 580.	<b>Me. Pluviseasonal Oceanic</b> <b>Me. Pluviseasonal Continental</b> <b>Me. Xeric Oceanic</b> <b>Me. Xeric Continental</b> <b>Me. Desertic Oceanic</b> <b>Me. Desertic Continental</b> <b>Me. Hyperdesertic Oceanic</b> <b>Me. Hyperdesertic Continental</b>	mepo mepc mexo mexc medo mede meho mehc	Ic ≤ 21 ≥ 21 ≤ 21 ≤ 21 ≤ 21 ≤ 21 ≤ 21 ≥ 21	Io > 2.0 > 2.0 1.0-2.0 1.0-2.0 0.2-1.0 0.2-1.0 < 0.2 < 0.2	- - - - - - - -	It (Itc) 450 - 580 350 - 450 220 - 350 80-220 < 80 - 7. Gelid <sup>(3)</sup> - 0	Tp <sup>(2)</sup> > 2400 > 2100 > 1500 > 900 500-900 1-500 gme - 0	ime tme mme sme ome cme gme - 0	1. Ultrahyperarid < 0.2 2. Hyperarid 0.2-0.4 3. Arid 0.4-1.0 4. Semiarid 1.0-2.0 5. Dry 2.0-3.6 6. Subhumid 3.6-6.0 7. Humid 6.0-12.0 8. Hyperhumid 12.0-24.0 9. Ultrahyperhumid 24.0-48.0 10. Extreme hyperhumid >48.0	aha har ari sar dry shu hum hhu uhh ehh	
Temperate Zone warm: subtropical and temperate (23° to 66° N & 23° to 54° S). From 23° to 35° N & S, at < 200 m, at least two values: T < 21°, M < 18°, Itc < 470, Ios <sub>2</sub> > 2, Ios <sub>3</sub> > 2.	<b>Te. Hyperoceanic</b> <b>Te. Oceanic</b> <b>Te. Continental</b> <b>Te. Xeric</b>	teho teoc teco texe	Ic ≤ 11 11-21 > 21 ≥ 4	Io > 3.6 ≥ 3.6 ≥ 3.6 ≤ 3.6	- - - -	It (Itc) > 410 290 - 410 190 - 290 < 190 - - 7. Gelid <sup>(3)</sup> - 0	Tp <sup>(2 y 4)</sup> > 2350 > 2000 > 1400 > 800 380-800 1-380 gte - 0	ite tte mte ste ote cte gte - 0	4. Semiarid < 2.0 5. Dry 2.0-3.6 6. Subhumid 3.6-6.0 7. Humid 6.0-12.0 8. Hyperhumid 12.0-24.0 9. Ultrahyperhumid 24.0-48.0 10. Extreme hyperhumid >48.0	sar sec shu hum hhu uhh ehh	
Boreal Zones temperate and cold (42° to 72° N, 49° to 56° S). At < 200 m: Ic ≤ 11; T ≤ 6°, Tp = 380-720; Tps > 320; Ic = 11-21: T ≤ 5.3°, Tp = 380-720; Ic = 21-28: T ≤ 4.8°, Tp = 380-740; Ic = 28-45: T ≤ 4.3°, Tp = 380-800; Ic ≥ 45: T ≤ 0°, Tp = 380-800.	<b>Bo. Hyperoceanic</b> <b>Bo. Oceanic</b> <b>Bo. Subcontinental</b> <b>Bo. Continental</b> <b>Bo. Hypercontinental</b> <b>Bo. Xeric</b>	boho booc bosc boco bohc boxe	Ic ≤ 11 11-21 21-28 28-46 > 46 < 46	Io > 3.6 ≥ 3.6 ≥ 3.6 ≥ 3.6 - ≤ 3.6	Tp ≤ 720 ≤ 720 ≤ 5.3° ≤ 740 ≤ 800 ≤ 800	T < 6.0° ≤ 5.3° ≤ 4.8° ≤ 3.8° ≤ 0.0° ≤ 3.8°	1. Thermoboreal 2. Mesoboreal 3. Supraboreal 4. Oroboreal 5. Cryoboreal 6. Gelid <sup>(3)</sup>	> 680 580-680 480-580 380-480 1-380 0	tbo mbo sbo obo cbo gbo	4. Semiarid < 2.0 5. Dry 2.0-3.6 6. Subhumid 3.6-6.0 7. Humid 6.0-12.0 8. Hyperhumid 12.0-24.0 9. Ultrahyperhumid 24.0-48.0 10. Extreme hyperhumid >48.0	sar sec shu hum hhu uhh ehh
Polar Zones temperate and cold (51° to 90° N & S). At < 100 m: Tp < 380.	<b>Po. Hyperoceanic</b> <b>Po. Oceanic</b> <b>Po. Continental</b> <b>Po. Xeric</b> <b>Po. Pergelid</b>	poho pooc poco poxe pope	Ic ≤ 11 11-21 > 21 ≥ 4 -	Io > 3.6 ≥ 3.6 ≥ 3.6 ≤ 3.6 -	Tp > 0 - - - -0	Tp <sup>(6)</sup> 380-600 280-380 100-280 1-100 0	ipo tpo mpo spo gpo	4. Semiarid < 2.0 5. Dry 2.0-3.6 6. Subhumid 3.6-6.0 7. Humid 6.0-12.0 8. Hyperhumid 12.0-24.0 9. Ultrahyperhumid 24.0-48.0 10. Extreme hyperhumid >48.0	sar sec shu hum hhu uhh ehh		

Ibb. Synoptical table Worldwide bioclimatic classification system (S. Rivas-Martínez, S. Rivas-Sáenz, A. Peñas &amp; S. del Río. Updated 30-08-2017) (Table 1)

(1) North and south of equatorial and eutropical latitudinal belt (23°N & 23°S), if the locality is at 200 m altitude or higher, the thermal values at this altitude must be calculated increasing T in 0.6°, M in 0.5°, and It or Itc in 13 units, every 100 m higher than 200m. But if the locality is northern 48° N or southern 51° S, the increases are T in 0.4° and Tp in 12 units, every 100 m higher than 200 m. (2) If Ic ≥ 21 (continental) or It o Itc < 120 the thermotype must by calculated through Tp values, and the theorics values of Tp at 200 m increasing 55 units every 100 m exceeding that altitude. (3) In the pergelid bioclimate (polar), the upper suprapolar and the gelid thermotype we recognize the following ombrotypes (chionotypes): un-snowy (<50 mm), scanty-snowy (50-200 mm), low-snowy (200-400 mm), medium-snowy (400-600 mm), high-snowy (600-1000 mm), super-snowy (1000-2000 mm), ultra-snowy (>2000 mm). (4) The hemiboreal thermotype (hbo) is used inside the temperate macrobioclimate, north of 45°N and south 49°S, within the following values: Ic < 21, altitude < 400 m, tp 720-900; Ic 21-28, altitude < 600 m, tp 740-900; Ic > 28, alt. < 1000 m, tp 800-900. (5) Bioclimatic variants: steppic (stp), submediterranean (sbm), bixerí (bix), antitropical (ant), seropluvial (spl), polar semiboreal (posbo), semipolar subantarctic (sepoa) and tropical semimediterranean desertic (trds), polar euhypereceanic (poeuh), boreal subantarctic (bosuba) and temperate subantarctic (tesuba). (6) The infrapolart thermotype (Tp: 380-600) only correspond to semipolar antarctic bioclimatic variant in the coast [values: Alt<100 m, T<7.5°, Tp<600, Tps<280, Tmax<10°, Ic<8, Io>10]; the polar semiboreal bioclimatic variant correspond to semicontinental to hypereceanic hyperhumid northern oroboreal treeless arctic tundra territories [values: Tp 380-480, Ic<28, Tmax≤11°, Tps≤320]. (7) In the polar pergelid bioclimate to identify three gelid thermotypes in the Antarctic Region and only two in the Circumarctic Region: hypogelid (T -10° to -25°, Tp 0, Tpmax< 30, Tpamax< 500, Twmax<-7°); hypergelid (T -25° to -45°, Tp 0, Tpmax 0, Tpmax 300, Twmax -7° to -22°); ultragelid (T <-45°, Tpmax 0, Tpamax 0, Twmax<-22°) (only in Antarctica). If necessary, on utilize the ombrotype. (10) Extreme hyperhumid value, Io>48.0 (ehh). 10a. Lower horizon Io 48.0-96.0; 10b. Upper horizon >96.0. Last global approach published: Global Geobotany 1: 1-638 (2011); DOI: 10.5616/gg110001.

Thermic zones	Latitudinal zones	Latitudinal bands	Latitude	
A. TROPICAL (warm) 0° - 36° N & S	1. EUTROPICAL 0° - 23° N & S	1a. Equatorial	7° N - 7° S	
		1b. Low eutropical	7° - 15° N & S	
		1c. High eutropical	15° - 23° N & S	
	2. SUBTROPICAL 23° - 36° N & S	2a. Low subtropical	23° - 29° N & S	
		2b. High subtropical	29° - 36° N & S	
	B. TEMPERATE 36° - 66° N & S	3. EUTEMPERATE 36° - 51° N & S	3a. Low eutemperate	36° - 43° N & S
		3b. High eutemperate	43° - 51° N & S	
		4. SUBTEMPERATE 51° - 66° N & S	4a. Low subtemperate	51° - 59° N & S
		4b. High subtemperate	59° - 66° N & S	
C. POLAR 66° - 90° N & S	5. POLAR 66° - 90° N & S	5a. Low polar	66° - 78° N & S	
		5b. High polar	78° - 90° N & S	

**Table 2.** Thermic latitudinal zones and latitudinal bands of Earth

M: Mean temperature of the maxima of the coldest month in C°.

m: Mean temperature of the minima of the coldest month in C°.

Tr<sub>1</sub>: Quarter corresponding to the winter solstice (winter, N: 12-2, S: 6-8).

Tr<sub>2</sub>: Quarter corresponding to the spring equinox (spring, N: 3-5, S: 9-11).

Tr<sub>3</sub>: Quarter corresponding to the summer solstice (summer, N: 6-8, S: 12-2).

Tr<sub>4</sub>: Quarter corresponding to the autumn equinox (autumn, N: 9-11, S: 3-5).

Cm<sub>1</sub>: Warmest consecutive four months of the year.

Cm<sub>2</sub>: Four months after the warmest four months of the year.

Cm<sub>3</sub>: Four months before the warmest four months of the year.

Pav: Period of plant activity, months of the year T<sub>i</sub> ≥ 3°C.

Io: Annual ombrothermic index (Pp/Tp) 10.

Io<sub>i</sub>: Monthly ombrothermic index (Pp<sub>i</sub>/Tp<sub>i</sub>) 10, where i: 1 = January, ..., 12 = December

Ios: Ombothermic index of the summer quarter (Pps/Tps) 10.

Ios<sub>1</sub>: Ombothermic index of the warmest month of the summer quarter (Tr<sub>3</sub>).

Ios<sub>2</sub>: Ombothermic index of the warmest two months of the summer quarter (Tr<sub>3</sub>).

Ios<sub>3</sub>: Ombothermic index of the summer quarter (Tr<sub>3</sub>).

Ios<sub>4</sub>: Ombothermic index of the four-month period adding the summer quarter (Tr<sub>3</sub>) and the month preceding it.

It: Thermicity index (T+M+m) 10 ≡ (T+Tmin x 2) 10.

Itc : Compensated thermicity index.

Aim: Aridic monthly index. Aim<sub>i</sub> = 200-100 Io<sub>i</sub>, where i: 1 = January, ..., 12 = December

Aiy: Aridic annual index. Aridic is the ombothermic expression of aridity range. (0.0-2.0). Aiy=ΣAim<sub>i</sub>, where i: 1 = January, ..., 12 = December

Oxiy: Ombroxic annual index. Ombroxic is the ombothermic expression of xericity range. (2.0-3.6).

Oxiy=ΣOxim<sub>i</sub>, where i: 1 = January, ..., 12 = December

Oxim: Ombroxic monthly index. Oxim<sub>i</sub>=160-100 Io<sub>i</sub>, where i: 1 = January, ..., 12 = December

### 1bc. Keys for bioclimatic classification

With simple dichotomous keys using latitudinal zones, bands and thermic zones (table 2), bioclimatic parameters and indexes, we have prepared an easy key to classify macrobioclimates, bioclimates and bioclimatic variants. that we recognize. As well as a synoptical “Worldwide bioclimatic classification system”, updated by S. Rivas-Martínez, S. Rivas-Sáenz, A. Penas & S. del Río (30-08-2017, pg. 5).

#### Key for macrobioclimates

1. Intertropical territories between parallels 23° N and S (eutropical latitudinal zone)..... TROPICAL
1. Territories north and south of these latitudes ..... 2
2. Territories between parallels 23° and 36° N & S (subtropical zone)..... 3
2. Territories to the N & S of parallel 36° (eutemperate, subtemperate, and polar zones) ..... 11
3. Eurasia: 26° to 36° N, longitude 70° E to 120° E, altitude ≥ 2.000 m ..... 10
3. Does not meet the conditions ..... 4
4. In subtropical territories (parallels 23° to 36° N & S) at least two of the thermicity parameters or indexes must have the following values: average annual temperature T ≥ 25°, average temperature of the minimums of the coldest month m ≥ 10°, thermicity index It, Itc ≥ 580 ..... TROPICAL
4. Does not meet the conditions ..... 5
5. In territories with altitudes less than 200 m (●) at least two of the thermicity parameters or indexes must have the following values: average annual temperature T > 21°, average temperature of the maximums of the coldest month M > 18°, thermicity index, It, Itc ≥ 470 ... 6
5. Does not meet the conditions ..... 8
6. Subtropical zone (parallels 23° to 36° N & S): precipitation for the warmest 6-month period of the year should be higher that of the coldest 6-month period, Pss > Psw ..... TROPICAL
6. Does not meet the conditions ..... 7

7. Summer without hydric deficit: ombrothermic index of the hottest two months of the summer quarter  $Ios_2 > 2$  or ombrothermic summer index resulting from the compensation  $Iosc > 2$  ..... TROPICAL  
 7. Does not meet the conditions ..... 9
8. Summer without hydric deficit; ombrothermic index of the hottest consecutive two months of the summer quarter  $Ios_2 > 2$  or ombrothermic summer index resulting from the compensation  $Iosc > 2$  ..... TEMPERATE  
 8. Does not meet the conditions ..... MEDITERRANEAN
9. Maximum precipitation during the warmest four months of the year,  $Pcm_3 < Pcm_1 > Pcm_2$  ..... TROPICAL  
 9. Does not meet the conditions ..... MEDITERRANEAN
10. Summer without hydric deficit; ombrothermic index of the hottest two months of the summer quarter  $Ios_2 > 2$  or ombrothermic summer index resulting from the compensation  $Iosc > 2$  ..... TEMPERATE  
 10. Does not meet the conditions ..... MEDITERRANEAN
11. In territories of northern latitude  $> 72^\circ$  or southern latitude  $> 56^\circ$ . In territories outside of this latitude and altitudes of less than 200m (•): positive annual temperature  $Tp < 380$  ..... POLAR  
 11. In territories with altitudes less than 200 m (•): positive annual temperature  $Tp > 380$  ..... 12
12. In territories with altitudes less than 200m (•): continentality index  $Ic < 11$ , positive temperature of the summer quarter  $Tps > 320$ , average annual temperature  $< 6^\circ$ , positive annual temperature 320-720 ..... BOREAL  
 12. Does not meet the conditions ..... 13
13. In territories with altitudes less than 200 m (•): depending on the continentality index  $Ic$ , the values for the average annual temperature  $T$  and positive annual temperature  $Tp$ , must be for:  $Ic < 21$ ,  $T < 5.3^\circ$  and  $Tp < 720$ ; for:  $Ic = 21-28$ ,  $T < 4.8^\circ$  to and  $Tp < 740$ ; for:  $Ic > 28$ ,  $T < 3.8^\circ$  and  $Tp < 800$  ..... BOREAL  
 13. Does not meet the conditions ..... 14
14. Summer without hydric deficit; ombrothermic index of the hottest two months of the summer quarter  $Ios_2 > 2$  or ombrothermic summer index resulting from the compensation  $Iosc_4 > 2$  ..... TEMPERATE  
 14. Does not meet the conditions ..... MEDITERRANEAN
- (•) If the locality has an altitude of more than 200 m, the temperature values must be calculated theoretically: increasing  $T$  by  $0.6^\circ$ ,  $M$  by  $0.5^\circ$ , and  $It$  or  $Itc$  by 13 units for every 100 m in excess of this altitude. If it is situated to the north of parallel  $48^\circ$  N or south of  $51^\circ$  S, the theoretical values of the average annual temperature and positive annual temperature  $Tp$  must be calculated, increasing  $T$  by  $0.4^\circ$  and  $Tp$  by 12 units for each 100 m in excess of this altitude. When  $Ic \geq 21$  (continental) or when  $It$  or  $Itc < 120$  the thermotype must be calculated based on the positive annual temperature  $Tp$  at 200 m increasing 55 units for each 100 m.

*Key for tropical bioclimates*

1. Annual ombrothermic index  $Io \leq 3.6$  (ultrahyperarid:  $< 0.2$ , hyperarid:  $0.2-0.4$ , arid:  $0.4-1.0$ , semiarid:  $1.0-2.0$ , dry:  $2.0-3.6$ ) ..... 3
1. Annual ombrothermic index  $Io > 3.6$  (subhumid:  $3.6-6.0$ , humid:  $6.0-12.0$ , hyperhumid:  $12.0-24.0$ , ultrahyperhumid  $> 24.0$ ) ..... 2
2. Driest two-monthly ombrothermic index of the driest quarter of the year  $Iod_2 \leq 2.5$  (when  $Ic$ : 0-11 hyperoceanic, 1-21 oceanic,  $> 21$  continental) ..... TROPICAL PLUVISEASONAL
2. Driest two-monthly ombrothermic index of the driest quarter of the year  $Iod_2 > 2.5$  ..... 5
3. Annual ombrothermic index  $Io < 0.2$  (ultrahyperarid) ..... TROPICAL HYPERDESERTIC
3. Annual ombrothermic index  $Io \geq 0.2$  ..... 4
4. Annual ombrothermic index  $Io 0.2-1.0$  ( $0.2-0.4$  hyperarid,  $0.4-1.0$  arid) ..... TROPICAL DESERTIC
4. Annual ombrothermic index  $Io 1.0-3.6$  ( $1.0-2.0$  semiarid,  $2.0-3.6$  dry) ..... TROPICAL XERIC
5.  $Tp > 1000$  ..... TROPICAL PLUVIAL
5.  $Tp < 1000$  (oro-cryorotropical) ..... 6
6. At least three consecutive months per year  $Pi < 10$  mm ..... TROPICAL PLUVISEASONAL
6. Without three consecutive months per year  $Pi < 10$  mm ..... TROPICAL PLUVIAL

*Key for mediterranean bioclimates*

1. Continentality index  $\leq 21$  [when  $Ic \leq 11$  hyperoceanic: ultrahyperoceanic (0-4), euhyperoceanic (4-8), semihyperoceanic (11-14), euoceanic (14-17) and semicontinental (17-21)] ..... 2
1. Continentality index  $> 21$  [when  $Ic$ : 21-28 subcontinental, 28-46 eucontinental, 46-66 hypercontinental] ..... 5
2. Annual ombrothermic index  $Io > 2.0$ , ombrotype: dry-extreme hyperhumid ..... MEDITERRANEAN PLUVISEASONAL OCEANIC
2. Annual ombrothermic index  $Io \leq 2.0$  ..... 3
3. Annual ombrothermic index  $Io < 0.2$  (ultrahyperarid) ..... MEDITERRANEAN HYPERDESERTIC
3. Annual ombrothermic index  $Io \geq 0.2$  (hyperarid:  $0.2-0.4$ , arid:  $0.4-1.0$ , semiarid:  $1.0-2.0$ ) ..... 4
4. Annual ombrothermic index  $Io: 0.2-1.0$  ..... MEDITERRANEAN DESERTIC OCEANIC
4. Annual ombrothermic index  $Io: 1.0-2.0$  ..... MEDITERRANEAN XERIC OCEANIC
5. Annual ombrothermic index  $Io < 0.2$  MEDITERRANEAN HYPERDESERTIC CONTINENTAL
5. Annual ombrothermic index  $Io \geq 0.2$  (dry:  $2.0-3.6$ , subhumid:  $3.6-6.0$ , humid:  $6.0-12.0$ , hyperhumid:  $12.0-24.0$ , ultrahyperhumid  $24.0-48.0$ , extreme hyperhumid  $> 48.0$ ) ..... 6

6. Annual ombrothermic index $Io > 2.0$ .....	
..... MEDITERRANEAN PLUVISEASONAL CONTINENTAL	
6. Annual ombrothermic index $Io \leq 2.0$ .....	7
7. Annual ombrothermic index $Io: 0.2 - 1.0$ .....	
..... MEDITERRANEAN DESERTIC CONTINENTAL	
7. Annual ombrothermic index $Io: 1.0-2.0$ .....	
..... MEDITERRANEAN XERIC CONTINENTAL	5.

#### Ibd. Thermotypes, ombrotypes and continentality

It will be useful to make easily relationship between plant communities and bioclimatic data, to remember the worldwide types and values of the thermotypes (table 3), ombrotypes (table 4), aridic and xeric ombric levels and vegetation types (table 6) as well as the continentality types (table 5).

#### Tropical thermotypes and horizons

Thermotype horizons	Abb	Tp values	It	$T^a C$
Lower infratropical	litr	>3200	780-890	26.8°
Upper infratropical	uitr	2860-3200	670-780	23.8°-26.8°
Lower thermotropical	lttr	2580-2860	590-670	21.3°-23.8°
Upper thermotropical	uttr	2300-2580	490-590	18.8°-21.3°
Lower mesotropical	lmtr	2000-2300	405-490	16.5°-18.8°
Upper mesotropical	umtr	1700-2000	320-405	14.2°-16.5°
Lower supratropical	lstr	1350-1700	240-320	11.3°-14.5°
Upper supratropical	ustr	1000-1350	160-240	8.3°-11.3°
Lower orotropical	lotr	800-1000	<160	6.7°-8.3°
Upper orotropical	uotr	600-800		5.0°-6.7°
Lower cryerotropical	lctr	300-600		2.5°-5.0°
Upper cryerotropical	uctr	1-300		>0°-2.5°
Gelid tropical-	gtr	≤0	-	≤0°

#### Mediterranean thermotypes and horizons

Thermotypic horizons	Abbr.	It, Itc	Tp: $Ic \geq 21, Itc < 120$
Lower inframediterranean	lime	515-580	>2600
Upper inframediterranean	uime	450-515	2400-2600
Lower thermomediterranean	ltme	400-450	2250-2400
Upper thermomediterranean	utme	350-400	2100-2250
Lower mesomediterranean	lmme	285-350	1800-2100
Upper mesomediterranean	umme	220-285	1500-1800
Lower supramediterranean	lsme	150-220	1200-1500
Upper supramediterranean	usme	(120)-150	900-1200
Lower oromediterranean	lome	-	675-900
Upper oromediterranean	uome	-	450-675
Lower cryromediterranean	lcme	-	100-450
Upper cryromediterranean	ucme	-	1-100
Gelid mediterranean	gme	-	0

#### Temperate thermotypes and horizons

Thermotypic horizons	Abbr.	It, Itc	Tp: $Ic \geq 21, Itc < 120$
Infratemperate	ite	>410	>2351
Lower thermotemperate	lite	350-410	2176-2350
Upper thermotemperate	utte	290-350	2000-2175
Lower mesotemperate	lmte	240-290	1700-2000
Upper mesotemperate	umte	190-240	1400-1700
Lower supratemperate	lste	(120)-190	1100-1400
Upper supratemperate	uste	-	800-1100
Lower orotemperate	lote	-	590-800
Upper orotemperate	uste	-	380-590
Lower cryotemperate	lcte	-	100-240-380
Upper cryotemperate	ucte	-	1-50-100
Gelid temperate	gte	-	0

**Table 3.** Thermotypic horizons and values of the tropical, mediterranean and temperate macrobioclimates

<i>Ombratypes (worldwide)</i>			
<i>Ombric types</i>	<i>Ombric horizons</i>	<i>Abr.</i>	<i>Io, Iom</i>
1. Ultrahyperarid	1a. Lower ultrahyperarid 1b. Upper ultrahyperarid	luha uuha	0.0-0.1 0.1-0.2
2. Hyperarid	2a. Lower hyperarid 2b. Upper hyperarid	lha uha	0.2-0.3 0.3-0.4
3. Arid	3a. Lower arid 3b. Upper arid	lar uar	0.4-0.7 0.7-1.0
4. Semiarid	4a. Lower semiarid 4b. Upper semiarid	lsa usa	1.0-1.5 1.5-2.0
5. Dry	5a. Lower dry 5b. Upper dry	ldry udry	2.0-2.8 2.8-3.6
6. Subhumid	6a. Lower subhumid 6b. Upper subhumid	lshu ushu	3.6-4.8 4.8-6.0
7. Humid	7a. Lower humid 7b. Upper humid	lhum uhum	6.0-9.0 9.0-12.0
8. Hyperhumid	8a. Lower hyperhumid 8b. Upper hyperhumid	lhh uhh	12.0-18.0 18.0-24.0
9. Ultrahyperhumid	9a. Lower ultrahyperhumid 9b. Upper ultrahyperhumid	luhh uuhh	24.0-36.0 36.0-48.0
10. Extreme ultrahyperhumid	10a. Lower extreme hyperhumid 10b. Upper extreme hyperhumid	lehh uehh	48.0-96.0 >96.0

**Table 4.** Threshold values of the ombric types and horizons recognised on Earth

<i>Continentality types.</i>			
<i>Types</i>	<i>Subtypes</i>	<i>Levels</i>	<i>Values</i>
1. Hyperoceanic (0-11)	Ultrahyperoceanic (0-4)	1.1a. Strong	0-2.0
		1.1b. Weak	2.0-4.0
	Euhyperoceanic (4-8)	1.2a. Strong	4.0-6.0
		1.2b. Weak	6.0-8.0
	Subhyperoceanic (8-11)	1.3a. Strong	8.0-10.0
		1.3b. Weak	10.0-11.0
2. Oceanic (11-21)	Semihyperoceanic (11-14)	2.1a. Strong	11.0-12.0
		2.1b. Weak	12.0-14.0
	Euoceanic (14-17)	2.2a. Strong	14.0-15.0
		2.2b. Weak	15.0-17.0
	Semicontinental (17-21)	2.3a. Weak	17.0-19.0
		2.3b. Strong	19.0-21.0
3. Continental (21-66)	Subcontinental (21-28)	3.1a. Weak	21.0-24.0
		3.1b. Strong	24.0-28.0
	Eucontinental (28-46)	3.2a. Weak	28.0-37.0
		3.2b. Strong	37.0-46.0
	Hypercontinental (46-66)	3.3a. Weak	46.0-56.0
		3.3b. Strong	56.0-66.0

**Table 5.** Types, subtypes and levels of simple continentality (Ic) recognised on Earth

For the simplicity, availability of data and excellent global correlation we always utilize the “simple continentality index” (Ic = Tmax-Tmin, in degrees centigrade)

#### **1be. Vegetation formations of the aridic and xeric types**

In the aridic (0.0-2.0) and xeric (2.0-3.6) mediterranean and tropical bioclimates and less commonly in polar, boreal and temperate ombric types , the values correspond with the following vegetation formations (table 6) . In tropical macrobioclimate on prefer utize the term savanna.

#### **1bf. Bioclimatic variants**

The bioclimatic variants are very informative and interesting typological units, that are recognized within the specific bioclimates, and which allow to identify climatic peculiarities of ombric and occasionally thermic nature. Within the eleven bioclimatic variants: steppic, submediterranean, bixer, antitropical, seropluvial, polar semiboreal, tropical semimediterranean desertic, semipolar subantarctic, polar euhyperoceanic, boreal subantarctic and temperate subantarctic, only four works in the tropical thermic zone (\*). (table 7).

Aridic and xeric types	Vegetation formations	Io
Dry moderate and strong	xeric woodland or taiga	2.0-3.6
Moderate semiarid	moderate semidesert	1.5-2.0
Strong semiarid	strong semidesert	1.0-1.5
Moderate arid	moderate desert	0.7-1.0
Strong arid	strong desert	0.4-0.7
Moderate hyperdesertic	moderate hyperdesert	0.2-0.4
Strong hyperdesertic	strong hyperdesert	0.1-0.2
Extreme hyperdesertic	extreme hyperdesert	0.0-0.1

**Table 6.** Relationship between the aridic and xeric types and the vegetation formations according with the ombrothermic index (Io= 0.0-3.6)

Bioclimatic variants	Abb.	Tr	Me	Te	Bo	Po
Steppic	stp	—	●	●	●	●
Submediterranean	sbm	—	—	●	●	●
Bixeric (*)	bix	●	—	—	—	—
Antitropical (*)	ant	●	—	—	—	—
Seropluvial (*)	spl	●	—	—	—	—
Polar semiboreal	posbo	—	—	—	●	—
Tropical semimediterranean desertic (*)	trsmd	●	●	—	—	—
Semipolar subantarctic	sepos	—	—	●	●	—
Polar euhyperoceanic	poeuhy	-	-	-	-	●
Boreal subantarctic	bosuba	-	-	-	●	-
Temperate subantarctic	tesuba	-	-	●	-	-

**Table 7.** Distribution of the bioclimatic variants in the five macrobioclimates of Earth. Tr: Tropical, Me: Mediterranean, Te: Temperate, Bo: Boreal, Po: Polar.

*Bixeric* (bix). Tropical bioclimatic variant, in which there are two annual periods of aridity of at least one month ( $P < 2T$ ), corresponding to both solstices or both equinoxes, separated by another two rainier periods during solstices at least with one month  $P \geq 2T$ . This variable does not occur in the tropical pluvial and tropical hyperdesertic bioclimates. Bixeric tropical plant formations have structural and occasionally corionomic and phylogenetic relationships with those of mediterranean pluviseasonal, xeric or desertic bioclimates.

*Antitropical* (ant). Tropical bioclimatic variant, restricted to the equatorial and low eutropical latitudinal bands ( $15^{\circ}$  N & S), in which rainfall during the winter solstice quarter is higher than that of the summer quarter. This variable does not occur in the pluvial tropical or in the hyperdesertic tropical bioclimates.

The antitropical plant formations are not very different in their structure to the tropical formations from the equivalent seropluvial or typical ombrötype (normal monsonic rains), although the floristic element that comprises them has a large number of endemisms, obviously caused by a phenological rainy period that is practically opposite to the normal tropical environment, which has favoured its isolation and therefore its speciation.

*Seropluvial* (spl.). Tropical bioclimatic variant in which the rainfall of the first two months of the summer solstice is at least 1.3 times less the rainfall corresponding to the two following months. This bioclimatic variant does not occur in the pluvial tropical bioclimate or in the hyperdesertic tropical bioclimate, (Io: 0.0-2.0); (the prefix sero-, means autumnal or late in the year round).

This bioclimatic variant indicates monsonic bioclimates (pluviseasonal, xeric or desertic) in which the rains coming

from the East arrive the territory late in the summer. This late rains occurs regularly towards the western of the continents in tropical and subtropical Africa, Hindustan, N & S America and Australia, increasing the dry season and aridic and xeric conditions.

*Tropical semimediterranean desertic* (trsmd). In the subtropical latitudinal zone ( $23^{\circ}$ - $36^{\circ}$  N & S) an arid, hyperarid or ultrahyperarid mediterranean territory (Io: 0.0-1.0) must be considered belong to tropical semimediterranean desertic variant when the precipitation of the warmest six-month consecutive period in the year is at least 0.6 times lower than the precipitation in the coldest six-month period of the year ( $Pss \leq 0.6 Psw$ ); this is the case of the most hottest subtropical deserts of California, Atacama deserts of South America, and in the African Saharan and Namibian deserts. Ombrosemestral desertic index  $Idss = Pss/Psw$ , where  $Io \leq 1.0$  Types: Not tropical semimediterranean ( $Idss$  0.1-0.6), moderately semimediterranean ( $Idss$  0.6-0.8), scarcely semimediterranean ( $Idss$  0.8-1.0), full tropical ( $Idss \geq 1.0$ ).

### 1c. Bioclimatic types, maps and data of Cabo Verde Islands

Cabo Verde has a tropical macrobioclimate; all belonging to the seropluvial bioclimatic variant; with rainfall of the two first months of the summer solstice: june and july, in Northern Hemisphere, are at least 1.3 times less than the two following months: august and september; this bioclimatic variant operate quite well in the western of the big continents, between  $10^{\circ}$ - $36^{\circ}$  N & S with tropical bioclimates from pluviseasonal to desertic. More than 90% of the territory is tropical desertic and tropical xeric going from upper infratropical to upper mesotropical,

and may be supratropical above 2400 m (Pico do Fogo 2829 m), and from upper ultrahyperarid to upper dry, particularly in Fogo: Monte Velha, Santo Antão: Cova, Chã de Lagoa, Santiago: Serra da Malagueta and Pico da Antónia. The annual and interannual strong variation of the rainfall, torrential precipitations, shallow stony and andic soils, and existence in last centuries of frequent year periods without or few precipitations, has block the migratory conditions of much of the xeric and pluviseasonal tropical african flora, as well as extinctions parti-

cularly plants and trees infra-thermotropical xeric and pluviseasonal dry-subhumid species of sahelian, guinean or angolan regions, mainly of forest/savanna. biomes, of Sahelian, Guinean or Angolan regions.

#### *Ica. Thermotype and ombrotypes of Cabo Verde Islands*

In Cabo Verde Islands on recognize six thermotypes horizons (table 8), ten ombrotypes horizons (table 9), as well as surface (%) in every island (table 10) [S. Rivas-Martínez, A. Penas, S. Rivas-Sáenz & S. del Río].

Nº	Thermotype horizons	Tp values	It	T <sup>a</sup> C	Abb	C.V.I
1a	Lower infratropical	3200-3600	780-890	26.9°-30.0°	litr	-
1b	Upper infratropical	2860-3200	670-780	23.8°-26.8°	uitr	●
2a	Lower thermotropical	2580-2860	590-670	21.3°-23.8°	lttr	●
2b	Upper thermotropical	2300-2580	490-590	18.8°-21.3°	uttr	●
3a	Lower mesotropical	2000-2300	405-490	16.5°-18.8°	lmtr	●
3b	Upper mesotropical	1700-2000	320-405	14.2°-16.5°	umtr	●
4a	Lower supratropical	1350-1700	240-320	11.3°-14.5°	lstr	●
4b	Upper supratropical	1000-1350	160-240	8.3°-11.3°	ustr	-
5a	Lower orotropical	800-1000	<160	6.7°-8.3°	lotr	
5b	Upper orotropical	600-800		5.0°-6.7°	uotr	
6a	Lower cryerotropical	300-600		2.5°-5.0°	lctr	
6b	Upper cryerotropical	>0-300		>0°-2.5°	uctr	
	Gelid Tropical-	0	Tp, Tpmax	<-10°	gtr	-

**Table 8.** Thermotypes and values occurring in Cabo Verde Islands (●).

Nº	Ombreic horizons	Io values	C. V. I	Abb
1a	Lower ultrahyperarid	0.0-0.1	-	luha
1b	Upper ultrahyperarid	0.1-0.2	●	uuha
2a	Lower hpearid	0.2-0.3	●	lha
2b	Upper hpearid	0.3-0.4	●	oha
3a	Lower arid	0.4-0.7	●	lar
3b	Upper arid	0.7-1.0	●	uar
4a	Lower semiarid	1.0-1.5	●	lsa
4b	Upper semiarid	1.5-2.0	●	usa
5a	Lower dry	2.0-2.8	●	ldry
5b	Upper dry	2.8-3.6	●	udry
6a	Lower subhumid	3.6-4.8	●	lsh
6b	Upper subhumid	4.8-6.0	-	ush
7a	Lower humid	6.0-9.0	-	lhu
7b	Upper humid	9.0-12.0	-	uhu
8a	Lower hyperhumid	12.0-18.0	-	lhh
8b	Upper hyperhumid	18.0-24.0	-	uhH
9a	Lower ultrahyperhumid	24.0-36.0	-	luhh
9b	Upper ultrahyperhumid	36.0-48.0	-	uuhh
10a	Lower extreme hyperhumid	48.0-96.0	-	lehh
10a	Upper extreme hyperhumid	>96.0	-	Uehh

**Table 9.** Ombrotypes,horizons,index values and abbreviations, occurring in Cabo Verdes (●). [S. Rivas-Martínez, A. Penas & S. del Río]

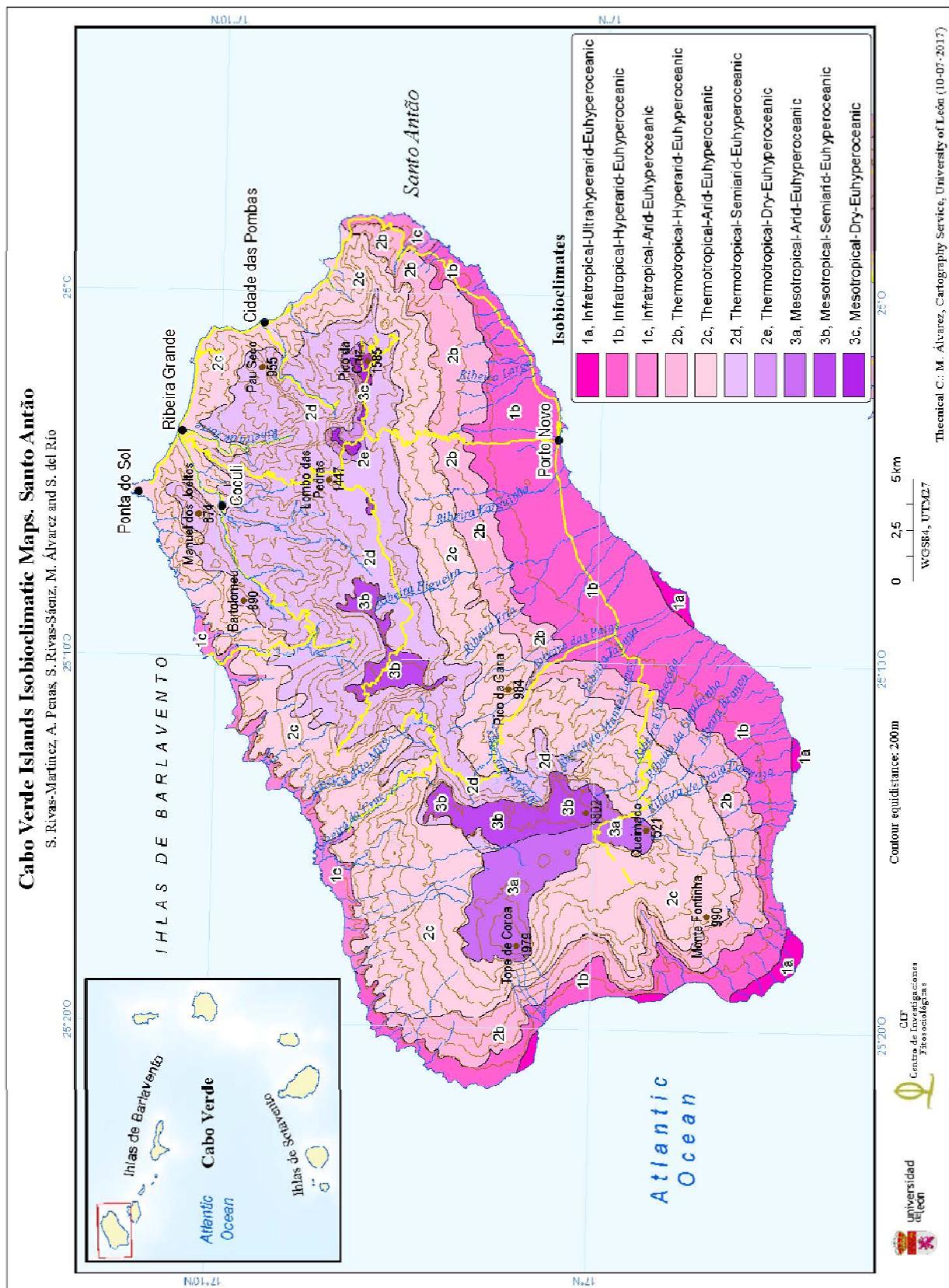
## 1cb. Bioclimatic data of Cabo Verde Islands

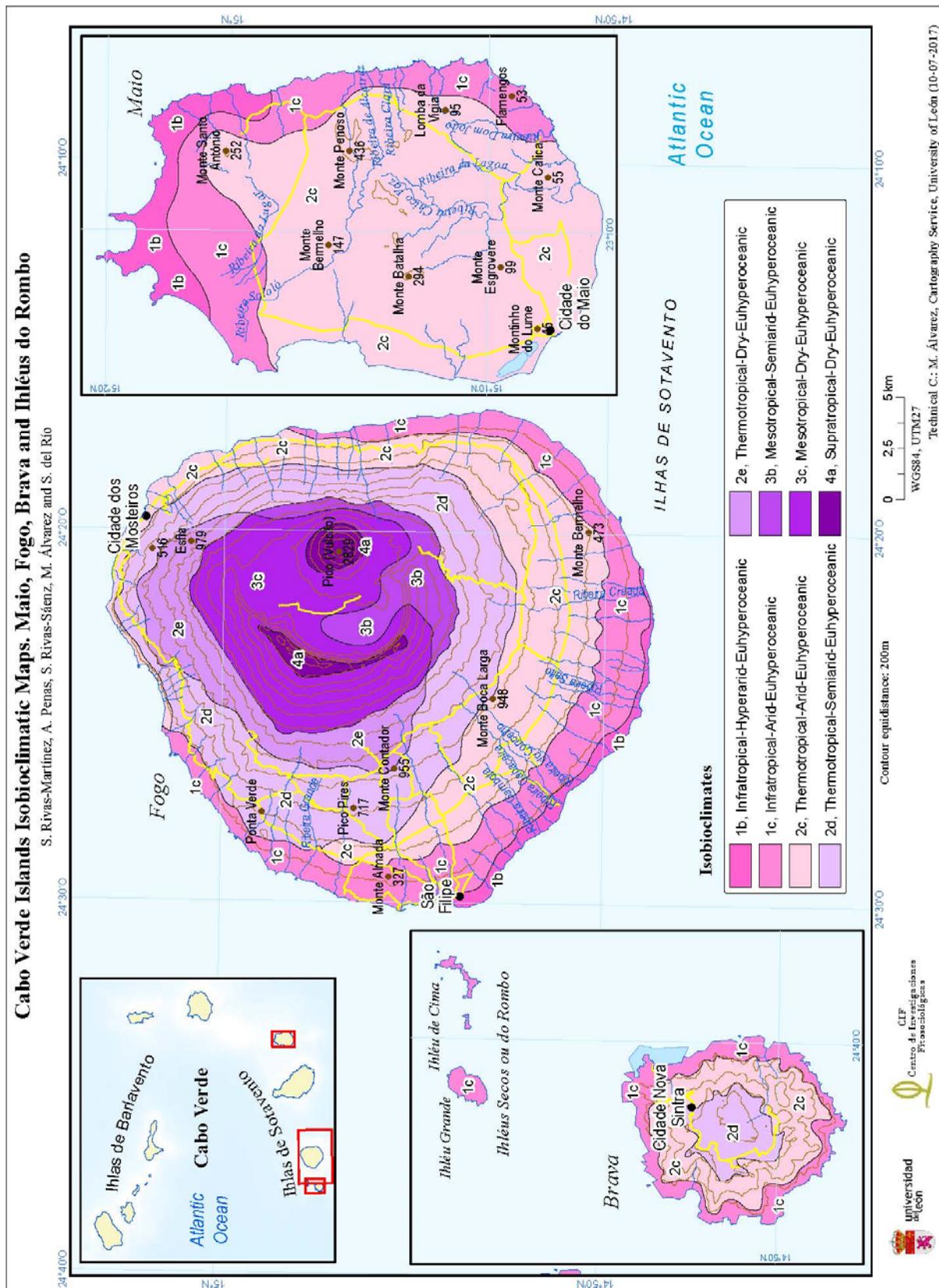
Nº	Locality	Island	Altit.	Latitude	Longitude	Years	T°C	P	Io	IT	Tp	Ic	AIY	Bioclimatic Diagnosis. Isobioclimates
v1	Praia Aeroporto	SN	64	14° 55' N	23° 29' W	60-05	25,1	150,8	0,50	709	3013	4,5	1865,2	Trop. Des. lo. infratr. lo. arid euhyperoc. st. lo arid
2	Santa Cruz	SN	84	15° 8' N	23° 33' W	61-05	23,9	260,3	0,91	670	2868	5,4	1660,0	Trop. Des. lo. infratr. up. arid euhyperoc., we. up. arid
3	Rui Vaz	SN	798	15° 2' N	23° 36' W	78-05	20,3	384,6	1,58	533	2436	5,2	1556,9	Trop. Xe. up. thermotr. up. semiarid, euhyperoc. st. up. arid
4	Serra Malagueta	SN	765	15° 11' N	23° 41' W	61-05	20,3	656,7	2,70	553	2436	5,2	1397,0	Trop. Pst. up. thermotr. lo. dry, euhyperoc. we. lo. sarid
8	S. Filipe	F	48	14° 54' N	24° 29' W	78-05	25,1	123,0	0,41	709	3012	4,5	1927,4	Trop. Des lo. infratr. lo. arid, euhyperoc. st. lo. arid
6	Mosteiros	F	52	15° 1' N	24° 19' W	93-05	23,3	224,0	0,80	643	2796	5,2	1650,6	Trop. Des. lo. thermotr. up. arid, euhyperoc. st. up. arid
5	Achada Furna	F	829	14° 52' N	24° 22' W	61-05	21,6	249,1	0,96	609	2592	4,5	1763,0	Trop. Des. up. thermotr. up. arid, euhyperoc. st. up. arid
7	Monte Velha	F	1245	15° 0' N	24° 40' W	78-03	17,8	717,7	3,36	478	2136	5,2	1200,0	Trop. Xe. lo. mesot. up. dry, euhyperoc. st. up. sarid
9	Figueral	BR	68	14° 52' N	24° 43' W	93-05	25,1	221,6	0,74	743	3013	4,5	1811,1	Trop. Des. lo. infratr. Up. arid euhyperoc., we. lo. arid
10	Mato	BR	725	14° 51' N	24° 41' W	93-05	22,1	259,0	0,98	619	2653	4,5	1564,6	Trop. Des. up. thermotr. Up. arid euhyperoc., we. up. arid
11	Monte Trigo	A	10	16° 57' N	25° 18' W	60-91	26,2	93,9	0,29	748	3144	5,4	2039,0	Trop. Des. lo. infratr. hyperarid euhyperoc., st. lo. harid
12	Cha da Igreja	A	20	17° 9' N	25° 9' W	51-10	24,4	193,3	0,66	680	2929	5,4	1783,1	Trop. Des. lo. infratr. lo. arid euhyperoc., st. up. arid
13	Pedro Diaz	A	1100	17° 6' N	25° 1' W	93-05	18,6	449,7	2,02	494	2232	5,2	1370,3	Trop. Xe. lo. mesot. lo. dry euhyperoc., we. lo. sarid
14	Pico da Cruz	A	1480	17° 6' N	25° 2' W	90-05	17,4	432,3	2,15	470	2088	5,2	1396,6	Trop. Xe. lo. mesot. lo. dry euhyperoc., we. lo. sarid
15	Mindelo	V	16	16° 53' N	25° 18' W	62-94	23,1	960	0,35	643	2772	4,4	1976,0	Trop. Des. lo. thermotr. up. hyperarid euhyperoc., we. lo. harid
16	Calhao	V	10	16° 50' N	24° 54' W	94-05	24,2	67,2	0,23	678	2904	4,8	1886,2	Trop. Des. lo. infratr. lo. hyperarid euhyperoc., we. lo. harid
17	Monte Verde	V	750	16° 50' N	25° 12' W	85-05	19,4	130,9	0,56	540	2328	4,4	1379,0	Trop. Des. up. thermotr. lo. arid euhyperoc., we. lo. sarid
18	Cachaco	N	724	16° 37' N	24° 20' W	93-05	19,5	396,3	1,69	591	2340	4,5	975,0	Trop. Des. up. thermotr. up. sarid euhyperoc., st. lo. sarid
19	Juncalinho	N	65	16° 36' N	24° 8' W	78-05	22,5	105,7	0,38	631	2820	4,5	1966,8	Trop. Des. up. thermotr. up. hyperarid euhyperoc., we. up. harid
20	Carrical	N	2	16° 33' N	24° 4' W	79-91	24,1	58,4	0,20	681	2892	4,6	2159,1	Trop. Des. lo. infratr. lo. hyperarid euhyperoc., we. lo. harid
21	Pedra de Lume	SL	10	16° 45' N	22° 53' W	67-94	23,6	48,8	0,17	656	2832	5,2	2209,0	Trop. Des. up. thermotr. ultrahyperarid euhyperoc., we. lo. harid
22	Santa Maria	SL	7	16° 35' N	22° 54' W	63-97	24,1	50,2	0,17	676	2892	5,2	2204,0	Trop. Des. lo. infratr. up. ultrahyperarid euhyperoc., we. lo. harid
23	Fundo das Figueiras	BO	20	16° 8' N	22° 43' W	61-01	23,3	65,5	0,23	643	2796	5,2	2141,2	Trop. Des. lo. thermotr. lo. hyperarid euhyperoc., we. lo. harid
24	Sal Rei	BO	10	16° 10' N	22° 55' W	61-01	24,2	101,8	0,34	680	2904	5,2	1835,0	Trop. Des. lo. infratr. up. hyperarid euhyperoc., we. lo. arid
25	Cascabulho	M	22	15° 16' N	23° 10' W	78-05	24,4	132,8	0,47	690	2928	5,0	1902,4	Trop. Des. lo. infratr. lo. arid euhyperoc., we. up. hyperarid
26	Pedra Vaz	M	39	15° 11' N	23° 7' W	78-05	24,4	145,8	0,50	732	2930	5,0	1887,0	Trop. Des. lo. infratr. lo. arid euhyperoc., we. up. Hyperarid

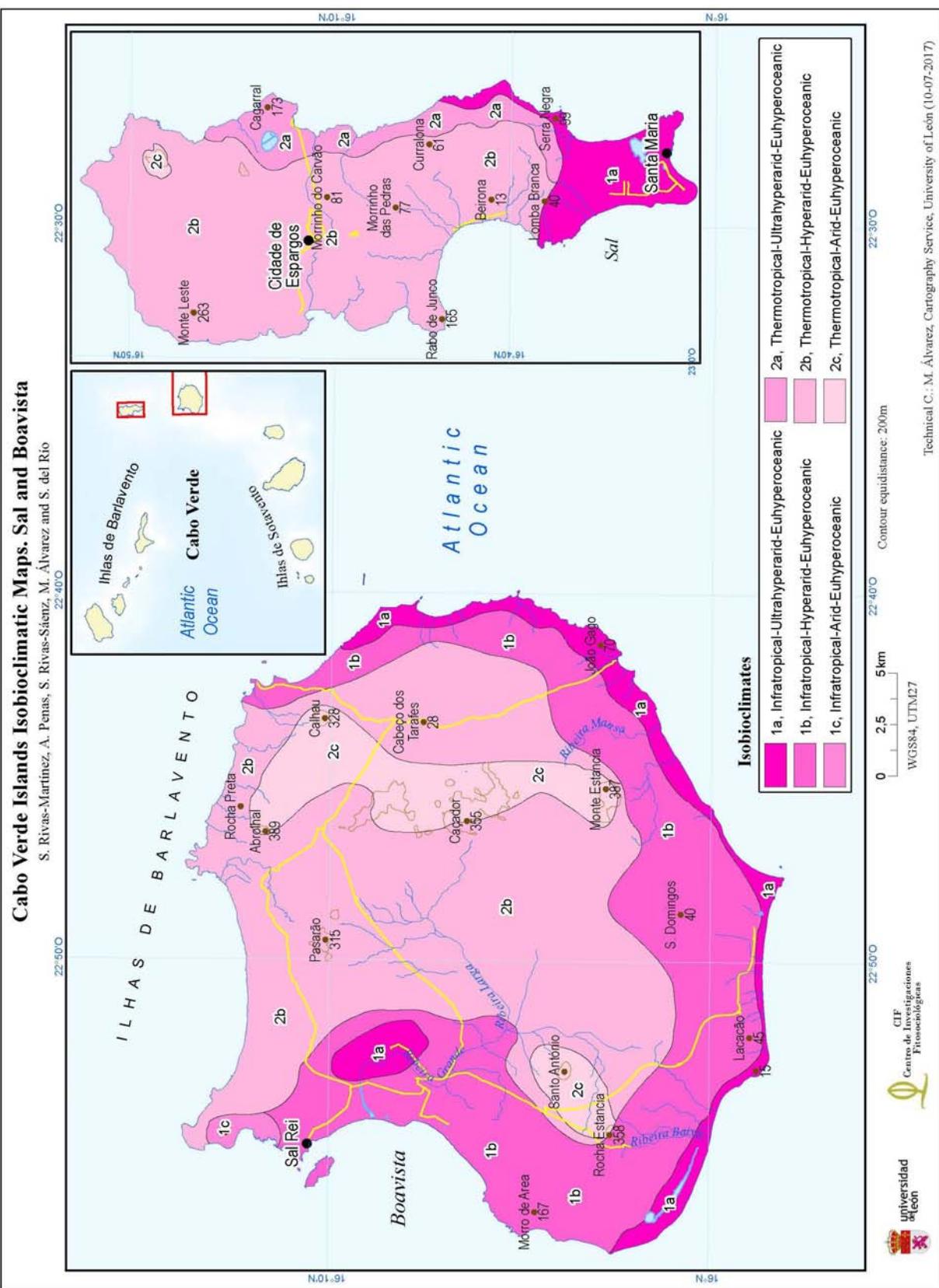
T= Average annual temperature; P= Average annual precipitation; Tp= Positive annual temperature; Itc= Compensated thermicity index, Io=Annual ombrothermic index; Ic=Continentiality index; AIY=Aridic annual index; BO= Boavista Island; BR= Brava Island; F= Fogo Island; M= Maio Island; A= São Anton; N=São Nicolau Island; V= São Vicente; SL= Sal Island; SN= Santiago island

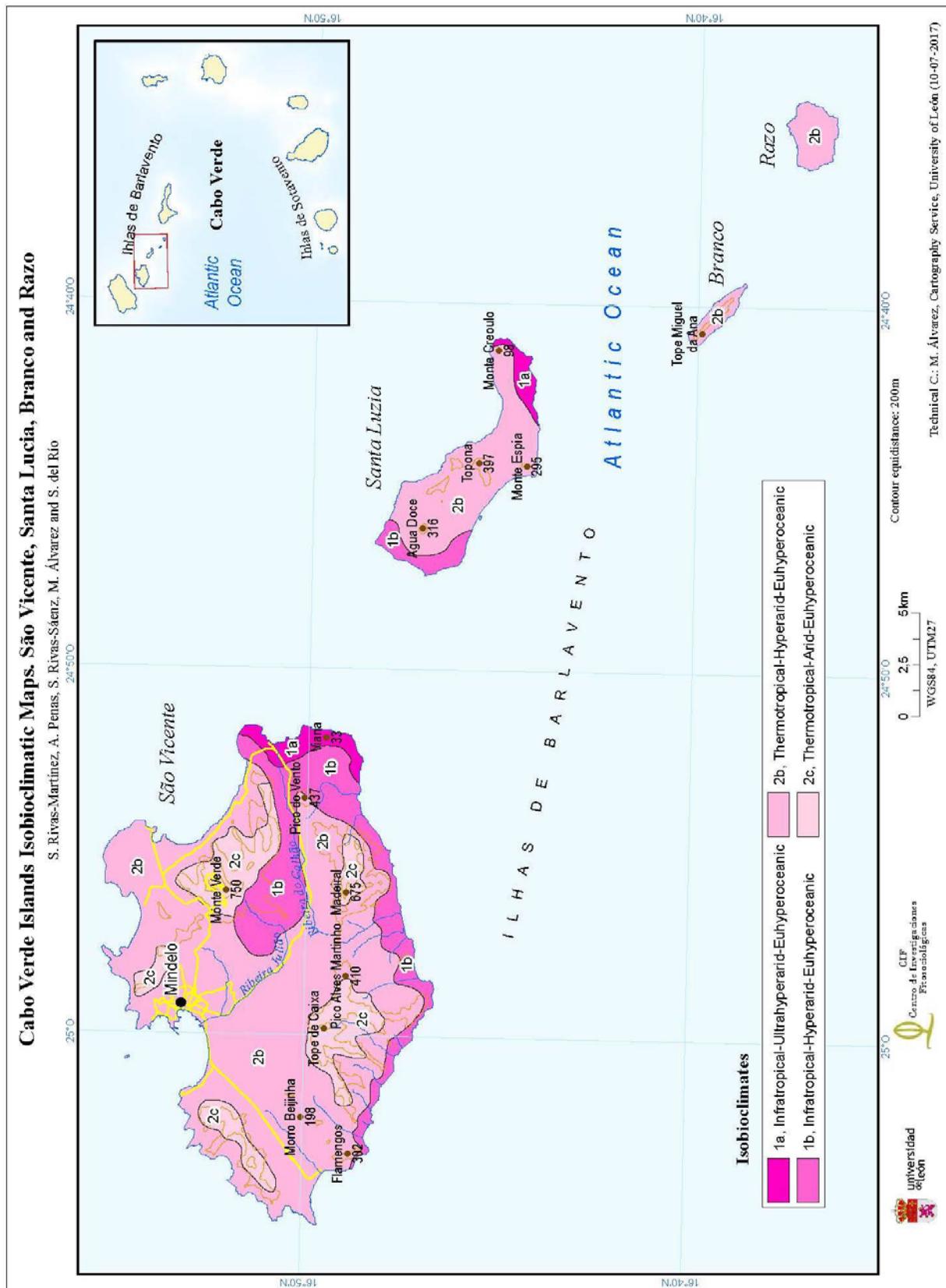
### *1cc. Bioclimatic maps and surfaces (%) of Cabo Verde Islands*

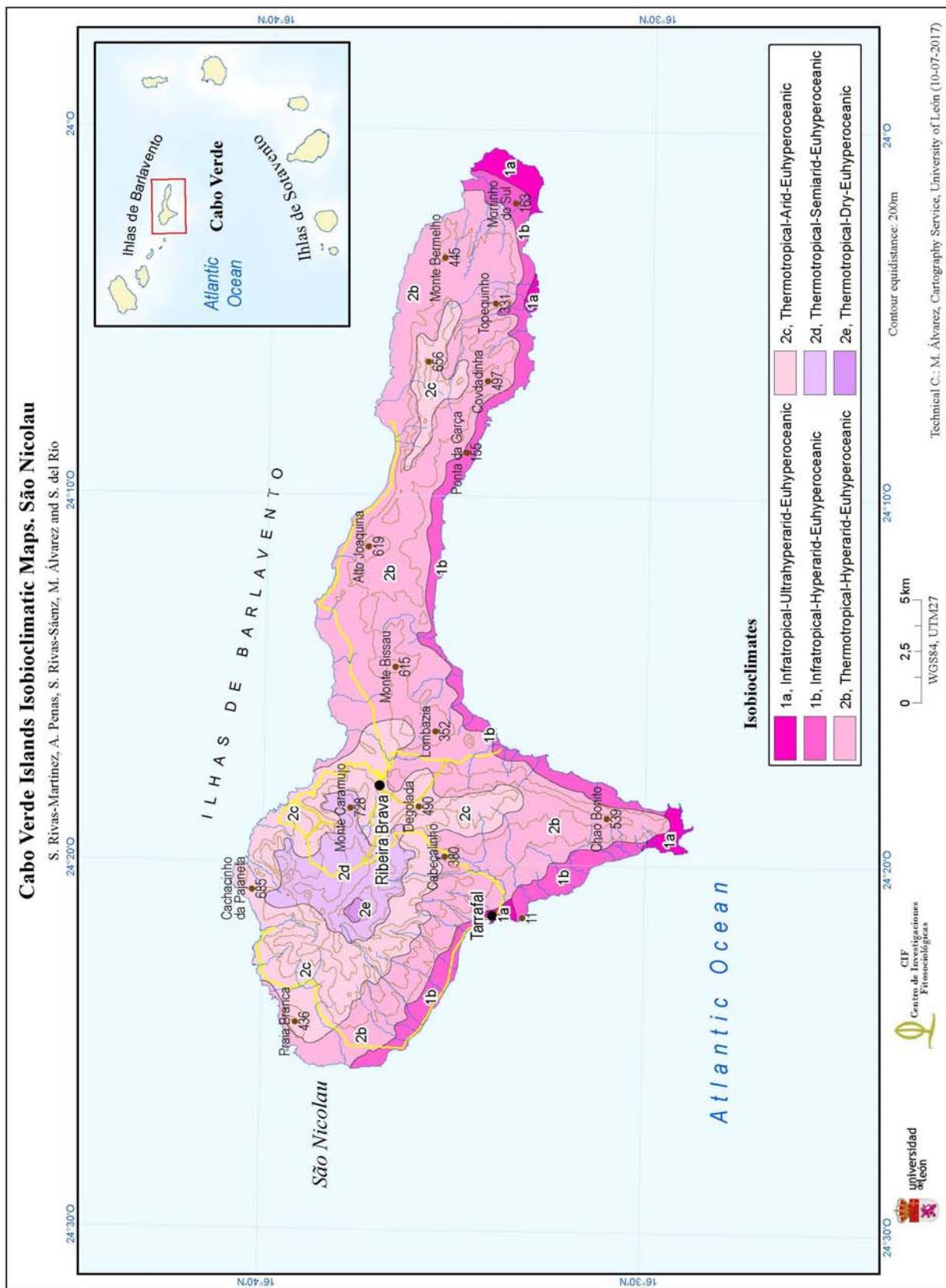
(Authors: S. Rivas-Martínez, A. Penas, S. Rivas-Sáenz, M. Álvarez & S. del Río)





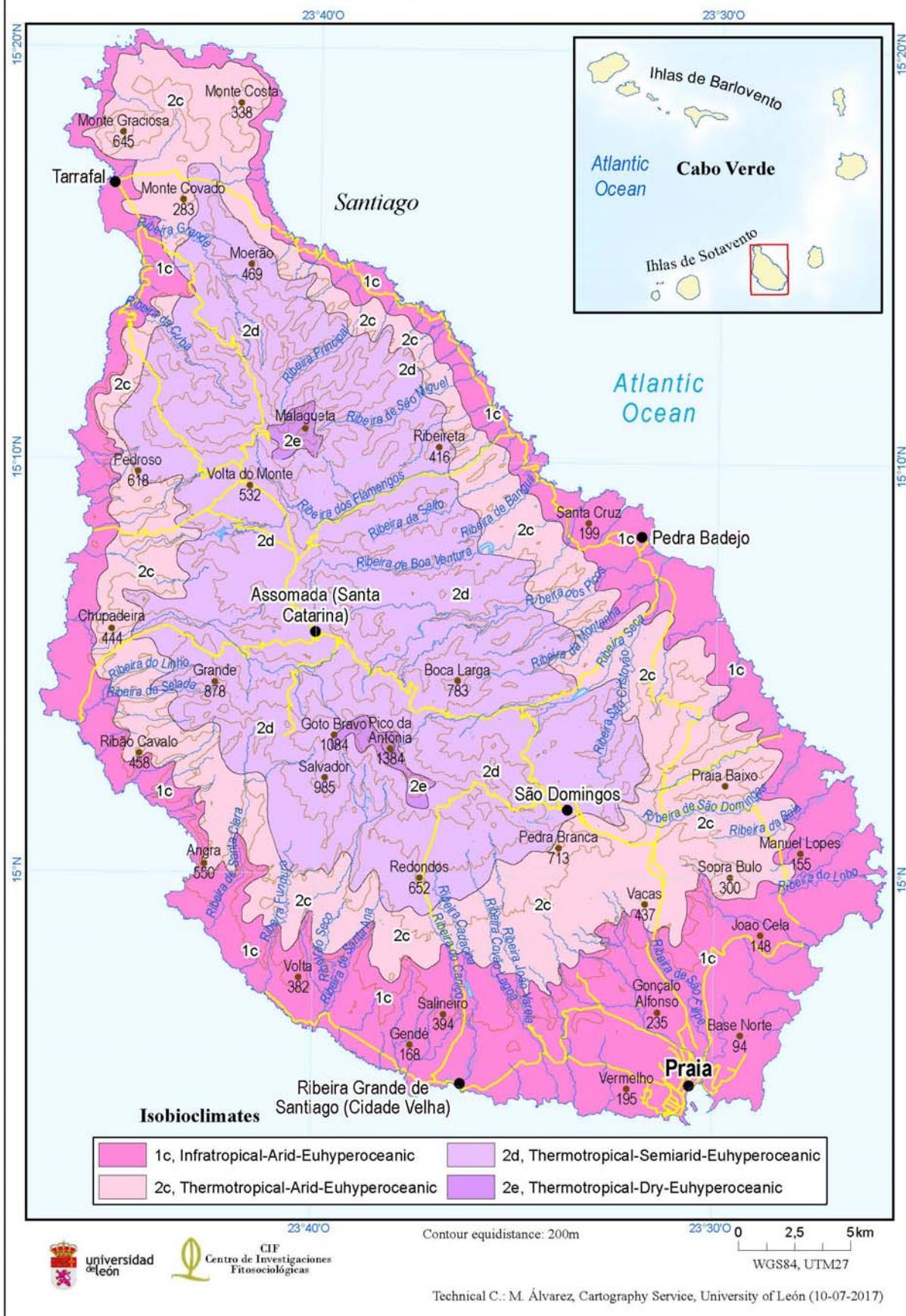






## Cabo Verde Islands Isobioclimatic Maps. Santiago

S. Rivas-Martínez, A. Penas, S. Rivas-Sáenz, M. Álvarez and S. del Río



Biogeography			Thermotypes (%)					Ombrotypes (%)					
Abbr.	Districts	Sector	Abbr.	In	Th	M	S	Abbr.	Uha	Ha	Ar	Sa	Dr
A	Santo Antão	North Cabo Verde	A	22	71	7	-	A	1	32	42	25	1
V	São Vicente		V	19	81	-	-	V	3	84	13	-	-
N	São Nicolau		N	14	86	-	-	N	2	65	25	7	-
SL	Sal	East Cabo Verde	SL	13	87	-	-	SL	24	75	1	-	-
BO	Boavista		BO	42	58	-	-	BO	7	82	11	-	-
M	Maio		M	28	72	-	-	M	-	8	92	-	-
SN	Santiago	South Cabo Verde	SN	31	69	-	-	SN	-	-	59	40	1
F	Fogo		F	19	58	21	2	F	-	2	41	30	27
BR	Brava		BR	33	67	-	-	BR	-	-	80	20	-

**Table 10a.** Thermotypes and ombrotypes surfaces (%) CaboVerde Islands, To V (São Vicente I) belongs Santa Luzia, Branco and Razo Islets and to Br (Brava): Rombo Islets

Nº	Thermotypes		Nº	Ombrotypes		Isobioclimates (%)								
1	Infratropical	Itr	1a	Ultrahyperarid	Uha	1	3	2	13	7	-	-	-	-
			1b	Hyperarid	Ha	19	16	11	-	34	8	-	2	-
			1c	Arid	Ar	2	-	-	-	1	21	31	17	33
2	Thermotropical	Ttr	2a	Ultrahyperarid	Uha	-	-	-	11	-	-	-	-	-
			2b	Hyperarid	Ha	13	68	54	75	48	-	-	-	-
			2c	Arid	Ar	36	13	25	1	10	72	29	24	47
			2d	Semiarid	Sar	22	-	7	-	-	-	40	25	20
			2e	Dry	Dry	-	-	-	-	-	-	1	9	-
3	Mesotropical	Mtr	3a	Arid	Ar	3	-	-	-	-	-	-	-	-
			3b	Semiarid	Sa	3	-	-	-	-	-	-	5	-
			3c	Dry	Dry	-	-	-	-	-	-	-	16	-
4	Supratropical	Str	4a	Dry	Dry	-	-	-	-	-	-	-	2	-
Cabo Verde Islands						A	V	N	SL	Bo	M	SN	F	BR

**Table 10b.** Surface (%) of the twelve isobioclimates (ombrotype + thermotype+ continentality type units) existing in the nine Cabo Verde Islands, where the Continentality Index is always euhypereceanic, Ic (4.0-8.0), and mostly belongs to the strong level (Ic 4.0-6.0)

## Biogeography

### 2a. Biogeographical notions

Biogeography is the science that studies the distribution of species, communities, habitats, biocoenosis, ecosystems, and ecoregions on the Earth, as well as the relationships between them and their causes. It takes into account the areas of taxa, syntaxa, plant communities, formations, biomes and ecoregions, as well as information coming from other natural sciences (geography, soil science, bioclimatology, geology, etc.). The biogeography also attempts to establish a hierarchical biogeographic typology of the territories on the Planet (isles and continents), whose main units in decreasing rank are: kingdom, region, province, sector, district, country, landscape cell and tesela (Rivas-Martínez & al., 2007, 2011). Terrestrial biogeography has been twinned with phytogeography due to the value as bioindicators of vascular and non-vascular plant species and communities in its definition and delimitation. The oceanic bioge-

graphy should be study mostly with oceanographic scientific methods.

The elementary biogeographic terrestrial unit or model of lowest rank is the tesela, which we define as a geographic space with a greater or lesser extension, ecologically homogeneous, what means that it has only a single type of potential natural vegetation (climax) and, as result, an unique sequence of substitution seral communities.

The permatesela is also an elementary model of lowest rank located in exceptional sites or cenotopes: polar, fluvial, lake and coast marine landscapes, deserts, high cold mountains, dunes, volcanic tephra, cohesive rock formations, coastal cliffs, etc., in which the permanent vegetation growing in these spaces lacks of perennial substitution communities in the sere. The tesela and permatesela are the only two biogeographical units which can be repeated in disjointed distribution. The landscape cells, such as peni-plains in horst, river valleys, lake systems, connected marshes, mountain summits, ridges, steep slopes, etc., are broad geographic

spaces characterized by an important group of teselas or permateselas and their corresponding complexes, assembled by networks of geosigmeta and geopermasigmeta distributed in function of the relief, the soil conditions or related isobioclimates of the territory.

The biogeographic country (in spanish: comarca biogeográfica) must be a broad, coherent and clearly delimited territory that has an abundant group of landscape cells, species, communities, associations, and above all particular topographic geosigmeta. The district must be a group of biogeographic countries, characterized by the existence of numerous differential species and even endemic taxa, particularly in coastal, oreadic rocky areas and interior saline or ultramafic soils, which permit easily recognition from the adjacent districts; it also includes communities, associations, and vegetation series, geoseries and geoclinoseries, which are absent in nearby districts.

The sector is a group of districts with a large-scale geographic entity, that have its own endemic taxa, associations, vegetation series, as well as original topographic and geoclinosequential geoseries, which are generally due to the existence of exclusive climatophilous, permanent and subserial communities, with their particular isobioclimates, as well as topographic paleoclimates and migratory routes.

The biogeographic province is a vast geographic territory which, out of latitudinally flat and cold territories, has an high number of endemisms and differential species (its own subelement), macroseries and geomacroseries; also, is characteristic of each province to have a particular vegetation zonation, climax and succession; generally, in northern boreal and hemiboreal big territories, could assamble a several broad of biogeographic sectors.

The biogeographic region is a very extend territory, formed by a group of provinces which, out of polar and cold territories of Earth, has an original and very rich flora or regional floristic element with species, genera or even endemic families; in addition, it has its own particular megaseries, geomegaseries and geomegapermaseseries and in consequence, its own vegetational belt sequences (Rivas-Martínez, 2005). Finally, the kingdom is the supreme typological unit of the biogeography, generally pluricontinental and multi-insular, which in addition of taxonomic and ecosystematic considerations addresses the origins of the flora and fauna, the vegetational formations ways and migration of the great continents, orogenies, and its own bioclimate: at present and in former times.

As is by now traditional in this science: Engler (1924), Braun-Blanquet (1928), Dice (1943), Takhtajan (1986), Rivas-Martínez, Navarro, Costa & Penas (2011), the denominations of the biogeographic units – both primary and auxiliary from the kingdoms to the biogeographic countries – are given based on more or less well-known geographical, orographic or historical designations, which are treated as rather coincident with the area they are intending to represent. Grammatically, all the biogeographical units are considered to be proper nouns identifying the zone. The names formed by juxtaposition of two geographical nouns are joined by means of a hyphen, maintaining the initial capital in both and keep their condition of proper nouns.

It must be emphasized that the biogeographical units can only be accurately delimited through their diagnosis and, of course, by the corresponding maps. All the territories – except for the tesela and permatesela – must be contiguous by land, lake or sea routes, and include all the orographic accidents and lithological diversity which may exist inside the area. Sometimes in the biogeographical territories, as a whole, there are introgressions of other adjacent territories, and these “islands” frequently occur in areas with a diverse lithology or near regional or provincial boundaries. Their possible typological independence, always of a lower rank than the area into which they introgress, depends on their geological or edaphic originality, floristic richness and phytocoenotic biodiversity, as well as on their extension isolation and bioclimate.

One of the criteria traditionally used to recognize and delimit biogeographic units with their own entity is to distinguish and mapping the taxa and syntaxa: families, genera, species and subspecies, as well associations and plant communities, whose territorial distribution is closely restricted to one particular typological area (Aleksandrova, 1977, Bolòs & Vigo, 1984, Chevalier & Emberger, 1937, Diels, 1908, Drude, 1890, Dupont, 1962, Engler, 1879-82, 1924, Engler & Gilg, 1919, Good, 1947, Lavrenko, 1964, Mattic, 1964, Meusel, Jaeger & Weinert, 1965, Quezel, 1978, Raven & Axelrod, 1974, Skottsberg, 1913, 1921, 1945, 1960, Szafer, 1952, Takhtajan, 1986 and Walter & Straka, 1970). These taxa and syntaxa are termed endemisms. Endemisms have been successfully used to define and delimit many chorological or biogeographical units (provinces, sectors and districts), as they form part of the phytogeographical subelement which characterize. Moreover, the endemisms (taxa, syntaxa and sigmataxa) which have a greater area or are regionals, and those which for migratory reasons are dispersed across diverse biogeographical provinces or regions, constitute the phytogeographical element or geoelement.

## **2b. Biogeographic typology of Cabo Verde and surrounding territories**

The archipelago of Cabo Verde, despite his traditional biogeographic obsolete location in the “Macaronesia Region”, conforms a paleotropical insular atlantic high eutropical saharan province – Cabo Verde –, that belongs to the Tropical Sahara Region (Rivas-Martínez, 2009: 259). The global biogeographical typology of Cabo Verde Islands and the rest of Macaronesian geographic isles (Canary, Madeira, and Azores), as well as African and European more or less surrounding geovicariant territories are synthesized at province level; but the Cabo Verde archipelago biogeographic typology are summarized in this paperat sector and district range.

### B. PALEOTROPICAL Kingdom. (Tropical Old World).

#### Ba. PALEOTROPICAL AFRICA Subkingdom. (Tropical Africa).

##### II. TROPICAL SAHARA Region. (Tropical ultrahyperarid and arid African Sahara, with their aridic island and high mountains summits and theirs foothills open or wadi savannas).

###### 1.1. Cabo Verde Province. (Cabo Verde Islands, serotropical mostly aridicand strong euhyper-

- oceanic, with local dry high summits mountains).
- 1.1a. North Cabo Verde Sector. (Barlovento Islands).
- 1.1.1. *Santo Antão Island* District.
- 1.1.2. *São Vicente Island* District. (include with Santa Luzia, Branco and Raso Islets).
- 1.1.3. *São Nicolau Island* District.
- 1.1b. East Cabo Verde Sector. (Eastern flat mostly hyperarid islands).
- 1.1.4. *Sal Island* District.
- 1.1.5. *Boavista Island* District.
- 1.1.6. *Maio Island* District.
- 1.1c. South Cabo Verde Sector. (Sotavento Islands).
- 1.1.7. *Santiago Island* District.
- 1.1.8. *Fogo Island* District.
- 1.1.9. *Brava Island* District. (with Rombo Islets)
- 1.2. **West Tropical Sahara** Province. (Mauritania and western tropical hyperdesertic Sahara from north Senegal to Dra river in North Morocco).
- 1.3. **Central Tropical Sahara** Province. (Hoggar and Tibesti aridic mountains with adjacent tropical Sahara hyperdeserts).
- 1.4. **East Tropical Sahara** Province. (Sudan and Nubian tropical Sahara hyperdeserts).
- III. SAHEL Region. (Senegal to South Sudan, upper arid low dry woodland eutropical savanna).
- 2.1. **West Sahel** Province. (Senegal-High Niger Sahel semiarid and dry savanna).
- 2.2. **Central Sahel** Province. (Lake Chad Basin Sahel semiarid and low dry savanna).
- 2.3. **Sudanese Sahel** Province. (Sudan Sahel semiarid to low dry savanna).
- A. Holarctic Kingdom. (Extratropical northern hemisphere).
- I. MEDITERRANEAN Region. (Mediterranean South Europe and North Africa).
- Ia. WEST MEDITERRANEAN Subregion. (Mediterranean Europe).
- 4.1. **Coastal Lusitanian-Andalusian** Province. (Mediterranean Lusitania and Andalusia Atlantic coasts).
- Ib. MAGREB MEDITERRANEAN Subregion. (Mediterranean North Africa, excl. Mediterranean Sahara deserts).
- 4.2. **Rif Mountain** Province. (Rif mountains with their foothills from the Loukos to lower Moulouya basin).
- 4.3. **Atlantic Mediterranean Morocco** Province. (Atlantic Mediterranean Morocco basins, excl., inner high mountains from Sidi Ifni to Larache).
- 4.4. **Atlas** Province. (Middle Atlas, High Atlas and AntiAtlas with winter rainy season).
- Ic. MEDITERRANEAN DESERTIC SAHARA Subregion. (Mediterranean arid to ultrahyperarid northern Sahara).
- 3.1. **Mediterranean Sahara Atlas** Province. (Mediterranean Sahara include Atlas deserts).
- 3.2. **Mediterranean Libya-Egypt Sahara** Province. (Mediterranean Libya and Egypt Sahara deserts).
- Id. CANARY AND MADEIRA Subregion. (Canaries and Madeira Islands).

4.7. **Madeira** Province. (Madeira Islands).

4.8. **Canary** Province. (Canary Islands).

II. EUROSIBERIAN Region. (Temperate and boreal Europe with Azores and West Siberia).

IIa. ATLANTIC-CENTRAL EUROPEAN Subregion. (Temperate oceanic and subcontinental Europe).

5.1. **Atlantic European** Province. (Temperate oceanic Atlantic Europe from North Portugal to South Norway).

5.2. **Azores** Province. (Azores Islands).

### 3. Cabo Verde flora

Documentation about the plant diversity of the Cape Verde dates from the 19th century with the pioneer works of Webb (1849), Spicilegia Gorgonea, and Schmidt (1852), Beiträge zur Flora der Cap Verdischen Inseln. In the XX century, it should be highlighted Chevalier (1935), the works of Lobin (1986), Lobin & Zizka (1987) and Hansen & Sunding (1993). In the mid-1990s several volumes of Flora de Cabo Verde were published (Martins et al. 1995, 1996, 2002), but this Flora it is still incomplete. Other relevant work is that of Brochmann et al. (1997), devoted to the endemic flora. The latest comprehensive catalogue is that of Arechavala et al. (2005) and more recently several taxonomic studies have been made in particular groups (e.g. Roimeiras et al. 2011, 2015, 2016, Marrero & Almeida Pérez 2012 and Sukhorukov & Nilova 2016). For us detailed dinsular (ined.) Caboverdian Checklist of M. Duarte has been essential. A long list of publications is also presented in the references.

#### 3a. New taxa and combinatio novae. Endemic of Cabo Verde [•]

##### *Species novae*

*Acacia caboverdeana* Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte sp. nova [*hoc loco*] [•]

*A. Acacia albida* Del., *afrotropicalis siccis silvis savannae arboris species differt: arborescens vel arbusculis* 3-6 m, *ramis tortuosis spinescentis, spineae brevis sed non curvatis, leguminis minoris valvis subcremaceis.*

*Typus:* LISC. Leg.: J. S. Orey & R. Rosado, Cabo Verde: Santiago, S. Francisco, 4-IX-1961, nº 14; *holotypus.*

*Asphodelus mariolousae* Rivas Mart., J.C. Costa & Maria C. Duarte sp. nova [*hoc loco*] [•] *A. Asphodelus fistulosus* L., *differt: caulis pluribus; foliis glabris nervatis (atque 12 nervis); bracteis minoribus quam pedicellis; floribus fasciculiformis pluribus cum tepalis minoribus (6-9 mm); capsulis minoris (3-3.5 mm) subglobosis et nervatis; seminibus papilosis albidis.*

*Typus:* LISC. Leg.: Maria C. Duarte, José C. Costa, Mário Lousã & Salvador Rivas-Martínez, Cabo Verde: Fogo, Montinho, 1810 m, 25-XI-2006, nº 3617; *holotypus.*

*Frankenia pseudoericifolia* Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte sp. nova [*hoc loco*] [•]

*Frankenia ericifolia* auct. cabov. pl. non C. Sm.

*A. Frankenia ericifolia* C. Sm. ex DC. Prodr. 1: 350. 1824 (*Insulae Canariae*), *differt: caulis prostratis, saepe ramosissimis, dense microscipulosis et pube-*

*rulis, foliis ericoidi-filiformis sparce vestitis; floribus in cymas brevis dichotomis subsessiliis dispositis; calycis parce spiculosis in maturitate helicoidalis et profunda costatis, subduplo minoris (2.5-4.5 mm) et petalis pallidae violaceis erosio-denticulatis.*

*Typus:* LISC. Leg.: Maria C. Duarte, José C. Costa, Mário Lousã & Salvador Rivas-Martínez, Cabo Verde: S. Vicente, Baía Norte, 6-XII-2005, nº 3022; *holotypus*.

*Hyparrhenia caboverdeana* Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte *sp. nova [hoc loco]*

*A Hyparrhenia hirta* (L.) Stapf, *differit: culmis vaginis pilosis, cum pilis subtriplo majoris; ligulis fimbriatis; spiculis majoris, longe pedunculatis, cum lema et palea dense pilosae; aristae tortiliformis et longioris (5-8 quo palea).*

*Typus:* LISC. Leg.: Maria C. Duarte, José C. Costa, Mário Lousã & Salvador Rivas-Martínez, Cabo Verde: Santo Antão, Espungeiro, 9-XII-2005, nº 3127; *holotypus*.

*Lotus chevalieri* Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte *sp. nova [hoc loco] [•]*

*Lotus bollei* Christ var. *argenteus* A. Chev. in Rev. Bot. Appl. Agric. Trop. 15: 965. 1935 (*syn. subst.*)

*Typus:* Herb. Mus. Nat. Hist. Nat. Paris. Archipel des Isles du Cap Vert: Boavista. Aug. Chevalier, 7-9 Juillet 1934, Plantes de l'Afrique Tropical, nº 44360 bis.

*Polycarpaea caboverdeana* Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte *sp. nova [hoc loco]*

*Polycarpaea nivea* auct. cabov. non (Ait.) Webb  
*A Polycarpaea nivea* (Aiton) Webb, *differit: caulis flexuosis, internodiis elongatis et subduplo majoris (1.5-4.0 cm); foliis subincanis linear-lanceolatis, sed non dense niveis, ovato-lanceolatis; stipulis villosis, subtriangularis, acuminatis ad marginem obsoleto fimbriatis; inflorescentiae compactis (1.5-2 cm) et bracteis obtusis.*

*Typus:* LISC. Leg.: Maria C. Duarte, José C. Costa, Mário Lousã & Salvador Rivas-Martínez, Cabo Verde: S. Vicente, Baía das Gatas, dunas, 16-XI-2004, nº 2808; *holotypus*.

*Suaeda caboverdeana* Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte *sp. nova [hoc loco]*

*Suaeda vermiculata* auct. cabov. non Forssk. ex J.F. Gmel.

*A Suaeda mollis* Delile, *differit: foliis subglobosis glabris, breviter abaxialis petiolatis in dissecationis spathulato-cocculatis; floribus subsolitaris, subsessilibus, roseo-viridis; stigmate trifidae > 0.7 mm, breviter pilosis.*

*Typus:* LISC. Leg.: Maria C. Duarte, José C. Costa, Mário Lousã & Salvador Rivas-Martínez, Cabo Verde: Maio, Banco da Antónia, 28-XII-2006, nº 3730; *holotypus*.

*Tetraena vicentina* Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte *sp. nova [hoc loco] [•]*

*A Tetraena fontanesii* (Webb & Berthel) Beirr. & Thulin (=*Zygophyllum fontanesii* Webb & Berthol.), *differit: follis trifoliatis cum foliolis rotundo-globulis, 3-4 mm; capsulis globulosis ad apicem truncatis et ad maturitatem pentacarpis, minoris (4-6 mm).*

*Typus:* LISC. Leg.: Cardoso Matos et S. Gomes, Cabo Verde: São Vicente, Calhau, Viana, próximo do vulcão do mesmo nome; sufrutice formando coxim, na cobertura arenosa que reveste a base do cone; alt. 60 m, 15-X-1990, nº 6575; *holotypus*.

### Combinatio novae

*Adiantum capillus-veneris* L. subsp. *trifidum* (Willd. ex Bolle) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte *comb. nov. [hoc loco]*

Basion.: *Adiantum trifidum* Willd. ex Bolle in Bonplandia 3(10): 121. 1851.

*Brachiaria caboverdeana* (Conert & C.Köhler) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte *comb. nov. [hoc loco]*

Basion.: *Brachiaria lata* (Schumach.) C.E. Hubb. subsp. *caboverdeana* Conert & C.Köhler in Senckenberg. Biol. 67:440. 1987. [•]

*Carex hansenii* (Lewej. & Lobin) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte *comb. nov. [hoc loco]*

Basion.: *Carex paniculata* Jusl. ex L. subsp. *hansenii* Lewej. & Lobin in Senckenberg. Biol. 67: 432. 1987.

*Centaurium viridense* (Bolle) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte *comb. nov. [hoc loco]*

Basion.: *Eryhraea viridense* Bolle in Bonplandia 9: 52. 1861. [•]

*Cressa salina* (J.A. Schmidt) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte *comb. nov. [hoc loco]*

Basion.: *Cressa cretica* L. var. *salina* J.A. Schmidt, Beitr. Fl. Cap Verd Ins.: 229. 1851. -

*Daucus humilis* (Lobin & K.H. Schmidt) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte *comb. nov. [hoc loco]*

Basion.: *Tornabenea humilis* Lobin & K.H. Schmidt in Sommerfeltia 24: 83. 1997. [•]

*Daucus ribeirensis* (Schmidt & Lobin) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte *comb. nov. [hoc loco]*

Basion.: *Tornabenea ribeirensis* K.H. Schmidt & Lobin, Feddes Repert. 110(1-2): 8. 1999. [•]

*Diplotaxis brochmannii* (Rustan) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte *comb. nov. [hoc loco]*

Basion.: *Diplotaxis gorgadensis* Rustan subsp. *brochmannii* Rustan in Nord. J. Bot. 16: 41. 1996. [•]

*Dracaena caboverdeana* (Marrero Rodr. & R.S. Almeida) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte *comb. nov. [hoc loco]*

Basion.: *Dracaena draco* (L.) L. subsp. *caboverdeana* Marrero Rodr. & R.S. Almeida in Int. J. Geobot. Res. 2(1): 36. 2012. [•]

*Frankenia caboverdeana* (Brochmann, Lobin & Sunding) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte *comb. nov. [hoc loco]*

Basion.: *Frankenia ericifolia* C. Sm. ex DC. subsp. *caboverdeana* Brochmann, Lobin & Sunding in Nord. J. Bot. 15: 620. 1995. [•]

*Frankenia montana* (Brochmann, Lobin & Sunding) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte *comb. nov. [hoc loco]*

Basion.: *Frankenia ericifolia* C. Sm. ex DC. subsp. *montana* Brochmann, Lobin & Sunding in Nord. J. Bot. 15: 622. 1995. [•]

*Indigofera microcarpa* (A. Chev.) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte comb. nov. [*hoc loco*]  
Basion.: *Indigofera tinctoria* L. var. *microcarpa* A. Chev. in Rev. Bot. Appl. Agric. Trop. 15: 969. 1935.

*Launaea arborescens* (Batt.) Murb. subsp. *melanostigma* (Pett.) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte comb. nov. [*hoc loco*]

Basion.: *Launaea melanostigma* Pett. in Commentat. Biol. XXII. No. 9 (Coll. Vasc. Pl. C. Verde Isl.): 60. 1960.

*Lobularia fruticosa* (Webb ex Christ) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte comb. nov. [*hoc loco*]

Basion.: *Koniga fruticosa* Webb in Christ in Bot. Jahrb. Syst. 9: 93. 1888.

*Pulicaria longifolia* (Gamal-Eldin) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte comb. nov. [*hoc loco*]

Basion.: *Pulicaria burchardii* Hutch. subsp. *longifolia* Gamal-Gaudin in Phaner. Monogr. 14: 270. 1981. [•].

*Tetraena waterlotii* (Maire) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte comb. nov. [*hoc loco*]

Basion.: *Zygophyllum waterlotii* Maire in Bull. Soc. Hist. Nat. Afr. Nord 28: 348 (1937)

### 3b. List of endemic plants and synonyms of Cabo Verde

In alphabetic order, on list the valid names with the authors of the endemic vascular plant of Cabo Verde Islands [•]. The valid name in italics and synonyms.

*Acacia caboverdeana* Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte

*Aeonium gorgoneum* J.A. Schmidt

*Antirrhinum elegans* G. Forst. (v. *Kickxia elegans*)

*Aristida cardosoi* Cout.

*Artemisia gorgonum* Webb

*Arthroc nemum franzii* Sukhor. & Nilova

*Asparagus squarrosum* J.A. Schmidt

*Asphodelus mario lousae* Rivas Mart., J.C. Costa & Maria C. Duarte

*Asteriscus daltonii* (Webb) Walp.

*Asteriscus smithii* (Webb) Walp.

*Asteriscus vogelii* (Webb) Walp.

*Brachiaria caboverdeana* (Conert & C.Köhler) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte

*Brachiaria laeta* (Schumach.) C.E. Hubb. subsp. *caboverdeana* Conert & C.Köhler (v. *Brachiaria caboverdeana*)

*Campanula bravensis* (Bolle) A. Chev.

*Campanula jacobaea* C.Sm. ex Webb

*Campanula jacobaea* C.Sm. ex Webb var. *bravensis* Bolle (v. *Campanula bravensis*)

*Campylanthus glaber* Benth

*Campylanthus spathulatus* A. Chev.

*Carex antoniensis* A. Chev.

*Carex hansenii* (Leweij. & Lobin) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte

*Carex paniculata* Jusl. ex L. subsp. *hansenii* Lewej. & Lobin (v. *Carex hansenii*)

*Celsia cystolithica* B. Pett. (v. *Verbascum cystolithicum*)

*Centaurium viridense* (Bolle) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte

*Conzya feae* (Bég.) Wild

*Conzya pannosa* Webb

*Conzya schlechtendalii* Bolle

*Conzya varia* (Webb) Wild

*Daucus annuus* (Bég.) Wojew., Reduron, Banasiak & Spalik,

*Daucus humilis* (Lobin & K.H. Schmidt) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte

*Daucus insularis* (Parl. ex Webb) Spalik, Wojew., Banasiak & Reduron

*Daucus ribeirensis* (Schmidt & Lobin) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte

*Daucus tenuissimus* (A.Chev.) Spalik, Wojew., Banasiak & Reduron

*Diplotaxis antoniensis* Rustan

*Diplotaxis brochmannii* (Rustan) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte

*Diplotaxis glauca* (Schmidt) O.E. Schultz

*Diplotaxis gorgadensis* Rustan

*Diplotaxis gorgadensis* Rustan subsp. *brochmannii* Rustan (v. *Diplotaxis brochmannii*)

*Diplotaxis gracilis* (Webb) O.E. Schulz

*Diplotaxis hirta* (A. Chev.) Rustan & L.Borgen

*Diplotaxis sundingii* Rustan

*Diplotaxis varia* Rustan

*Diplotaxis vogelii* (Webb) Cout.

*Dracaena caboverdeana* (Marrero, Rodr. & R.S. Almeida) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte

*Dracaena draco* (L.) L. subsp. *caboverdeana* Marrero Rodr. & R.S. Almeida (v. *Dracaena caboverdeana*)

*Echium glabrescens* B. Pett.

*Echium hypertropicum* Webb

*Echium lindbergii* B. Pett.

*Echium stenosiphon* Webb

*Echium vulcanorum* A. Chev.

*Eragrostis conertii* Lobin

*Erysimum caboverdeanum* (A. Chev.) Sunding

*Erythraea viridense* Bolle (v. *Centaurium viridense*)

*Euphorbia tuckeyana* Steud. ex Webb

*Fagonia mayana* Schltdl.

*Forsskaolea procridifolia* Webb

*Francoeuria diffusa* Shuttlew. (v. *Pulicaria diffusa*)

*Frankenia caboverdeana* (Brochmann, Lobin & Sunding) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte

*Frankenia ericifolia* auct. non C. Sm. (v. *Frankenia pseudericifolia*)

*Frankenia ericifolia* C. Sm. subsp. *caboverdeana* Brochmann, Lobin & Sunding (v. *Frankenia caboverdeana*)

*Frankenia ericifolia* C. Sm. subsp. *montana* Brochmann, Lobin & Sunding (v. *Frankenia montana*)

*Frankenia montana* (Brochmann, Lobin & Sunding) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte

- Frankenia pseudoericifolia* Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte
- Globularia amygdalifolia* Webb
- Helianthemum gorgoneum* Webb
- Hyparrhenia caboverdeana* Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte
- Indigofera microcarpa* (A. Chev.) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte
- Indigofera tinctoria* L. var. *microcarpa* A. Chev. (v. *Indigofera microcarpa*)
- Kickxia dichondrifolia* (Benth.) Janch.
- Kickxia elegans* (G. Forst.) D.A. Sutton
- Kickxia webbiana* (J.A. Schmidt) Sunding
- Koniga fruticosa* Webb (v. *Lobularia fruticosa*)
- Koniga spathulata* J.A. Schmidt (v. *Lobularia spathulata*)
- Launaea arborescens* (Batt.) Murb. subsp. *melanostigma* (B. Pett.) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte
- Launaea gorgadensis* (Bolle) N. Kilian
- Launaea melanostigma* (v. *Launaea arborescens* subsp. *melanostigma*)
- Launaea picridioidea* (Webb) Engl.
- Launaea thalassica* N. Kilian, Brochmann & Rustan
- Lavandula rotundifolia* Benth.
- Limonium braunii* (Bolle) A. Chev.
- Limonium brunneri* (Webb) Kuntze
- Limonium jovi-barba* (Webb) Kuntze
- Limonium lobinii* N. Kilian & Leyens
- Limonium sundingii* Leyens, Lobin, N. Kilian & Erben
- Linaria dichondrifolia* Benth. (v. *Kickxia dichondrifolia*)
- Linaria webbiana* J.A. Schmidt non Vis. (syn. subst.) (v. *Kickxia webbiana*)
- Lobularia fruticosa* (Webb ex Christ) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte
- Lobularia spathulata* (J.A. Schmidt) O.E. Schulz
- Lotus arborescens* Lowe ex Cout.
- Lotus bollei* Christ var. *argenteus* A. Chev. (syn. subst.) (v. *Lotus chevalieri*)
- Lotus brunneri* Webb
- Lotus chevalieri* Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte
- Lotus jacobaeus* L.
- Lotus jacobaeus* L. var. *villosus* A. Chev.
- Lotus latifolius* Brand
- Lotus purpureus* Webb
- Lotus villosus* (v. *Lotus jacobaeus* var. *villosus*)
- Matthiola caboverdeana* A. Chev. (v. *Erysimum caboverdeanum*)
- Melanoselinum bischoffii* (J.A. Schmidt) A. Chev.
- Melanoselinum tenuissimum* A. Chev. (v. *Daucus tenuissimum*)
- Micromeria forbesii* Benth.
- Odontospermum daltonii* Webb (v. *Asteriscus daltonii*)
- Odontospermum smithii* Webb (v. *Asteriscus smithii*)
- Odontospermum vogelii* Webb (v. *Asteriscus vogelii*)
- Papaver gorgoneum* Cout. subsp. *gorgoneum*
- Papaver gorgoneum* Cout. subsp. *theresias* Kadereit & Lobin
- Paronychia illecebroides* Webb
- Periploca chevalieri* Browicz
- Phagnalon melanoleucum* Webb
- Phoenix atlantica* A. Chev.
- Polycarpaea caboverdeana* Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte
- Polycarpaea gayi* Webb
- Pulicaria burchardii* Hutch. subsp. *longifolia* Gamal-Eldin (v. *Pulicaria longifolia*)
- Pulicaria diffusa* (Shuttlew.) Pett.
- Pulicaria longifolia* (Gamal-Eldin) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte
- Rhabdotheca picridioides* Webb (v. *Launaea picridioides*)
- Sapota marginata* Decne. (v. *Sideroxylon marginata*)
- Sarcostemma daltonii* Decne.
- Schmidia farinulosa* Webb (v. *Tolpis farinulosa*)
- Sideroxylon marginata* (Decne.) Cout.
- Sinapidendron glaucum* J.A. Schmidt (v. *Diplotaxis glauca*)
- Sinapidendron gracile* Webb (v. *Diplotaxis gracilis*)
- Sinapidendron hirtum* A. Chev. (v. *Diplotaxis hirta*)
- Sinapidendron vogelii* Webb (v. *Diplotaxis vogelii*)
- Sonchus daltonii* Webb
- Sonchus gorgadensis* Bolle (v. *Launaea gorgadensis*)
- Sporobolus confertus* J.A. Schmidt
- Statice braunii* Bolle (v. *Limonium braunii*)
- Statice brunneri* Webb (v. *Limonium brunneri*)
- Statice jovi-barba* Webb (v. *Limonium jovi-barba*)
- Suaeda caboverdeana* Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte
- Tetraena vicentina* Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte
- Tetraena fontanesii* (Webb & Berthel.) Beiorr. & Thulin
- Tetraena waterlotii* (Maire) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte
- Tetrapleura insularis* Parl. (v. *Daucus insularis*)
- Tolpis farinulosa* (Webb) J.A. Schmidt
- Tornabenea annua* Bég. (v. *Daucus annuus*)
- Tornabenea bischoffii* J.A. Schmidt (v. *Melanoselinum bischoffii*)
- Tornabenea humilis* Lobin & K.H. Schmidt (v. *Daucus humilis*)
- Umbilicus schmidii* Bolle
- Verbascum capitis-viridis* Hub.-Mor.
- Verbascum cystolithicum* (Pett.) Hub.-Mor.
- Withania chevalieri* A.E. Gonç.

### 3c. Cabo Verde endemic species: distribution and syntaxa

The distribution of the Cabo Verde endemic taxa considered in this publication (some of them corresponding to new taxa or new combinations, (see 3b) are presented in table 11, as well as their characteristic syntaxa

<b>Endemic taxa // Isles</b>	<b>A</b>	<b>V</b>	<b>N</b>	<b>SL</b>	<b>BO</b>	<b>M</b>	<b>SN</b>	<b>F</b>	<b>BR</b>	<b>Nº</b>	<b>Characteristic syntaxa</b>
<i>Acacia caboverdeana</i>	♦	♦	-	♦	♦	♦	♦	♦	♦	7	<i>Fico-Acacion caboverdeanae</i>
<i>Aeonium gorgoneum</i>	♦	♦	♦	-	-	-	-	-	-	3	<i>Euphorbio-Sarcostemmetalia daltonii</i>
<i>Aristida cardosoi</i>	♦	♦	♦	♦	♦	♦	♦	♦	♦	9	<i>Aristido cardosoi-Tetraenion simplicis</i>
<i>Artemisia gorgonum</i>	♦	-	-	-	-	-	♦	♦	-	3	<i>Globulario-Periplocion chevalieri</i>
<i>Asparagus squarrosum</i>	♦	♦	♦	♦	♦	♦	-	-	-	6	<i>Asparago-Sarcostemmion daltonii</i>
<i>Asphodelus mariolousae</i>	♦	-	-	-	-	-	-	♦	-	2	<i>Aristido- cardosoi-Tetraenion simplicis</i>
<i>Asteriscus daltonii</i>	-	-	-	-	-	-	♦	-	-	1	<i>Globulario-Periplocion chevalieri</i>
<i>Asteriscus smithii</i>	-	-	♦	-	-	-	-	-	-	1	<i>Globulario-Periplocion chevalieri</i>
<i>Asteriscus vogelii</i>	♦	♦	♦	-	-	♦	♦	♦	♦	7	<i>Cocculo-Sarcostemmetea daltonii</i>
<i>Brachiaria caboverdeana</i>	-	♦	♦	-	♦	-	♦	-	-	4	<i>Aristido cardosoi-Tetraenion simplicis</i>
<i>Campanula bravensis</i>	-	-	-	-	-	-	♦	♦	♦	3	<i>Adiantion trifidi</i>
<i>Campanula jacobaea</i>	♦	♦	♦	-	-	-	♦	-	-	4	<i>Kickxieta elegans</i>
<i>Campylanthus glaber</i>	♦	♦	♦	-	-	-	♦	♦	♦	6	<i>Kichxieta elegans</i>
<i>Campylanthus spathulatus</i>	♦	-	-	-	-	-	-	-	-	1	<i>Asparago-Sarcostemmion daltonii</i>
<i>Carex antoniensis</i>	♦	-	-	-	-	-	-	-	-	1	<i>Globulario-Periplocion chevalieri</i>
<i>Carex hansenii</i>	♦	-	-	-	-	-	-	-	-	1	<i>Adiantion trifidi</i>
<i>Centaurium viridense</i>	-	-	-	-	-	-	♦	♦	♦	3	<i>Melinio grandiflorae-Heteropogonetalia contorti</i>
<i>Cistanche brunneri</i>	♦	♦	-	♦	♦	♦	-	-	-	5	<i>Polycarpeo-Tetraenion waterlotii</i>
<i>Conyza feae</i>	♦	♦	♦	-	-	-	♦	♦	♦	6	<i>Globulario-Periplocion chevalieri</i>
<i>Conyza pannosa</i>	♦	♦	♦	-	-	-	-	♦	♦	5	<i>Globulario-Periplocion chevalieri</i>
<i>Conyza schlechtendalii</i>	-	-	♦	-	-	-	-	-	-	1	<i>Globulario-Periplocion chevalieri</i>
<i>Conyza varia</i>	♦	♦	♦	-	-	-	♦	♦	-	5	<i>Globulario-Periplocion chevalieri</i>
<i>Daucus annuus</i>	-	-	-	-	-	-	♦	-	-	1	<i>Globulario-Periplocion chevalieri</i>
<i>Daucus humilis</i>	-	-	-	-	-	-	-	♦	-	1	<i>Fico-Acacion caboverdeanae</i>
<i>Daucus insularis</i>	-	♦	♦	-	-	-	-	-	♦	3	<i>Globulario-Periplocion chevalieri</i>
<i>Daucus tenuissimus</i>	-	-	-	-	-	-	-	-	♦	1	<i>Globulario-Periplocion chevalieri</i>
<i>Diplotaxis antoniensis</i>	♦	-	-	-	-	-	-	-	-	1	<i>Globulario-Periplocion chevalieri</i>
<i>Diplotaxis brochmannii</i>	♦	-	-	-	-	-	-	-	-	1	<i>Globulario-Periplocion chevalieri</i>
<i>Diplotaxis glauca</i>	-	-	-	♦	-	-	-	-	-	1	<i>Asparago-Sarcostemmion daltonii</i>
<i>Diplotaxis gorgadensis</i>	♦	-	-	-	-	-	-	-	-	1	<i>Kickxieta elegans</i>
<i>Diplotaxis gracilis</i>	-	-	♦	-	-	-	-	-	-	1	<i>Globulario-Periplocion chevalieri</i>
<i>Diplotaxis hirta</i>	-	-	-	-	-	-	-	♦	-	1	<i>Kickxieta elegans</i>
<i>Diplotaxis sundingii</i>	-	-	♦	-	-	-	-	-	-	1	<i>Globulario-Periplocion chevalieri</i>
<i>Diplotaxis varia</i>	-	-	-	-	-	-	♦	-	♦	2	<i>Kickxieta elegans</i>

<i>Diplotaxis vogelii</i>	-	♦	-	-	-	-	-	-	-	1	<i>Asparago-Sarcostemminion daltonii</i>
<i>Dracaena caboverdeana</i>	♦	♦	♦	-	-	-	♦	♦	♦	6	<i>Fico-Acacion caboverdeanae</i>
<i>Echium glabrescens</i>	-	-	♦	-	-	-	-	-	-	1	<i>Euphorbio-Sarcostemmetalicia daltonii</i>
<i>Echium hypertropicum</i>	-	-	-	-	-	-	♦	-	♦	2	<i>Globulario-Periplocion chevalieri</i>
<i>Echium lindbergii</i>	♦	-	-	-	-	-	-	-	-	1	<i>Euphorbio-Sarcostemmetalicia daltonii</i>
<i>Echium stenosiphon</i>	-	♦	-	-	-	-	-	-	-	1	<i>Euphorbio-Sarcostemmetalicia daltonii</i>
<i>Echium vulcanorum</i>	-	-	-	-	-	-	-	♦	-	1	<i>Globulario-Periplocion chevalieri</i>
<i>Eragrostis concertii</i>	♦	♦	♦	-	-	-	♦	♦	-	5	<i>Aristido cardosoi-Tetraenion simplicis</i>
<i>Erysimum caboverdeanum</i>	-	-	-	-	-	-	-	♦	-	1	<i>Globulario-Periplocion chevalieri</i>
<i>Euphorbia tuckeyana</i>	♦	♦	♦	♦	♦	-	♦	♦	♦	8	<i>Euphorbio-Sarcostemmetalicia daltonii</i>
<i>Fagonia mayana</i>	-	-	-	-	♦	♦	-	-	-	2	<i>Asparago-Sarcostemminion daltonii</i>
<i>Forsskaolea procridifolia</i>	♦	♦	♦	♦	-	♦	♦	♦	♦	8	<i>Cocculo-Sarcostemmetea daltonii</i>
<i>Frankenia caboverdeana</i>	♦	♦	♦	-	-	-	-	-	-	3	<i>Euphorbio-Sarcostemmetalicia daltonii</i>
<i>Frankenia montana</i>	♦	♦	-	-	♦	-	-	-	-	2	<i>Globulario-Periplocion chevalieri</i>
<i>Frankenia pseudoericifolia</i>	♦	♦	♦	♦	♦	♦	-	♦	♦	8	<i>Polycarpaceo-Tetraenion waterlotii</i>
<i>Globularia amygdalifolia</i>	♦	-	♦	-	-	-	♦	♦	♦	5	<i>Globulario-Periplocion chevalieri</i>
<i>Helianthemum gorgoneum</i>	♦	-	-	-	-	-	-	♦	♦	3	<i>Globulario-Periplocion chevalieri</i>
<i>Hyparrhenia caboverdeana</i>	♦	♦	♦	♦	-	-	♦	♦	♦	7	<i>Melinio-Heteropogonetalia contorti</i>
<i>Indigofera microcarpa</i>	-	-	-	-	-	-	-	-	♦	1	<i>Cocculo-Sarcostemmetea daltonii</i>
<i>Kickxia dichondrifolia</i>	♦	♦	♦	-	-	-	♦	-	-	4	<i>Kickxieta elegans</i>
<i>Kickxia elegans</i>	♦	♦	♦	♦	♦	♦	♦	♦	♦	9	<i>Kickxieta elegans</i>
<i>Kickxia webbiana</i>	♦	-	-	-	-	-	-	-	-	1	<i>Kickxieta elegans</i>
<i>Launaea gorgadensis</i>	♦	♦	♦	-	-	-	-	-	-	3	<i>Asparago-Sarcostemminion daltonii</i>
<i>Launaea picridioides</i>	♦	♦	♦	-	-	-	-	-	-	3	<i>Euphorbio-Sarcostemmetalicia daltonii</i>
<i>Launaea thalassica</i>	-	-	-	-	-	-	-	-	♦	1	<i>Kickxieta elegans</i>
<i>Lavandula rotundifolia</i>	♦	♦	♦	-	-	-	♦	♦	-	5	<i>Cocculo-Sarcostemmetea daltonii</i>
<i>Limonium braunii</i>	♦	-	♦	-	-	-	-	♦	♦	4	<i>Asparago-Sarcostemminion daltonii</i>
<i>Limonium brunneri</i>	-	♦	-	♦	-	-	-	-	-	2	<i>Polycarpaceo-Tetraenion waterlotii</i>
<i>Limonium jovi-barba</i>	-	♦	♦	-	-	-	-	-	-	2	<i>Asparago-Sarcostemminion daltonii</i>
<i>Limonium lobinii</i>	-	-	-	-	-	-	♦	-	-	1	<i>Globulario-Periplocion chevalieri</i>
<i>Limonium sundingii</i>	-	-	♦	-	-	-	-	-	-	1	<i>Globulario-Periplocion chevalieri</i>
<i>Lobularia fruticosa</i>	♦	-	♦	-	-	-	♦	♦	♦	5	<i>Euphorbio-Sarcostemmetalicia daltonii</i>
<i>Lobularia spathulata</i>	-	♦	♦	-	-	-	-	-	-	2	<i>Globulario-Periplocion chevalieri</i>
<i>Lotus arborescens</i>	-	-	♦	-	-	-	-	-	-	1	<i>Globulario-Periplocion chevalieri</i>

<i>Lotus brunneri</i>	-	♦	-	♦	♦	♦	-	-	-	4	<i>Polycarpaeo-Tetraenion waterlotii</i>
<i>Lotus chevalieri</i>	-	-	-	-	♦	-	-	-	-	1	<i>Polycarpaeo-Tetraenion waterlotii</i>
<i>Lotus jacobaeus</i>	-	-	-	-	-	-	♦	♦	-	2	<i>Globulario-Periplocion chevalieri</i>
<i>Lotus latifolius</i>	♦	-	-	-	-	-	-	-	-	1	<i>Globulario-Periplocion chevalieri</i>
<i>Lotus purpureus</i>	♦	♦	♦	-	♦	-	♦	♦	♦	7	<i>Cocculo-Sarcostemmetea daltonii</i>
<i>Lotus villosus</i>	-	-	-	-	-	-	-	♦	-	1	<i>Globulario-Periplocion chevalieri</i>
<i>Melanoselinum bischoffii</i>	♦	-	-	-	-	-	-	-	-	1	<i>Globulario-Periplocion chevalieri</i>
<i>Micromeria forbesii</i>	♦	-	-	-	-	-	-	♦	♦	3	<i>Euphorbio-Sarcostemmetalica daltonii</i>
<i>Papaver gorgoneum</i>	-	-	♦	-	-	-	-	♦	-	2	<i>Chenopodietalia muralis</i>
<i>Papaver thesesias</i>	♦	-	-	-	-	-	-	-	-	1	<i>Chenopodietalia muralis</i>
<i>Paronychia illecebroides</i>	♦	♦	♦	-	♦	♦	♦	♦	-	7	<i>Euphorbio-Sarcostemmetalica daltonii</i>
<i>Periploca chevalieri</i>	♦	-	♦	-	-	-	♦	♦	♦	5	<i>Euphorbio-Sarcostemmetalica daltonii</i>
<i>Phagnalon melanoleucum</i>	♦	♦	♦	-	-	-	♦	♦	-	5	<i>Globulario-Periplocion chevalieri</i>
<i>Phoenix atlantica</i>	-	♦	-	♦	♦	♦	♦	-	-	5	<i>Phoenicion atlanticae</i>
<i>Polycarpaea caboverdeana</i>	♦	♦	-	♦	♦	-	-	♦	-	5	<i>Polycarpaeo-Tetraenion waterlotii</i>
<i>Polycarpaea gayi</i>	♦	♦	♦	♦	-	-	♦	♦	-	6	<i>Kickxieta elegans</i>
<i>Pulicaria diffusa</i>	-	-	-	♦	♦	♦	♦	♦	-	5	<i>Polycarpaeo-Tetraenion waterlotii</i>
<i>Pulicaria longifolia</i>	-	-	-	♦♦	-	-	-	-	-	1	<i>Polycarpaeo-Tetraenion waterlotii</i>
<i>Sarcostemma daltonii</i>	♦	♦	♦	E?	♦	-	♦	♦	♦	8	<i>Cocculo-Sarcostemmetea daltonii</i>
<i>Sideroxylon marginata</i>	♦	♦	♦	-	-	-	♦	♦	♦	6	<i>Fico-Acacion caboverdeanae</i>
<i>Sonchus daltonii</i>	♦	♦	♦	-	-	-	♦	♦	-	5	<i>Globulario-Periplocion chevalieri</i>
<i>Sporobolus confertus</i>	-	-	-	♦	-	♦	-	-	-	2	<i>Sesuvion sesuviodis</i>
<i>Suaeda caboverdeana</i>	-	♦	-	♦	♦	♦	-	-	-	4	<i>Polycarpaeo-Tetraenion waterlotii</i>
<i>Tolpis farinulosa</i>	♦	♦	-	-	-	-	♦	♦	♦	5	<i>Globulario-Periplocion chevalieri</i>
<i>Umbilicus schmidtii</i>	♦	-	♦	-	-	-	♦	♦	-	4	<i>Kickxieta elegans</i>
<i>Verbascum capitis-viridis</i>	♦	♦	♦	-	♦	♦	♦	-	-	6	<i>Euphorbio-Sarcostemmetalica daltonii</i>
<i>Verbascum cystolithicum</i>	-	-	-	-	-	-	-	♦	-	1	<i>Globulario-Periplocion chevalieri</i>
<i>Withania chevalieri</i>	♦	♦	-	♦	-	-	-	♦	-	4	<i>Euphorbio-Sarcostemmetalica daltonii</i>
<i>Tetraena vicentina</i>	-	♦	-	-	-	-	-	-	-	1	<i>Polycarpaeo-Tetraenion waterlotii</i>

**Table 11.** Endemic plants of Cabo Verde Isles: A : Santo Antão, V : São Vicente, N : São Nicolau, SL : Sal, BO : Boavista, M : Maio, SN : Santiago, F : Fogo, BR : Brava, and their characteristic syntaxa, E: extinct

Exclusive insular endemics	A	V	N	SL	Bo	M	SN	F	BR	Syntaxa
<i>Campylanthus spathulatus</i>	♦	-	-	-	-	-	-	-	-	1.1.2
<i>Carex antoniensis</i>	♦	-	-	-	-	-	-	-	-	1.2
<i>Carex hansenii</i>	♦	-	-	-	-	-	-	-	-	11.1
<i>Diplotaxis antoniensis</i>	♦	-	-	-	-	-	-	-	-	1.2
<i>Diplotaxis brochmannii</i>	♦	-	-	-	-	-	-	-	-	1.2
<i>Diplotaxis gorgadensis</i>	♦	-	-	-	-	-	-	-	-	12.1
<i>Echium lindbergii</i>	♦	-	-	-	-	-	-	-	-	1a
<i>Kickxia webbiana</i>	♦	-	-	-	-	-	-	-	-	12.1.1
<i>Lotus latifolius</i>	♦	-	-	-	-	-	-	-	-	1.2.6
<i>Melanoselinum bischoffii</i>	♦	-	-	-	-	-	-	-	-	1.2.7
<i>Papaver theresias</i>	♦	-	-	-	-	-	-	-	-	15.1
<i>Diplotaxis vogelii</i>	-	♦	-	-	-	-	-	-	-	1.1.5
<i>Echium stenosiphon</i>	-	♦	-	-	-	-	-	-	-	1.1.5
<i>Tetraena vicentina</i>	-	♦	-	-	-	-	-	-	-	4.1.1
<i>Asteriscus smithii</i>	-	-	♦	-	-	-	-	-	-	1.2.8
<i>Conyza schlechtendalii</i>	-	-	♦	-	-	-	-	-	-	1.2.8
<i>Diplotaxis gracilis</i>	-	-	♦	-	-	-	-	-	-	1.2.8
<i>Diplotaxis sundingii</i>	-	-	♦	-	-	-	-	-	-	1.2.8
<i>Echium glabrescens</i>	-	-	♦	-	-	-	-	-	-	1a
<i>Lotus arborescens</i>			♦							1.2.8
<i>Diplotaxis glauca</i>	-	-	-	♦	-	-	-	-	-	1.1.4
<i>Pulicaria longifolia</i>	-	-	-	♦♦	-	-	-	-	-	4.1
<i>Lotus chevalieri</i>	-	-	-	-	♦	-	-	-	-	4.1
<i>Daucus annuus</i>	-	-	-	-	-	-	♦	-	-	12.4
<i>Limonium lobinii</i>	-	-	-	-	-	-	♦	-	-	12.4
<i>Daucus humilis</i>	-	-	-	-	-	-	-	♦	-	1.3
<i>Diplotaxis hirta</i>	-	-	-	-	-	-	-	♦	-	12.1.2
<i>Echium vulcanorum</i>	-	-	-	-	-	-	-	♦	-	1.2.2
<i>Erysimum caboverdeanum</i>	-	-	-	-	-	-	-	♦	-	1.2
<i>Lotus villosus</i>	-	-	-	-	-	-	-	♦	-	1.2
<i>Verbascum cystolithicum</i>	-	-	-	-	-	-	-	♦	-	1.2.2
<i>Daucus tenuissimus</i>	-	-	-	-	-	-	-	-	♦	1.2
<i>Indigofera microcarpa</i>	-	-	-	-	-	-	-	-	♦	1.3
<i>Launaea thalassica</i>	-	-	-	-	-	-	-	-	♦	12.5

**Table 12.** List, distribution and number of characteristic syntaxa the of 33 exclusive one isle endemic taxa of Cabo Verde

#### 4. Vegetation synthesis of Cabo Verde Islands

The first approach of the study of Cabo Verde vegetation was made by Chevalier (1935) and Barbosa (1968). Latter Diniz & Matos (1986, 1987, 1988, 1988a, 1993, 1994, 1994a, 1999, 1999a, 1999b) prepared the "Carta da zonagem agro-ecológica e da vegetação de Cabo Verde" (Agro-Ecological zoning and vegetation maps of Cabo Verde), using in most cases annual and nitrophilous species as bioindicators. Duarte (1998), Duarte & Moreira (2002) and Duarte et al. (2005) developed important works on the vegetation of Santiago Island, both in an historical and present-day perspective. Rivas-Martínez (2009: 255-296) in a geobotanical synthesis about "Macaronesia", using bioclimatical, phytosociological and floristic bioindicators and other data,

proposed the biogeographic province of Cabo Verde Islands inside the Sahara Tropical Subregion with tropical desertic and xeric bioclimates; Canary and Madeira archipelagos were placed in the Mediterranean Region as two independent provinces, with a desertic, xeric and pluviseasonal mediterranean bioclimates with submediterranean hyperhumid in oreal Madeira; and finally, the whole and high endemic Azores archipelago were considered also as a particular biogeographic Azores Province, inside the Eurosiberian Region, with a temperate hyperoceanic and submediterranean humid-hyperhumid bioclimate. Recently, Gomes et al. (2012) and Costa et al. (2014) developed studies on the plant communities of the dunes and marshes of the islands of São Vicente, Sal, Boavista and Maio.

#### 4a. World formation types

Our interest for global vegetation classification remains a research priority. Since D. Faber-Langendoen sent to us for opinion the interesting and documented draft paper – HRWG: Hierarchy Revisions Working Group (Federal Geographic Data Committee). 2011, November 22. Classification and description of world formations types. Contributing authors: D. Faber-Langendoen, C. Josse, G. Navarro, T. Keeler-Wolf, D. Meidinger, E. Helmer, B. Hoagland, G. Fults, S. Ponomarenko, J.P. Saucier, D. Tart and A. Weakly. FGDC Secretariat, U.S. Geological Survey. Reston, VA and NaturServe, Arlington, VA; a developed Vegetation Classification of FGDC. 1997 (2008) – our purpose was try to combine the units, names, grow forms definitions, nomenclature and the hierarchical classification of natural vegetation of this new approach, with the geobotanical systems units of Braun-Blanquet syntaxa, macrobioclimates, bioclimates and biogeographic models that we utilize since years ago. As we were at time preparing this paper about geobotanical survey of Cabo Verde Islands (West Africa), we use the opportunity for beginning to correlate the units and information of both approaches.

The classification of world formation types (Faber-Langendoen & al. 2011, Nov. 22) recognize first three

large hierarchies: A. Natural Vegetation, B. Cultural Vegetation (“anthromorphic”: agricultural and with strong human impacts), C. Non-Vegetated (hot and cold extreme hyperdeserts with less 1% of natural plant cover). Within “Natural Vegetation”, a diverse, long and ecological process has determine in coevolution at least five ecomorphic types having similar structure, grow forms of plants, habitat and vegetation types: 1. Mesomorphic (able to living in moderate moisture habitats), 2. Xeromorphic (able to prevent water loss by evaporation and living in hyperarid to low dry habitats), 3. Cryomorphic (able to survive in very cold temperature and frost damage), 4. Hydromorphic (able to living in aquatic habitats), 5. Lithomorphic (able for living on rocky habitats having limitations for rooting), 6. Anthropic (able to living in ruderal high nitrified or with strong human impact habitats). (Tables 13, 14).

The eight formation class recognized for natural and cultural vascular plant vegetation categories are show in the table 12.

Besides the six cosmopolite natural and seminatural formation class proposed by Faber-Langendoen & al. (2011, Nov. 22: 17-19), we admit in the category B, as agricultural vegetation, a new broad anthropic, cultural and ruderal formation class (7).

Natural Hierarchy Level	Level groups	Cultural Hierarchy Level
I.1 Formation Class	Upper Level	I.1 Cultural Class
I.2 Formation Subclass		I.2 Cultural Subclass
I.3 Formation		I.3 Cultural Formation
I.4 Division	Mid Level	I.4 Cultural Subformation
I.5 Macrogroup		I.5 Cultural Group
I.6 Group		I.6 Cultural Subgroup
I.7 Alliance	Lower Level	I.7 Cultural Type
I.8 Association		I.8 Cultural Subtype

**Table 13.** Hierarchy levels in natural and cultural vegetation (Faber-Langendoen & al. 2011, Nov. 22: 12, tb. 3)

Categories	Formation class. Level 1 (mostly cosmopolite)
A. Natural and seminatural vegetation	1. Mesomorphic forest and tall woodland vegetation
	2. Mesomorphic shrubland and grassland vegetation
	3. Xeromorphic short open woodland and desert vegetation ( $Io < 2.0$ )
	4. Cryomorphic polar and high mountain vegetation ( $Tp < 600$ )
	5. Hydromorphic aquatic vegetation (with some wetland formations)
	6. Lithomorphic rupestrian vegetation (chasmophytic and comophytic)
B. Agricultural vegetation	7. Anthropic ruderal and agricultural vegetation

**Table 14.** Natural, seminatural and cultural formation classes. An outline based on FGDC (2008) and Faber-Langendoen & al. (2011), with little modifications and phytosociological additions (Rivas-Martínez, Penas & del Río in progress).

Natural hierarchy level	Ecomorphic types	Bioclimatic units	Biogeographic units	Floristic elements	Phytosociologic units	Grow forms
1. Formation class	One type	Macrobioclimate	Cosmopolite or kingdom	Many diagnostic species	Many classes	Dominant general and specific
2. Formation subclass	Same or divided type	Macrobioclimate and bioclimate	Regions and sub-regions	Many diagnostic species	Several classes	General specific dominant and diagnostic
3. Formation basic	Divided type	Bioclimate	Subregions and provinces	Many diagnostic species and endemics	Classes and orders	Dominant diagnostic and individual diagnostic
4. Division	Small divided type	Bioclimate and isobioclimates	Provinces, sectors and districts	Several diagnostic species and endemics	Orders and alliances	Dominant diagnostic and individual diagnostic

**Table 15.** Natural hierarchy level: formation class, subclass, basic formation and divisions

Formation Class	Phytosociological equivalent classes (syntax. equiv.)
A. Xeromorphic short open woodland, scrub and grassland (aridic and xeric tropical savanna)	1. <i>Coccule penduli-Sarcostemmetea daltonii</i> 2. <i>Heteropogonetea contorti</i> 3. <i>Tetraenetea simplicis</i> 4. <i>Frankenio pseudoericifoliae-Suaedetea caboverdeanae</i>
B. Aquatic vegetation (hydromorphic) (included: fresh and salt-water marshes)	5. <i>Lemnetea minoris</i> 6. <i>Potametea pectinati</i> 7. <i>Halodulo wrightii-Talassietea testudinum</i> 8. <i>Ruppieteа maritimae</i> 9. <i>Magnocarici-Phragmitetea australis</i> 10. <i>Arthrocnemetea franzii</i>
C. Lithomorphic vegetation (rupestrian)	11. <i>Adiantetea capilli-veneris</i> 12. <i>Asplenietea trichomanis</i> 13. <i>Parietarietea judaicae</i>
D. Ruderal vegetation (anthropomorphic)	14. <i>Polygono-Poetea annuae</i> 15. <i>Stellarietea mediae</i> 16. <i>Rudero-Manihotetea utilissimae</i>

**Table 16.** Relation between formation classes and phytosociological classes

The upper level of formations types: class (level 1), subclass (level 2) and the “basic” third level, correspond to biomes defined by his predominant growth forms, structure, physiognomy and environmental factors. The name description of the upper and mid level groups should express: geographical distribution (biogeographic unit if possible), ecomorphic type, vegetational structure and bioclimatic unit. As we try to collaborate and increase the information of the “World Formations Types”, in the upper and mid level ranks existent in Cabo Verde Islands (West Africa), we include the phytosociological syntaxa (class, order or alliances), that could be considered as equivalent (syntax. equiv.).

The most significant criteria to distinguish and define the upper hierarchical levels of the natural vegetation formations (classes, subclasses, basic types and divisions) are suggest by Faber-Langendoen & al. 2011, Nov. 22: 27-28, with some bioclimatic and biogeographic precisions, are synthesized in the table 15.

#### 4b. Classification formation types and syntaxa of Cabo Verde Islands

All natural, seminatural and anthropic vegetation of Cabo Verde Islands (Cabo Verde Biogeographic Province) can be included in four formation classes: A. Xero-

morphic short open woodland, scrub and grassland vegetation, B. Aquatic vegetation, C. Lithomorphic vegetation and D. Agricultural and ruderal anthropic vegetation. The table 16 show the relation between formation classes and phytosociological vegetation classes in Cabo Verde Islands.

#### 4c. Typological syntaxonomy and formation types

\* Nomenclatural typus of higher syntaxon, [●] Cabo Verde endemic sintaxa

- A. AFROTROPICAL XEROMORPHIC OPEN MICRO-WOODLAND HIGH DESERTIC ARIDIC AND DRY SAVANNA FORMATION CLASS
- Aa. TROPICAL SAHARAN XEROMORPHIC OPEN MICRO-WOODLAND DESERTIC ARIDIC AND DRY SAVANNA FORMATION SUBCLASS
  - Aaa. CABO VERDE XEROMORPHIC CLIMACTIC OPEN MICRO-WOODLAND DESERTIC ARIDIC AND DRY SAVANNA FORMATION (syntax equiv.:1)
    - 1. COCCULO PENDULI-SARCOSTEMMETEA DALTONII
      - Aaa.1. CABO VERDE XEROMORPHIC CLIMACTIC SCRUB DESERTIC ARIDIC SAVANNA DIVISON (syntax equiv.:1a)
        - 1a.\**EUPHORBIO TUCKEYANAEE-SARCOSTEMMETALIA DALTONII* [A, V, N, SL, BO, M, SN, F, BR]. [●]
        - 1.1.\**Asparago squarrosi-Sarcostemmetion daltonii* [A, V, N, SL, BO, M, SN, BR]. [●]
          - 1.1.1. *Cocculo penduli-Sarcostemmetum daltonii* [Bo, M, SN]
          - 1.1.2.\**Campylanthro spathulati-Sarcostemmetum daltonii* [A]
          - 1.1.3. *Frankenio caboverdeanae-Asparagetum squarrosi* [A]
          - 1.1.4. *Aeonio gogonei-Sarcostemmetum daltonii* [V, N]
          - 1.1.5. *Echio stenosiphonis-Euphorbietum tuckeyanae* [V]
          - 1.1.6. *Suaedo caboverdeanae-Asparagetum squarrosii* [SL, BO, M]
          - 1.1.7. *Tetraeno waterlotii-Sarcostemmetum daltonii* [BR]
        - 1.2. ***Globulario amygdalifoliae-Periplocion chevalieri*** [A, N, SN, F, BR]. [●]
          - 1.2.1.\**Erysimo caboverdeanae-Periploctum chevalieri* [F]
          - 1.2.2. *Echietum vulcanori* [F]
          - 1.2.3. *Actinopterido radiatae-Sarcostemmetum daltonii* [F]
          - 1.2.4. *Echio hypertropici-Euphorbietum tuckeyanae* [SN]
          - 1.2.5. *Launaeo thalassicae-Euphorbietum tuckeyanae* [BR]
          - 1.2.6. *Loto latifolii-Artemisietum gogonei* [A]
          - 1.2.7. *Melanoselino bischoffii-Globularietum amygdalifoliae* [A]
          - 1.2.8. *Asterisco smithii-Euphorbietum tuckeyanae* [N]

- Aaa.2. CABO VERDE XEROMORPHIC CLIMACTIC MICRO-WOODLAND XERIC SAVANNA DIVISION. (syntax equiv.: 1b)
- 1b. *DICHROSTACHYO PLATYCARPAE-ACACIETALIA CABOVERDEANAE* [A, V, N, SL, BO, M, SN, F, BR]
- 1.3.\****Fico gnaphalocarpae-Acacion caboverdeanae*** [A, V, N, Bo, M, SN, F, BR]. [●]
  - 1.3.1.\**Dichrostachyo platycarpae-Acacietum caboverdeanae* [SN, F, BR]
  - 1.3.2. *Cocculo penduli-Acacietum caboverdeanae* [Bo, M, SN]
  - 1.3.3. *Forsskaoleo procridifoliae-Acacietum caboverdeanae* [A, V]
  - 1.3.4. *Cocculo penduli-Ficetum gnaphalocarpae* [Bo, M, SN]
  - 1.3.5. *Forsskaoleo procridifoliae-Ficetum gnaphalocarpae* [F, BR]
  - 1.3.6. *Dichrostachyo platycarpae-Ficetum sur* [F, SN]
  - 1.3.7. *Euphorbio tuckeyanae-Ficetum sur* [A]
  - 1.3.8. *Sideroxyletum marginati* [A, V, N, SN, F, BR]
  - 1.3.9. *Dracaenetum caboverdeanae* [A, N]
- 1.4. ***Phoenicition atlanticae*** [V, SL, B, M, SN]. [●]
  - 1.4.1.\**Cocculo penduli-Phoenicetum atlanticae* [V, SL, BO, M, SN]
- 1.5. ***Tamaricion senegalensis*** [A, V, N, SL, BO, M, SN, BR]
  - 1.5.1.\**Cocculo penduli-Tamaricetum senegalensis* [A, V, N, SL, BO, M, SN, BR]
- Ab. AFROTROPICAL XEROMORPHIC GRASSLAND DESERTIC AND XERIC SAVANNA FORMATION SUBCLASS. (syntax. equiv.: 2 & 3)
- Aba. AFROTROPICAL XEROMORPHIC PERENNIAL GRASS-LAND DESERTIC AND XERIC SAVANNA FORMATION (syntax. equiv.: 2)
  - 2. HETEROPOGONETEA CONTORTI [A, V, N, SL, BO, M, SN, F, BR]
  - 2a.\****Melinio grandiflorae-Heteropogonetalia contorti*** [A, V, N, SL, BO, M, SN, F, BR]
    - 2.1.\* ***Heteropogonion melanocarpo-contorti*** [A, V, N, SN, F, BR]
      - 2.1.1.\**Dichanthio foveolati-Heteropogonetum contorti* [A]
      - 2.1.2. *Heteropogonetum melanocarpi* [SN, F]
    - 2.2.\* ***Enneapogonion desvauxii*** [A, V, SL, SN, BO, M]
      - 2.2.1. *Bothriochloo bladhii-Enneapogonetum desvauxii* [A, V, SL, BO, M, SN, F]
  - Abb. AFROTROPICAL XEROMORPHIC ANNUAL GRASS-LAND DESERTIC SAVANNA FORMATION (syntax. equiv.: 3)
  - 3. TETRAENETEA SIMPLICIS [A, V, N, SL, BO, M, SN, F, BR]
  - 3a.\* ***Aristido cardosoi-Tetraenetalia simplicis*** [A, V, N, SL, BO, M, SN, F, BR]

- 3.1.\***Aristido cardosoi-Tetraenion simplicis** [A, V, N, SL, BO, M, SN, F, BR]
- 3.1.1.\**Aristido cardosoi-Tetraenetus simplicis* [A, V, N, SL, BO, M, SN, F, BR]
- 3.1.2. *Asphodelo mariolousae-Aristidetum cardosoi* [A, F]
- 3.1.3. *Sehimatetum ischaemoidis* [SL]
- Ac. TROPICAL SAHARA COASTAL DESERTIC SANDY DWARF-SHRUB SAVANNA FORMATION SUBCLASS. (syntax. equiv.: 4)
- Aca. TROPICAL WEST SAHARA COASTAL DESERTIC SANDY DWARF-SHRUB SAVANNA FORMATION (syntax. equiv.: 4a)
- Aca.1. CABO VERDE COASTAL DESERTIC SANDY DWARF-SHRUB SAVANNA DIVISION (syntax. equiv.: 4.1)
4. FRANKENIO PSEUDOERICIFOLIAE-SUAEDETEA CABOVERDEANAE [V, SL, BO, M, SN]
- 4a.\**FRANKENIO PSEUDOERICIFOLIAE-SUAEDETALIA CABOVERDEANAE* [V, SL, BO, M, SN]
- 4.1.\***Polycarpeo caboverdeanae-Tetraenion waterlotii** [V, SL, BO, M, SN]
- 4.1.1.\**Polycarpeo caboverdeanae-Tetraenetus waterlotii* [SL, BO, M, SN]
- 4.1.2. *Tetraenetus vicentinae* [V]
- 4.1.3. *Sporobolo spicati-Cyperetum crassipedis* [SL, BO, M]
- 4.1.4. *Loto brunneri-Pulicarietum diffusae* [SL, BO]
- B. COSMOPOLITE HYDROMORPHIC VEGETATION FORMATION CLASS (syntax. equiv.: 5, 6, 7, 8)
- Ba. COSMOPOLITE HYDROMORPHIC FRESHWATER VEGETATION FORMATION SUBCLASS
- Baa. COSMOPOLITE HYDROMORPHIC FRESHWATER FREE FLOATING PLEUSTOPHYTE FORMATION. (syntax. equiv.: 5)
- Baa.1. HOLARCTIC HYDROMORPHIC FRESHWATER FREE FLOATING DIVISION. (syntax. equiv.: 5a)
5. LEMNETEA MINORIS [SN]
- 5a.\**LEMNETALIA MINORIS* [SN]
- 5.1.\***Lemnion minoris** [SN]
- 5.1.1. *Lemna minor* community [SN]
- Bab. COSMOPOLITE HYDROMORPHIC FRESHWATER SUBMERGED ROOTED HYDROPHYTE FORMATION (syntax. equiv.: 6)
6. POTAMETEA [SN]
- 6a.\**POTAMETALIA PECTINATI* [SN]
- 6.1.\***Potamion pectinati** [SN]
- 6.1.1. *Potamogeton pusillus* community [SN]
- Bb. NEOTROPICAL HYDROMORPHIC MARINAЕ SALT-WATER SUBMERGED ROOTED PERENNIAL FORMATION SUBCLASS (syntax equiv.: 7, 8)
- Bba. NEOTROPICAL HYDROMORPHIC MARINAЕ SALT-WATER SUBMERGED ROOTED PERENNIAL FORMATION (syntax. equiv.: 7)
7. HALODULO WRIGHTII-THALASSIETEA TESTUDINUM [SN]
- 7a.\**THALASSIO TESTUDINUM-SYRINGODIETALIA FILIFORMIS* [SN]
- 7.1. **Cymodoceion nodosae** [SN]
- 7.1.1. *Cymodocea nodosa* community [SN]
- Bbb. COSMOPOLITE HYDROMORPHIC SALTWATER TEMPORARY SUBMERGED ROOTED ANNUAL FORMATION (syntax. equiv.: 8)
8. RUPPIETEA MARITIMAE [SL, BO]
- 8a.\**RUPPIETALIA MARITIMAE* [SL, BO]
- 8.1.\***Ruppion maritimae** [SL, BO]
- 8.1.1. *Ruppia maritima* community [SL, BO]
- Bc. COSMOPOLITE FRESH AND SALTWATER MARSHES VEGETATION FORMATION SUBCLASS (syntax. equiv.: 9, 10)
- Bca. COSMOPOLITE RIVERINE AND HELOPHYTIC FRESH-WATER MARSHLAND VEGETATION FORMATION (syntax. equiv.: 9)
9. MAGNOCARICI ELATAE-PHRAGMITETEA AUSTRALIS [A, V, N, BO, M, SN, F, BR]
- 9a.\**PHRAGMITETALIA AUSTRALIS* [BO, M, SN]
- 9.1.\***Phragmition australis** [BO, M, SN]
- 9.1.1. *Typha domingensis* community [BO, M, SN]
- 9b. *RORIPPO NASTURTHI-AQUATICAE-GLYCERETALIA FLUITANTIS* [A, V, N, SN, F, BR]
- 9.2.\* **Rorippion nasturtii-aquaticae** [A, V, N, SN, F, BR]
- 9.2.1. *Rorippa nasturtium-aquaticum* community [A, V, N, SN, F, BR]
- Bcb. COASTAL AFRICAN TROPICAL SALTWATER MARSH DWARF SUCCULENT VEGETATION FORMATION (syntax. equiv.: 10)
10. ARTHROCNEMETEA FRANZII [A, V, SL, BO, M, SN]
- 10a.\**ARTROCNEMETALIA FRANZII* [SL, BO, M]
- 10.1.\***Arthroc nemeton franzii** [SL, BO, M, SN]
- 10.1.1.\**Arthroc nemeton franzii* [SL, BO, M]
- 10.1.2. *Cressetum salinae* [SL, BO, M, SN]
- 10b. *SESUVIETALIA SESUVIOLIDIS* [A, V, SL, BO, M, SN]
- 10.2.\**Sesuvion sesuvioidis* [A, V, SL, BO, M, SN]
- 10.2.1.\**Sesuvietum sesuvioidis* [V, SL, BO]
- 10.2.2. *Sesuvietum portulacastri* [SL, BO, M, SN]
- 10.2.3. *Blutaparontetum vermicularis* [A, SL, BO, M, SN]
- C. LITHOMORPHIC CHASMOPHYTIC AND COMOPHYTIC HOLARCTIC AND SUBTROPICAL VEGETATION FORMATION CLASS (syntax. equiv.: 11, 12, 13)
11. ADIANTETEA CAPILLI-VENERIS [A, V, N, SN, F, BR]
- 11a.\**ADIANTETALIA CAPILLI-VENERIS* [A, V, N, SN, F, BR]
- 11.1. **Adiantion trifidi** [A, V, N, SN, F, BR]
- 11.1.1. *Adiantetum trifidi* [A, V, N, SN, F, BR]
- 11.1.2. *Hypodematio crenati-Campanuletum brasensis* [SN, F, BR]

12. ASPLENIETEA TRICHOMANIS [A, V, N, SL, BO, M, SN, F, BR]  
 12a. *KICKXIETALIA ELEGANTIS* [A, V, N, SL, BO, M, SN, F, BR]. [•]  
 12.1.\****Kickxion elegantis*** [A, V, N, SL, BO, M, SN, F, BR]. [•]  
 12.1.1.\**Kickxietum webbianaee* [A]  
 12.1.2. *Diplotaxio hirtae-Kickxietum elegantis* [F]  
 12.1.3. *Umbilico schmidtii-Cheilanthesetum acrosticae* [F]  
 12.1.4. *Campanuletum jacobaeae* [A, SN]  
 12.1.5. *Campanulo bravensis-Launaetum thalassicae* [BR]
13. PARIETARIETEA JUDAICAE [A, V, N, SN, F, BR]  
 13a.\****PARIETARIETALIA JUDAICAE*** [A, V, N, SN, F, BR]  
 13.1. ***Adiantion inciso-philippensis*** [A, V, N, SN, F, BR]  
 13.1.1.\**Adiantetum inciso-philippensis* [A, V, N, SN, F, BR]
- D. RUDERAL COSMOPOLITE ANTHROPIC VEGETATION FORMATION CLASS (syntax. equiv. 14, 15, 16)
14. POLYGO NO ARENSTRI-POETEA ANNUAE [A, V, N, SL, BO, M, SN, F, BR]  
 14a. *EUPHORBIETALIA PROSTRATO-HIRTAE* [A, V, N, SL, BO, M, SN, F, BR]  
 14.1. ***Trianthemion portulacastri*** [A, V, N, SL, BO, M, SN, F, BR]  
 14.1.1.\**Trianthemetum portulacastri* [A, V, N, SL, BO, M, SN, F, BR]  
 14.1.2. *Euphorbio hirtae-Boerhavietum repentis* [A, V, N, BO, M, SN]  
 14.1.3. *Oldenlandietum corymbosae* [A, V, SN, F]
15. STELLARIETEA MEDIAE [A, V, N, SL, BO, M, SN, F, BR]  
 15a. *CHENOPODIETALIA MURALIS* [A, V, N, SL, BO, M, SN, F, BR]  
 15.1.\****Chenopodium muralis*** [A, V, N, SL, BO, M, SN, F, BR]  
 15.1.1. *Chenopodium murale* and *Malva parviflora* community [A, V, N, SL, BO, M, SN, F, BR]
16. RUDERO-MANIHOTETEA UTILISSIMAE [A, V, N, BO, M, SN, F, BR]  
 16a. *BIDENTETALIA PILOSAE* [A, V, N, BO, M, SN, F, BR]  
 16.1. ***Ecliption prostratae*** [A, V, N, BO, M, SN, F, BR]
- 4d. Description of Cabo Verde syntaxa (plant communities). [•] Endemic of Cabo Verde**
- Alphabetical list of phytosociological classes growing in Cabo Verde Islands
- Adiantetea capilli-veneris* (11)  
*Arthroc nemetea franzii* (10)  
*Asplenietea trichomanis* (12)  
*Coccu penduli-Sarcostemmetea daltonii* [•] (1)  
*Frankenio -Suaedetea caboverdeanae* (4)  
*Halodulo wrightii-Talassietea testudinum* (7)  
*Heteropogonetea contorti* (2)  
*Lemnetea minoris* (5)  
*Magnocarici-Phragmitetea australis* (9)  
*Parietarietea judaicae* (13)  
*Polygono arenastri-Poetea annuae* (14)  
*Potametea pectinati* (6)  
*Rudero-Manihotetea utilissimae* (16)  
*Ruppieteа maritimae* (8)  
*Stellarietea mediae* (15)  
*Tetraenetea simplicis* (3)

Nº	High syntaxa: Alliances	A	V	N	SL	BO	M	SN	F	BR
1.1	<i>Asparago squarroso-Sarcostemmion daltonii</i> [•]	•	•	•	•	•	•	•	•	•
1.2	<i>Globulario amygdalifoliae-Periplocion chevalieri</i> [•]	•	-	•	-	-	-	•	•	•
1.3	<i>Fico gnaphalocarpae-Acacion caboverdeanae</i> [•]	•	•	•	•	•	•	•	•	•
1.4	<i>Phoenicion atlanticae</i> [•]	-	•	-	•	•	•	•	-	-
1.5	<i>Tamaricion senegalensis</i>	•	•	•	•	•	•	•	-	•
2.1	<i>Heteropogonion melanocarpo-contorti</i>	•	•	•	•	•	•	•	•	•
3.1	<i>Aristido cardosoi-Tetraenion simplicis</i> [•]	•	•	•	•	•	•	•	•	•
4.1	<i>Polycarpeao caboverdeanae- Tetraenion waterlotii</i>	-	•	-	•	•	•	•	-	-
10.1	<i>Arthroc nemion franzii</i>	-	-	-	•	•	•	•	-	-
10.2	<i>Sesuvion sesuviodis</i>	•	•	-	•	•	•	•	-	-
11.1	<i>Adiantion trifidi</i>	•	•	•	-	-	-	•	•	•
12.1	<i>Kickxion elegantis</i> [•]	•	•	•	•	•	•	•	•	•
13.1	<i>Adiantion inciso-philippensis</i>	•	•	•	-	-	-	•	•	•
14.1	<i>Trianthemion portulacastri</i>	•	•	•	•	•	•	•	•	•

**Table 17.** Distribution of the main alliances in Cabo Verde Islands (biogeographic districts). A: Santo Antão, V:São Vicente, N: São Nicolau, SL: Sal, BO: Boavista, M: Maio, SN: Santiago, F: Fogo and BR: Brava. [•] Endemic alliances of Cabo Verde Islands; • Ocurring in the island (district) 1.1, 1.2, 1.3, 1.4, 1.5 (1. *Coccu penduli-Sarcostemmetea daltonii*; 2.1 (2. *Heteropogonetea contorti*); 3.1 (3. *Tetraenetea simplicis*); 4.1 (4. *Frankenio pseudoericifoliae-Suaedetea caboverdeanae*); 10.1, 10.2 (10. *Arthroc nemetea franzii*); 11.1 (11. *Adiantetea capilli-veneris*); 12.1 (12. *Asplenietea trichomanis*); 13.1 (13. *Parietarietea judaicae*) and 14.1 (14. *Polygono arenastri-Poetea annuae*).

N.º	Sintaxón/ District Islands	A	V	N	SL	BO	M	SN	F	BR	CV
1.1.	<i>Asparago squarrosi-Sarcostemmetum daltonii</i> [●]	●	●	●	●	●	●	●	●	●	9
1.1.1.	<i>Cocculo penduli-Sarcostemmetum daltonii</i>	-	-	-	-	●	●	●	-	-	3
1.1.2.*	<i>Campylanthe spathulati-Sarcostemmetum daltonii</i>	●	-	-	-	-	-	-	-	-	1
1.1.3.	<i>Frankenio caboverdeanae-Asparageto squarroso</i>	●	-	-	-	-	-	-	-	-	1
1.1.4.	<i>Aeonio gogonei-Sarcostemmetum daltonii</i>	-	●	●	-	-	-	-	-	-	2
1.1.5.	<i>Echio stenosiphonis-Euphorbietum tuckeyanae</i>	-	●	-	-	-	-	-	-	-	1
1.1.6.	<i>Suaedo caboverdeanae-Asparageto squarroso</i>	-	-	-	●	●	●	-	-	-	3
1.1.7.	<i>Tetraeno waterlotii-Sarcostemmetum daltonii</i>	-	-	-	-	-	-	-	-	●	1
1.2.	<i>Globulario amygdalifoliae-Periplocion chevalieri</i> [●]	●	-	●	-	-	-	●	●	●	5
1.2.1.*	<i>Erysimo caboverdeanae-Periplocetum chevalieri</i>	-	-	-	-	-	-	-	●	-	1
1.2.2.	<i>Echietum vulcanori</i>	-	-	-	-	-	-	-	●	-	1
1.2.3.	<i>Actinopterido radiatae-Sarcostemmetum daltonii</i>	-	-	-	-	-	-	-	●	-	1
1.2.4.	<i>Echio hypertropici-Euphorbietum tuckeyanae</i>	-	-	-	-	-	-	●	-	-	1
1.2.5.	<i>Launaeo thalassicae-Euphorbietum tuckeyanae</i>	-	-	-	-	-	-	-	-	●	1
1.2.6.	<i>Loto latifolii-Artemisietum gogonei</i>	●	-	-	-	-	-	-	-	-	1
1.2.7.	<i>Melanoselino bischoffii-Globarietum amygdalifoliae</i>	●	-	-	-	-	-	-	-	-	1
1.2.8.	<i>Asterisco smithii-Euphorbietum tuckeyanae</i>	-	-	●	-	-	-	-	-	-	1
1.3.	<i>Fico gnaphalocarpae-Acacion caboverdeanae</i> [●]	●	●	●	-	●	●	●	●	●	8
1.3.1.*	<i>Dichrostachyo platycarpae-Acacietum caboverdeanae</i>	-	-	-	-	-	-	●	●	●	3
1.3.2.	<i>Coccoco penduli-Acacietum caboverdeanae</i>	-	-	-	-	●	●	●	-	-	3
1.3.3.	<i>Forsskaoleo procridifoliae-Acacietum caboverdeanae</i>	●	●	-	-	-	-	-	-	-	2
1.3.4.	<i>Coccoco penduli-Ficetum gnaphalocarpae</i>	-	-	-	-	●	●	●	-	-	3
1.3.5.	<i>Forsskaoleo picridifoliae-Ficetum gnaphalocarpae</i>	-	-	-	-	-	-	-	●	●	2
1.3.6.	<i>Dichrostachyo platycarpae-Ficetum sur</i>	-	-	-	-	-	-	●	●	-	2
1.3.7.	<i>Euphorbio tuckeyanae-Ficetum sur</i>	●	-	-	-	-	-	-	-	-	1
1.3.8.	<i>Sideroxyletum marginati</i>	●	●	●	-	-	-	●	●	●	6
1.3.9.	<i>Dracaenetum caboverdeanae</i>	●	-	●	-	-	-	-	-	-	2
1.4.	<i>Phoenicion atlanticae</i> [●]	-	-	-	●	●	●	●	-	-	4
14.1.*	<i>Coccoco penduli-Phoenicetum atlanticae</i>	-	-	-	●	●	●	●	-	-	4
1.5.	<i>Tamaricion senegalensis</i>	-	-	-	●	●	●	●	-	-	4
1.5.1.*	<i>Coccoco penduli-Tamaricetum senegalensis</i>	-	-	-	●	●	●	●	-	-	4

**Table 18.** Insular distribution of syntaxa (associations and alliances) of the classis *Coccoco penduli-Sarcostemmetea daltonii* in Cabo Verde Islands districts

**Bioindicator** in this paper, means any endemic or non endemic native or naturalized Cabo Verde growing species, specially those of Tropical Sahara, Mediterranean Sahara, Sahel-Sudan, Afrotrropical and Pantropical origin or distribution, that could be useful for characterize, evaluate or determine boundaries or ecological factors of plant communities (syntaxa) in Cabo Verde Islands. ● Cabo Verde endemic vascular plant, [●] Cabo Verde endemic syntaxa and sigmataxa.

**Savanna** Word of Antillean origin. Strictly means a perennial tall grassland community, which can carry annual plants and grasses, scattered trees or shrubs, with tropical or subtropical (0°-36°N / S) with American, Afroasiatic, Indomalayan, Neozelandian and Polynesian distribution, and tropical pluviseasonal subhumid, tropical xeric dry or semiarid and tropical desertic arid or hyperarid bioclimate (aridic). Except in the case of savannas of the marshes or river basins, almost permanently flooded, which can represent the local edaphic climax or final stage of equilibrium in succession. The true savannas are usually seril perennial grasslands, shrublands or open woodland communities, produced by the destructive action of man, herbivores, agriculture and fires, of the regional climatophilous forests and woodlands. The subserial savannas, in turn, by the natural processes of succession and geobiotic regression, trend

to achieve equilibrium in nature. So that transformation into savanna is a common process evidenced in all tropical biogeographic regions of Earth and, as a consequence, permanently affect the appearance or structure of the natural plant communities that constitute the vegetation landscape, especially of thermoclimatic types infra, thermo and mesotropical from the hyperarid to lower subhumid ombrotype. The simple and accurate classification of the wooded, shrub and grassland savanna succession is one of the most important tropical question in physiography, geobotany, biogeography and vegetation classification.

#### 1. COCCULO PENDULI-SARCOSTEMMETEA DALTONII classis nova hoc loco

Micro-shrubland often succulent and deciduous micro-woodland open savanna of Cabo Verde Islands, mostly with aridic tropical bioclimate; occurring in desertic, xeric, infra-thermo-meso to lower supratropical ultrahyperarid to upper dry, strongly euhyperoceanic bioclimate; growing on arenosols, andosols, leptosols (lithic, skeletic, hyperskeletal) or fluvi-regosols and sometimes on little altered volcanic materials (lava and tephra). Two savanna orders are acknowledged: 1a. *Euphorbio tuckeyanae-Sarcostemmetalia daltonii* (open bis close shrub and dwarf

scrub savanna, desertic and xeric hyperarid to dry, infra-mesotropical, exceptionally lower supratropical), 1b. *Dichrostachyo platycarpae-Acacieta* *caboverdeanae* (open micro-woodlands and thickets, aridic and dry thermotropical deciduous desertic and xeric savanna). The associations of this classis of vegetation are endemic to Cabo Verde and occurring in all islands [A, V, N, SL, BO, M, SN, F, BR] [•].

*Typus:* *Euphorbia tuckeyanae-Sarcostemmetalia daltonii* ordo novus hoc loco (1a)  
Characteristic species and bioindicators growing in Cabo Verde Islands: *Asteriscus vogelii* •, *Daucus insularis* •, *Forsskaolea procridifolia* •, *Indigofera microcarpa* •, *Lavandula rotundifolia* •, *Lotus purpureus* •, *Sarcostemma daltonii* •.

Table 19

1.1.1. *Cocculo penduli-Sarcostemmetum daltonii* ass. nova hoc loco  
(*Asparago-Sarcostemmion*, *Euphorbio-Sarcostemmetalia*, *Coccuco-Sarcostemmetea daltonii*)

	19	20	25	22	15	20
W	SW	W	SW	W	.	
40	40	100	40	50	54	
6	6	7	4	10	7	
1	2*	3	4	5	6	
Characteristic species						
<i>Sarcostemma daltonii</i> •	5	5	4	5	3	V
<i>Cocculus pendulus</i>	+	1	+	1	1	V
<i>Euphorbia tuckeyana</i> •	+	2	2	.	.	III
<i>Asparagus squarrosum</i> •	+	2	.	.	.	II
Companion species						
<i>Jatropha curcas</i>	.	1	+	1	.	III
<i>Commicarpus helenae</i>	.	.	.	3	1	II
<i>Momordica charantia</i>	.	.	1	.	1	II
<i>Nicotiana glauca</i>	+	.	.	.	1	II
<i>Sida alba</i>	+	1	.	.	.	II

Other companion species: *Ipomoea asarifolia* and *Senna bicapsularis* 2 in 5; *Spermacoce verticillata* and *Cleome brachycarpa* 1 in 5; *Portulaca oleracea* 1 in 5; *Rhynchosia minima* and *Melinis grandiflora* + in 3.

Localities: 1. Boavista: Pico de Santo António; 2. Boavista: Pico de Santo António (*holotypus* ass. reg. 2005: 192); 3, 4. Santiago: Praia, Pedregal; 5. Santiago: Cidade Velha; 6. Synthesized table

1a. *EUPHORBIO TUCKEYANAE-SARCOSTEMMETALIA DALTONII* ordo novo hoc loco

Climactical and edaphoxerophilous shrub and dwarf scrub savanna communities; occurring in infra-thermo-mesotropical and lower supratropical, ultrahyperarid to semiarid and, some times, in lower dry bioclimate. The communities of this order are rich in Cabo Verde endemic species and can be found in all islands. [A, V, N, SL, BO, M, SN, F, BR].

*Typus:* 1.1. *Asparago squarrosum-Sarcostemmion daltonii* all. nova hoc loco

Characteristic species and bioindicators growing in Cabo Verde Islands: *Aeonium gorgoneum* •, *Echium glabrescens* •, *Echium stenosiphon* •, *Euphorbia tuckeyana* •, *Helianthemum gorgoneum* •, *Frankenia caboverdeana* •, *Launaea picridioides* •, *Micromeria forbesii* •, *Pennisetum polystachyon*, *Periploca chevalieri* •, *Tolpis farinulosa* •, *Verbascum capitis-viridis* •, *Withania chevalieri* •.

1.1. *Asparago squarrosum-Sarcostemmion daltonii* alliancia nova hoc loco

Climactical and edaphoxerophilous desertic and hyperdesertic shrub and dwarf scrub open savanna communities; occurs in infra-thermotropical from ultrahyperarid to lower arid,

on leptosols (lithic, skeletic, hyperskeletal), under strong euhyperoceanic bioclimate; on poorly developed arenosols, andosols or regosols, arenic, skeletic, leptic or tephric. The associations of this alliance are endemic of Cabo Verde [A, V, N, SL, BO, M, SN, BR]. [•]

*Typus:* *Campylantho spathulati-Sarcostemmetum daltonii* ass. nova hoc loco (1.1.1.)  
Characteristic species and bioindicators growing in Cabo Verde Islands: *Asparagus squarrosum* •, *Campylanthus spathulatus* •, *Diplotaxis glauca* •, *Diplotaxis vogelii* •, *Echium stenosiphon* •, *Fagonia mayana* •, *Launaea gorgadensis* •, *Limonium jovi-barba* •.

1.1.1. *Cocculo penduli-Sarcostemmetum daltonii* associatio nova hoc loco

Climactical and edaphoxerophilous desertic shrub savanna community, occurring in infra-thermotropical, upper ultrahyperarid, strong euhyperoceanic bioclimate, on leptic regosols and arenosols. Endemic association of East Cabo Verde Sector; in which thrive *Sarcostemma daltonii*, *Cocculus pendulus*, *Euphorbia tuckeyana* and *Asparagus squarrosum* (*holotypus* relevé n° 2, table 19). It occurs in Boavista, Maio and Santiago islands. [SN, BO, M]. [•]

**1.1.2. *Campylantho spathulati-Sarcostemmetum daltonii* associatio nova hoc loco**

Climactical and edaphoxerophilous desertic shrub savanna community, occurring in thermotropical, arid and strong euhyperoceanic bioclimate, on leptic regosols and lithosols. Occurs in north coast of Santo Antão Island, and is formed and characterized by *Sarcostemma daltonii*, *Campylanthus spathulatus* (local insular endemic), *Lavandula rotundifolia*, *Asteriscus vogelii*, *Launaea picridioides*, *Echium lindbergii*, *Paronychia illecebroides*, *Diplotaxis gorgadensis*, etc. (*holotypus relevé 3, table 20*) [A]. [•]

**1.1.3. *Frankenio caboverdeanae-Asparageto tum squarroso* associatio nova hoc loco**

Climactical and edaphoxerophilous desertic open dwarf shrub savanna community, occurring in infra-thermotropical, hyperarid and low arid, strong euhyperoceanic bioclimate, on leptic regosols and lithosols. Endemic association of Santo Antão Island can be found facing to the sea, from sea level to 250 m. Formed and characterized by *Asparagus squarrosum*, *Campylanthus spathulatus*, *Diplotaxis gorgadensis*, *Asteriscus vogelii*, *Frankenia caboverdeana*,

*deana*, *Lavandula rotundifolia*, *Paronychia illecebroides*, *Launaea gorgadensis*, etc. (*holotypus relevé n° 2, table 21*); *Sarcostemma daltonii* and *Echium lindbergii* are absent [A]. [•]

**1.1.4. *Aeonio gogonei-Sarcostemmetum daltonii* associatio nova hoc loco**

Climactical and edaphoxerophilous drawf shrub savanna community rich in succulents plants well-developed in S. Nicolau and São Vicente Islands on skeletal leptosols ancient altered volcanic rocky, in tropical desertic, thermotropical arid bioclimate, often affected by the trade winds from the north, especially in winter. Besides the succulent species *Aeonium gorgoneum* and *Sarcostemma daltonii*, are present *Launaea picridioides*, *Asteriscus vogelii*, *Lotus purpureus*, *Daucus insularis*, *Echium stenosiphon*, *Echium glabrescens*, *Campylanthus glaber*, *Limonium jovi-barba*, *Lobularia spathulata*, etc. (*holotypus relevé 2, table 22*). We recognize two subassociations: *typicum* (rel. 2, *typus*) and on cohesive dark basalts steep walls of the both islands *limonietosum jovi-barbae* subass nova hoc loco (*holotypus relevé 1, table 22*) [V, N]. [•]

**Table 20**

**1.1.2. *Campylantho spathulati-Sarcostemmetum daltonii* ass. nova hoc loco  
(Asparago-Sarcostemmion, Euphorbio-Sarcostemmetalia,  
Cocculo-Sarcostemmetea daltonii)**

	10	14	15	20	22	16
Altitude (1=10 m)						
Orientation	NE	N	N	NW	W	
Area m <sup>2</sup>	40	60	60	80	80	<u>64</u>
Nº of species	9	12	8	13	18	<u>12</u>
Ordinal number	1	2	3*	4	5	6
Characteristic species						
<i>Sarcostemma daltonii</i> •	2	3	4	4	4	V
<i>Campylanthus spathulatus</i> •	3	3	2	2	2	V
<i>Asteriscus vogelii</i> •	1	2	1	2	+	V
<i>Lavandula rotundifolia</i> •	+	1	1	+	3	V
<i>Launaea picridioides</i> •	+	+	1	2	.	IV
<i>Echium lindbergii</i> •	.	+	1	+	.	III
<i>Paronychia illecebroides</i> •	+	+	.	+	.	III
<i>Diplotaxis gorgadensis</i> •	.	.	+	1	+	III
<i>Asparagus squarrosum</i> •	.	.	+	1	.	II
<i>Frankenia caboverdeana</i> •	1	.	.	.	.	I
<i>Limonium braunii</i> •	+	.	.	.	.	I
<i>Launaea gorgadensis</i> •	.	+	.	.	.	I
Companion species						
<i>Cynodon dactylon</i>	.	2	.	+	+	III
<i>Tridax procumbens</i>	.	1	.	.	2	II
<i>Polyarpaea gayi</i> •	.	.	.	1	1	II
<i>Kickxia elegans</i> •	1	.	.	.	+	II

Other companion species: *Hyparrhenia caboverdeana* • 2 in 5; *Fagonia latifolia* 1 in 2; *Heliotropium pterocarpum* 1 in 2; *Heteropogon melanocarpus* 1 in 4; *Cenchrus ciliaris* and *Tricholaena teneriffae* 1 in 5; *Furcraea foetida* + in 4; *Desmanthus virgatus*, *Lavandula coronopifolia*, *Aristida funiculata*, *Nicotiana glauca* and *Lantana camara* + in 5.

Localities: 1. *Santo Antão*: Ribeira Grande; 2. *Santo Antão*: Ponta do Sol to Fontainhas; 3. *Santo Antão*: Ponta do Sol to Fontainhas (*holotypus ass. reg. 2005: 53*); 4. *Santo Antão*: Ponta do Sol to Fontainhas; 5. *Santo Antão*: Canto da Cagarra; 6. Synthesized table.

**Table 21****1.1.3. *Frankenio caboverdeanae-Asparagetum squarrosoi* ass. nova hoc loco**

*Asparago-Sarcostemmion, Euphorbio-Sarcostemmetal, Cocco-  
Sarcostemmetea daltonii)*

Altitude (1 = 10m)	7	8	14	22	0.5	0.2	8
Orientation	E	N	W	NE	E	E	-
Area m <sup>2</sup>	100	100	100	100	60	50	<u>85</u>
Nº of species	13	12	10	14	15	15	<u>13</u>
Ordinal number	1	2*	3	4	5	6	7
Characteristic species							
<i>Asparagus squarroso</i> ●	3	3	2	1	3	2	V
<i>Campylanthus spathulatus</i> ●	1	1	+	1	3	3	V
<i>Asteriscus vogelii</i> ●	3	3	3	3	1	.	V
<i>Frankenia caboverdeana</i> ●	1	+	1	.	3	2	V
<i>Lavandula rotundifolia</i> ●	+	+	2	.	1	+	V
<i>Paronychia illecebroides</i> ●	+	+	.	+	1	1	V
<i>Launaea gorgadensis</i> ●	+	+	.	+	.	+	IV
<i>Limonium braunii</i> ●	2	.	.	.	+	.	II
<i>Launaea picridioides</i> ●	.	.	.	.	+	1	II
Companion species							
<i>Aristida funiculata</i>	+	1	2	+	.	.	IV
<i>Aizoon canariense</i>	1	+	+	.	.	1	IV
<i>Nicotiana glauca</i>	.	+	+	1	.	+	IV
<i>Abutilon pannosum</i>	+	+	+	+	.	.	IV
<i>Polycarpaea gayi</i> ●	+	.	.	+	1	.	III
<i>Lavandula coronopifolia</i>	.	.	+	2	.	.	II
<i>Cenchrus ciliaris</i>	.	.	.	2	.	+	II
<i>Kickxia elegans</i> ●	+	+	.	.	.	.	II
<i>Heliotropium pterocarpum</i>	+	.	.	+	.	.	II
<i>Trichodesma africanum</i>	.	.	.	+	+	.	II
<i>Cynodon dactylon</i>	.	.	.	.	+	+	II
<i>Tridax procumbens</i>	.	.	.	.	+	+	II

Other companion species: *Malvastrum americanum* + in 4; *Crotalaria sene-galensis*, *Cucumis anguria* and *Calotropis procera* + in 5; *Diplotaxis gor-gadensis* ●, *Patellifolia patellaris* and *Tricholaena teneriffae* + in 6;

Localities: 1. *Santo Antão*: between the Faro and Ribeira da Zurinca; 2. *Santo Antão*: between the Faro and Ribeira da Zurinca (relevé J.C. Costa & I. Gomes, holotypus ass. reg. 2014: 44); 3. *Santo Antão*: Ribeira da Zurinca; 4. *Santo Antão*: between Ribeira da Zurinca and Ribeira Brava; 5, 6. *Santo Antão*: Cruzinha da Graça; 7. Synthesized table.

**1.1.5. *Echio stenosiphonis-Euphorbietum tuckeyanae* associatio nova hoc loco**

Climactical shrub savanna community, growing on leptic andosols near the summit of de São Vicente Island, in topographical tropical cloudy, thermotropical, upper arid, euhyperoceanic bioclimate. The most important species of this community are *Euphorbia tuckeyana*, *Echium stenosiphon* (local endemic), *Asteriscus vogelii*, *Daucus insularis*, *Lotus purpureus*, *Phagnalon melanoleucum*, *Lobularia spathulata*, *Conyza pannosa*, *Davallia canariensis*, etc. (holotypus relevé 1, table 23). The *Euphorbia tuckeyana* seems to be an important relict species of the former times; for this paleobioclimatical and actual situation on propose this new community as a local relict summit cloudy association of the isle, included in the hyper-

arid-arid alliance *Asparago squarroso-Sarcostemmion daltonii* [V]. [●]

**1.1.6. *Suaedo caboverdeanae-Asparagetum squarrosoi* associatio nova hoc loco**

Climactical and edaphoxerophilous sandy desertic open dwarf shrub community, occurring in infra-thermotropical hyperarid, strong euhyperocenic bioclimate, on leptic regosols and arenosols. Endemic association of East Cabo Verde Sector; in which is dominant *Asparagus squarroso*, and thrive *Tetraena waterlotii*, *Frankenia pseudoericifolia* and *Suaeda caboverdeana* (holotypus relevé nº 4, table 24). This chamaepic permanent sandy association is intermediate between the classis *Euphorbio-Sarcostemmetal* and *Frankenio-Suaedetea caboverdeanae*, where probably will be better placed. [SL, BO,M]. [●]

**Table 22**

	53	44	46	40	8	15	34
Altitude (1=10 m)	NE	W	W	SW	N	N	
Orientation	20	40	40	40	60	60	
Area m <sup>2</sup>	7	13	13	11	17	12	
Nº of species	1*	2*	3	4	5	6	
Ordinal number							7
Characteristic species							
<i>Sarcostemma daltonii</i> •	1	4	3	4	5	5	V
<i>Launaea picridioides</i> •	1	1	3	2	.	+	V
<i>Asteriscus vogelii</i> •	1	2	2	.	+	2	V
<i>Lotus purpureus</i> •	1	2	2	+	+	.	V
<i>Aeonium gorgoneum</i> •	2	2	2	3	.	.	IV
<i>Echium glabrescens</i> •	.	.	.	3	+	+	III
<i>Daucus insularis</i> •	+	1	2	.	.	.	III
<i>Echium stenosiphon</i> •	.	+	1	.	.	.	II
<i>Campylanthus glaber</i> •	.	1	+	.	.	.	II
<i>Forsskaolea procridifolia</i> •	.	+	.	1	.	.	II
<i>Lavandula coronopifolia</i>	.	+	.	.	2	.	II
<i>Paronychia illecebroides</i> •	.	.	.	.	+	+	II
<i>Limonium jovi-barba</i> • (subass.)	2	.	.	.	.	.	I
<i>Lobularia fruticosa</i> •	.	.	.	1	.	.	I
<i>Launaea gorgadensis</i> •	.	.	.	1	.	.	I
<i>Asparagus squarrosum</i> •	.	.	.	.	1	.	I
<i>Frankenia caboverdeana</i> •	.	.	.	.	.	1	I
<i>Lobularia spathulata</i> •	.	.	+	.	.	.	I
Companion species							
<i>Lantana camara</i>	.	.	1	1	2	.	III
<i>Heteropogon contortus</i>	.	1	1	1	.	.	III
<i>Commicarpus helenae</i>	.	.	.	.	2	2	II
<i>Cynodon dactylon</i>	.	.	.	.	1	2	II

Other companion species: *Rhynchosia minima* and *Salvia aegyptiaca* 2 in 5; *Elionurus royleanus* 1 in 3; *Grewia villosa* 1 in 4; *Desmanthus virgatus*, *Indigofera tinctoria* and *Desmodium ospriostreblum* 1 in 5; *Boerhavia coccinea* 1 in 6; *Launaea intybacea* + in 2; *Kickxia elegans* • + in 2; *Cenchrus ciliaris* + in 3; *Heliotropium crispum* + in 5; *Abutilon pannosum* and *Tetrapogon cenchriformis* + in 6.

Localities: 1. São Vicente: Monte Verde, north-east slope, dark cohesive basalt (*holotypus subass. limonietosum jovi-barbae* . reg. 2004: 71); 2. São Vicente: Monte Verde, west slope (*holotypus ass. reg. 2004: 66*); 3. São Vicente: Monte Verde, west slope; 4. S. Nicolau: Fajã de Baixo; 5. S. Nicolau: Belém; 6. S. Nicolau: Salto; 7. Synthesized table.

**Table 23**

	75	73
Altitude (1=10 m)	SW	W
Orientation	10	10
Area m <sup>2</sup>	10	13
Nº of species	1*	2
Ordinal number		
Characteristic species		
<i>Euphorbia tuckeyana</i> •	3	4
<i>Echium stenosiphon</i> •	3	3
<i>Asteriscus vogelii</i> •	2	3
<i>Lotus purpureus</i> •	2	2
<i>Daucus insularis</i> •	2	2
<i>Phagnalon melanoleucum</i> •	+	+
<i>Lobularia spathulata</i> •	.	2
<i>Conyza pannosa</i> •	.	+
Companion species		
<i>Lantana camara</i>	2	1
<i>Furcraea foetida</i>	2	1
<i>Cynodon dactylon</i>	1	2
<i>Davallia canariensis</i>	+	1
<i>Paronychia illecebroides</i> •	.	+

Localities: 1. São Vicente: Monte Verde, near summit *holotypus ass. (reg. 2004: 73)*; 2. São Vicente: Monte Verde, near summit.

**Table 24**  
**1.1.6. *Suaedo caboverdeanae-Asparageto squarrosoi* ass. nova**  
**hoc loco**

(*Asparago-Sarcostemmion, Euphorbio-*  
*Sarcostemmetalia, Cocco-Sarcostemmetea*)

Altitude (1=10 m)	1	7	7	2
Orientation	SE	W	W	SE
Area m <sup>2</sup>	4	10	10	60
Nº of species	3	3	4	9
Ordinal number	1	2	3	4*
Characteristic species				
<i>Asparagus squarrosum</i> •	4	4	4	3
Species of <i>Frankenio-Suaedetea caboverdeanae</i>				
<i>Suaeda caboverdeana</i> •	1	1	2	2
<i>Tetraena waterlotii</i>	+	.	.	2
<i>Frankenia pseudoericifolia</i> •	.	+	.	2
Other companion species: <i>Lotus brunneri</i> • 1 in 3; <i>Lotus chevalieri</i> • and <i>Tetraena simplex</i> 1 in 4; <i>Senna bicapsularis</i> + in 3; <i>Bulbostylis barbata</i> , <i>Fagonia latifolia</i> and <i>Heliotropium pterocarpum</i> + in 4				
Localities: 1. <i>Maio</i> : Banco da Antónia; 2, 3. <i>Sal</i> : base of Fonte Grande; 4. <i>Boavista</i> : Porto Ferreira (relevé J.C. Costa & I. Gomes, holotypus ass. reg. 2008: 19).				

**Table 25**

**1.1.7. *Tetraeno waterlotii-Sarcostemmetum daltonii* ass. nova hoc loco**

(*Asparago-Sarcostemmion, Euphorbio-Sarcostemmetalia, Cocco-Sarcostemmetea*)

Altitude (1 = 10m)	1	30	15	29	0.5	0.7	24	14
Orientation	N	NW	N	NE	NE	E	E	
Area m <sup>2</sup>	50	50	50	50	20	60	100	54
Nº of species	4	6	8	9	10	12	16	8
Ordinal number	1	2	3	4	5	6*	7	8
Characteristic species								
<i>Sarcostemma daltonii</i> •	3	4	3	3	4	4	3	V
<i>Campylanthus glaber</i> •	.	1	1	1	1	1	2	V
<i>Tetraena waterlotii</i>	2	.	1	2	2	+	.	IV
<i>Lavandula coronopifolia</i>	.	.	1	.	.	1	+	III
<i>Lotus purpureus</i> •	.	.	.	.	1	.	+	II
<i>Daucus insularis</i> •	.	.	.	+	+	.	.	II
<i>Forsskaolea procridifolia</i> •	.	.	.	.	+	+	.	II
Companion species								
<i>Launaea melanostigma</i> •	1	2	1	2	.	+	+	V
<i>Cenchrus ciliaris</i>	1	1	3	+	+	.	2	V
<i>Commicarpus helenae</i>	.	1			+	1	2	III
<i>Cynodon dactylon</i>	.	.	.	+	2	2	.	III
<i>Nicotiana glauca</i>	.	+	.	+	.	.	1	III
<i>Hyparrhenia caboverdeana</i> •	.	.	2	.	.	.	+	II
<i>Trichodesma africanum</i>	.	.	.	.	.	1	+	II
<i>Senna bicapsularis</i>	.	.	.	.	.	1	+	II
<i>Kickxia elegans</i> •	.	.		+	+	.	.	II
<i>Heliotropium pterocarpum</i>	.	.	+	.	.	.	+	II

Other companion species: *Momordica charantia* 1 in 6; *Cucumis anguria* + in 6; *Indigofera tinctoria* 2, *Ziziphus mauritiana*, *Salvia aegyptiaca* and *Leucaena leucocephala* + in 7.

Localities: 1. *Brava*: Furnas; 2. *Brava*: Cruzinha; 3, 4. *Brava*: Figueiral; 5, 6. *Brava*: Fajã de Água; 6. *Brava*: Fajã de Água (relevé J.C. Costa & I. Gomes, holotypus ass. reg. 2014: 26); 7. *Brava*: Lomba; 8. Synthesized table.

**1.1.7. *Tetraeno waterlotii-Sarcostemmetum daltonii* associatio nova hoc loco**

Climactical and edaphoxerophilous close dwarf shrub savanna community, occurring in Brava Island on leptosols in lower thermotropical arid, euhyperoceanic bioclimate,. It is dominated by the succulent species *Sarcostemma daltonii* and *Tetraena waterlotii* accompanied by *Campylanthus glaber* •, *Commicarpus heleneae*, *Lavandula coronopifolia*, *Lotus purpureus* •, *Trichodesma africanum*, *Daucus insularis* •, *Launaea melanostigma* •, etc. (holotype relevé 6, table 25) [BR]. [•]

**1.2. *Globulario amygdalifoliae-Periplocion chevalieri* alliance nova hoc loco**

Desertic and xeric climactical tropical and edaphoxerophilous tall shrub savanna community; growing in thermo-mesotropical and occasionally lower supratropical, from upper arid to upper dry and locally some years low subhumid (Fogo Island); developed on leptosols, andosols, colluvial and tephric soils. The

communities of this alliance are endemic of Cabo Verde Islands [A, N, SN, F, BR]. [•]

*Typus:* 16.2.1. *Erysimo caboverdeanae-Periplocetum chevalieri* ass. nova hoc loco

Characteristic species and bioindicators growing in Cabo Verde Islands: *Artemisia gorgonum* •, *Asteriscus daltonii* •, *Asteriscus smithii* •, *Carex antoniensis* •, *Conyza feae* •, *Conyza pannosa* •, *Conyza schlechtendalii* •, *Conyza varia*, *Daucus annuus* •, *Daucus insularis* •, *Daucus tenuissimus* •, *Diplotaxis antoniensis* •, *Diplotaxis brochmannii* •, *Diplotaxis gracilis* •, *Diplotaxis sundingii* •, *Echium hypertropicum* •, *Echium vulcanorum* •, *Erysimum caboverdeanum* •, *Frankenia montana* •, *Globularia amygdalifolia* •, *Limonium lobinii* •, *Limonium sundingii* •, *Lobularia spathulata* •, *Lotus arborescens* •, *Lotus jacobaeus* •, *Lotus jacobaeus* var. *villosus* •, *Lotus latifolius* •, *Melanoselinum bischoffii* •, *Phagnalon melanoleucum* •, *Sonchus daltonii* •, *Tolpis farinulosa* •, *Verbascum cystolithicum* •.

**Table 26**  
1.2.1. *Erysimo caboverdeanae-Periplocetum chevalieri* ass. nova hoc loco

(*Globulario-Periplocion chevalieri Euphorbio-Sarcostemmetalia, Coccule Sarcostemmetea daltonii*)

Altitude (1=10 m)	171	157	180	174	158	168
Orientation	NE	S	N	E	S	.
Area m <sup>2</sup>	200	200	200	50	60	<u>142</u>
Nº of species	15	14	21	15	12	16
Ordinal number	1	2	3*	4	5	6
Characteristic species						
<i>Periploca chevalieri</i> •	2	2	2	1	2	V
<i>Lotus purpureus</i> •	1	1	2	2	+	V
<i>Lavandula rotundifolia</i> •	2	3	.	3	3	IV
<i>Diplotaxis hirta</i> •	2	.	+	1	+	IV
<i>Micromeria forbesii</i> •	1	.	1	+	1	IV
<i>Euphorbia tuckeyana</i> •	4	3	3	.	.	III
<i>Sarcostemma daltonii</i> •	+	2	.	.	2	III
<i>Artemisia gorgonum</i> •	+	+	3	.	.	III
<i>Sonchus daltonii</i> •	.	1	1	+	.	III
<i>Erysimum caboverdeanum</i> •	1	.	2	.	.	II
<i>Phagnalon melanoleucum</i> •	.	.	2	1	.	II
<i>Campylanthus glaber</i> •	.	1	.	1	.	II
<i>Withania chevalieri</i> •	.	.	.	+	+	II
<i>Helianthemum gorgoneum</i> •	.	2	.	.	.	I
<i>Conyza feae</i> •	.	.	+	.	.	I
<i>Globularia amygdalifolia</i> •	.	.	.	2	.	I
<i>Lotus jacobaeus</i> •	.	.	.	1	.	I
<i>Verbascum cystolithicum</i> •	.	.	.	+	.	I
Companion species						
<i>Hyparrhenia caboverdeana</i> •	+	2	2	+	.	IV
<i>Melinis repens</i>	.	+	+	.	1	III
<i>Heteropogon contortus</i>	.	.	1	2	+	III
<i>Aristida adscensionis</i>	+	.	2	.	.	II
<i>Cosentinia vellea</i>	+	.	.	.	1	II

Other companion species: *Asphodelus marioioides* 2 in 3; *Dichanthium annulatum* 2 in 5; *Andropogon fastigiatus* 1 in 2; *Polycarpha gayi* • 1 in 2; *Pteridium aquilinum* 1 in 3; *Galium parisiense* 1 in 3; *Cenchrus ciliaris* + in 1; *Bidens pilosa* + in 1; *Solanum nigrum* + in 1; *Ricinus communis* in 3; *Ipomoea batatas* + in 3; *Brachypodium distachyon* + in 3; *Campanula bravensis* • + in 4; *Tricholaena teneriffae* + in 5

Localities: 1. *Fogo*: 4 Km SW from Chã das Caldeiras; 2. *Fogo*: Chã das Caldeiras, Fernão Ferro; 3. *Fogo*: Montinho (holotype ass. reg. 2006: 46); 4. *Fogo*: Chã das Caldeiras; 5. *Fogo*: Chã das Furnas; 6. Synthesized table

**1.2.1. *Erysimo caboverdeanae-Periplocetum chevalieri* associatio nova hoc loco**

Climactical and edaphoxerophilous tall shrub savanna community, occurring on leptosols and leptic andosols in Fogo Island, in tropical xeric, thermo-mesotropical, semiarid to upper dry, euhyperoceanic bioclimate. It's characterized by *Periploca chevalieri*, *Lotus purpureus*, *Lavandula rotundifolia*, *Diplotaxis hirta*, *Micromeria forbesii*, *Euphorbia tuckeyana*, *Artemisia gorgonum*, *Erysimum caboverdeanum*, *Sonchus daltonii*, *Phagnalon melanoleucum*, *Withania chevalieri*, *Sarcostemma daltonii*, *Hyparrhenia caboverdeana*, etc. (*holotypus* relevé 3, table 26) [F]. [•]

**1.2.2. *Echietum vulcanori* associatio nova hoc loco**

Shrub climactical open savanna community dominated and well characterized by the local endemic *Echium vulcanorum*, accompanied by *Verbascum cystolithicum*, *Lotus purpureus*, *Periploca chevalieri*, *Artemisia gorgonum*, *Lavandula rotundifolia*, *Withania chevalieri*, *Micromeria forbesii*, *Hyparrhenia caboverdeana*, *Cenchrus ciliaris*, etc. (*holotypus* relevé 3, table 27). It can be found on lapilli soils and tephra volcanic deposits, at high altitude in Fogo Island, in tropical xeric, meso and

lower supratropical dry and some years lower subhumid, euhyperoceanic bioclimate [F]. [•]

**1.2.3. *Actiniopterido radiatae-Sarcostemmetum daltonii* associatio nova hoc loco**

Stony badlands edaphoxerophilous dwarf shrub open savanna community growing on leptosols, scree and bedrocks of recent basaltic rocks, characterized by *Sarcostemma daltonii* and particularly by the scree fern *Actinopteris radiata* accompanied by *Forsskaolea procridifolia*, *Diplotaxis hirta*, *Rhynchosia minima*, *Periploca chevalieri*, *Macrotyloma daltonii*, *Tricholaena teneriffae*, etc. (*holotypus* relevé 2, table 28). It occurs in Fogo Island in thermotropical arid to semiarid, strong euhyperoceanic bioclimate [F]. [•]

**1.2.4. *Echio hypertropici-Euphorbietum tuckeyanae* associatio nova hoc loco**

Edaphoxerophytic and climactical tall crowded shrub savanna community of Serra da Malagueta (Santiago Island), growing on andosols and coluvisols, in tropical xeric and occasionally some years pluviseasonal, thermotropical, semiarid to dry euhyperoceanic bioclimate. Probably, in Santiago and Fogo Islands, the climatophilous natural potential vegetation in this bioclimatic stage correspond: in the deep

**Table 27**  
1.2.2. *Echietum vulcanori* ass. nova hoc loco

(*Globulario-Periplocion chevalieri*, *Euphorbio-Sarcostemmetalicia*,  
*Cocculo-Sarcostemmetea daltonii*)

	180	177	170	181
Altitude (1=10 m)				
Orientation	NE	W	W	SW
Area m <sup>2</sup>	200	100	100	200
Nº of species	13	7	9	11
Ordinal number	1	2	3*	4
Characteristic species				
<i>Echium vulcanorum</i> •	2	1	3	3
<i>Verbascum cystolithicum</i> •	2	1	1	+
<i>Lotus purpureus</i> •	+	2	+	2
<i>Periploca chevalieri</i> •	.	2	1	4
<i>Lavandula rotundifolia</i> •	.		2	2
<i>Withania chevalieri</i> •	.	2	1	.
<i>Micromeria forbesii</i> •	1	.	.	1
<i>Artemisia gorgonum</i> •	3	.	.	.
<i>Diplotaxis hirta</i> •	1	.	.	.
<i>Forsskaolea procridifolia</i> •	1	.	.	.
<i>Conyza feae</i> •	.	.	1	.
Companion species				
<i>Hyparrhenia caboverdeana</i>	1	3	1	+
<i>Cenchrus ciliaris</i>	.	2	1	2
<i>Tricholaena teneriffae</i>	2	.	.	1
<i>Ricinus communis</i>	+	.	.	+

Other companion species: *Cajanus cajan* 1 in 4; *Solanum nigrum* + in 1; *Chloris pycnothrix* + in 1; *Bidens pilosa* + in 1

Localities: 1. Fogo: Chã das Caldeiras; 2. Fogo: Chã das Caldeiras, Pico Pequeno; 3. Fogo: Chã das Caldeiras, Pico Pequeno *holotypus* ass. (reg. 2006: 43); 4. Fogo: 2 km SW from Chã das Caldeiras

**Table 28**

1.2.3. *Actiniopterido radiatae-Sarcostemmetum daltonii* ass. nova hoc loco  
*(Globulario-Periplocion chevalieri, Euphorbio-Sarcostemmetalia*  
*Coccoco-Sarcostemmetea daltonii)*

Altitude (1=10 m)	103	53
Orientation	S	S
Area m <sup>2</sup>	20	100
Nº of species	10	14
Ordinal number	1	2*
Characteristic species		
<i>Sarcostemma daltonii</i> •	4	5
<i>Actiniopteris radiata</i>	1	2
<i>Forsskaolea procridifolia</i> •	1	1
<i>Rhynchosia minima</i>	3	.
<i>Periploca chevalieri</i> •	2	.
<i>Diplotaxis hirta</i> •	+	.
<i>Macrotyloma daltonii</i>	.	2
<i>Euphorbia tuckeyana</i> •	.	1
<i>Withania chevalieri</i> •	+	.
Companion species		
<i>Tricholaena teneriffae</i>	+	1

Other companion species: *Melinis repens* 1 in 2, *Tephrosia uniflora* 1 in 2, *Tripogon minimus* 1 in 2, *Hyparrhenia caboverdeana* + in 1 *Cosentinia vellea* + in 1, *Aristida adscensionis* + in 2, *Tephrosia bracteolata* + in 2, *Eragrostis conertii* • + in 2, *Aristida funiculata* + in 2, *Sesbania grandiflora* + in 2

Localities: 1. Fogo: Chão das Furnas; 2. Fogo: Figueira Pavão (*holotypus ass. reg.* 2006: 28)

**Table 29**

1.2.4. *Echio hypertropici-Euphorbiatum tuckeyanae* ass. nova hoc loco  
*(Globulario-Periplocion chevalieri, Euphorbio-Sarcostemmetalia,*  
*Coccoco-Sarcostemmetea daltonii)*

Altitude (1=10 m)	87	80	76	95	80	85	96	74	84
Orientation	SE	W	SW	NE	N	W	E	SE	.
Area m <sup>2</sup>	60	40	200	100	60	80	50	100	<u>86</u>
Nº of species	13	10	13	12	13	10	6	12	<u>11</u>
Ordinal number	1	2	3	4	5	6*	7	8	9
Characteristic species									
<i>Euphorbia tuckeyana</i> •	3	1	+	1	5	5	2	3	V
<i>Echium hypertropicum</i> •	3	3	4	3	2	2	3	1	V
<i>Lotus jacobaeus</i> •	1	+	1	+	+	+	.	1	V
<i>Lavandula rotundifolia</i> •	2	2	2	+	.	1	.	.	IV
<i>Daucus annuus</i> •	+	.	.	.	+	+	+	1	IV
<i>Diplotaxis varia</i> •	1	1	1	1	.	.	.	.	III
<i>Asteriscus daltonii</i> •	.	.	.	2	.	.	2	3	II
<i>Verbascum capitis-viridis</i> •	.	.	+	.	+	1	.	.	II
<i>Limonium lobinii</i> •	.	.	.	.	2	.	.	.	I
<i>Globularia amygdalifolia</i>	.	.	.	.	.	.	.	1	I
<i>Forsskaolea procridifolia</i> •	.	+	.	.	.	.	.	.	I
<i>Campylanthus glaber</i> •	.	.	.	+	.	.	.	.	I
<i>Conyza pannosa</i> •	.	.	.	+	.	.	.	.	I
<i>Lobularia fruticosa</i> •	.	.	.	.	+	.	.	.	I
Companion species									
<i>Lantana camara</i>	2	2	2	2	1	2	1	2	V
<i>Furcraea foetida</i>	3	.	1	2	.	+	+	1	IV
<i>Heteropogon melanocarpus</i>	1	1	1	1	.	.	1	1	IV
<i>Polycarphaea gayi</i> •	1	+	.	.	.	+	.	+	III
<i>Ipomoea cairica</i>	.	.	.	.	2	.	.	+	II
<i>Oxalis corniculata</i>	.	.	.	.	2	+	.	.	II
<i>Hyptis pectinata</i>	.	.	.	.	1	.	.	1	II
<i>Hyparrhenia caboverdeana</i>	1	.	+	.	.	.	.	.	II
<i>Tagetes patula</i>	1	.	.	+	.	.	.	.	II
<i>Campanula jacobaea</i> •	+	.	+	.	.	.	.	.	II

Other companion species: *Indigofera canescens* and *Dichrostachys platycarpa* 1 in 3; *Desmodium ospriostreblum* 1 in 5; *Ageratum conyzoides* 1 in 5; *Kickxia elegans* • + in 2; *Desmodium tortuosum* and *Sida cordifolia* + in 8.

Localities: 1, 2, 3, 4, 8 (relevés J.C. Costa), Santiago: Serra da Malagueta; 5. Santiago: Serra da Malagueta, Curral de Asnos; 6. Santiago: Serra da Malagueta, Curral de Asnos (*holotypus ass. reg.* 2005: 81); 7. Santiago: Serra da Malagueta; 9. Synthesized table.

Table 30

1.2.5. *Launaea thalassicae-Euphorbiatum tuckeyanae* ass. nova hoc loco

(Globulario-Periplocion chevalieri, Euphorbio-Sarcostemmetalio, Cocco-Sarcostemmetea)

	60	68	53	57	78	63
Altitude (1=10 m)	NW	N	W	NE	N	
Orientation	100	200	200	200	100	160
Area m <sup>2</sup>	17	14	19	16	11	15
Nº of species	1	2	3*	4	5	6
Characteristic species						
<i>Euphorbia tuckeyana</i> •	3	3	4	3	4	V
<i>Daucus insularis</i> •	1	1	1	+	2	V
<i>Lotus purpureus</i> •	1	1	1	+	.	IV
<i>Launaea thalassica</i> •	+	+	+	.	.	III
<i>Echium hypertropicum</i> •	2	+	.	.	.	II
<i>Ficus gnaphalocarpa</i>	1	.	.	1	.	II
<i>Ipomoea carica</i>	.	.	1	.	1	II
<i>Globularia amygdalifolia</i> •	.	.	3	.	.	I
<i>Periploca chevalieri</i> •	.	.	.	1	.	I
<i>Diplotaxis varia</i> •	.	.	.	1	.	I
<i>Campylanthus glaber</i> •	.	.	.	1	.	I
<i>Sarcostemma daltonii</i> •	+	.	.	.	.	I
Companion species						
<i>Lantana camara</i>	3	3	2	+	+	V
<i>Furcraea foetida</i>	3	2	2	.	+	IV
<i>Cenchrus ciliaris</i>	1	1	1	2	.	IV
<i>Heteropogon contortus</i>	1	+	1	1	.	IV
<i>Nicotiana glauca</i>	.	1	+	+	1	IV
<i>Campanula brvensis</i> •	+	+	+	.	.	III
<i>Desmodium ospriostreblum</i>	+	+	.	.	+	III
<i>Hyparrhenia caboverdeana</i> •	.	.	1	2	.	II
<i>Arundo donax</i>	.	1	1	.	.	II
<i>Ageratina adenophora</i>	1	.	1	.	.	II
<i>Hyptis pectinata</i>	+	.	+	.	.	II
<i>Pteris vittata</i>	+	.	.	+	.	II
<i>Senna bicapsularis</i>	.	.	.	+	+	II

Other companion species: *Launaea melanostigma* • 2 in 4; *Rhynchosia minima* 1 in 2; *Cynodon dactylon* and *Cyperus laevigatus* 1 in 5; *Oxalis corniculata* + in 1; *Abrus precatorius*, *Jatropha curcas* and *Psidium guajava* + in 3; *Foeniculum vulgare* + in 5.

Localities: 1. Brava: Espadão; 2. Brava: Senhora do Monte, Ribeira da Fajã de Água, 3. Brava: Figueira Grande (relevé J.C. Costa & I. Gomes, holotypus ass. reg. 2014: 21); 4. Brava: Ribeiro Ferreiros, Campo Baixo; 5. Brava: Mato, Costa Perú; 6. Synthesized table.

temporihygrophilous soils to the *Ficus sur* woodland savanna series (*Dichrostachyo-Fico sur sigmetum*) and in the sallow or thinner soils to the *Acacia caboverdeana* short woodland savanna series (*Dichrostachyo-Acacio caboverdeanae sigmetum*) both near destroyed by the men influence. The *Echio hypertropicum-Euphorbiatum tuckeyanae* is formed by the caboverdian endemisms: *Euphorbia tuckeyana*, *Echium hypertropicum*, *Lotus jacobaeus*, *Daucus annuus* (*Asteriscus daltonii*, *Lavandula rotundifolia*, *Verbascum capitis-viridis*, *Limonium lobinii*, *Diplotaxis varia*, *Globularia amygdalifolia*, etc., (holotypus relevé 6, table 29) [SN]. [•]

1.2.5. *Launaea thalassicae-Euphorbiatum tuckeyanae* ass. nova hoc loco

Edaphoxerophilous closed shrub savanna community, growing on leptosols and basalt onrocks and near vertical walls exposed to moist and wet winds; is structured by *Euphorbia tuckeyana*, *Daucus insularis*, *Lotus purpureus*, *Launaea thalassica*,

*Echium hypertropicum*, *Ipomoea carica*, *Globularia amygdalifolia*, etc. (holotypus relevé 3, table 30). It occurs in tropical xeric, upper thermotropical, semiarid lower dry, euhyperoceanic bioclimate, in Brava Island [BR]. [•]

1.2.6. *Loto latifolii-Artemisiatum gogonei* associatio nova hoc loco

Climactical closed shrub savanna community, growing on leptics andosols, in upper thermotropical and lower mesotropical, semiarid to lower dry, euhyperoceanic bioclimate in Santo Antão Island, with *Artemisia gorgonum*, *Lotus latifolius*, *Periploca chevalieri*, *Asteriscus vogelii*, *Helianthemum gorgoneum*, *Diplotaxis antonensis*, *Euphorbia tuckeyana*, *Sonchus daltonii*, *Echium lindbergii*, *Globularia amygdalifolia*, *Lavandula rotundifolia*, etc., but lacking *Melanoselinum bischoffii*, *Tolpis farinulosa*, *Diplotaxis brochmannii* and *Lobularia fruticosa* (holotypus ass.: relevé 4, table 31) [A]. [•]

Table 31

1.2.6. *Loto latifolii-Artemisietum gogonei* ass. nova hoc loco  
*(Globulario-Periplocion chevalieri, Euphorbio-Sarcostemmetalia, Coccuco-Sarcostemmetea)*

	144	139	137	134	140	175	145
Orientation	W	E	W	NW	NE	S	
Area m <sup>2</sup>	60	100	100	60	40	100	77
Nº of species	7	9	8	8	6	12	8
Ordinal number	1	2	3	4*	5	6	7
Characteristic species							
<i>Artemisia gorgonum</i> •	3	5	4	5	4	1	V
<i>Lotus latifolius</i> •	.	+	2	2	2	1	V
<i>Periploca chevalieri</i> •	.	+	1	+	+	1	V
<i>Asteriscus vogelii</i> •	.	.	3	2	+	2	IV
<i>Helianthemum gorgoneum</i> •	.	.	3	1	.	3	III
<i>Diplotaxis antoniensis</i> •	.	.	.	2	+	1	III
<i>Sonchus daltonii</i> •	1	.	+	+	.	.	III
<i>Euphorbia tuckeyana</i> •	3	1	.	.	.	.	II
<i>Globularia amygdalifolia</i> •	2	.	.	.	.	+	III
<i>Lavandula rotundifolia</i> •	.	.	+	.	.	+	II
<i>Echium lindbergii</i> •	2	.	.	.	.	.	I
<i>Conyza feae</i> •	.	2	.	.	.	.	I
<i>Conyza varia</i> •	.	1	.	.	.	.	I
<i>Campylanthus glaber</i> •	.	.	.	.	.	1	I
<i>Phagnalon melanoleucum</i> •	+	.	.	.	.	.	I
Companion species							
<i>Hyparrhenia caboverdeana</i> •	.	1	2	1	2	+	V

Other companion species: *Cynodon dactylon* 2 in 2; *Andropogon tridentatus* 1 in 1; *Aristida cardosoi* • 1 in 6; *Lantana camara* + in 2; *Asphodelus mariolousae* • + in 6.

Localities: 1. *Santo Antão*: Espungeiro, Casa Florestal; 2, 3. *Santo Antão*: Laginha; 4. *Santo Antão*: Chã da Companhia (*holotypus* ass. reg. 2005: 44); 5. *Santo Antão*: Espungeiro; 6. *Santo Antão*: Moroços; 7. Synthesized table.

#### 1.2.7. *Melanoselino bischoffii-Globarietum amygdalifoliae* associatio nova hoc loco

Edaphoxerophilous nanophanerophytic short savanna community, growing on leptosols and basalt walls exposed to moist and wet winds, in tropical pluviseasonal, thermotropical, dry, euhyperoceanic bioclimate, in Santo Antão Island. It is organized by the endemisms: *Globularia amygdalifolia*, *Echium lindbergii*, *Melanoselinum bischoffii*, *Tolpis farinulosa*, *Phagnalon melanoleucum*, *Micromeria forbesii*, *Aeonium gorgoneum*, *Sonchus daltonii*, *Diplotaxis brochmannii*, *Conyza varia*, *Conyza feae*, *Euphorbia tuckeyana*, *Launaea picridioides*, *Lobularia fruticosa*, etc., but missing *Artemisia gorgonum*, *Asteriscus vogelii*, *Helianthemum gorgoneum* and *Diplotaxis antoniensis* (*holotypus relevé* 3, table 32) [A]. [•]

#### 1.2.8. *Asterisco smithii-Euphorbiagetum tuckeyanae* associatio nova hoc loco

Climactical closed shrub savanna community growing on coluvisol and leptic andosols, characterized by *Euphorbia tuckeyana*, *Verbascum capitis-viridis*, *Campylanthus glaber*, *Daucus insularis*, *Conyza pannosa*, and *Asteriscus smithii*, *Echium glabrescens*, *Lotus arborescens* (São Nicolau, insular endemic), etc. (*holotypus relevé* 2, table 33). It occurs in tropical pluviseasonal, upper thermotropical to lower mesotropical semiarid to dry euhy-

peroceanic bioclimate, occurring on Monte Gordo highes zones in São Nicolau Island [N]. [•]

#### 1b. *DICHROSTACHYO PLATYCARPAE-ACACIETALIA CABOVERDEANA* ordo novus hoc loco

Deciduous micro-woodland climactic savanna (*Fico gnaphalocarpae-Acacion caboverdeanae*), growing on lithosols, arenosols, andosols and tephras, including the edaphohydrophilous coastal palm groves (*Phoenix atlanticae*) and the temporary wet tamarisk thickets (*Tamaricion sene-galensis*), occurring in infra-thermotropical and low mesotropical upper arid to dry bioclimates, and occasionally in lower subhumid; but when grows in arid bioclimates seems to be necessary a shallow temporary hydromorphism on the soils. This caboverdian order is quite poor in endemic species, but has more sahelian and angolan-zambezian tropical elements. The communities belonging to this order are found in all islands of Cabo Verde except Sal.

The thermotropical desertic and xeric micro-woodlands savannas, with deciduous or evergreen shrubby or small tree plants, represents the mature wooded stages of climactical and seasonal superficially wet soils, in favourable stations of the archipelago. They are structured by short trees: *Acacia caboverdeana*, *Dracaena caboverdeana*, *Ficus gnaphalocarpa*, *Ficus sur*, *Phoenix atlantica* and *Sideroxylon marginata*, but the secular use of wood, extensive farming and intensive grazing, has reduced severely the cover of natural tree species in the last five centuries.

**Table 32**  
**1.2.7. *Melanoselino bischoffii-Globularietum amygdalifoliae* ass. nova hoc loco**  
**(Globulario-Periplocion chevalieri, Euphorbio-Sarcostemmetal, Cocco-Sarcostemmetea)**

	125	120	123	86
Altitude (1=10m)				
Orientation	SE	E	NW	SE
Area m <sup>2</sup>	100	200	50	200
Nº of species	15	27	15	23
Ordinal number	1	2	3*	4
Characteristic species				
<i>Globularia amygdalifolia</i> •	3	3	4	1
<i>Echium lindbergii</i> •	3	2	1	3
<i>Phagnalon melanoleucum</i> •	3	2	1	1
<i>Tolpis farinulosa</i> •	1	+	+	1
<i>Micromeria forbesii</i> •	.	2	2	1
<i>Aeonium gorgoneum</i> •	+	+	.	2
<i>Melanoselinum bischoffii</i> •	.	1	1	+
<i>Sonchus daltonii</i> •	+	+	.	1
<i>Conyza varia</i> •	.	1	.	1
<i>Euphorbia tuckeyana</i> •	.	+	1	.
<i>Conyza feae</i> •	.	1	.	+
<i>Launaea picridioides</i> •	+	.	.	1
<i>Diplotaxis brochmannii</i> •	.	+	+	.
<i>Lobularia fruticosa</i> •	.	+	.	+
<i>Lavandula rotundifolia</i> •	.	.	.	+
<i>Periploca chevalieri</i> •	.	.	1	.
<i>Campylanthus glaber</i> •	.	+	.	.
<i>Lotus latifolius</i> •	.	+	.	.
<i>Sarcostemma daltonii</i> •	.	+	.	.
Companion species				
<i>Polycarpea gayi</i> •	+	2	+	.
<i>Kickxia dichondrifolia</i> •	1	+	.	+
<i>Lantana camara</i>	.	1	+	1
<i>Oxalis corniculata</i>	+	+	.	+
<i>Lavandula dentata</i>	1	1	+	.
<i>Campanula jacobaea</i> •	.	+	+	1
<i>Aristida cardosoi</i> •	2	1	.	.
<i>Hyparrhenia caboverdeana</i>	.	+	2	.
<i>Misopates orontium</i>	.	+	.	+
<i>Brachypodium distachyon</i>	.	.	+	+

Other companion species: *Grevillea robusta* 2 in 1; *Sporobolus molleri* 1 in 4; *Umbilicus schmidtii* • and *Cynodon dactylon* + in 1; *Tricholaena teneriffae*, *Ruta chaleensis* and *Echinochloa colona* + in 2; *Kickxia webbiana* •, *Diplotaxis gorgodensis* •, *Nicotiana glauca* and *Furcraea foetida* + in 4.

Localities: 1, 2. *Santo Antão*: Cova; 3 *Santo Antão*: Ribeira do Paul (relevé J.C. Costa & I. Gomes, *holotypus* ass. reg. 2014: 55); 4. *Santo Antão*: Ribeira de Sanica.

This anthropogenic erosive circumstance has joined with a very irregular late summer precipitations, as well as the high frequency of droughts over several consecutive years and even decades [A, V, N, BO, M, SN, F, BR]. [•]

*Typus*: 1.3. *Fico gnaphalocarpae-Acacion caboverdeanae* all. nova hoc loco

Characteristic species and bioindicators growing in Cabo Verde Islands: *Acacia caboverdeana* •, *Daucus humilis* •, *Dichrostachys platycarpa*, *Ficus gnaphalocarpa*, *Ficus sur* and *Ziziphus mauritiana*.

**1.3. *Fico gnaphalocarpae-Acacion caboverdeanae* alliancia nova hoc loco**

Deciduous open micro-woodlands savanna, climacterial, edaphoxerophilous or seasonally hygrophilous with fleeting superficial temporal hydromorphy; growing in upper infra and thermotropical arid to dry bioclimates; developed on lithic or regosolic soils, occurring

in near all Cabo Verde Islands [A, V, N, M, BO, SN, F, BR]. [•]

*Typus*: 16.3.1. *Dichrostachyo platycarpae-Acacietum caboverdeanae* ass. nova hoc loco  
 Characteristic species and bioindicators growing in Cabo Verde Islands: *Dracaena caboverdeana* •, *Sideroxylon marginata* •.

**1.3.1. *Dichrostachyo platycarpae-Acacietum caboverdeanae* associatio nova hoc loco**

Climactic phanerophytic deciduous micro-woodland savanna community, growing on andosols and leptosols, in Santiago Island. It occurs in upper infra and thermotropical, upper arid, semiarid and lower dry bioclimate, formed by *Acacia caboverdeana*, *Dichrostachys platycarpa*, *Ziziphus mauritiana*, *Lotus purpureus*, *Lavandula rotundifolia*, etc. (*holotypus* relevé 3, table 34) (*acacietosum caboverdeanae*). In Fogo and Brava Island we recognize the poorer

**Table 33**

1.2.8. *Asterisco smithii-Euphorbietum tuckeyanae* ass. nova hoc loco  
*(Globulario-Periplocion chevalieri, Euphorbio-Sarcostemmetalia, Cocco-Sarcostemmetea daltonii)*

Altitude (1=10 m)	97	107	127	124	122	119	116
Orientation	N	N	SW	NW	S	W	.
Area m <sup>2</sup>	20	20	30	40	50	40	<u>33</u>
Nº of species	10	10	6	8	9	9	9
Ordinal number	1	2*	3	4	5	6	7
Characteristic species							
<i>Asteriscus smithii</i> •	1	2	3	2	3	3	V
<i>Euphorbia tuckeyana</i> •	5	5	3	3	+	.	V
<i>Echium glabrescens</i> •	.	+	2	+	3	3	V
<i>Campylanthus glaber</i> •	.	.	1	.	2	+	III
<i>Verbascum capitis-viridis</i> •	.	.	.	+	1	2	III
<i>Daucus insularis</i> •	3	3	.	.	.	.	II
<i>Conyza pannosa</i> •	.	3	.	.	.	.	I
<i>Lotus arborescens</i> •	.	1	.	.	.	.	I
Companion species							
<i>Lantana camara</i>	2	2	4	3	2	1	V
<i>Hyparrhenia caboverdeana</i>	1	1	1	1	1	1	V
<i>Galinsoga quadriradiata</i>	2	.	.	1	1	+	IV
<i>Oxalis corniculata</i>	2	2	.	.	.	.	II
<i>Tagetes patula</i>	.	1	.	.	1	.	II
<i>Campanula jacobaea</i> •	.	.	.	+	.	+	II

Other companion species: *Galium parisiense* 2 in 1; *Furcraea foetida* 1 in 1; *Davallia canariensis* + in 1; *Paraceterach marantae* + in 6  
 Localities: 1. São Nicolau: Cachaço; 2. São Nicolau: Monte Gordo (*holotypus* ass. reg. 2004: 131 bis); 3, 4, 5, 6. São Nicolau: Monte Gordo; 7. Synthesized table.

**Table 34**

1.3.1. *Dichrostachyo platycarpae-Acacietum caboverdeanae* ass. nova hoc loco  
*acacietsum caboverdeanae* subass. nova hoc loco (rel. 1-8),  
*periplocetosum chevalieri* subass. nova hoc loco (rel. 9-10)  
*(Fico-Acacion caboverdeanae, Dichrostachyo-Acacietalia, Cocco-Sarcostemmetea daltonii)*

Altitude (1=10 m)	35	27	39	31	90	41	48	95	7	6	42
Orientation	NE	N	NE	E	S	NW	E	SW	SW	N	,
Area m <sup>2</sup>	30	10	40	50	15	20	40	10	200	100	<u>59</u>
Nº of species	12	10	9	9	13	11	13	13	17	8	<u>12</u>
Ordinal number	1	2	3*	4	5	6	7	8	9*	10	11
Characteristic species											
<i>Acacia caboverdeana</i> •	2	3	3	2	3	3	1	2	3	2	V
<i>Dichrostachys platycarpa</i>	4	3	3	3	2	4	4	5	1	.	V
<i>Ziziphus mauritiana</i>	2	2	2	2	1	+	2	.	2	1	V
<i>Lotus purpureus</i> •	+	+	+	2	2	.	.	.	.	.	III
<i>Lavandula rotundifolia</i> •	.	2	1	+	1	.	.	.	.	.	III
<i>Periploca chevalieri</i> •	.	.	.	.	.	.	.	.	1	1	I
<i>Sideroxylon marginata</i> •	.	.	.	.	.	.	1	.	.	.	I
<i>Daucus annus</i> •	.	.	.	.	.	.	.	1	.	.	I
<i>Indigofera microcarpa</i> •	.	.	.	.	.	.	.	.	1	.	I
Companion species											
<i>Lantana camara</i>	1	.	2	2	2	.	2	2	+	2	V
<i>Heteropogon melanocarpus</i>	1	1	.	1	+	.	2	.	1	1	V
<i>Hyparrhenia caboverdeana</i> •	1	1	.	.	.	1	1	.	+	1	IV
<i>Prosopis juliflora</i>	2	1	.	.	1	.	.	+	1	3	IV
<i>Furcraea foetida</i>	2	.	2	.	+	.	2	+	.	.	III
<i>Jatropha curcas</i>	.	.	+	.	.	1	+	1	+	.	III
<i>Andropogon tridentatus</i>	1	.	.	.	.	1	.	3	+	.	III
<i>Indigofera tinctoria</i>	+	.	.	.	+	.	2	.	.	.	II
<i>Melinis repens</i>	.	.	.	.	1	1	.	2	.	.	II

Other companion species: *Blainvillea gayana* 2 in 6 and + in 9; *Mentzelia aspera* 1 in 2 and + in 6; *Merremia aegyptia* + in 3 and 1 in 6; *Launaea intybacea* + in 1 and 4; *Nicotiana glauca* + in 2 and 4; *Ipomoea eriocarpa* + in 6 and 9; *Desmodium tortuosum* + in 8 and 9; *Grewia villosa* and *Melhania ovata* 2 in 9; *Stylosanthes fruticosa* 2 in 7; *Momordica charantia* 1 in 8; *Pennisetum polystachyon* 1 in 9; *Panicum maximum* and *Foeniculum vulgare* + in 5; + in 8; *Grewillea robusta* + in 8; *Launaea melanostigma* • + in 9.

Localities: 1. Santiago: S. Jorge dos Orgãos; 2. Santiago: Flamengos; 3. (relevé J.C. Costa), Santiago: Montanha (*holotypus* ass. 2005: 15); 4. Santiago: Orgãos Pequenos; 5. Santiago: Chão de Tanque; 6. Santiago: Longueira; 7. Santiago: Monte Tchota; 8. Santiago: Monte Tchota; 9. Fogo: (relevé J. Costa & I. Gomes) Lagariça de S. Filipe (*holotypus* subass. *periplocetosum chevalieri* reg. 2014: 41); 10. Brava: Cachaço.

**Table 35**

	1.3.2. <i>Coccoco penduli-Acacietaum caboverdeanae</i> ass. nova hoc loco ( <i>Fico-Acacion caboverdeanae</i> , <i>Dichrostachyo-Acacieta</i> <i>lia</i> , <i>Coccoco-Sarcostemmetea daltonii</i> )							
Altitude (m)	30	25	30	350	320	30	30	161
Orientation	SE	S	S	S	S	N	N	.
Area m <sup>2</sup>	200	180	100	60	80	100	60	<u>111</u>
Nº of species	14	18	14	12	11	13	7	13
Ordinal number	1	2*	3	4	5	6	7	8
Characteristic species								
<i>Acacia caboverdeana</i> ●	3	4	4	4	5	4	5	V
<i>Cocculus pendulus</i>	2	2	4	1	1	3	3	V
<i>Ziziphus mauritiana</i>	2	2	2	3	1	1	.	V
Companion species								
<i>Commicarpus helenae</i>	2	3	+	2	2	.	+	V
<i>Lantana camara</i>	+	1	+	1	1	.	.	IV
<i>Parkinsonia aculeata</i>	.	2	1	2	.	1	.	III
<i>Prosopis juliflora</i>	1	1	.	1	.	.	.	III
<i>Desmanthus virgatus</i>	1	2	1	.	.	+	.	III
<i>Rhynchosia minima</i>	1	2	.	.	+	.	.	III
<i>Merremia aegyptia</i>	+	2	.	.	.	1	.	III
<i>Ipomoea eriocarpa</i>	+	1	.	.	.	+	.	III
<i>Jatropha curcas</i>	+	.	.	.	+	+	.	III
<i>Indigofera tinctoria</i>	+	.	+	.	.	+	1	III
<i>Salvia aegyptiaca</i>	.	.	.	2	1	.	.	II
<i>Chloris virgata</i>	+	1	.	.	.	.	.	II
<i>Momordica charantia</i>	1	.	+	.	.	+	.	II
<i>Dalechampia parviflora</i>	.	1	+	.	.	.	.	II
<i>Melinis grandiflora</i>	.	.	.	2	2	.	.	II

Other companion species: *Senna bicapsularis* 2 in 2; *Grewia villosa* 2 in 3; *Cenchrus echinatus*, *Dicliptera verticillata* and *Panicum maximum* 1 in 2, *Cajanus cajan* + in 2; *Aloe vera*, *Heteropogon melanocarpus*, *Stylosanthes fruticosa* and *Convolvulus prostratus* 1 in 3; *Hyparrhenia caboverdeana* and *Euphorbia hypericifolia* + in 3; *Nicotiana glauca* and *Cucumis anguria* + in 4; *Calotropis procera* 1 in 5; *Aerva javanica* and *Ipomoea kotschyana* + in 5; *Launaea melanostigma* ● + in 6; *Tetraena waterlotii* + in 6; *Suaeda caboverdeana* ● + in 6.

Localities: 1. *Santiago*: between Praia e Cidade Velha; 2. *Santiago*: Cidade Velha (*holotypus ass. reg. 2006: 6*); 3. *Santiago*: Cidade Velha; 4. *Santiago*: Pico Leão; 5. *Santiago*: Mato Sancho; 6. *Maio*: Pedro Vaz; 7. *Boavista*: Baía das Gatas; 8. Synthesized table.

**Table 36**

	1.3.3. <i>Forsskaoleo procridifoliae-Acacietaum caboverdeanae</i> ass. nova hoc loco ( <i>Fico-Acacion caboverdeanae</i> , <i>Dichrostachyo-Acacieta</i> <i>lia</i> , <i>Coccoco-Sarcostemmetea daltonii</i> )			
Altitude (1=10m)		29	23	6
Orientation		W	W	NE
Area m <sup>2</sup>		120	200	100
Nº of species		18	18	11
Ordinal number		1*	2	3
Characteristic species				
<i>Acacia caboverdeana</i> ●		5	2	3
<i>Sarcostemma daltonii</i> ●		+	4	2
<i>Forsskaoleo procridifolia</i> ●		+	1	+
<i>Campylanthus spathulatus</i> ●		.	.	2
<i>Asparagus squarrosum</i> ●		.	1	.
<i>Lavandula rotundifolia</i> ●		.	.	+
<i>Asteriscus vogelii</i> ●		.	.	+
Companion species				
<i>Commicarpus helenae</i>		3	2	+
<i>Cenchrus ciliaris</i>		2	2	.
<i>Malvastrum coromandelianum</i>		2	2	.
<i>Fagonia cretica</i>		2	1	.
<i>Desmanthus virgatus</i>		1	1	.
<i>Brachiaria caboverdeana</i> ●		1	+	.
<i>Cynodon dactylon</i>		.	+	+

Other companion species: *Grewia villosa* 2 in 1; *Jatropha curcas* 2 in 2; *Bidens bipinnata*, *Setaria verticillata* and *Mentzelia aspera* 1 in 1; *Trichodesma africanum* 1 in 2; *Prosopis juliflora* and *Tridax procumbens* 1 in 3; *Blainvillea gayana*, *Patellifolia patellaris*, *Acanthospermum hispidum*, *Crotalaria senegalensis* and *Emex spinosa* + in 1; *Rhynchosia minima*, *Lavandula coronopifolia*, *Cynodon dactylon*, *Sida alba*, *Aloe vera* and *Lantana camara* + in 2; *Fagonia latifolia* + in 3.

Localities: 1. *S. Vicente*: Casa Velha, Monte Verde (*holotypus ass reg. 2004: 58*); 2. *S. Vicente*: Casa Velha, Monte Verde; 3. *Santo Antão*: Ponta do Sol, Casa Branca.

Table 37

1.3.4. *Coccoco penduli-Ficetum gnaphalocarpae* ass. nova hoc loco  
*(Fico-Acacion caboverdeanae, Dichrostachyo-Acacietalia,  
Coccoco-Sarcostemmetea daltonii)*

	115	20	60	320	40	111
Altitude (m)						.
Orientation	W	W	NW	W	W	.
Area m <sup>2</sup>	100	80	60	40	200	96
Nº of species	14	16	8	7	9	11
Ordinal number	1*	2	3	4	5	6
Characteristic species						
<i>Ficus gnaphalocarpa</i>	3	3	5	4	3	V
<i>Coccus pendulus</i>	2	+	3	3	.	IV
<i>Indigofera microcarpa</i> •	2	3	.	.	1	III
<i>Ziziphus mauritiana</i>	+	+	.	.	.	II
<i>Phoenix atlantica</i> •	+	.	.	.	.	I
<i>Acacia caboverdeana</i> •	.	.	2	.	.	I
<i>Sarcostemma daltonii</i> •	.	.	.	+	.	I
Companion species						
<i>Prosopis juliflora</i>	2	3	.	.	2	III
<i>Jatropha curcas</i>	.	2	.	1	+	III
<i>Commicarpus heleneae</i>	.	2	2	.	2	III
<i>Blainvillea gayana</i>	2	2	.	.	.	II
<i>Setaria verticillata</i>	2	+	.	.	.	II
<i>Sida alba</i>	2	.	.	2	.	II
<i>Cynodon dactylon</i>	.	2	1	.	.	II
<i>Brachiaria ramosa</i>	.	1	1	.	.	II
<i>Aerva javanica</i>	.	+	.	.	1	II
<i>Arundo donax</i>	.	.	3	.	+	II

Other companion species: *Achyranthes aspera*, *Peristrophe paniculata*, 1 *Abutilon pannosum* and *Lantana camara* 1 in 1; *Desmodium tortuosum* and *Desmodium ospriostreblum* 1 in 2; *Merremia aegyptia* 1 in 3; *Parkinsonia aculeata* 1 in 5; *Calotropis procera* 1 in 5; *Panicum maximum* and *Cucumis anguria* + in 1; *Crotalaria* sp. and *Melinis repens* + in 2; *Nicotiana glauca* + in 4.

Localities: 1. *Santiago*: Praia Formosa, Ribeira Formosa (*holotypus* ass. reg. 2005: 93); 2. *Santiago*: Praia Formosa, Ribeira Formosa; 3. *Boavista*: Fundo Figueiras; 4. *Boavista*: Pico de Santo António; 5. *Maio*: Figueira da Horta; 6. Synthesized table.

subassociation *periplocetosum chevalieri* subass. nova hoc loco, which principal differential species is *Periploca chevalieri* (*holotypus* relevé 9, table 34). This open microforest savanna has been near destroyed by men, especially its representative small endemic tree *Acacia caboverdeana*, mostly used as firewood; however in recent years there seems to be some recovery in *Acacia* and *Dichrostachys platycarpa*, but unfortunately substituted by the alien tree *Prosopis juliflora*. [Sn, F, BR]. [•]

### 1.3.2. *Coccoco penduli-Acacietum caboverdeanae* associatio nova hoc loco

Micro-woodland savanna community occurring in Santiago, Maio and Boavista Islands with *Acacia caboverdeana*, *Coccus pendulus* and *Ziziphus mauritiana* and several afrotropical subnitrophilous lianoid herbs: *Commicarpus heleneae*, *Rhynchosia minima*, *Merremia aegyptia*, *Ipomoea eriocarpa*, etc.; growing on lithosols and andosols, in tropical desertic infra-thermotropical upper arid bioclimate (*holotypus* relevé 2, table 35). Most of the natural potential vegetation area of this micro-woodland savanna community has been unfortunately occupied by the alien trees *Prosopis juliflora* and *Parkinsonia aculeata*. [SN, M, BO]. [•]

### 1.3.3. *Forsskaoleo procridifoliae-Acacietum caboverdeanae* associatio nova hoc loco

Nano and microphanerophytic climactic deciduous micro-woodland savanna community, growing on litic andosols and regosols, in São Vicente and Santo Antão Islands. This relict microforest open savanna is uncommon in North Cabo Verde Islands and is very poor in tree species, but is well characterized by *Acacia caboverdeana*, *Sarcostemma daltonii*, *Forsskaolea procridifolia*, *Campylanthus spathulatus*, *Asparagus squarrosum*, etc. (*holotypus* relevé 1, table 36), and occurs in tropical desertic thermotropical arid bioclimate. [V, A].[•]

### 1.3.4. *Coccoco penduli-Ficetum gnaphalocarpae* associatio nova hoc loco

Mesophanerophytic micro-woodland desertic savanna association, growing on seasonal temporality mostly sandy wet soils with fleeting superficial hydromorphy in plains, depressions and torrents, formed by: *Ficus gnaphalocarpa*, *Coccus pendulus*, *Ziziphus mauritiana*, *Indigofera microcarpa*, etc. (*holotypus* relevé 1, table 37). It occurs in tropical desertic, infra-thermotropical mostly arid bioclimate, in Santiago, Boavista and Maio Islands. [M, BO, SN]. [•]

**Table 38**

1.3.5. *Forsskaoleo procridifoliae-Ficetum gnaphaloarcae* ass. nova hoc loco  
(*Fico-Acacion caboverdeanae, Dichrostachyo-Acacieta*lia, *Coccuco-Sarcostemmetea daltonii*)

Altitude (1=10 m)	53	68	58	59	58	44	52	32	34	51
Orientation	W	S	N	NW	W	E	W	NW	N	
Area m <sup>2</sup>	100	50	100	100	200	100	100	100	100	106
Nº of species	4	8	7	14	12	9	13	7	13	10
Ordinal number	1	2	3	4	5*	6	7	8	9	10
Characteristic species										
<i>Ficus gnaphalocarpa</i>	5	5	3	4	4	4	3	3	3	V
<i>Forsskaolea procridifolia</i> •	+	.	.	+	1	1	+	+	1	IV
<i>Euphorbia tuckeyana</i> •	.	.	1	1	1	.	1	.	.	III
<i>Campylanthus glaber</i> •	.	.	.	.	1	+	+	+	.	III
<i>Sarcostemma daltonii</i> •	.	.	.	.	.	.	3	3	3	II
<i>Periploca chevalieri</i> •	.	.	.	.	+	1	1	.	.	II
<i>Lotus purpureus</i> •	.	.	.	+	+	.	+	.	.	II
<i>Lavandula rotundifolia</i>	.	.	.	.	.	.	.	.	2	I
<i>Diplotaxis hirta</i> •	.	.	.	.	.	.	.	.	2	I
<i>Echium hypertropicum</i> •	.	.	.	1	.	.	.	.	.	I
<i>Daucus insularis</i> •	.	.	.	1	.	.	.	.	.	I
<i>Diplotaxis varia</i> •	.	.	.	.	1	.	.	.	.	I
<i>Lavandula rotundifolia</i> •	.	.	.	+	.	.	.	.	.	I
<i>Launaea thalassica</i> •	.	.	.	.	.	+	.	.	.	I
<i>Daucus humilis</i> •	.	.	.	.	.	.	.	.	.	+
Companion species										
<i>Lantana camara</i>	.	+	1	3	1	.	1	2	2	IV
<i>Nicotiana glauca</i>	.	1	1	.	1	1	+	1	+	IV
<i>Furcraea foetida</i>	+	+	2	2	.	+	.	1	.	IV
<i>Cenchrus ciliaris</i>	.	.	.	+	1	.	+	.	+	III
<i>Ageratina adenophora</i>	.	.	2	1	.	.	.	.	.	II
<i>Hyparrhenia caboverdeana</i> •	.	.	.	.	2	.	1	.	.	II
<i>Cynodon dactylon</i>	.	1	.	1	.	.	.	.	.	II
<i>Arundo donax</i>	1	.	.	1	.	.	.	.	.	II
<i>Prosopis juliflora</i>	.	.	.	.	1	1	.	.	.	II

Other companion species: *Boerhavia diffusa* 1 in 9; *Senna bicapsularis* + in 2; *Passiflora edulis* and *Abrus precatorius* + in 4; *Sida rhombifolia* + in 6; *Andropogon gayanus*, *Hypxis pectinata* and *Aloe vera* + in 9:

Localities: 1. Brava: Figueira Grande; 2. Brava: Senhora do Monte; 3. Brava: Cova Joana; 4. Brava: Espadão; 5. Brava: Campo Baixo, Ribeira de Ferreiros (relevé J.C. Costa & I. Gomes, holotypus ass. reg. 2014: 36); 6. Brava: Nova Sintra, Ribeira Pedra Martins; 7. Brava: Ribeira de Ferreiros; 8. Brava: Figueiral; 9. Fogo: Santo António; 10. Synthesized table.

### 1.3.5. *Forsskaoleo procridifoliae-Ficetum gnaphaloarcae* associatio nova hoc loco

Micro-mesophanerophytic woodland savanna community, growing on seasonal temporary moist shallow soils, on plains and torrents with fleeting superficial temporary hydromorphs, formed by *Ficus gnaphalocarpa*, *Forsskaolea procridifolia*, *Euphorbia tuckeyana*, *Campylanthus glaber*, *Periploca chevalieri* and the Fogo insular endemic species; *Daucus humilis* and *Diplotaxis hirta*, etc. (holotypus relevé 5, table 38). *Sarcostemma daltonii* can be seen as abundant on rock walls. It occurs in thermotropical arid to lower semiarid bioclimate in Brava and Fogo Islands [F, BR]. [•]

### 1.3.6. *Dichrostachyo platycarpae-Ficetum sur* associatio nova hoc loco

Micro-mesophanerophytic woodland savanna community, growing on near deep

soils with a temporary seasonal short moist period. Occurring in tropical xeric thermotropical semiarid to low dry bioclimate in Santiago and Fogo, structured by *Ficus sur*, *Dichrostachys platycarpa*, *Ziziphus mauritiana*, *Periploca chevalieri*, etc. (holotypus relevé 3, table 39) [F, SN]. [•]

### 1.3.7. *Euphorbia tuckeyanae-Ficetum sur* associatio nova hoc loco

Mesophanerophytic woodland savanna community, growing on temporarily seasonal deep moist soils and in rocky torrents, structured by *Ficus sur*, *Sarcostemma daltonii*, *Euphorbia tuckeyana*, *Launaea picridioides*, *Globularia amydalifolia*, *Conyza varia*, *Artemisia gorgonum*, and the Santo Antão insular endemic species: *Echium lindbergii* and *Diplotaxis gorgadensis*. (holotypus relevé 3, table 40). It can be found in Santo Antão Island in thermo and mesotropical upper arid, semiarid to lower dry bioclimate [A]. [•]

**Table 39**

1.3.6. *Dichrostachyo platycarpa-Ficetum sur* ass. nova hoc loco  
*(Fico-Acacion caboverdeanae, Dichrostachyo-Acacieta, Coccoco-Sarcostemmetea daltonii)*

Altitude (1=10 m)	107	55	55	30
Orientation	SW	N	N	NE
Area m <sup>2</sup>	100	100	120	100
Nº of species	16	5	14	14
Ordinal number	1	2	3*	4
Characteristic species				
<i>Ficus sur</i>	1	1	3	4
<i>Dichrostachys platycarpa</i>	3	4	2	2
<i>Ziziphus mauritiana</i>	2	.	.	2
<i>Indigofera canescens</i>	.	.	2	1
<i>Euphorbia tuckeyana</i> •	.	1	2	.
<i>Ipomoea cairica</i>	.	.	3	.
<i>Withania chevalieri</i> •	2	.	.	.
<i>Periploca chevalieri</i> •	2	.	.	.
<i>Echium hypertropicum</i> •	.	.	.	+
Companion species				
<i>Jatropha curcas</i>	1	.	3	2
<i>Grewia villosa</i>	2	1	.	2
<i>Merremia aegyptia</i>	1	.	1	+
<i>Lantana camara</i>	.	.	3	3
<i>Furcraea foetida</i>	.	2	2	.
<i>Spermacoce verticillata</i>	+	.	+	.
<i>Launaea intybacea</i>	+	.	.	+
<i>Nicotiana glauca</i>	.	+	.	+

Other companion species: *Heteropogon melanocarpus*, *Aristida adscensionis* and *Hyparrhenia caboverdeana* • 2 in 1; *Andropogon tridentatus* 2 in 3; *Panicum maximum* and *Momordica charantia* 2 in 4; *Parkinsonia aculeata* and *Rhynchosia minima* 1 in 1; *Calotropis procera*, *Desmanthus virgatus* and *Pennisetum polystachyon* 1 in 4; *Commicarpus helenae* and *Hyptis pectinata* + in 1; *Pteridium aquilinum*, *Nicandra physalodes* and *Macrotyloma daltonii* + in 3.

Localities: 1. Fogo: Miguel Gonçalves; 2. Fogo: Ribeira do Inferno; 3. Fogo: Campanas de Baixo (*holotypus* ass. reg. 2006: 40); 4. Santiago: Orgãos Pequenos.

### 1.3.8. *Sideroxyletum marginatae* associatio nova hoc loco

Evergreen meso-microwoodland savanna community, mostly growing on near inaccessible wall and rocky leptosols, characterized by *Sideroxylon marginata* accompanied by *Sarcostemma daltonii*, *Euphorbia tuckeyana*, *Lavandula rotundifolia*, etc. (*holotypus* relevé 5, table 41). It occurs in thermotropical arid bioclimate, in Santo Antão, São Vicente, São Nicolau, Santiago, Fogo and Brava Islands. Nowadays, practically, only can *Sideroxylon marginata* collect in inaccessible rocky cliffs. Due to the good quality of the wood it has been widely used by the population for various purposes, making this tree rare and near extinct. [A, V, N, SN, F, BR] [•].

### 1.3.9. *Dracaenetum caboverdeanae* associatio nova hoc loco

Evergreen micro-mesowoodland community, dominated by the endemic *Dracaena caboverdeana* accompanied by *Echium lindbergii*, *Launaea picridioides*, *Sarcostemma daltonii*, *Globularia amygdalifolia*, *Aeonium gorgoneum*, *Echium glabrescens*,

etc., (*holotypus* relevé 1, table 42). It occurs on leptosols, colluviums and rocky stations, in thermotropical and lower mesotropical subhumid to dry bioclimate, in Santo Antão and São Nicolau Islands. [A, N]. [•].

### 1.4. *Phoenicion atlanticae* alliance nova hoc loco

Palms with plume woodland savanna, up to 10 m high, typical of riparian streams and depressed low stations lower and more humid than the surrounding surface, mostly near the coast, with temporary variable hydromorphic depth; in infra-thermotropical hyperarid to arid bioclimate; develop on allochthonous, arenic or regosolic fluvisols, favoured by bars or coastal dune deposits limited to exorheic runoff into the sea. Occurs in the eastern and northern islands of Cabo Verde, and are well characterized by the remarkable endemism *Phoenix atlantica*, having very pungent sharp pointed new button leaves tree [SL, BO, M, SN, BR]. [•]

*Typus*: 1.4.1. *Coccoco penduli-Phoenicetum atlanticae* ass. nova hoc loco

Characteristic species and bioindicators growing in Cabo Verde Islands: *Phoenix atlantica* •.

**Table 40**1.3.7. *Euphorbia tuckeyanae-Ficetum sur* ass. nova hoc loco

	122	125	54	50
Altitude (1=10 m)	SE	NW	N	NE
Orientation	100	400	50	200
Area m <sup>2</sup>				
Nº of species	12	13	12	14
Ordinal number	1	2	3*	4
Characteristic species				
<i>Ficus sur</i>	2	3	4	3
<i>Sarcostemma daltonii</i> •	3	3	+	3
<i>Echium lindbergii</i> •	+	2	2	1
<i>Euphorbia tuckeyana</i> •	.	3	+	1
<i>Launaea picridioides</i> •	.	.	1	1
<i>Globularia amygdalifolia</i> •	+	1	.	.
<i>Conyza varia</i> •	+	+	.	.
<i>Artemisia gorgonum</i> •	+	+	.	.
<i>Asparagus squarrosum</i> •	1	.	.	.
<i>Periploca chevalieri</i> •	.	1	.	.
<i>Aeonium gorgoneum</i> •	.	.	1	.
<i>Lobularia fruticosa</i> •	+	.	.	.
<i>Phagnalon melanoleucum</i> •	.	+	.	.
<i>Diplotaxis gorgadensis</i> •	.	.	+	.
<i>Lavandula rotundifolia</i> •	.	.	.	+
Companion species				
<i>Lantana camara</i>	1	1	2	2
<i>Furcraea foetida</i>	.	.	2	2
<i>Cenchrus ciliaris</i>	.	.	2	1
<i>Tricholaena teneriffae</i>	+	1	.	.
<i>Lavandula dentata</i>	+	+	.	.

Other companion species: *Desmanthus virgatus* 1 in 3; *Hyparrhenia caboverdeana*, *Desmodium tortuosum* and *Arundo donax* 1 in 4; *Echinochloa colona* + in 1; *Heteropogon contortus* + in 2; *Hyptis pectinata* + in 3; *Tridax procumbens* and *Foeniculum vulgare* + in 4.

Localities: 1. *Santo Antão*: Cova, Rocha da Mina; 2. *Santo Antão*: Cova; 3. *Santo Antão*: Cruz (relevé J.C. Costa & I. Gomes, holotypus ass. reg. 2014: 64); 4. *Santo Antão*: Losnas, Ribeira de Espinheiros.

**Table 41**1.3.8. *Sideroxyletum marginatae* ass. nova hoc loco

(*Fico-Acacion caboverdeanae*, *Dichrostachyo-Acacieta*, *Coccuto-Sarcostemmetea daltonii*)

	20	65	50	40	28	41
Altitude (1=10 m)	E	SW	NW	N	NW	
Orientation	60	60	60	60	90	67
Area m <sup>2</sup>	5	7	6	13	16	9
Nº of species	1	2	3	4	5*	6
Ordinal number						
Characteristic species						
<i>Sideroxylon marginata</i> •	3	3	3	3	4	V
<i>Sarcostemma daltonii</i> •	3	2	3	3	2	V
<i>Euphorbia tuckeyana</i> •	.	.	+	2	1	III
<i>Lavandula rotundifolia</i> •	.	.	.	2	1	II
<i>Lotus jacobaeus</i> •	.	.	.	1	1	II
<i>Launaea picridioides</i> •	+	1	.	.	.	II
<i>Daucus humilis</i> •	.	.	.	1	+	II
<i>Echium lindbergii</i> •	2	.	.	.	.	II
<i>Echium glabrescens</i> •	.	2	.	.	.	I
<i>Aeonium gorgoneum</i> •	.	2	.	.	.	I
<i>Lobularia fruticosa</i> •	.	2	.	.	.	I
Companion species						
<i>Lantana camara</i>	.	3	+	2	1	III
<i>Nicotiana glauca</i>	.	.	+	+	1	III
<i>Pennisetum polystachyon</i>	.	.	.	2	1	II
<i>Rhynchosia minima</i>	.	.	.	2	+	II
<i>Andropogon gayanus</i>	.	.	.	1	1	II

Other companion species: *Merremia aegyptia* 2 in 4; *Ipomoea carica*, *Tamarindus indica* and *Jatropha curcas* 2 in 5; *Kickxia elegans* • 1 in 4; *Polycarpaea gayi* • + in 1; *Launaea melanostigma* • + in 3; *Abrus precatorius* and *Momordica charantia* + in 5.

Localities: 1. *Santo Antão*: Paul de Baixo, Passo; 2. *São Nicolau*: Cachaço; 3. *Brava*: Ribeira de Ferreiros; 4. *Fogo*: S. Jorge; 5. *Fogo*: Galinheiros (relevé J.C. Costa & I. Gomes, holotypus ass. reg. 2014: 8); 6. Synthesized table.

**Table 42****1.3.9. *Dracaenetum caboverdeanae* ass. nova hoc loco****(*Fico-Acacion caboverdeanae*, *Dichrostachyo-Acacieta*l*a*, *Coccu*-*Sarcostemmetea daltonii*)**

Altitude (1=10 m)	73	45	53	126	118	120	89
Orientation	NE	SW	N	SE	SE	NE	
Area m <sup>2</sup>	40	60	50	100	50	100	67
Nº of species	7	7	12	6	6	5	7
Ordinal number	1*	2	3	4	5	6	7
Characteristic species							
<i>Dracaena caboverdeana</i> •	4	3	3	5	4	4	V
<i>Echium lindbergii</i> •	2	.	2	1	1	+	V
<i>Launaea picridioides</i> •	1	1	2	+	.	.	IV
<i>Sarcostemma daltonii</i> •	2	.	1	.	.	2	III
<i>Globularia amygdalifolia</i> •	.	.	.	2	+	.	II
<i>Aeonium gorgoneum</i> •	.	1	1	.	.	.	II
<i>Echium glabrescens</i> •	.	1	.	.	.	.	I
<i>Forsskaolea procridifolia</i> •	+	.	.	.	.	.	I
<i>Lotus latifolius</i> •	.	.	+	.	.	.	I
<i>Campylanthus glaber</i> •	.	.	+	.	.	.	I
<i>Diplotaxis gorgadensis</i> •	.	.	+	.	.	.	I
Companion species							
<i>Lantana camara</i>	2	2	1	1	2	2	V
<i>Furcraea foetida</i>	.	.	1	.	.	2	II

Other companion species: *Aloe vera* 3 in 5; *Heteropogon contortus* and *Leucaena leucocephala* 2 in 3; *Lavandula dentata* 1 in 4; *Echinochloa colona* 1 in 5; *Jatropha curcas* + in 2; *Desmanthus virgatus*, *Cenchrus ciliaris*, *Tridax procumbens* and *Cynodon dactylon* + in 3.

Localities: 1. *Santo Antão*: Ribeira do Penedo: Pontinha da Janela (*holotypus ass. reg. 2005: 20*); 2. *São Nicolau*: Fajã Baixa; 3. *Santo Antão*: Cruz; 4, 5. *Santo Antão*: Cova; 6. *Santo Antão*: Ribeira do Espinhadeiro, Losnas; 7. Synthesized table

**Table 43****1.4.1. *Coccu penduli-Phoenicetum atlanticae* ass. nova hoc loco****(*Phoenicetum atlanticae*, *Dichrostachyo-Acacieta*l*a*, *Caboverdeanae*,*****Coccu-Sarcostemmetea daltonii*)**

Altitude (1=10 m)	1	2	0.5	1	1	1	7	6	2
Area m <sup>2</sup>	100	60	100	120	40	50	40	50	<u>63</u>
Nº of species	11	11	9	8	7	10	7	7	9
Ordinal number	1	2	3	4*	5	6	7	8	9
Characteristic species									
<i>Phoenix atlantica</i> •	5	4	5	5	5	5	5	5	V
<i>Cocculus pendulus</i>	1	2	1	2	1	2	1	3	V
<i>Commicarpus helenae</i>	3	2	2	3	2	2	.	2	V
<i>Ziziphus mauritiana</i>	.	2	1	1	.	2	+	.	IV
<i>Rhynchosia minima</i>	.	2	.	.	1	+	1	+	IV
<i>Merremia aegyptia</i>	.	.	2	+	.	1	.	1	III
<i>Blainvillea gayana</i>	2	1	.	.	.	.	.	.	II
<i>Pennisetum polystachyon</i>	.	.	.	.	.	1	.	.	I
<i>Acacia caboverdeana</i> •	.	.	.	.	.	.	.	1	I
Companion species									
<i>Prosopis juliflora</i>	1	2	+	.	.	.	1	.	III
<i>Sesbania grandiflora</i>	.	1	.	2	+	+	.	.	III
<i>Setaria verticillata</i>	.	1	1	2	2	.	.	.	III
<i>Desmanthus virgatus</i>	.	.	1	.	.	1	2	.	II
<i>Parkinsonia aculeata</i>	.	.	.	+	+	+	.	.	II
<i>Cynodon dactylon</i>	.	.	2	.	.	.	.	2	II

Other companion species: *Trianthema portulacastrum* 2, *Peristrophe paniculata* 2, *Commelina benghalensis* 2, *Corchorus tridens* + and *Sida alba* 1 in 1; *Aloe vera* 1, *Senna bicapsularis* 2 and *Calotropis procera* 1 in 2; *Sesbania leptocarpa* + in 6; *Jatropha curcas* 2 in 7.

Localities: 1, 2 y 3. *Santiago*: Ribeira Formosa; 4. *Santiago*: Praia de Ribeira Formosa, (*holotypus ass. 2005:107*). 5 y 6. *Santiago*: Praia Baixo; 7. *Maio*: Pedro Vaz, Herdade do Ulisses; 8. *Boavista*: Fundo Figueiras; 9. Synthesized table.

**Table 44**

1.5.1. *Coccoco penduli-Tamaricetum senegalensis* ass. nova hoc loco  
*(Tamaricion senegalensis, Dichrostachyo-Acacietales caboverdeanae*  
*Coccoco-Sarcostemmetea daltonii)*

Area m <sup>2</sup>	60	60	40	50	60	56
Number of species	9	6	6	5	5	6
Ordinal number	1	2*	3	4	5	6
Characteristic species						
<i>Tamarix senegalensis</i>	5	5	5	5	5	V
<i>Coccus pendulus</i>	4	3	2	2	3	V
<i>Commicarpus helenae</i>	3	2	1	.	.	III
<i>Merremia aegyptia</i>	2	1	.	.	.	II
<i>Fagonia mayana</i> •	2	.	2	.	.	II
<i>Rhynchosia minima</i>	1	.	.	.	.	I
<i>Indigofera suffruticosa</i>	1	.	.	.	.	I
Companion species						
<i>Suaeda caboverdeana</i> •	3	.	2	1	1	III
<i>Brachiaria caboverdeana</i> •	2	1	2	.	.	II
<i>Parkinsonia aculeata</i>	1	.	.	.	.	I
<i>Tetraena waterlotii</i>	1	.	.	.	+	I

Other companion species: *Momordica charantia* 2 in 1; *Cucumis anguria* 2 in 1; *Sesbania leptocarpa* 1 in 1; *Caylusea hexagyna* + in 3 *Acrachne racemosa* 2 in 3; *Melinis grandiflora* 1 in 4.

Localities: 1. *Santiago*: Belém; 2. *Boavista*: João Galego (*holotypus* reg. 2005:148); 3. *Boavista*: Fundo Figueiras; 4, 5. *Sal*: Santa Maria; 6. Synthesized table

#### 1.4.1. *Coccoco penduli-Phoenicetum atlanticae* associatio nova hoc loco

Cabo Verde palm microforest savanna association, on riparian streams, near the coast, with temporary variable depth hydromorphy, on allochthonous arenic or regosolic fluvisols favoured by bars or coastal dune deposits limited to exorheic runoff into sea. Can be found in the eastern and southern islands of Cabo Verde, and is well characterized by the remarkable endangered endemism *Phoenix atlantica*, up 10 m high, with *Coccus pendulus*, *Commicarpus helenae*, *Ziziphus mauritiana*, *Rhynchosia minima*, etc. (*holotypus* relevé n°4, table 43), occurs in infra-thermotropical hyperarid to arid bioclimate. [SL, BO, M, SN, BR]. [•]

#### 1.5. *Tamaricion senegalensis* alliancia nova hoc loco

Nano-microphanerophytic thickets of tamarisk (*Tamarix senegalensis*), growing on temporary riparian streams and short rambblas, generally with scarce intermittent flow, in infra-thermotropical hyperarid to semiarid bioclimate; developed on allochthonous, arenic or fractopetric soils, with near deep temporal hydromorphism; occurs in all the islands of Cabo Verde, except in Fogo. In Sahara, Mauritania and Senegal are also commons the riparian thicket savannas with *Tamarix aphylla*, *T. amplexicaulis*, *T. passeinoides* and *T. getula*. Provisionally, on include the new alliance *Tamaricion senegalensis* in the ordo *Dichrostachyo platycarpae-Acacietales caboverdeanae*, until the Saharian and Sahelian riparian thickets of *Tamarix* where phytosociologically better

known and described [A, V, N, SL, BO, SN, BR].

#### Typus: 1.5.1. *Coccoco penduli-Tamaricetum senegalensis* ass. nova hoc loco

Characteristic species and bioindicators growing in Cabo Verde Islands: *Tamarix senegalensis*.

#### 1.5.1. *Coccoco penduli-Tamaricetum senegalensis* associatio nova hoc loco

Nano-microphanerophytic tamarisk savanna thickets of *Tamarix senegalensis* in Cabo Verde Islands, growing on temporary watercourses and torrents, with generally scarce intermittent flow, developed on allochthonous, arenic or fractopetric soils, with near permanent deep temporal hydromorphism. It occurs in all islands of Cabo Verde, except in Fogo, in infra to thermotropical hyperarid to semiarid bioclimate. *Holotypus* rel. 2 table 44 [A, V, N, SL, BO, SN, BR]. •

#### 2. HETEROPOGONETEA CONTORTI classis nova hoc loco

Afrotropical xeromorphic short to medium grass savanna communities with scarce shrubs and trees, structured by short to medium perennial grasses. This kind of grass vegetation with scattered short trees, occur in West Tropical Africa, in desertic and xeric infra to lower-mesotropical and from hyperarid to dry bioclimates. [A, V, N, SL, BO, M, SN, F, BR]

#### Typus: 2a. *Melinio grandiflorae-Heteropogonetalia contorti* ordo novus hoc loco

Characteristic species and bioindicators growing in Cabo Verde Islands: *Bothriochloa bladhii*, *Bothriochloa insculpta*, *Brachiaria deflexa*, *Brachiaria ramosa*, *Chloris pilosa*, *Chloris virgata*, *Dichanthium annulatum*, *Dichanthium foveolatum*, *Digitaria nodosa*, *Enteropogon prieurii*, *Enteropogon rupestris*,

*Heteropogon contortus*, *Melinis grandiflora*, *Pennisetum pedicellatum*, *Rottboellia conchinchinensis*, *Schmidia pappophoroides*, *Schoenfeldia gracilis*, *Stipagrostis uniplumis*, *Tephrosia bracteolata*, *Tephrosia uniflora*, *Tripogon multiflorus*.

Aba.1. Cabo Verde xeromorphic perennial short grassland savanna division (syntax. equiv.: 2a)

2a. MELINIO GRANDIFLORAE-HETEROPOGONETALIA  
CONTORTI ordo novus hoc loco

Tropical desertic and xeric infra to lower mesotropical, from hyperarid to dry; afrotropical xeromorphic perennial grassland savanna communities with scarce trees.

On recognize two alliaces in Cabo Verde Islands:  
2.1 *Heteropogonion melanocarpo-contorti* (thermo-mesotropical arid to dry) and 2.2 *Eneapogonion desvauxii* (infra-thermotropical hyperarid to low arid)

**Table 45**  
2.1.1. *Dichanthio foveolati-Heteropogonetum contorti* ass. nova hoc loco  
(*Heteropogonion melanocarpo-contorti*, *Melinio-Heteropogonetalia*,  
*Heteropogonetea contorti*)

	110	130	138	134	61	145	120
Altitude (1=10 m)	50	100	40	40	100	100	
Area m <sup>2</sup>							
Number of species	7	8	8	11	9	9	9
Ordinal number	1	2	3	4*	5	6	7
Characteristic species							
<i>Heteropogon contortus</i>	3	2	4	3	3	4	V
<i>Dichanthium foveolatum</i>	2	+	2	1	2	.	IV
<i>Hyparrhenia caboverdeana</i> •	.	2	3	3	2	1	IV
<i>Melinis grandiflora</i>	.	2	1	1	+	2	IV
<i>Andropogon tridentatus</i>	.	2	.	.	2	.	II
Companion species							
<i>Cynodon dactylon</i>	2	+	.	1	+	1	IV
<i>Diplotaxis antoniensis</i> •	+	.	+	1	+	.	III
<i>Tagetes minuta</i>	.	+	+	+	.	.	III
<i>Lotus latifolius</i> •	.	.	2	1	1	.	III
<i>Conyza feae</i> •	+	.	.	.	.	+	II
<i>Helianthemum gorgoneum</i> •	.	.	2	1	.	.	II
<i>Artemisia gorgonum</i> •	.	.	.	+	.	+	II

Other companion species: *Echium lindbergii* • + in 1; *Melhania ovata* + in 2;  
*Crotalaria retusa* 1 in 5; *Melanoselinum bischoffii* • + in 5.

Localities: 1. *Santo Antão*: Corda; 2. *Santo Antão*: near Espungeiro; 3. *Santo Antão*: Espungeiro; 4. *Santo Antão*: Chã Companhia (*holotypus* reg. 2005: 43); 5. *Santo Antão*: Rachada; 6. *Santo Antão*: Pedra Rachada. 7. Synthesized table.

**Table 46**  
2.1.2. *Heteropogonetum melanocarpi* ass. nova hoc loco  
(*Heteropogonion melanocarpo-contorti*, *Melinio-Heteropogonetalia*,  
*Heteropogonetea contorti*)

	89	106	35	32	116	76
Altitude (1=10 m)	60	40	60	100	40	
Area m <sup>2</sup>						
Number of species	12	10	10	11	9	10
Ordinal number	1	2	3	4*	5	6
Characteristic species						
<i>Heteropogon melanocarpus</i>	2	2	3	2	5	V
<i>Melinis grandiflora</i>	2	2	1	2	1	V
<i>Andropogon tridentatus</i>	3	3	3	3	.	IV
<i>Pennisetum polystachyon</i>	1	.	1	2	+	IV
<i>Andropogon fastigiatus</i>	1	+	+	.	.	III
<i>Hyparrhenia caboverdeana</i> •	.	+	.	1	2	III
<i>Rottboellia cochinchinensis</i>	.	.	+	2	.	II
<i>Tephrosia bracteolata</i>	.	.	2	.	1	II
Companion species						
<i>Lotus jacobaeus</i> •	1	+	.	.	+	III
<i>Zinnia pauciflora</i>	+	1	.	.	+	III
<i>Aristida adscensionis</i>	+	.	1	1	.	III
<i>Cenchrus ciliaris</i>	.	.	1	1	.	III

Other characteristic species: *Bothriochloa bradpii* 1 in 1; *Chloris pycnothrix* 2 in 2; *Tephrosia uniflora* 2 in 4; *Pennisetum pedicellatum* + in 5. Other companion species: *Blainvillea gayana* 1 in 2; *Desmodium ospriostreblum* 1 in 4; *Daucus annuus* • + in 1; *Forsskaolea procridifolia* • + in 4; *Stylosanthes fruticosa* + in 5.

Localities: 1. *Santiago*: Monte Tchota; 2. *Santiago*: near summit Monte Tchota; 3. *Fogo*: Santo António; 4. *Fogo*: Santo António (*holotypus* reg. 2004: 24); 5. *Fogo*: Chã das Furnas; 6. Synthesized table.

*Typus:* 2.1. *Heteropogonion melanocarpo-contorti* alliancia nova hoc loco

Characteristic species and bioindicators growing in Cabo Verde Islands: See classis.

Aba.1a. Cabo Verde xeromorphic thermo-mesotropical from upper arid to dry, short perennial grassland savanna macrogroup (syntax. equiv.:2.1)

### 2.1. *Heteropogonion melanocarpo-contorti* alliancia nova hoc loco

Desertic and xeric xeromorphic perennial short and medium grassland savanna communities, with scarce trees, growing from thermo- to low mesotropical and from upper arid to dry bioclimates in Cabo Verde Islands. [A, V, N, SN, F, BR]

*Typus:* 2.1.1. *Dichanthio foveolati-Heteropogonetum contorti* ass. nova hoc loco

Characteristic species and bioindicators growing in Cabo Verde Islands: *Andropogon fastigiatus*, *Andropogon gayanus* var. *tridentatus*, *Brachiaria xantholeuca*, *Chloris pycnothrix*, *Heteropogon melanocarpus*, *Hyparrhenia caboverdeana* •. [A, V, N, SN, F, BR] [•]

#### 2.1.1. *Dichanthio foveolati-Heteropogonetum contorti* associatio nova hoc loco

Xeromorphic perennial grassland savanna, growing on leptic andosols, in upper thermotropical to lower mesotropical and from lower semiarid to dry bioclimates, structured and characterized by *Heteropogon contortus*, *Dichanthium foveolatum*, *Hyparrhenia caboverdeana*, *Melinis grandiflora*, *Andropogon tridentatus*, etc., occurring in Santo Antão Island (*holotypus* relevé 4, table 45). [A] [•]

#### 2.1.2. *Heteropogonetum melanocarpi* associatio nova hoc loco

Xeromorphic perennial short grassland savanna, occurring in thermo to lower mesotropical semiarid to dry bioclimates, in Santiago and Fogo Islands, growing on leptic andosols and characterized by *Heteropogon melanocarpus*, *Melinis grandiflora*, *Andropogon tridentatus*, *Pennisetum polystachyon*, *Andropogon fastigiatus*, *Hyparrhenia caboverdeana*, *Rottboellia cochinchinensis*, etc. (*holotypus* reléve 4, table 46). [SN, F] •

### 2.2. *Eneapogonion desvauxii* alliancia nova hoc loco

Tropical desertic infra- to low thermotropical hyperarid to arid, short open grassland savanna growing on sandy regosols and lithosols in most of Cabo Verde Islands and Mauritanian Sahara. [A, V, SL, SN, BO, M]

*Typus:* 2.2.1. *Bothriochloo bladhii-Enneapogonetum desvauxii* associatio nova hoc loco

Characteristic species and bioindicators growing in Cabo Verde Islands: *Andropogon gayanus*, *Andropogon gayanus*, *Bothriochloa bladhii*, *Eneapogon desvauxii*, *Tetrapogon cenchriformis*.

#### 2.2.1. *Bothriochloo bladhii-Enneapogonetum desvauxii* associatio nova hoc loco

Xeromorphic perennial short grassland savanna, occurring in infra-thermotropical hyperarid to arid bioclimate, growing on sandy lithosols in most of low lands of Cabo Verde Islands. It is characterized by *Enneapogon desvauxii*, *Pennisetum polystachyon*, *Bothriochloa bladhii*, *Tetrapogon cenchriformis*, *Andropogon gayanus*, etc. (*holotypus* reléve 2, table 47). [A, V, SL, BO, M, SN].

**Table 47**  
2.2.1. *Bothriochloo bladhii-Enneapogonetum desvauxii*  
(*Eneapogonion desvauxii Melinio-Heteropogonetalia, Heteropogonetea contorti*)

	10	20	25	30
Altitude m				
Area m <sup>2</sup>	100	20	20	20
Nº of species	12	6	6	7
Ordinal number	1	2*	3	4
Characteristic species				
<i>Enneapogon desvauxii</i>	2	3	3	3
<i>Pennisetum polystachyon</i>	2	1	2	1
<i>Bothriochloa bladhii</i>	.	2	1	1
<i>Tetrapogon cenchriformis</i>	.	1	2	.
Companion species				
<i>Tetraena waterlotii</i>	.	2	1	2
<i>Suaeda caboverdeana</i> •	.	1	1	.
<i>Fagonia isolricha</i>	+	.	.	1

Other companion species: *Cyperus conglomeratus* 2 in 1; *Aerva javanica*, *Lotus brunneri* • and *Commicarpus helenae* 1 in 1, *Cynodon dactylon*, *Abutilon pannosum*, *Melhania ovata* and *Rhynchosia minima* + in 1, *Ophioglossum polyphyllum* and *Sehima ischaemoides* + in 4.

Localities: 1 Boavista: Varandinha; 2 Sal: near Airport (*holotypus* ass. reg. 2004: 175); 3, 4, Sal: South of Airport.

**Table 48**3.1.1. *Aristido cardosoi-Tetraenetus simplicis* ass. nova hoc loco

(Aristido cardosoi-Tetraenion simplicis, Aristido-Tetraenetalia simplicis, Tetraenetea simplicis)

	1	145	153	102	145	122	163	169	193	23	122
Altitude (m)							N	SW	-	NE	.
Orientation	-	-	-	-	-	-					.
Area m <sup>2</sup>	4	4	4	4	10	4	4	4	4	4	4
Nº of species	5	4	6	6	4	6	7	5	7	9	6
Ordinal number	1	2	3	4	5	6	7	8	9	10*	11
Characteristic species											
<i>Tetraena simplex</i>	3	5	3	5	3	3	2	3	2	4	V
<i>Brachiaria caboverdeana</i> •	.	.	2	1	.	+	.	.	.	1	III
<i>Cleome viscosa</i>	.	.	.	.	1	2	.	.	+	+	III
<i>Aristida cardosoi</i>	.	.	.	.	.	.	+	2	1	2	III
<i>Heliotropium pterocarpum</i>	.	1	.	+	.	+	.	.	.	.	II
<i>Dactyloctenium aegyptium</i>	.	.	.	.	1	.	.	2	.	2	II
<i>Chloris virgata</i>	.	.	.	.	.	.	+	2	.	.	II
<i>Mollugo nudicaulis</i>	+	.	.	.	.	.	.	.	1	.	II
<i>Heliotropium crispum</i>	2	.	.	.	.	.	.	.	.	+	II
<i>Cleome brachycarpa</i>	.	2	.	.	.	.	.	.	1	.	II
<i>Fagonia isotricha</i>	.	.	1	+	.	.	.	.	.	.	II
<i>Andrachne telephiooides</i>	.	.	+	.	.	1	.	.	.	.	II
<i>Corchorus depressus</i>	.	.	.	.	.	.	1	.	+	.	II
Companion species											
<i>Frankenia pseudoerericifolia</i> •	1	.	.	.	+	.	.	.	.	.	II
<i>Indigostrum parviflorum</i>	.	.	.	.	.	.	1	1	.	.	II
<i>Corchorus tridens</i>	.	.	.	3	.	.	2	.	.	.	II
<i>Sclerocephalus arabicus</i>	.	.	.	.	.	2	.	.	.	.	I
<i>Crotalaria senegalensis</i>	.	.	.	.	.	.	1	.	.	.	I
<i>Indigofera senegalensis</i>	.	.	.	.	.	.	.	.	+	.	I
<i>Digitaria nodosa</i>	.	.	.	.	.	.	.	.	.	+	I
<i>Abutilon pannosum</i>	.	.	1	.	.	.	.	.	.	.	I

Other companion species: *Bulbostylis barbata* 2 in 3, *Launaea intybaceae* 2 in 10, *Sida cordifolia* 1 in 2, *Sida salviifolia* 1 in 10, *Chenopodium murale* + in 1, *Phyllanthus rotundifolius* + in 1, *Fagonia cretica* + in 4, *Portulaca oleracea* + in 9

Localities: 1. *Sal*: Palmeira; 2. *Boavista*: Ribeira do Norte, Campo Serra; 3. *Boavista*: João Galegos to Fundo Figueiras; 4. *Santiago*: Praia Formosa, Praia Baixo; 5. *São Nicolau*: Ponta da Coruja; 6. *São Vicente*: Salamasa; 7. *Sal*: Farol do Fiura; 8. *Sal*: Monte Leste; 9. *Boavista*: Pico Santo Antônio; 10. *Fogo*: São Filipe beach (*holotypus ass reg.* 2006: 50). 11. Synthesized table.

**Table 49**3.1.2. *Asphodelo marioalousae-Aristidetum cardosoi* ass. nova hoc loco

(Aristido cardosoi-Tetraenion simplicis, Aristido-Tetraenetalia simplicis, Tetraenetea simplicis)

Altitude (1=10 m)	173	174	180
Orientation	N	N	N
Area m <sup>2</sup>	6	4	4
Number of species	9	8	6
Ordinal number	1	2*	3
Characteristic species			
<i>Aristida cardosoi</i> •	3	3	3
<i>Asphodelus marioalousae</i> •	2	3	3
Companion species			
<i>Trichodesma africanum</i>	+	1	.
<i>Themeda triandra</i>	.	3	.
<i>Tagetes minuta</i>	.	1	.
<i>Diplotaxis antoniensis</i> •	+	1	.
<i>Misopates orontium</i>	+	+	.
<i>Melinis repens</i>	+	.	+
<i>Hyparrhenia caboverdeana</i>	+	.	+

Other companion species: *Galium parisiense* 1 in 3; *Campylanthus glaber* • + in 1; *Lobularia fruticosa* • + in 1; *Ajuga iva* + in 2; *Brachypodium distachyon* + in 3

Localities: 1. Santo Antão: Moroços, 2. Santo Antão: Moroços (*holotypus reg.* 2005: 47), 3. Fogo: Montinho

## 3. TETRAENETA SIMPLICIS classis nova hoc loco

Xeromorphic ephemeral short annual grassland savanna communities, occurring in tropical desertic and tropical xeric infra-thermotropical hyperarid to semi-arid (mostly arid) bioclimates, often but scarcely dis-

tributed in Tropical Sahara and Sahel biogeographic regions. [A, V, N, SL, Bo, M, SN, F, BR, MAU, SAHEL].

*Typus*: 3a. *Aristido funiculatae-Tetraenetalia simplicis* ordo novus hoc loco

Characteristic species and bioindicators growing in Cabo Verde Islands: *Aristida funiculata*, *Arthraxon lancifolius*, *Boerhavia coccinea*, *Boerhavia diffusa*, *Corchorus tridens*, *Corchorus trilocularis*, *Cleome brachycarpa*, *Cleome scaposa*, *Cleome viscosa*, *Digitaria eriantha*, *Digitaria horizontalis*, *Digitaria nuda*, *Eragrostis ciliaris*, *Leptochloa panicea*, *Melinis minutiflora*, *Melinis repens*, *Mollugo nudicaulis*, *Oldenlandia herbacea*, *Panicum laetum*, *Panicum tenuillum*, *Polygala eriopelta*, *Sclerocephalus arabicus*, *Sehima ischaemoides*, *Setaria barbata*, *Sporobolus minutus*, *Tripogon minimus*, *Tetraena simplex*.

### 3a. ARISTIDO FUNICULATAE-TETRAENETALIA SIMPLICIS ordo novus hoc loco

Xeromorphic ephemeral short annual grassland savanna communities, occurring in tropical desertic and xeric infra-mesotropical hyperarid to dry bioclimates, Sahara and Sahel Regions. [A, V, N, SL, BO, M, SN, F, BR]. *Typus*: 3.1 *Aristido cardosoi-Tetraenion simplicis* alliancia nova hoc loco

Aca.1. Cabo Verde xeromorphic infra-thermotropical hyperarid to semiarid ephemeral annual savanna divisio (syntax. equiv. 3.1)

#### 3.1. Aristido cardosoi-Tetraenion simplicis alliancia nova hoc loco

Xeromorphic ephemeral annual grassland savanna communities, growing in tropical desertic and xeric, infra-mesotropical mostly aridic, occurring in all Cabo Verde Islands. [A, V, N, SL, BO, M, SN, F, BR]. [•]

*Typus*: *Campylantho spathulati-Sarcostemmetum daltonii* ass. nova hoc loco (1.1.1.)

Characteristic species and bioindicators growing in Cabo Verde Islands: *Asparagus squarrosum* •, *Campylanthus spathulatus* •, *Diplotaxis glauca* •, *Diplotaxis vogelii* •, *Echium stenosiphon* •, *Fagonia mayana* •, *Launaea gorgadensis* •, *Limonium jovi-barba* •.

Climactical and edaphoxerophilous desertic shrub savanna community, occurring in infra-thermotropical, upper ultrahyperarid, strong euhyperoceanic bioclimate, on leptic regosols and arenosols. Endemic association of East Cabo Verde Sector; in which thrive *Sarcostemma daltonii*, *Cocculus pendulus*, *Euphorbia tuckeyana* and *Asparagus squarrosum* (*holotypus* relevé nº 2, table 48). It occurs in Boavista, Maio and Santiago islands. [SN, BO, M]. [•]

*Typus*: 3.1.1. *Aristido cardosoi-Tetraenion simplicis* ass. nova hoc loco

Characteristic species and bioindicators growing in Cabo Verde Islands: *Aristida cardosoi* •, *Asphodelus marioi* •, *Brachiaria caboverdeana* •, *Eragrostis conertii* •.

##### 3.1.1. Aristido cardosoi-Tetraenion simplicis associatio nova hoc loco

Xeromorphic ephemeral annual capverdian grassland association, occurring in all islands on desertic infra-thermotropical aridic bioclimate, characterized by *Tetrae-*

*na simplex*, *Brachiaria caboverdeana*, *Cleome viscosa*, *Aristida funiculata*, etc. (*holotypus* reléve 10, table 48). It can be found scarcely distributed after rain periods in all islands of Cabo Verde. [A, V, N, SL, BO, M, SN, F, BR]. [•]

### 3.1.2. Asphodelo marioi-Aristidetum cardosoi associatio nova hoc loco

Annual ephemeral grassland savanna association, characterized by the endemic species *Aristida cardosoi* and *Asphodelus marioi*, growing in high mountains of Santo Antão and Fogo Islands. It occurs on lapilli tephra and sandy soils, in tropical xeric mesotropical semiarid to dry bioclimate. (*Holotypus* reléve 2, table 49). [A, F]. [•].

### 3.1.3. Sehimatetum ischaemoidis associatio nova hoc loco

Desertic infra-thermotropical hyperarid ephemeral annual open grassland savanna association, growing on small sandy deposits during the short rainy season, in Sal Island, is frequent but are distributed in near all capverdeian islands, is characterized by the small plant *Sehima ischaemoides* accompanied by *Cleome brachycarpa*, *Heliotropium crispum*, *Lotus brunneri* •, *Frankenia pseudoericifolia* •, *Senna bicapsularis*, etc.. (*holotypus* reléve 3, table 50). [A, N, SL, BO, M, SN]. [•].

### 4. FRANKENIO PSEUDOERICIFOLIAE-SUAEDETEA CABOVERDEANA classis nova hoc loco

Pioneer and permanent coastal high endemic chamaephyte succulent, suffruticose, prostrate and occasionally predominant rhizomatous perennial grasses savanna communities, growing in infra-thermotropical low arid to ultrahyperarid desertic coastal mobile aerohaline sand dune habitats of Eastern Cabo Verde biogeographic province. In Mauritanian and South Rio de Oro sandy coast exist a geovicarian community (*Traganion nudati* Rivas-Martínez, V. E. Martín & Wildpret inéd.). [V, SL, BO, M]. [•].

*Typus nominis*: 4a. *Frankenia pseudoericifoliae-Suaedetalia caboverdeanae* ordo novus hoc loco

Characteristic species and bioindicators growing in Cabo Verde Islands: *Cistanche brunneri* •, *Frankenia pseudoericifolia* •, *Limonium brunneri* •, *Lotus brunneri* •, *Lotus chevalieri* •, *Polycarpaea caboverdeana* •, *Pulicaria diffusa* •, *Pulicaria longifolia* •, *Suaeda caboverdeana* •, *Tetraena waterlotii*, *Tetraena vicentina* •.

### 4a. FRANKENIO PSEUDOERICIFOLIAE-SUAEDETALIA CABOVERDIANA ordo novus hoc loco

Permanent succulent microphyllous chamaephyte and perennial grasses, infra-thermotropical ultrahyperarid-arid coastal sand dune communities of desertic Cabo Verde., [V, SL, BO, M]. [•].

*Typus nominis*: 4.1. *Polycarpaea caboverdeanae-Tetraenion waterlotii* alliancia nova hoc loco

Characteristic species and bioindicators growing in Cabo Verde Islands: see classis 4.

**Table 50**

3.1.3. *Sehimatetum ischaemoidis* ass. nova hoc loco  
*Aristido cardosoi-Tetraenion simplicis, Aristido-Tetraenetalia simplicis, Tetraenetea simplicis)*

Altitude (m)	10	45	30	30	20	27
Orientation			N	SE		
Area m <sup>2</sup>	4	4	20	100	20	<u>12</u>
Nº of species	3	3	7	11	7	6
Order number	1	2	3*	4	5	6
Characteristic species						
<i>Sehima ischaemoides</i>	3	3	3	3	2	V
<i>Cleome brachycarpa</i>	.	.	2	+	2	III
<i>Heliotropium crispum</i>	.	.	2	1	+	III
<i>Calotropis procera</i>	.	.	.	+	(+)	II
<i>Corchorus depressus</i>	.	2	.	.	.	I
Companion species						
<i>Lotus brunneri</i> •	1	1	2	3	(+)	V
<i>Senna bicapsularis</i>	1	1	1	+	.	IV
<i>Aerva javanica</i>	.	.	+	+	.	II
<i>Citrullus colocynthis</i>	.	.	1	+	.	II
Other companion species: <i>Forsskaolea procridifolia</i> • 3 in 5, <i>Lavandula coronopifolia</i> 2 in 4; <i>Frankenia pseudoericifolia</i> • 1 in 5, <i>Pulicaria diffusa</i> • + in 4						
Localities: 1. <i>Sal</i> : Bottom of Monte Grande; 2. <i>Sal</i> : from Farol Fiura to Monte Leste; 3. <i>Sal</i> : Monte Leste ( <i>holotypys</i> ass. reg 2004: 174); 4. <i>Sal</i> : Calheta de Palmeira; 5. <i>Sal</i> : Monte Leão; 6. Synthesized table						

**Table 51**

4.1.1. *Polycarpeo caboverdeanae-Tetraenetum waterlotii* ass. nova hoc loco

(*Polycarpeo-Tetraenion, Frankenio-Suaedetalia caboverdeanae, Frankenio-Suaedetea caboverdeanae*)

Area m <sup>2</sup>	8	4	2	6	4	4	8	4	2	4	4	8	8	4	4	4	8	6	8	
Nº of species	7	3	3	2	3	3	6	2	3	2	3	5	3	3	3	3	4	6	3	5
Ordinal number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16*	17	18	19	
Characteristic species																				
<i>Tetraena waterlotii</i>	3	2	1	3	4	2	3	3	4	4	4	2	3	3	3	3	4	3	2	V
<i>Suaeda caboverdeana</i>	.	4	4	3	3	3	2	3	1	2	1	2	2	.	.	.	.	.	.	IV
<i>Polycarpea caboverdeana</i> •	.	.	.	.	.	.	.	.	.	1	3	2	2	3	2	2	3	3	III	
<i>Frankenia pseudoericifolia</i> •	.	.	1	.	1	.	.	+	.	.	1	.	1	.	1	1	.	II		
<i>Cistanche brunneri</i> •	2	+	.	.	+	1	.	.	.	.	.	.	.	.	1	.	1	II		
<i>Sporobolus spicatus</i>	1	.	.	.	.	2	.	.	.	.	.	.	.	2	.	.	.	I		
<i>Lotus chevalieri</i> •	3	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	I		
<i>Pulicaria diffusa</i>	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	+		
Companion species																				
<i>Heliotropium pterocarpum</i>	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	I		
<i>Sesuvium sesuviodes</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	+			

Localities: 1. *Boavista*: Sal Rei, Praia do Cabral; 2. *Boavista*: Sal Rei, Praia do Estoril; 3. 4. *Boavista*: Praia da Varandinha; 5. *Boavista*: Praia de S<sup>t</sup> Mónica; 6. *Boavista*: Ponta do Porto Ferreira; 7. *Boavista*: Praia de Viana; 8. *Sal*: Murdeira; 9. *Maio*: Dunas do Montinho; 10. *Maio*: Banco da Antónia; 11. 12. 14. *Boavista*: Espungeira; 13. 17. *Sal*: SW Praia de Santa Maria; 15. *Sal*: Santa Maria, near Hotel Riu; 16. *Sal*: Santa Maria, Praia Oriental near "Mistério Grill" (*holotypus* ass. reg. 2004: 206); 18. *Sal*: Santa Maria, Igreijinha; 19. Synthesized table

#### 4.1. *Polycarpeo caboverdeanae-Tetraenion waterlotii* alliance nova hoc loco

Perennial and permanent succulent microphyllous dwarf-shrub, suffruticose and rhizomatous grass, infra-thermotropical ultrahyper-arid-arid, coastal desertic mobile sand dune of south-eastern Cabo Verde communities. A geovicariant alliance *Traganion nudati* is developed in Mauritania and South Rio de Oro coastal desertic sand dunes [West Tropical Sahara biogeographic province], no far of the

tropical sandy desertic oued micro-open savanna: *Panico turgidi-Acacion raddiana*. In the mediterranean hyperoceanic south atlantic Morocco coast and central-east Canarian provinces exist an ecogeovicarian alliance: *Traganion moquini* (*Polycarpeo niveae-Traganetea moquini*). [V, SL, BO, M]. [•].

*Typus nominis*: 4.1.1. *Polycarpeo caboverdeanae-Tetraenetum waterlotii* associatio nova hoc loco

Characteristic species and bioindicators growing in Cabo Verde Islands: see classis 4.

Table 52

4.1.2. *Tetraenetus vicentiae* ass. nova hoc loco

(Polycarpaeo-Tetraenion waterlotii, Frankenio-Suaedetalia caboverdeanae, Frankenio-Suaedetea caboverdeanae)

	6	8	8	10	6	8	8	4	10	10	8	8	8	8
Area m <sup>2</sup>														
Nº of species	3	3	4	7	3	4	4	3	8	7	4	5	4	5
Ordinal number	1	2	3	4	5*	6	7	8	9	10	11	12	13	14
Characteristic species														
<i>Tetraena vicentina</i> ●	3	2	2	3	4	3	2	3	3	2	3	4	2	V
<i>Frankenia pseudoericifolia</i> ●	1	2	2	2	2	2	2	1	2	4	.	2	1	V
<i>Polycarpaea caboverdeana</i> ●	3	.	.	2	2	2	3	.	2	1	4	1	3	III
<i>Cistanche brunneri</i> ●	.	.	+	.	.	.	.	.	+	.	1	1	1	II
<i>Suaeda caboverdeana</i> ●	.	3	3	+	.	.	.	.	.	.	.	.	.	II
<i>Limonium braunii</i> ●	.	1	.	.	.	.	.	.	.	.	.	.	.	+
Companion species														
<i>Heliotropium pterocarpum</i>	.	.	.	+	.	.	.	+	+	1	+	.	.	II
<i>Lotus bollei</i> ●	.	.	.	+	.	2	.	+	+	.	.	.	.	II
<i>Aizoon canariense</i>	.	.	.	+	.	.	+	.	+	.	.	.	.	II
<i>Patellifolia patellaris</i>	.	.	.	.	.	.	1	+	.	.	.	.	.	I
<i>Tetraena simplex</i>	.	.	.	.	.	.	.	.	1	.	.	.	.	+
<i>Andrachne telephiooides</i>	.	.	.	.	.	.	.	.	+	.	.	.	.	+

Localities: 1, 7, 8, 9, 10. São Vicente: Baía Norte; 2, 3, 4, 6. São Vicente: Vila Miséria; 5. São Vicente: Vila Miséria (*holotypus* ass. reg. 2004: 114); 11, 12, 13. São Vicente: Praia Grande. 14. Synthesized table.

4.1.1. *Polycarpaeo caboverdeanae-Tetraenetus waterlotii* associatio nova hoc loco

Typical association of the Cabo Verde endemic alliance *Polycarpaeo caboverdeanae-Tetraenion waterlotii*. Perennial permanent dwarf-shrub microphyllous succulent thermo-infratropical ultrahyperarid to low arid association growing on coastal sand dunes of Sal, Boavista and Maio Islands. *Polycarpaeo caboverdeanae-Tetraenetus waterlotii* is known from Sal, Boavista and Maio Islands. [SL, BO, M] [●]. *Type relevé (holotypus)*: table 51, relevé n.16. Rivas-Martínez, reg. 2004: 206, 21.11.2004, made with Lousã, J.C. Costa & Maria C. Duarte. *Site*: Cabo Verde: Ilha Sal, Santa Maria, Praia Oriental, near "Mistério Grill". 16° 38' N, 22° 50' W. 10 m, SE, 8 m<sup>2</sup>. *Physiognomy and habitat*: Sand dune open xeromorphic succulent microphyllous dwarf-shrub savannoid desert. *Estimated bioclimatic factors*: Tropical hyperdesertic to desertic, euhyperoceanic (Ic = 5.3), from upper infratropical to lower thermotropical (It = 670), lower hyperarid (Io = 0.3). *Biogeographic location*: Tropical Saharian Region, Cabo Verde Province, East Cabo Verde Sector, Sal Island District. Floristic combination: *Frankenio-Suaedetea* characteristic species: 4 *Tetraena waterlotii*, 2 *Polycarpaea caboverdeana* ●, 1 *Cistanche brunneri* ●, 1 *Frankenia pseudoericifolia* ●

4.1.2. *Tetraenetus vicentini* associatio nova hoc loco

Perennial permanent dwarf-shrub microphyllous succulent hyperarid association,

growing on northwest coastal sand dunes of São Vicente Island. The local endemic *Tetraena vicentina* is a characteristic species and grow with other capverdian endemics: *Frankenia pseudoericifolia*, *Polycarpaea caboverdeana* and *Cistanche brunneri* ● in lower thermotropical and lower hyperarid bioclimate. [V]. [●].

*Type relevé (holotypus)*: table 52, relevé n.5. Rivas-Martínez, reg. 2004: 114, 17.11.2004, made with Lousã, J.C. Costa & Maria C. Duarte. *Site*: Cabo Verde: Ilha de S. Vicente: Vila Miséria.

4.1.3. *Sporobolo spicati-Cyperetum crassipes* associatio nova hoc loco

East Cabo Verde permanent sand dune pioneer perennial grassland dwarf savanna associatio (20-40 cm), well differentiated by the presence of two tropical African arid sandy coast savanna graminaceous species: *Cyperus crassipes* and *Sporobolus spicatus*, intermingled with some crassifolius and non-microcrassifolius sandy dwarf-scrubs characteristic species of *Frankenio pseudoericifoliae-Suaedetea caboverdeanae*. *Sporobolo spicati-Cyperetum crassipedis* association is well represented in arid and hyperarid sandy coasts of Sal, Maio and Boavista Isles [SL, BO, M]. [●].

*Type relevé (holotypus)*: table 53, relevé n.11. Rivas-Martínez, reg. 2005: 176, 14.12.2005, made with Lousã, J.C. Costa & Maria C. Duarte. *Site*: Cabo Verde: Boavista Island, Praia das Gatas. 16° 10'

N, 22° 40' W. 10m, E, 8 m<sup>2</sup>. *Physiognomy and habitat:* Sand dune pioneer xeromorphic arid grassland savanna. *Estimated bioclimatic factors:* Tropical Desertic, eu-hyperoceanic (Ic = 5.2), infratropical (It = 680), lower arid (Io = 0.6). *Biogeographic location:* Tropical Saharian Region, Cabo Verde Province, East Cabo Verde Sector, Boavista Island District. Floristic combination: *Fankienio-Suaedetea* characteristic species: characteristic and territorial species: 3 *Cyperus crassipes*, 3 *Sporobolus spicatus*, 1 *Lotus chevalieri* •, + *Tetraena waterlotii*, + *Cistanche brunneri*

#### 4.1.4. *Loto brunneri-Pulicarietum diffusae* associatio nova hoc loco

Dwarf-shrub and subshrub pioneer associatio, growing in coasts and foothills of Sal and Boavista Islands, on hard sandy dune soils and basaltic substratum slightly covered by mobile sand, in infra- to thermotropical ultrahyperarid-arid bioclimate. Well characterized by East Cabo Verde endemics like: *Pulicaria diffusa*, *Lotus chevalieri* and *Lotus bollei*, as well as other Cabo Verde and Tropical Saharian hyperoceanic elements (table 54). [SL, BO]. •

**Table 53**  
4.1.3. *Sporobolo spicati-Cyperetum crassipedis* ass. nova hoc loco  
(*Polycarpaeo-Tetraenion waterlotii*, *Frankenio-Suaedetalia*, *Frankenio-Suaedetea caboverdeanae*)

	8	8	8	4	4	6	8	6	6	4	4	8	6
Area m <sup>2</sup>													
Nº of species	5	5	4	3	4	4	5	5	4	3	3	5	4
Ordinal number	1	2	3	4	5	6	7	8	9	10	11*	12	13
Characteristic species													
<i>Sporobolus spicatus</i>	4	3	3	2	3	4	1	1	1	3	3	4	V
<i>Cyperus crassipes</i>	1	.	.	1	1	1	2	3	3	3	3	1	V
<i>Tetraena waterlotii</i>	.	2	2	2	2	1	2	1	3	.	.	.	IV
<i>Lotus chevalieri</i> •	.	.	.	.	.	.	+	1	+	+	.	.	II
<i>Lotus brunneri</i> •	2	.	2	.	.	.	.	.	.	.	.	+	II
<i>Cistanche brunneri</i> •	.	1	.	.	.	.	+	.	.	.	+	.	II
<i>Suaeda caboverdeana</i> •	.	1	.	.	1	.	.	.	.	.	.	.	II
<i>Polycarpa caboverdeana</i> •	.	.	+	.	.	.	.	.	.	.	.	.	I
Companion species													
<i>Heliotropium pterocarpum</i>	2	.	.	.	.	.	.	.	.	.	.	+	II
<i>Cyperus conglomeratus</i>	2	.	.	.	.	2	.	.	.	.	.	1	I

Localities: 1. *Maio*: Banco da Antónia; 2. *Boavista*: Sal Rei, Praia do Cabral; 3. *Sal*: Santa Maria, Ponta Preta; 4. *Boavista*: Sal Rei, Praia do Estoril; 5. *Boavista*: Praia das Gatas; 6,10. *Boavista*: Praia da Varandinha; 7. *Boavista*: Praia de Viana; 8. *Boavista*: Porto Ferreira; 9. *Boavista*: Praia das Gatas; 11. *Boavista*: Praia das Gatas (*holotypus ass. reg. 2005: 176*); 12 *Boavista*: Praia das Gatas. 13. Synthesized table.

**Table 54**  
4.1.4. *Loto brunneri-Pulicarietum diffusae* ass. nova hoc loco  
(*Polycarpaeo-Tetraenion waterlotii*, *Suaedetalia caboverdeanae*,  
*Frankenio-Suaedetea caboverdeanae*)

	20	10	20	40	10	20
Area m <sup>2</sup>						
Nº of species	4	6	7	4	4	5
Ordinal number	1	2*	3	4	5	6
Charateristic species						
<i>Pulicaria diffusa</i> •	4	3	3	3	3	V
<i>Frankenia pseudoericifolia</i> •	1	+	+	.	.	III
<i>Suaeda caboverdeana</i> •	.	.	.	2	1	II
<i>Lotus brunneri</i> •	1	1	2	+	+	V
<i>Tetraena waterlotii</i>	.	.	.	2	2	II
<i>Lotus chevalieri</i> •	.	.	.	.	+	I
Companion species						
<i>Senna bicapsularis</i>	+	2	2	.	.	III
<i>Sehima ischaemoides</i>	.	1	+	.	.	II
<i>Kickxia elegans</i> •	.	.	1	.	.	I
<i>Cynodon dactylon</i>	.	.	.	1	.	I
<i>Calotropis procera</i>	.	+	.	.	.	I

Localities: 1. *Sal*: West foothills of Monte Grande; 2 *Sal*: Coast of Monte Grande (*holotypus ass. reg.: 2004: 161*); 3. *Sal*: Buracona, Base Monte Leste; 4. *Sal*: East of Santa Maria; 5. *Boavista*: Lagoon Porto Ferreira; 6. Synthesized table.

- Type relevé (holotypus):* table 54, relevé n.1. Rivas-Martínez, reg. 2004: 161, 20.11.2006, made with Lousã, J.C. Costa & Maria C. Duarte. *Site:* Cabo Verde: Sal Island, west foothills of Monte Grande. 16° 48' N, 22° 54' W. 30m, SW, 10 m<sup>2</sup>. *Physiognomy and habitat:* Dwarf-shrub and subshrub open sandy or stony-basaltic desert. *Estimated bioclimatic factors:* Tropical desertic, euhyperoceanic ( $I_c = 5.7$ ), lower thermotropical ( $I_t = 650$ ), upper hyperarid ( $I_o = 0.4$ ). *Biogeographic location:* Tropical Saharan Region, Cabo Verde Province, East Cabo Verde Sector, Sal Island District. *Floristic combination:* *Tetraeno-Suaedetea* characteristic species: 4 *Pulicaria diffusa* •, 1 *Lotus brunneri* •, 1 *Frankenia pseudoericifolia* •, Companion species: + *Senna bicapsularis*.
5. LEMNETE MINORIS Tüxen ex O. Bolós & Masclans 1955  
 Bryo-cormophyte freshwater free floating pleustophyte communities. Cosmopolite, occasional in Cabo Verde Islands.  
*Typus:* (holotypus, art. 18): *Lemnetalia minoris* Characteristic species and bioindicators growing in Cabo Verde Islands: *Lemna minor* (Lemnaceae) (doubtful native).  
 5a. LEMNETALIA MINORIS Tüxen ex O. Bolós & Masclans 1955  
 Single order in Cabo Verde Islands: see classis 1.  
*Typus:* (holotypus, art. 18): *Lemnion minoris*  
 5.1. **Lemnion minoris** Tüxen ex O. Bolós & Masclans 1955  
 Small to medium size acropleustophyte cosmopolite communities  
*Typus:* *Lemno gibbae-Azolletum filiculoides* Br.-Bl. 1952  
 5.1.1. *Lemna minor* community  
 Occasional, doubtful native. [SN]
6. POTAMETEA Klika in Klika & Novák 1991  
 Aquatic fresh water macrophyte communities. Rooted hydrophytes: elodeids, batraquids or nymphaeids (*Potametalia pectinati*) and non-rooted nutrient-rich: utriculariads or ceratophyllids (*Utricularieta vulgaris*). Cosmopolite.  
*Typus:* (holotypus, art. 18): *Potametalia pectinati*. Characteristic species and bioindicators growing in Cabo Verde Islands: *Potamogeton pusillus* (Potamogetonaceae). [A, N, SN, F].  
 6a. *POTAMETALIA PECTINATI* Koch 1926  
 Rooted hydrophytes communities.  
*Typus:* (lectotypus, art. 20): *Potamion pectinati*  
 Single order in Cabo Verde Islands: see classis 6.  
 6.1. **Potamion pectinati** (Koch 1926) Libbert 1931  
 Fresh water fluvial and lacustrine elodeids mostly holarctic communities. Single alliance and community in Cabo Verde Islands.
- Typus: (lectotypus, art. 19): *Zannichellio palustris-Potametum pectinati* Koch 1926  
 Characteristic species and bioindicators growing in Cabo Verde Islands: see classis 6.
- 6.1.1. *Potamogeton pusillus* community  
 Occasional in Cabo Verde Islands. [A, N, SN, F]
7. HALODULO WRIGHTII-THALASSIETEA TESTUDINUM Den Hartog ex Rivas-Martínez, Fernández-González & Loidi 1999  
 Benthic infralittoral zosterid and elodeid communities on muddy or sandy substrata of calm shallow coasts, lagoons, estuaries and reefs, infra-thermotropical, but attain the subtropical latitude: infra-thermomediterranean and infratemperate thermotypes in not cold seas. Tropical and subtropical, occasional in Cabo Verde Islands. [SN].  
*Typus:* (holotypus, art. 18): *Thalassio testudinum-Syringodietalia filiformis* Characteristic species and bioindicators growing in Cabo Verde Islands: *Cymodocea nodosa* (Cymodoceaceae) (Cabo Verde Islands ?), *Zostera* sp. (Zosteraceae) (Cabo Verde ?). [SN].
- 7a. THALASSIO TESTUDINUM-SYRINGODIETALIA FILIFORMIS Borhidi, Muñiz & Del Risco in Borhidi 1996  
*Typus:* *Syringodio-Thalassion* Borhidi, Muñiz in Borhidi 1996 (Caribbean; do not attain Cabo Verde Islands)  
 Single order in Cabo Verde Islands: see classis 7.
- 7.1. **Cymodoceion nodosae** Den Hartog 1976  
 Benthic infralittoral zosterid communities growing on calm coast of marine sandy soil. Tropical and subtropical atlantic and Mediterranean (Mauritania and Sahara coasts, Morocco and Canary Islands).  
*Typus:* (lectotypus, art. 20): *Cymodoceetum nodosae* Feldmann 1937
- 7.1.1. *Cymodocea nodosa* community [SN].
8. RUPPIETA MARITIMAE J. Tüxen 1960  
 Coastal and semicontinental temporarily submerged halophytic and brackish pioneer seasonal communities, from thermotropical to supratemperate. Holarctic. Cosmopolite, uncommon in Cabo Verde Islands.  
*Typus:* (holotypus, art. 18): *Ruppietalia maritimae* Characteristic species and bioindicators growing in Cabo Verde Islands: *Ruppia maritima* (Ruppiaceae).  
 8a. *RUPPIETALIA MARITIMAE* J. Tüxen 1960 Single order: see classis 8.  
*Typus:* (holotypus, art. 18): *Ruppion maritimae*  
 8.1. **Ruppion maritimae** Br.BI. ex Westhoff in Bennema, Sissingh & Westhoff  
 Coastal and continental, halophytic temporarily submerged, flexible filiform leaf elodeids with spring development pioneer communities.  
*Typus:* (lectotypus, art. 20): *Ruppietum maritimae* Hocquette 1924.
- 8.1.1. *Ruppia maritima* community. [SL, BO].

Table 55

10.1.1. *Arthroc nemetum franzii* ass. nova hoc loco*(Arthroc nemion franzii, Arthroc nemetalia franzii, Arthroc nemetea franzii)*

Area m <sup>2</sup>	10	10	10	10	10	10	20	20	10	20	10	10	12
Nº of species	1	1	1	2	2	2	3	2	4	2	2	2	2
Ordinal number	1	2	3	4	5	6	7	8	9	10	11*	12	13
Characteristic species													
<i>Arthroc nemum franzii</i>	5	5	5	5	3	5	5	5	4	4	5	5	V
<i>Cressa salina</i>	.	.	.	3	.	.	.	2	.	.	.	.	I
Companion species													
<i>Suaeda caboverdeana</i> •	.	.	.	.	.	.	.	1	1	+	1	1	II
<i>Sesuvium sesuvioides</i>	.	.	.	.	1	1	+	.	.	.	.	.	II
<i>Tamarix senegalensis</i>	.	.	.	.	.	+	1	.	.	.	.	.	I
<i>Tetraena waterlotii</i>	.	.	.	.	.	.	.	+	.	.	.	.	I

Localities: 1, 4. Sal: Murdeira; 2. Boavista: Sal Rei, Praia de Cabral; 3. Maio: Banco da Antónia; 5, 6. Sal: Salinas de Santa Maria; 7, 8, 9. Boavista: Porto Ferreira lagoon; 10 Boavista: Baía das Gatas; 11. Boavista: Praia da Varandinha (*holotypus* ass. reg. 2005: 206); 12. Boavista: Praia das Gatas; 13. Synthesized table.

## 9. MAGNOCARICI ELATAE-PHRAGMITETEA AUSTRALIS Klika in Klika &amp; V. Nóvak 1941 nom. inv.

Riverine cosmopolite helophytic freshwater marshland communities

*Typus:* (holotypus, art. 18): *Phragmitetalia australis* Koch 1926

Characteristic species and bioindicators growing in Cabo Verde Islands (probably introduced): *Phragmites australis* (Poaceae), *Rorippa nasturtium-aquaticum* (Brassicaceae), *Typha domingensis* (Typhaceae), *Veronica anagallis-aquatica* (Scrophulariaceae), *Veronica beccabunga* (Scrophulariaceae). [A, V, N, BO, M, SN, F, BR].

9a. *PHRAGMITETALIA AUSTRALIS* Koch 1926 [Bo, M, SN].

*Typus:* (lectotypus, art. 20): *Phragmition australis* Koch 1926.

9.1. **Phragmition australis** Koch 1926 nom. mut.

*Typus:* (holotypus, art. 18): *Schoenoplecto lacustris-Phragmitetum australis* Koch 1926 nom. mut.

9.1.1 *Typha domingensis* community. [Bo, M, SN].

9b. *RORIPPO NASTURTHI-AQUATICA-GLYCERETALIA FLUITANTIS* Pignatti 1954.

*Typus:* (holotypus, art. 18): *Glycerio fluitantis-Sparganion neglecti* Br.-Bl. & Sissingh in Boer 1942.

9.2. **Rorippion nasturtii-aquaticae** Gehu & Gehu-Frank 1987

*Typus:* (holotypus, art. 18): *Helosciadetum nodiflori* Maire 1924.

9.2.1 *Rorippa nasturtium-aquaticum* community. [A, V, N, SN, F, BR].

## 10. ARTHROC NEMETEA FRANZII classis nova hoc loco

Coastal saltwater marshes flooded by sea tides or occasionally interior saline waters: succulent shrub, forbs and grass communities, growing in infra-thermotropical desertic and xeric Capeverdean, West Tropical (Morocco), Saharan, Mauritanian and Senegalese and coastal Angolese biogeographic terri-

tories. [A, V, SL, BO, M, SN, MAU, SENEGAL, ANGOLA].

Characteristic species and bioindicators growing in Cabo Verde Islands: *Arthroc nemum franzii*, *Cressa salina*.

*Typus:* 7a. *Arthroc nemetalia franzii* ordo novo.

10a. **ARTHROC NEMETALIA FRANZII** ordo novo hoc loco

Permanent succulent nanophanerophyte, chamaephyte and perennial pioneer community growing on salty occasionally flooded soils, in infra-thermotropical desertic coast of eastern Cabo Verde Islands, Atlantic Tropical Morocco, Angola and Mauritania. [SL, BO, M, MAU, SEN, ANG AND TROPICAL ATLANTIC SAHARA].

*Typus:* 10.1. *Arthroc nemion franzii* all. nova hoc loco

10.1. **Arthroc nemion franzii** allianzia nova hoc loco

Permanent succulent nanophanerophyte and chamaephyte coastal halophilous communities, occasionally flooded growing in infra-thermotropical desertic coasts of Cabo Verde and Atlantic Mauritania (Saharo Tropical biogeographical subregion). (J. C. Costa has found *Arthroc nemum franzii* in the desertic coast of South Angola (Nambib Desert) and Rivas-Martínez near the Drá river coast in Morocco and coasts of Senegal River). [SL, BO, M, MAU, SEN, ANG AND TROPICAL ATLANTIC SAHARA].

*Typus:* 10.1.1. *Arthroc nemetum franzii* ass. nova hoc loco

Characteristic species and bioindicators growing in Cabo Verde Islands: *Arthroc nemum franzii* •

10.1.1. **Arthroc nemetum franzii** associatio nova hoc loco

Permanent succulent halophilous nanophanerophyte association, growing on coastal sandy soils only occasionally and temporarily flooded soils, in infra-thermotropical desertic arid to ultrahyperarid coasts of East Cabo Verde, Morocco Atlantic Sahara, Mauritania, Senegal coastal river and

Angola Namib Desert coast. It is well characterized by *Arthrocnemum franzii*. [SL, BO, M]

*Type relevé (holotypus)*: table 55, relevé n.11. Rivas-Martínez, reg. 2005: 206, 15.12.2005, made with Lousã, J.C. Costa & Maria C. Duarte. *Site*: Cabo Verde, Boavista, Praia da Varandinha, 10m<sup>2</sup>.

#### 10.1.2. *Cressetum salinae* associatio nova hoc loco

Psammo-halophyte coastal annual and biennial association, growing on temporary humid halophilic sandy soils, and seral

of *Arthrocnemetum franzii* scrubby sigmetum, occurring in infra-thermotropical hyperarid-arid, coasts and lagoons of the eastern islands of Cabo Verde and in the littoral of tropical Sahara (Morocco, Mauritania and Senegal). It is well characterized by the small prostrate, mostly biennial *Convolvulaceae* with large flowers *Cressa salina*. [SL, BO, M, SN]

*Type relevé (holotypus)*: table 56, relevé n.5. J.C. Costa, reg. 2007: 19.6.2007, *Site*: Cabo Verde, Boavista, Porto Ferreira lagoon, 4m<sup>2</sup>.

Table 56

#### 10.1.2. *Cressetum salinae* ass. nova hoc loco

	Area m <sup>2</sup>	2	2	4	6	4	4	4	4
Number of species	1	1	2	5	2	3	2	2	2
Ordinal number	1	2	3	4	5*	6	7	8	
Characteristic species									
<i>Cressa salina</i>		5	5	5	4	4	4	4	V
<i>Arthrocnemum franzii</i>		.	.	1	1	.	1	.	II
Companion species									
<i>Sesuvium sesuvioides</i>		.	.	.	.	1	1	.	II
<i>Sesuvium portulacastrum</i>		.	.	.	+	.	.	.	I

Other companion species: *Bulbostylis barbata* 2 in 7; *Suaeda caboverdeana* • + in 4; *Tetraena waterlotii* + in 4.

Localities: 1. 6. *Sal*: Murdeira; 2, 3, 4. *Boavista*: Porto Ferreira lagoon; 5. *Boavista*: Porto Ferreira lagoon (*holotypus* ass. reg. 2007: 22); 7 *Maio*: Banco da Antónia; 7. Synthesized table.

#### 10b. *SESUVIETALIA SESUVIOIDES* ordo novo hoc loco

Annual becoming rooting perennials succulent coastal communities hygrohalophilic and aero-halophilic, growing in infra-thermotropical ultrahyperarid-arid West Africa coasts from Morocco to South Africa. Characterized by succulent species of *Sesuvion* (*Sesuvium sesuvioides* and *S. portulacastrum*) This new ordo is now included in the class *Arthrocnemetea franzii*, but probably in the future it will need a new aridic pantropical class.

*Typus*: *Sesuvion sesuvioides* all. nova hoc loco

#### 10.2. *Sesuvion sesuvioides* alliance nova hoc loco

Annual becoming perennials coastal succulent communities, hygrohalophilic and aero-halophilic, growing in infra-thermotropical ultra-hyperarid-arid West African tropical coasts. [A, V, SL, BO, M, SN, BR]

Characteristic species and bioindicators growing in Cabo Verde Islands: *Blutaparon vermiculare* [A, SL, BO, M, SN], *Sesuvium portulacastrum* [SL, BO, M, SN, M], *Sesuvium sesuvioides*. [V, SL, BO, M, BR]

*Typus*: 10.2.1. *Sesuvietum sesuvioidis* ass. nova hoc loco

#### 10.2.1. *Sesuvietum sesuvioidis* associatio nova hoc loco

Association of the new alliance *Sesuvion sesuvioides*, which thrives as common dominant plant in saline and subsaline wet coastal stations, waterlogged and flooded

by salt water. Is characterized by the annual become perennials afrotropical succulent Aizoaceae *Sesuvium sesuvioides*, which according to topography, anthropic influence and adjacent coastal vegetation, may be accompanied by other tropical annual or perennial plants. [V, SL, BO, M, BR].

*Type relevé (holotypus)*: table 57, relevé n.7. Rivas-Martínez, reg. 2004: 119, 17.11.2004, made with Lousã, J.C. Costa & Maria C. Duarte. *Site*: Cabo Verde, São Vicente, Ribeira das Vinhas, 10m<sup>2</sup>.

#### 10.2.2. *Sesuvietum portulacastri* associatio nova hoc loco

Halophilous association on margins of temporarily flooded saline sandy in contact with *Arthrocnemetum franzii*, characterized by *Sesuvium portulacastrum*, a pioneer succulent prostrate rooting plant with pantropical distribution reaching the Eastern Canaries. Sometimes is accompanied by the afrotropical small erect thin succulent annual *Blutaparon vermiculare*, which has its optimum in Cabo Verde aero-halophilic coastal stations. (v. 10.2.3. *Blutaparontum vermicularis*). *Sesuvietum portulacastri* occurs in Sal, Boavista, Maio and Santiago islands. [SL, BO, M, SN].

*Type relevé (holotypus)*: table 58, relevé n.2. Rivas-Martínez, reg. 2006: 119, 13.12.2005, made with Lousã, J.C. Costa & Maria C. Duarte. *Site*: Boavista, Salinas de Sal Rei, 4m<sup>2</sup>.

10.2.3. *Blutaparontetum vermicularis* associatio nova hoc loco

Coastal aerohaline Cabo Verde new association, characterized by the small thin succulent terophyte *Blutaparon vermiculare*, that may be accompanied by other small tropical chamaephytes or therophytes growing in infra-thermotropical ultra-

hyperarid to arid bioclimates. [A, SL, BO, M, SN].

*Type relevé (holotypus):* table 59, relevé n. 2. Rivas-Martínez, reg. 2005: 90, 11.12. 2005, made with Lousã, J.C. Costa & Maria C. Duarte. *Site:* Santiago, Biscainhos, 15 m, 4m<sup>2</sup>.

**Table 57**  
10.2.1. *Sesuvietum sesuviodis* ass. nova hoc loco  
(*Sesuvion sesuviodis*, *Sesuvietalia sesuviodis*, *Arthrocnemetea franzii*)

Area m <sup>2</sup>	2	2	2	2	2	2	4	2	4	4	10	2
Nº of species	1	1	1	1	1	1	2	2	2	2	2	2
Ordinal number	1	2	3	4	5	6	7*	8	9	10	11	12
Characteristic species												
<i>Sesuvium sesuviodes</i>	3	3	5	5	5	5	5	5	4	5	2	V
<i>Sporobolus virginicus</i>	.	.	.	.	.	.	.	.	.	.	4	+
Companion species												
<i>Suaeda caboverdeana</i> ●	.	.	.	.	.	.	.	.	+	2	1	.
Other companion species: <i>Heliotropium curassavicum</i> 1 in 8.												

Localities: 1. São Vicente: Calhau; 2. Brava: Fajã d'Agua; 3. Boavista; Praia do Cabral; 4. Boavista: Praia da Varandinha; 5. São Vicente: Mindelo; 6, 9. Sal: Santa Maria Ponta Preta; 7. São Vicente: Ribeira das Vinhas (*holotypus* ass. reg. 2004: 119); 8, 11. Sal: Pedra Lume; 10. Sal: Santa Maria: Hotel Riu; 12. Synthesized table.

**Table 58**  
10.2.2. *Sesuvietum portulacastri* ass. nova. hoc loco  
(*Sesuvion sesuviodis*, *Sesuvietalia sesuviodis*, *Arthrocnemetea franzii*)

Area m <sup>2</sup>	2	4	4	4	4	4	4
Number of species	1	2	2	3	1	2	
Ordinal number	1	2*	3	4	5	6	
Characteristic species							
<i>Sesuvium portulacastrum</i>	5	5	5	5	4	5	V
<i>Blutaparon vermiculare</i>	.	1	.	1	.	II	
Companion species							
<i>Arthrocnemum franzii</i>	.	.	+	+	.	II	

Localities: 1. Maio: Salinas de Vila do Maio; 2. Maio: Salinas de Vila do Maio (*holotypus* ass. reg. 2006: 109); 3. Boavista: Salinas de Sal Rei; 4. Boavista: Salinas de Santa Mónica; 5 Sal: Baía de Murdeira; 6. Synthesized table.

**Table 59**  
10.2.3. *Blutaparontetum vermicularis* ass. nova hoc loco

(*Sesuvion sesuviodis*, *Sesuvietalia sesuviodis*, *Arthrocnemetea franzii*)

Area m <sup>2</sup>		4	4	4	4	4	2	4
Number of species	2	3	2	3	5	4	3	3
Ordinal number	1	2*	3	4	5	6	7	8
Characteristic species								
<i>Blutaparon vermiculare</i>	4	4	3	4	3	4	3	V
<i>Cressa salina</i>	.	.	.	.	1	+	.	II
<i>Sesuvium portulacastrum</i>	.	.	.	2	.	.	.	I
Companion species								
<i>Tetraena simplex</i>	.	.	2	2	.	.	.	II
<i>Aizoon canariense</i>	.	.	.	.	1	+	1	II
<i>Frankenia pseudoerericifolia</i> ●	.	.	.	.	2	+	.	II
<i>Paronychia illecebroides</i> ●	.	+	.	.	.	.	+	II

Other companion species: *Sporobolus robustus* 1 in 1; *Launaea melanostigma* ● + in 2; *Gymnocarpos sclerocephalus* + in 5.

Localities: 3. Santiago: Praia Formosa; 1. Santiago: Biscainhos; 2. Santiago: Biscainhos (*holotypus* ass. reg. 2005: 90); 4. Maio: Salines of Vila de Maio; 5, 6, 7. Santiago: Praia de S. Francisco; 8. Synthesized table.

**Table 60**

11.1.1. <i>Adiantetum trifidi</i> ass. nova hoc loco			
(Adiantion trifidi, Adiantetalia capilli-veneris, Adiantetea capilli-veneris)			
Altitude (1=10 m)	4	4	4
Orientation	N	N	N
Area m <sup>2</sup>	10	2	2
Nº species	3	4	6
Ordinal number	1	2*	3
Characteristic species			
<i>Adiantum trifidum</i>	5	5	2
<i>Samolus valerandi</i>	+	+	1
Companion species			
<i>Eucladium verticillatum</i>	2	.	2
<i>Launaea picridioides</i> •	.	1	.
<i>Sonchus oleraceus</i>	.	1	.
<i>Polypogon viridis</i>	.	.	1
<i>Cyperus involucratus</i>	.	.	1
<i>Ammannia senegalensis</i>	.	.	+

Localities: *Santo Antão*: Pontinha da Janela; 2. *Santo Antão*: Pontinha da Janela, basaltic rich wall under water-flushed coming from a irrigation channel (*holotypus ass. reg. 2005: 18*); 3. *Santo Antão*: Pontinha da Janela.

**Table 61**  
11.1.2 *Hypodematio crenati-Campanuletum bravensis* ass. nova hoc loco  
(Adiantion trifidi, Adiantetalia capilli-veneris, Adiantetea capilli-veneris)

Altitude (1=10 m)	55	47	47	54	51	59	52
Orientation	N	NE	N	N	N	NW	
Area m <sup>2</sup>	4	4	4	4	4	4	
Nº species	2	4	5	4	4	6	4
Ordinal number	1	2*	3	4	5	6	7
Characteristic species							
<i>Hypodematum crenatum</i>	2	3	4	1	4	1	V
<i>Pteris vittata</i>	2	2	+	4	4	3	V
<i>Campanula bravensis</i> •	.	+	1	2	2	3	IV
<i>Adiantum trifidum</i>	.	.	+	.	1	2	II
Companion species							
<i>Arthraxon lancifolius</i>	.	+	+	.	2	.	I
<i>Lavandula rotundifolia</i> •	.	.	.	+	1	.	I
<i>Oxalis corniculata</i>	.	.	.	.	.	+	I
<i>Cyperus laevigatus</i>	.	.	.	.	.	+	I

Localities: 1. *Fogo*: Ribeira do Inferno; 2. *Fogo*: Espigão, humid and shady hard basalt wall (*holotypus ass. reg. 2006: 30*); 3. *Fogo*: Espigão, potential natural vegetation: *Dichrostachyoficetum sur*; 4, 5. *Fogo*: Campanas de Baixo. 6. *Brava*: Espadão; 7. Synthesized table.

#### 11. ADIANTETEA CAPILLI-VENERIS Br.-Bl. in Br.-Bl., Rousine & Negré 1952

Perennial rupicolous water flow communities rich in chasmophyte ferns and seed plants, hemicryptophytes, chamaephytes and, usually, with plentiful bryophytes, growing on cliff, walls canyons and caves, with permanent or semipermanent water flow, rock crevices or tufa, with generally water-flushed or water plashed rich in calcium carbonates; infra-supramediterranean desertic to pluvioseasonal submediterranean temperate and infra-supratropical xeric and desertic bioclimatic zones, mostly in Holarctic or locally in Paleotropical African biogeographic territories. [A, V, N, SN, F, BR].

*Typus*: 11a. *Adiantetalia capilli-veneris*

Characteristic species and bioindicators growing in Cabo Verde Islands: *Adiantum capillus-veneris* subsp. *trifidum*, *Eucladium verticillatum*, *Didymodon tophaceus*, *Pteris vittata*, *Thamnobryum alopecurum*.

#### 11a. ADIANTETALIA CAPILLI-VENERIS Br.-Bl. ex Horvatic 1934

Single order.

Characteristic species and bioindicators growing in Cabo Verde Islands: See classis 11.

*Typus*: *Adiantum capilli-veneris* Br.-Bl. 1931

#### 11.1. *Adiantion trifidi* alliance nova hoc loco

Perennial communities with chasmophyte ferns and seed plants, growing on permanent or temporary calcium rich water flow rock crevices or tufa, in cliffs, canyons and caves; infra-supratropical desertic to xeric; through Paleotropical Africa, in Saharan Tropical sub-region: Cabo Verde and Mauritania biogeographical provinces, well characterized by the translucent and thin leaf segments tropical desert rockyphilous tufa fern: *Adiantum trifidum*.

*Typus:* 11.1.1. *Adiantetum trifidi* ass. nova hoc loco

Characteristic species and bioindicators growing in Cabo Verde Islands: *Adiantum capillus-veneris* subsp. *trifidum*, *Campanula bravensis* •, *Carex hansenii* •, *Dryopteris gorgonea* •.

11.1.1. *Adiantetum trifidi* associatio nova hoc loco

Infra-thermotropical hyperarid-semiarid association, growing on basaltic rich wall under water-flushed, characterized by the tropical fern *Adiantum capillus-veneris* subsp. *trifidum*, occurring mostly in Northern Islands (Santo Antão, São Vicente, S. Nicolau and occasionally Fogo, Santiago and Brava). (*Holotypus reléve* 2, table 60). [A, V, N, SN].

11.1.2. *Hypodematio crenati-Campanuletum bravensis* associatio nova hoc loco

Infra-thermotropical arid to semiarid community, in humid and shady hard basaltic walls, characterized by *Campanula bravensis* and quite big ferns like *Hypodematum crenatum*, *Pteris vittata* and *Adiantum capillus-veneris* subsp. *trifidum* (*holotypus relevé n. 2, table 61*). It occurs in southern islands (Fogo, Brava and Santiago). [SN, F, BR]. [•].

12. ASPLENIETEA TRICHOMANIS (Br.-Bl. in Meier & Br.-Bl. 1934) Oberdorfer 1977

Vegetation class which includes the chasmophytic mostly holarctic communities growing on vertical rocky walls and cliff narrow rock fissures, that receive direct the water of rainfall. They consist of small size perennials rupicolous plant communities: small pteridophytes and seed plants hemicryptophytic

and chamaephytic not nitrophilous, whose compact root system is lodged inside of narrow fissures on steep faces rock that are wetted during the heavy rains. These rupicolous communities have a high number of characteristic species, mostly with a high climatic, geographic and edaphic bioindication values.

*Typus (lectotypus, art. 19): Potentilletalia caulescens* Br.-Bl. & Jenny 1926 [Denkschr. Schweiz. Naturforsch. Ges. 63: 183].

Characteristic species and bioindicators growing in Cabo Verde Islands: *Asplenium aethiopicum* subsp. *braithwaitii*, *Cheilanthes acrostica*, *Cystopteris fragilis*, *Paraceterach marantae*.

12a. *KICKXIETALIA ELEGANTIS* ordo novus hoc loco

Cabo Verde chasmophytic and chasmo-comophytic communities rich in small local endemic species, growing on cliffs and big rocky blocks, from infra- to mesotropical and hyperarid to dry bioclimate. Ocurring only in all Cabo Verde Islands.

*Typus:* 12.1. *Kickxion elegans* all. nova hoc loco  
Characteristic species and bioindicators growing in Cabo Verde Islands: *Campanula jacobaea* •, *Campylanthus glaber* •, *Diplotaxis gorgadensis* •, *Diplotaxis hirta* •, *Diplotaxis varia* •, *Kickxia dichondrifolia* •, *Kickxia elegans* •, *Kickxia webbiana* •, *Launaea thalassica* •, *Polycarpaea gayi* •, *Umbilicus schmidtii* •. [A, V, N, SL, BO, M, SN, F, BR]. [•]

12.1. *Kickxion elegans* alliance nova hoc loco

Single alliance of the ordo well representate and characterized by many local endemic species in all Cabo Verde insular territories.

*Typus:* 12.1.1. *Kickxietaum webbianae* ass. nova hoc loco

Characteristic species and bioindicators growing in Cabo Verde Islands: see ordo 12a.

Table 62  
12.1.1. *Kickxietaum webbianae* ass. nova hoc loco  
(*Kickxion elegans*, *Kickxietalia elegans*, *Asplenietea trichomanis*)

Altitude (1= 10 m)	3	73	6	14	13	22
Orientation	N	E	NE	N	N	
Area m <sup>2</sup>	10	10	10	2	2	
Nº species	3	6	5	3	3	4
Ordinal number	1	2	3	4*	5	6
Characteristic species						
<i>Kickxia webbiana</i> •	3	2	2	3	4	V
<i>Diplotaxis gorgadensis</i> •	.	.	.	+	+	II
<i>Polycarpaea gayi</i> •	+	.	.	.	.	I
<i>Pellaea viridis</i>	.	2	.	.	.	I
Companion species						
<i>Limonium braunii</i>	+	.	2	.	.	II
<i>Paronychia illecebroides</i> •	.	.	1	+	.	II

Other companion species: *Samolus valerandi* 2 in 5; *Campylanthus spathulatus* • 1 in 3; *Frankenia caboverdeana* • 1 in 3; *Launaea gorgadensis* • + in 2, *Aeonium gorgoneum* • + in 2; *Campylanthus glaber* • + in 2.

Localities: 1. *Santo Antão*: Sinagoga; 2. *Santo Antão*: Delgadinha; 3. *Santo Antão*: Ponta do Sol, 4. *Santo Antão*: Ponta do Sol, Fontainhas (*holotypus ass. reg. 2005: 55*); 5. *Santo Antão*: Ponta do Sol, Fontainhas; 6. Synthesized table.

**Table 63**

**12.1.2. *Diplotaxio hirtae-Kickxietum elegantis* ass. nova hoc loco**  
*(Kickxion elegantis, Kickxietalia elegantis, Asplenietea trichomanis)*

Altitude (1=10 m)	33	33	55
Orientation	N	NE	NE
Area m <sup>2</sup>	4	4	4
Nº of species	4	4	4
Ordinal number	1	2*	3
Characteristic species			
<i>Kickxia elegans</i> •	2	3	1
<i>Diplotaxis hirta</i> •	+	1	1
<i>Polycarpaea gayi</i> •	.	.	2
<i>Campanula bravensis</i> •	+	.	.
Companion species			
<i>Hypodematum crenatum</i>	+	+	.
<i>Pteris vittata</i>	.	+	+

Localities: 1. Fogo: Ribeira da Cruz do Inferno; 2. Fogo: Espigão holotypus (reg. 2006: 29 bis); 3. Fogo: Espigão.

**12.1.1. *Kickxietum webbiana* associatio nova  
hoc loco**

Thermotropical arid to semiarid association, on mafic volcanic rocky fissures, than kept the moist for some time after periods of rainfall. It is frequent in the walls of the northern slopes of the island of Santo Antão. It is well characterized by the island local endemics: *Kickxia webbiana* • and *Diplotaxis gorgadensis* •. [A]. [•]

**12.1.2. *Diplotaxio hirtae-Kickxietum elegan-*  
*tis* associatio nova hoc loco [F].**

Chasmophytic thermotropical semiarid to dry association growing on ultramafic cliff rocks well exposed to the north, in Fogo Island. It is characterized by the local endemism *Diplotaxis hirta* and also by the Cabo Verde endemic chasmophytes: *Kickxia elegans*, *Campanula bravensis* and *Polycarpaea gayi*. [F]. [•].

**12.1.3. *Umbilico schmidtii-Cheilanthes-*  
*acrosticae* associatio nova hoc loco**

Growing on basalt rock crevices and men built walls in Chã das Caldeiras (mesotropical dry), we collect in November 2004 and December 2006, a particular stiff *Cheilanthes acrostica*, the only locality we know in Cabo Verde Islands, with long pseudodindusiae fimbriae and shiny black spores (a local micro-taxon?). It was living with a small *Cosentinia vellea* (subsp. *bivalens* ?), *Umbilicus schmidtii* and the Fogo local endemic *Diplotaxis hirta*. Despite his local occurrence we propose a new association for all populations of *Cheilanthes acrostica* with *Cosentinia vellea* that we know in this small but original territory of Fogo Isle. Type relevé (holotypus): table 64 relevé n. 2. [F]. [•].

**Table 64**

**12.1.3. *Umbilico schmidtii-Cheilanthes-*  
*acrosticae* associatio nova hoc loco**  
*(Kickxion elegantis, Kickxietalia elegantis, Asplenietea trichomanis)*

Altitude (1=10 m)	172	172	169
Orientation	E	E	N
Area m <sup>2</sup>	2	2	10
Nº of species	3	4	7
Ordinal number	1	2*	3
Characteristic species			
<i>Cheilanthes acrostica</i>	2	3	3
<i>Cosentinia vellea</i>	3	1	2
<i>Umbilicus schmidtii</i> •	.	1	+
<i>Diplotaxis hirta</i> •	.	.	1
Companion species			
<i>Anogramma leptophylla</i>	1	.	2
<i>Conyza pannosa</i> •	.	+	.
<i>Micromeria forbesii</i> •	.	.	+
<i>Wahlenbergia lobelioides</i>	.	.	+

Localities: 1. Fogo: Chã das Caldeiras; 2. Fogo: Chã das Caldeiras (holotypus ass. reg. 2004: 37); 3. Fogo: Chã das Caldeiras.

**Table 65**

12.1.4. *Campanuletum jacobaeae* ass. nova hoc loco  
(*Kickxion elegans*, *Kickxietaea elegans*, *Asplenietea trichomanis*)

Altitude (1=10 m)	86	77	144	61
Orientation	NE	NE	N	NW
Area m <sup>2</sup>	8	6	10	4
Nº of species	9	8	6	8
Ordinal number	1*	2	3	4
Characteristic species				
<i>Campanula jacobaea</i> ●	2	2	1	3
<i>Polycarpaea gayi</i> ●	2	2	.	2
<i>Diplotaxis varia</i> ●	2	2	.	.
<i>Kickxia elegans</i> ●	1	1	.	.
<i>Umbilicus schmidtii</i> ●	.	1	2	.
<i>Kickxia dichondrifolia</i> ●	.	.	.	2
Companion species				
<i>Paronychia illecebroides</i> ●	+	+	.	.
<i>Lobularia fruticosa</i> ●	+	.	.	.
<i>Phagnalon melanoleucum</i> ●	.	.	+	+
<i>Musci</i>	.	.	3	.
<i>Sonchus daltonii</i> ●	.	.	1	.
<i>Forskaolea procridifolia</i> ●	+	.	.	.
<i>Lotus jacobaeus</i> ●	+	.	.	.
<i>Micromeria forbesii</i> ●	.	.	+	.

Localities: 1. *Santiago*: Serra da Malagueta (*holotypus* ass. reg. 2006: 14); 2. *Santiago*: Serra da Malagueta; 3. *Santo Antão*: Espungeiro; 4. *Santo Antão*: Posto.

#### 12.1.4. *Campanuletum jacobaeae* associatio nova hoc loco

Chasmophytic association, thermo-mesotropical semiarid to dry, growing on volcanic rocks and cliffs of Serra da Malagueta and Pico da Antónia (Santiago Island), as well as in Santo Antão Island. It is well characterized by the endemic comophyte *Campanula jacobaea* accompanied by other endemic species with similar geobotanic valence: *Polycarpaea gayi*, *Diplotaxis varia*, *Kickxia elegans*, *Umbili-*

*cus schmidtii* and *Kickxia dichondrifolia*.  
3

Type relevé (*holotypus*): table 65 relevé n. 1 [A, SN]. [●].

#### 12.1.5. *Campanulo bravensis-Launaetum thalassicae* associatio nova hoc loco

Thermotropical arid to semiarid chasmophytic association, occurs on volcanic rocks of Brava Island. Characterized by local endemism *Launaea thalassica*, as well as *Campanula bravensis*, *Kickxia elegans* and *Diplotaxis varia*. Type relevé (*holotypus*): table 66 relevé n. 2. [BR]. [●].

**Table 66**

12.1.5. *Campanulo bravensis-Launaetum thalassicae* ass. nova hoc loco  
(*Kickxion elegans*, *Kickxietaea elegans*, *Asplenietea trichomanis*)

Altitude (1=10 m)	59	72	62	53	59	61
Orientation	NW	N	N	W	NE	
Area m <sup>2</sup>	4	4	4	4	4	
Nº of species	6	5	6	5	5	5
Ordinal number	1	2*	3	4	5	6
Characteristic species						
<i>Launaea thalassica</i> ●	3	1	1	1	1	V
<i>Campanula bravensis</i> ●	2	2	2	2	1	V
<i>Kickxia elegans</i> ●	2	2	3	3	3	V
<i>Diplotaxis varia</i> ●	.	.	.	.	2	I
Companion species						
<i>Daucus insularis</i> ●	1	1	1	+	.	IV
<i>Pteris vittata</i>	1	.	.	1	1	III
<i>Lotus purpureus</i> ●	.	1	+	.	.	II
<i>Conyza varia</i> ●	+	.	.	.	.	I
<i>Oxalis corniculata</i>	.	.	1	.	.	I

Localities: 1. *Brava*: Espadão; 2. *Brava*: Senhora do Monte (relevé J.C. Costa & I. Gomes, *holotypus* ass. reg. 2014: 15); 3. *Brava*: Cova Joana; 4. *Brava*: Figueira Grande; 5. *Brava*: Campo Baixo; 5. Synthesized table.

13. PARIETARIETEA JUDAICAE Rivas-Martínez in Rivas Goday, Veg. Fl. Guadiana: 104. 1964

Rupicolous, nitrophilous, sometimes epiphytic plant communities, consisting in chasmophyte or comophyte species, demanding nitrates and ammonium salts of organic origin. Cosmopolite distribution, mostly in urban and rural areas.

Characteristic species and bioindicators growing in Cabo Verde Islands: *Asplenium trichomanes* subsp. *quadrivalens*, *Cymbalaria muralis*, *Ficus carica*, *Parietaria judaica*.

*Typus*: 13a. *Parietarietalia judaicae* (Rivas-Martínez 1960) Rivas Goday 1964

13a. *PARIETARIETALIA JUDAICAE* (Rivas-Martínez 1960) Rivas Goday, Veg. Fl. Guadiana: 104. 1964

[*Parietarietalia muralis* Rivas-Martínez in Anales Real Acad. Farm.: 26(1): 165. 1960 (arts. 34, 39, rec. 11c)]

Single order

Characteristic species and bioindicators growing in Cabo Verde Islands: see classis 13.

*Typus*: *Parietario diffusae-Centranthion rubri* Rivas-Martínez in Anales Real Acad. Farm.: 26 (2): 165. 1960

13.1. ***Adiantum inciso-philippensis*** alliance nova hoc loco

Tropical desertic and xeric nitrophilous and seminitrophilous communities, growing on shadow walled urban refuges in Cabo Verde Islands, except in the hyperarid eastern isles. [A, V, N, SN, F, BR].

Characteristic species and bioindicators growing in Cabo Verde Islands: *Adiantum incisum*, *Adiantum philippense*, *Hypodematum crenatum*.

*Typus*: 13.1.1. *Adiantetum inciso-philippensis* ass. nova hoc loco

13.1.1. ***Adiantetum inciso-philippensis*** association nova hoc loco

Thermotropical arid to dry association, growing on nitrogen-rich urban and rural shadow and often wet walls. It is characterized by the tropical sahelic ferns: *Adiantum philippense*, *Adiantum incisum* and *Hypodematum crenatum* (*holotypus* table 67 relevé n. 1). It occurs in Santo Antão, São Vicente, S. Nicolau, Santiago, Fogo and Brava Islands. [A, V, N, SN, F, BR]

Table 67

13.1.1. ***Adiantetum inciso-philippensis*** ass. nova hoc loco

	34	34
Altitude (1=10 m)		
Orientation	NW	NW
Area m <sup>2</sup>	4	4
Number species	4	4
Ordinal number	1*	2
Characteristic species		
<i>Adiantum philippense</i>	3	2
<i>Adiantum incisum</i>	2	2
<i>Hypodematum crenatum</i>	+	2
Companion species		
<i>Arthraxon lancifolius</i>	+	.
<i>Forsskaolea procridifolia</i> •	.	+

Localities: 1. *Fogo*: Pai António, nitrogen-rich shady wall (*holotypus* ass. reg. 2006: 33); 2. *Fogo* Pai António, Mosteiros.

14. POLYGO ARENSTRI-POETEA ANNUAE Rivas-Martínez 1975

Pioneer communities of nitrophilous therophytes, with creeping annual and perennials species, adapted to compacted tramped soils due to trampling paths of urban and rural areas. Cosmopolitan distribution. [A, V, N, SL, BO, M, SN, F, BR].

Characteristic species and bioindicators growing in Cabo Verde Islands: *Lepidium didymum*, *Polycarpon tetraphyllum*.

*Typus*: *Polygono arenastri-Poetalia annuae* Tüxen in Géhu & al. 1972 corr. Rivas-Martínez & al. 1991

14a. *EUPHORBIETALIA PROSTRATO-HIRTAE* ordo novus hoc loco

Urban, ruderal rural and road nitrophilous communities formed by annual prostrate or erect small size plants, which are developed on soils subjected to continuous trampling by humans or domesticated animals. From paleotropical origin

infra-mesotropical hyperarid-subhumid, reached as neophytic infra-mesomediterranean, submediterranean, subtropical and infratemperate.

*Typus*: *Euphorbion prostratae* Rivas-Martínez 1976

Characteristic species and bioindicators growing in Cabo Verde Islands: *Alternanthera pungens*, *Euphorbia canescens*, *Euphorbia forsskalii*, *Euphorbia glaucocephala*, *Euphorbia hirta*, *Euphorbia inequilatera*, *Euphorbia prostrata*, *Euphorbia granulata*, *Euphorbia scordifolia*, *Euphorbia serpens*.

14.1. ***Trianthemion portulacastri*** alliance nova hoc loco

Annual ruderal-road, urban and rural strong nitrified communities, formed by small erect and prostrate quick growing plants, infra-thermotropical, hyperarid to arid. Occur in all the islands of Cabo Verde.

Table 68

14.1.1. *Triathemetum portulacastri* ass. nova hoc loco

(Trianthemion portulacastri, Euphorbieta prostrato-hirtae, Polygono-Poetea anuae)

	32	70	60	15	5	25	3	3	30	115	50	8	8	164	170	5	20	115	8	8	8	8	71	
Altitude (m)																								
Area m <sup>2</sup>	4	2	10	10	4	4	4	4	4	2	2	4	6	4	4	2	10	2	4	4	4	4	.4	
Nº of species	7	7	6	7	7	5	3	5	7	5	3	4	6	6	6	4	7	4	4	3	3	5	5	
Order number	1	2	3	4	5	6*	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
Characteristic species																								
<i>Trianthema portulacastrum</i>	.	.	.	.	3	3	3	2	2	1	+	2	+	3	2	3	3	2	4	2	4	2	V	
<i>Alternanthera pungens</i>	1	3	3	1	3	2	4	3	3	2	3	3	4	2	2	.	.	.	.	.	.	.	IV	
<i>Euphorbia serpens</i>	3	.	+	.	2	2	.	.	3	.	1	3	.	.	.	.	1	.	.	.	.	.	II	
<i>Talinum paniculatum</i>	.	.	.	.	.	.	.	.	2	.	.	1	.	.	.	.	3	2	3	3	4	II		
<i>Eleusine indica</i>	1	+	.	.	+	+	.	.	.	.	.	1	.	.	.	.	+	.	.	.	.	.	II	
<i>Euphorbia prostrata</i>	3	+	.	.	2	.	.	1	.	.	.	.	.	.	.	.	.	2	.	.	.	.	II	
<i>Zaleya pentandra</i>	.	.	3	2	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	
<i>Euphorbia granulata</i>	.	1	.	2	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	I	
<i>Lepidium didymum</i>	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	
<i>Euphorbia hirta</i>	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	
<i>Eragrostis minor</i>	.	.	.	1																			+	
Companion species																								
<i>Portulaca oleracea</i>	2	2	.	.	1	.	.	.	2	.	2	+	1	.	3	.	2	1	.	.	1	III		
<i>Corchorus depressus</i>	.	.	.	1	.	3	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	I		
<i>Amaranthus spinosus</i>	.	.	.	.	.	1	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	I		
<i>Chloris virgata</i>	.	.	.	.	.	.	+	1	.	.	1	.	.	.	.	.	.	.	.	.	.	I		
<i>Mollugo verticillata</i>	3	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	
<i>Chenopodium murale</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.	.	.	.	.	.	+		
<i>Setaria verticillata</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.	.	.	.	.	.	+		
<i>Dactyloctenium aegyptium</i>	.	.	.	.	.	.	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	+		
<i>Amaranthus caudatus</i>	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	+	.	I			
<i>Sida salviifolia</i>	.	.	.	.	.	.	.	.	.	.	.	+	.	.	1	.	.	.	.	.	.	+		

Other companion species: *Achyranthes aspera* 3 in 17; *Amaranthus graecizans* 3 in 4; *Tetragonia tetragonoides* 2 in 2; *Bidens bipinnata* 2 in 14; *Schmidia pappophoroides* 2 in 15; *Peristrophe paniculata* 2 in 17; *Ageratum conyzoides* 1 in 2; *Rhynchosia minima* 1 in 3; *Mollugo nudicaulis* 1 in 15; *Amaranthus cruentus* + in 1; *Digitaria horizontalis* + in 2; *Salvia aegyptiaca* + in 3; *Malvastrum coromandelianum* + in 3; *Tribulus terrestris* + in 9; *Cynodon dactylon* + in 11; *Cucumis anguria* + in 17; *Cuscuta umbellata* + 22; *Sesuvium sesuvioides* + in 22.

Localities: 1, 9. *Santiago*: Praia; 2. *São Vicente*: Monte Verde, Antenas; 3. *Boavista*: Fundo de Figueiras; 4: *Maio*: Vila de Maio; 5. *Santiago*: Praia, Porto; 6 *Santiago*: Praia, eroporto (*holotypus* ass. reg. 2004: 18); 7, 8. *Santiago*: Tarrafal; 10, 18. *Fogo*: S. Filipe; 11. *Santo Antão*: Ponta do Sol; 12, 13. *São Nicolau*: Preguiça; 14. *São Nicolau*: Ribeira Brava; 15. *São Nicolau*: Jalunga; 16, 17. *Santiago*: S. Francisco; 19, 20, 21, 22. *São Vicente*: Mindelo; 23. Synthesized table.

*Typus*: *Trianthemetum portulacastri* ass. nova hoc loco

Characteristic species and bioindicators growing in Cabo Verde Islands: *Trianthema portulacastri*, *Boerhavia repens*, *Oldenlandia corymbosa*, *Talinum paniculatum*, *Zaleya pentandra*. [A, V, N, SL, BO, M, SN, F, BR].

#### 14.1.1. *Trianthemetum portulacastri* association nova hoc loco

Infra-thermotropical hyperarid-arid association, ruderal-nitrophilous urban and road, formed by small annual plants erect or prostrate (*Trianthema portulacastri*, *Alternanthera pungens*, *Euphorbia serpens*, *Euphorbia prostrata*, *Talinum paniculatum*, *Eleusine indica*, *Zaleya pentandra*, etc.), with Sahel-Sudanic and Cabo Verde distribution. Type relevé (*holotypus*): table 68 relevé n. 6. [A, V, N, SL, BO, M, SN, F, BR].

#### 14.1.2. *Euphorbio hirtae-Boerhavietum repentis* associatio nova hoc loco

Infra-thermotropical hyperarid-semiarid association, ruderal-nitrophilous, on swampy coarse volcanic sands, characterized by small annual plants like *Boerhavia repens*, *Euphorbia hirta*, *Alternanthera pungens*, *Euphorbia prostrata*, *Eleusine indica*, etc. in Cabo Verde Islands. Type relevé (*holotypus*): table 69 relevé n. 2. [A, V, N, BO, M, SN].

#### 14.1.3. *Oldenlandietum corymbosae* associatio nova hoc loco

Thermotropical hyperarid to semiarid association, growing on gravelly places, characterized by the small annual plant *Oldenlandia corymbosa*, in Cabo Verde Islands. Type relevé (*holotypus*): table 69 relevé n. 8. [A, V, N, BO, M, SN].

**Table 69**  
**14.1.2. *Euphorbia hirtae*-*Boerhavietum repentis* ass. nova hoc loco**  
**14.1.3. *Oldenlandietum corymbosae* ass. nova hoc loco**

	(Trianthemion portulacastri, Euphorbieta prostrato-hirtae, Polygono-Poetea annuae)							
Altitude (m)	68	68	580	30	20	750	262	320
Area m <sup>2</sup>	1	1	2	4	4	4		2
Number of species	5	7	6	6	7	9	6	5
Ordinal number	1	2*	3	4	5	6	7	8*
Characteristic species								
<i>Boerhavia repens</i>	2	4	1	1	+	.	V	.
<i>Euphorbia hirta</i>	2	2	1	1	.	2	V	.
<i>Alternanthera pungens</i>	.	.	3	3	2	3	IV	1
<i>Euphorbia prostrata</i>	2	+	1	.	2	.	IV	.
<i>Eleusine indica</i>	.	.	2	+	.	1	III	2
<i>Euphorbia serpens</i>	.	.	.	.	.	2	I	1
<i>Zaleya pentandra</i>	.	.	.	.	2	.	I	.
<i>Gomphrena globosa</i>	.	.	2	.	.	.	I	.
<i>Euphorbia canescens</i>	1	.	.	.	.	.	I	.
<i>Eragrostis minor</i>	.	.	.	+	.	.	I	.
<i>Oldenlandia corymbosa</i>	.	.	.	.	.	.	.	3
companion species								
<i>Portulaca oleracea</i>	1	1	+	.	+	.	IV	1

Other companion species: *Leucas martinicensis* 1 in 2; *Phyllanthus* sp. 1 in 2; *Amaranthus graecizans* 1 in 4; *Corchorus depressus* 1 in 5; *Heliotropium crispum* 1 in 5; *Chloris virgata* 1 in 6; *Chloris pycnothrix* 1 in 6; *Polypogon viridis* 1 in 6; *Kohautia aspera* + in 2; *Chenopodium murale* + in 6.

Localities: 1. Santiago: São Francisco; 2\*. Santiago: São Francisco (*holotypus ass. reg.* 2004: 16); 3 Santiago: Assomada; 4. Santo Antão: Ribeira Grande; 5. Santo Antão: Porto Novo; 6. Santiago: Serra da Malagueta; 7. Synthesized table; 8\*. Fogo: Pai António (*holotypus ass. reg.* 2006: 35).

15. STELLARIETEA MEDIAE Tüxen, Lohmeyer & Preising ex von Rochow 1951

Nitrophilous or semi-nitrophilous vegetation, consisting on annual ephemeral plants, that inhabit in nitrogenous rich matter substrates: usually in disturbed soils in urban and agricultural areas, including fringe of paths and roads, crops, etc. Cosmopolitan distribution, except very warm tropical territories. [A, V, N, SL, BO, M, SN, F, BR]

Characteristic species in Cabo Verde Islands: *Apium leptophyllum*, *Arabidopsis thaliana*, *Avena fatua*, *Bromus diandrus*, *Bromus madritensis*, *Centaurea melitensis*, *Cyperus rotundus*, *Digitaria sanguinalis*, *Eragrostis barrelieri*, *Galinsoga quadriradiata*, *Misopates orontium*, *Mollugo cerviana*, *Paspalum vaginatum*, *Patellifolia patellaris*, *Plantago afra*, *Polypogon viridis*, *Setaria pumila*, *Setaria verticillata*, *Solanum nigrum*, *Sonchus oleraceus*.

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

15a. *CHENPODIETALIA MURALIS* Br.-Bl. in Br.-Bl., Gajewski, Wraber & Walas 1936 em. Rivas-Martínez 1977

Nitrophilous plant communities, markedly rich in annual cosmopolitan species, common in Mediterranean region, reaching temperate or warm tropical areas, mostly dry to semi-arid bioclimate. [A, V, N, SL, BO, M, SN, F, BR]

Characteristic species in Cabo Verde Islands: *Aizoon canariense*, *Amaranthus graecizans*, *Emex spinosa*, *Patellifolia procumbens*, *Portulaca oleracea*.

*Typus*: 15.1 *Chenopodium muralis* Br.-Bl. in Br.-Bl., Gajewski, Wraber & Walas 1936

15.1. *Chenopodium muralis* Br.-Bl. in Br.-Bl., Gajewski, Wraber & Walas 1936

Urban and rural high nitrophilous associations, with Mediterranean optimal, Eurosiberian irradiation and reaching high populated tropical territories. [A, V, N, SL, BO, M, SN, F, BR]

Characteristic species in Cabo Verde Islands: *Amaranthus viridis*, *Chenopodium murale*, *Erigeron bonariensis*, *Datura stramonium*, *Malva parviflora*, *Tribulus terrestris*.

*Typus*: *Chenopodietum muralis* Br.-Bl. in Br.-Bl., Gajewski, Wraber & Walas 1936

15.1.1. *Chenopodium murale* and *Malva parviflora* community

High nitrified stations and wide spraed annual ruderal cosmopolite neophytic community [A, V, N, SL, BO, M, SN, F, BR].

16. RUDERO-MANIHOTETEA UTILISSIMAE Leonard in Taton 1949

Ruderal, anthropic and nitrophilous vegetation, trampled soils, debris and road edges and arvense vegetation, thermotropical dry to humid, with pantropical distribution.

16a. *BIDENTETALIA PILOSAE* Lebrun in Mullenders 1949

Weed vegetation communities on dry and subhumid land and grass in tropical Afro-Asiatic territories.

16.1. *Ecliption prostratae* Lebrun 1947

Afrotropical weed vegetation.

Characteristic species and bioindicators growing in Cabo Verde Islands: *Eclipta prostrata*, *Bidens pilosa*.

## Indexes

### 5a. Alphabetic list of Cabo Verde endemic vascular plants and taxa mentioned in the text

- Abrus precatorius* L. subsp. *africanus* Verdc. (Fabaceae)  
*Abutilon pannosum* (G.Forst.) Schltdl. (Malvaceae)  
*Acacia caboverdeana* Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte (Fabaceae) •  
*Acanthospermum hispidum* DC. (Asteraceae)  
*Achyranthes aspera* L. (Amaranthaceae)  
*Acrache racemosa* (B.Heyne ex Roth) Ohwi (Poaceae)  
*Actiniopteris radiata* (Sw.) Link (Pteridaceae)  
*Adiantum capillus-veneris* L. subsp. *trifidum* (Willd. ex Bolle)  
 Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte (Pteridaceae)  
*Adiantum incisum* Forssk. (Pteridaceae)  
*Adiantum philippense* L. (Pteridaceae)  
*Aeonium gorgoneum* J.A.Schmidt (Crassulaceae) •  
*Aerva javanica* (Burm. f.) Juss. ex Schult. (Amaranthaceae)  
*Ageratina adenophora* (Spreng.) R.M.King & H.Rob. (Asteraceae)  
*Ageratum conyzoides* (L.) L. (Asteraceae)  
*Aizoon canariense* L. (Aizoaceae)  
*Ajuga iva* (L.) Schreb. (Lamiaceae)  
*Aloe vera* (L.) Burm. f. (Xanthorrhoeaceae)  
*Alternanthera pungens* Kunth (Amaranthaceae)  
*Amaranthus caudatus* L. (Amaranthaceae)  
*Amaranthus cruentus* L. (Amaranthaceae)  
*Amaranthus graecizans* L. (Amaranthaceae)  
*Amaranthus spinosus* L. (Amaranthaceae)  
*Amaranthus viridis* L. (Amaranthaceae)  
*Ammannia senegalensis* Lam. (Lythraceae)  
*Andrachne telephiooides* L. (Phyllanthaceae)  
*Andropogon fastigiatus* Sw. (Poaceae)  
*Andropogon gayanus* Kunth (Poaceae)  
*Andropogon gayanus* var. *tridentatus* Hack. (Poaceae)  
*Andropogon tridentatus* (v. *Andropogon gayanus* var. *tridentatus*)  
*Anogramma leptophylla* (L.) Link (Pteridaceae)  
*Apium leptophyllum* (Pers.) F.Muell. ex Benth. (Apiaceae)  
*Arabidopsis thaliana* (L.) Heynh. (Brassicaceae)  
*Aristida adscensionis* L. (Poaceae)  
*Aristida cardosoi* Cout. (Poaceae) •  
*Aristida funiculata* Trin. & Rupr. (Poaceae)  
*Artemisia gorgonum* Webb (Asteraceae) •  
*Arthraxon lancifolius* (Trin.) Hochst. (Poaceae)  
*Arthrocnemum franzii* Sukhor. (Amaranthaceae) •  
*Arundo donax* L. (Poaceae)  
*Asparagus squarrosum* J.A. Schmidt (Asparagaceae) •  
*Asphodelus marioi* Rivas Mart., J.C. Costa & Maria C. Duarte (Xanthorrhoeaceae) •  
*Asplenium aethiopicum* (Burm. f.) Bech. subsp. *braitwaitii* Ormonde (Aspleniaceae)  
*Asplenium trichomanes* L. subsp. *quadrivalens* D.E. Mey. (Aspleniaceae)  
*Asteriscus daltonii* (Webb) Walp. (Asteraceae) •  
*Asteriscus smithii* (Webb) Walp. (Asteraceae) •  
*Asteriscus vogelii* (Webb) Walp. (Asteraceae) •  
*Avena fatua* L. (Poaceae)  
*Bidens bipinnata* L. (Asteraceae)  
*Bidens pilosa* L. (Asteraceae)  
*Blainvillea gayana* Cass. (Asteraceae)  
*Blutaparon vermiculare* (L.) Mears (Amaranthaceae)  
*Boerhavia coccinea* Mill. (Nyctaginaceae)  
*Boerhavia diffusa* L. (Nyctaginaceae)  
*Boerhavia repens* L. (Nyctaginaceae)  
*Bothriochloa bladhii* (Retz.) S.T.Blake (Poaceae)  
*Bothriochloa insculpta* (A.Rich.) A.Camus (Poaceae)
- Brachiaria caboverdeana* (Conert & C.Köhler) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte (Poaceae) •  
*Brachiaria deflexa* (Schumach.) C.E.Hubb. ex Robyns (Poaceae)  
*Brachiaria ramosa* (L.) Stapf (Poaceae)  
*Brachiaria xantholeuca* (Schinz) Stapf (Poaceae)  
*Brachypodium distachyon* (L.) P.Beauv. (Poaceae)  
*Bromus diandrus* Roth (Poaceae)  
*Bromus madritensis* L. (Poaceae)  
*Bulbostylis barbata* (Rottb.) C.B.Clarke (Cyperaceae)  
*Cajanus cajan* (L.) Millsp. (Fabaceae)  
*Calotropis procera* (Aiton) Dryand. (Asclepiadaceae)  
*Campanula bravensis* (Bolle) A.Chev. (Campanulaceae) •  
*Campanula feijoana* Gardère (Campanulaceae) •  
*Campanula hortelensis* Gardère (Campanulaceae) •  
*Campanula jacobaea* C.Sm. ex Webb (Campanulaceae) •  
*Campylanthus glaber* Benth. (Plantaginaceae) •  
*Campylanthus spathulatus* A.Chev. (Plantaginaceae) •  
*Carex antoniensis* A.Chev. (Cyperaceae) •  
*Carex hansenii* (Lewej. & Lobin) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte (Cyperaceae) •  
*Caylusea hexagyna* (Forssk.) M.L.Green (Resedaceae)  
*Cenchrus ciliaris* L. (Poaceae)  
*Cenchrus echinatus* L. (Poaceae)  
*Centaurea melitensis* L. (Asteraceae)  
*Centaurium viridense* (Bolle) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte •  
*Cheilanthes acrostica* (Balb.) Tod. (Pteridaceae)  
*Chenopodium ambrosioides* L. (Chenopodiaceae)  
*Chenopodium murale* L. (Amaranthaceae)  
*Chloris pilosa* Schumach. & Thonn. (Poaceae)  
*Chloris pycnothrix* Trin. (Poaceae)  
*Chloris virgata* Sw. (Poaceae)  
*Cistanche brunneri* (Webb) Bég. (Orobanchaceae)  
*Citrullus colocynthis* (L.) Schrad. (Cucurbitaceae)  
*Cleome brachycarpa* (Forssk.) Vahl ex DC. (Cleomaceae)  
*Cleome scaposa* DC. (Cleomaceae)  
*Cleome viscosa* L. (Cleomaceae)  
*Cocculus pendulus* (J.R.Forst. & G.Forst.) Diels (Menispermaceae)  
*Commelinia benghalensis* L. (Commelinaceae)  
*Commicarpus helenae* (Roem. & Schult.) Meikle (Nyctaginaceae)  
*Convolvulus prostratus* Forssk. (Convolvulaceae)  
*Conyza feae* (Bég.) Wild (Asteraceae) •  
*Conyza pannosa* Webb (Asteraceae) •  
*Conyza schlechtendalii* Bolle (Asteraceae) •  
*Conyza varia* (Webb) Wild (Asteraceae) •  
*Corchorus depressus* (L.) Stocks (Malvaceae)  
*Corchorus tridens* L. (Malvaceae)  
*Corchorus trilocularis* L. (Malvaceae)  
*Cosentinia vellea* (Aiton) Tod. (Hemionitidaceae)  
*Cressa salina* (J.A. Schmidt) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte (Convolvulaceae) •  
*Crotalaria retusa* L. (Fabaceae)  
*Crotalaria senegalensis* (Pers.) DC. (Fabaceae)  
*Cucumis anguria* L. (Cucurbitaceae)  
*Cuscuta umbellata* Kunth (Convolvulaceae)  
*Cymbalaria muralis* P.Gaertn., B.Mey. & Scherb. (Plantaginaceae)  
*Cymodocea nodosa* (Ucria) Asch.  
*Cynodon dactylon* (L.) Pers. (Poaceae)  
*Cyperus conglomeratus* Rottb. (Cyperaceae)  
*Cyperus crassipes* Vahl (Cyperaceae)  
*Cyperus involucratus* Rottb. (Cyperaceae)  
*Cyperus laevigatus* L. (Cyperaceae)  
*Cyperus rotundus* L. (Cyperaceae)  
*Cystopteris fragilis* (L.) Bernh. (Cystopteridaceae)  
*Dactyloctenium aegyptium* (L.) Willd. (Poaceae)  
*Dalechampia parviflora* Lam. (Euphorbiaceae)

- Dalechampia scandens* var. *cordofana* (Hochst. ex Webb) Müll.Arg. (Euphorbiaceae)
- Datura stramonium* L. (Solanaceae)
- Daucus annuus* (Beg.) Wojew. et al.
- Daucus annuus* (Bég.) Wojew., Reduron, Banasiak & Spalik (Apiaceae) •
- Daucus humilis* (Lobin & K.H. Schmidt) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte (Apiaceae) •
- Daucus insularis* (Parl. ex Webb) Spalik, Wojew., Banasiak & Reduron (Apiaceae) •
- Daucus ribeirensis* (Schmidt & Lobin) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte (Apiaceae) •
- Daucus tenuissimus* (A.Chev.) Spalik, Wojew., Banasiak & Reduron (Apiaceae) •
- Davallia canariensis* (L.) Sm. (Davalliaceae)
- Desmanthus virgatus* (L.) Willd. (Fabaceae)
- Desmodium ospriostreblum* Chiov. (Fabaceae)
- Desmodium tortuosum* (Sw.) DC. (Fabaceae)
- Dichanthium annulatum* (Forssk.) Stapf (Poaceae)
- Dichanthium foveolatum* (Delile) Roberty (Poaceae)
- Dichrostachys cinerea* (L.) Wight & Arn. subsp. *platycarpa* (W.Bull) Brenan & Brummitt (Fabaceae)
- Dichrostachys platycarpa* W. Bull (v. *Dichrostachys cinerea* (L.) Wight & Arn. subsp. *platycarpa* (W.Bull) Brenan & Brummitt)
- Dicliptera verticillata* (Forssk.) C.Chr. (Acanthaceae)
- Didymodon tophaceus* (Bridel) Lisa
- Digitaria eriantha* Steud. (Poaceae)
- Digitaria horizontalis* Willd. (Poaceae)
- Digitaria nodosa* Parl. (Poaceae)
- Digitaria nuda* Schumach. (Poaceae)
- Digitaria sanguinalis* (L.) Scop. (Poaceae)
- Diplotaxis antoniensis* Rustan (Brassicaceae) •
- Diplotaxis brochmannii* (Rustan) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte (Brassicaceae) •
- Diplotaxis glauca* (Schmidt) O.E.Schulz (Brassicaceae) •
- Diplotaxis gorgadensis* Rustan (Brassicaceae) •
- Diplotaxis gracilis* (Webb) O.E.Schulz (Brassicaceae) •
- Diplotaxis hirta* (A.Chev.) Rustan & L.Borgen (Brassicaceae) •
- Diplotaxis sindingii* Rustan (Brassicaceae) •
- Diplotaxis varia* Rustan (Brassicaceae) •
- Diplotaxis vogelii* (Webb) Cout. (Brassicaceae) •
- Dracaena caboverdeana* (Marrero Rodr. & R.S. Almeida Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte (Asparagaceae) •
- Dryopteris gorgonea* J.P.Roux (Dryopteridaceae) •
- Echinochloa colona* (L.) Link (Poaceae)
- Echium glabrescens* Pett. (Boraginaceae) •
- Echium hypertropicum* Webb (Boraginaceae) •
- Echium lindbergii* Pett. (Boraginaceae) •
- Echium stenosiphon* Webb (Boraginaceae) •
- Echium vulcanorum* A.Chev. (Boraginaceae) •
- Eclipta prostrata* (L.) L. (Asteraceae)
- Eleusine indica* (L.) Gaertn. (Poaceae)
- Elionurus royleanus* Nees ex A.Rich. (Poaceae)
- Emex spinosa* (L.) Campd. (Polygonaceae)
- Enneapogon desvauxii* P.Beauv. (Poaceae)
- Enteropogon prieurii* (Kunth) Clayton (Poaceae)
- Enteropogon rupestris* (J.A.Schmidt) A.Chev. (Poaceae)
- Eragrostis barbieri* Daveau (Poaceae)
- Eragrostis ciliaris* (L.) R.Br. (Poaceae)
- Eragrostis conertii* Lobin (Poaceae) •
- Eragrostis minor* Host (Poaceae)
- Erigeron bonariensis* L. (Asteraceae)
- Erysimum caboverdeanum* (A. Chev.) Sunding (Brassicaceae) •
- Eucladium verticillatum* (Hedw.) Bruch & Schimp. (Pottiaceae)
- Euphorbia canescens* L. (Euphorbiaceae)
- Euphorbia forskalii* J. Gay (Euphorbiaceae)
- Euphorbia glaucophylla* Poir. (Euphorbiaceae)
- Euphorbia granulata* Forssk. (Euphorbiaceae)
- Euphorbia hirta* L. (Euphorbiaceae)
- Euphorbia hypericifolia* (L.) Millsp. (Euphorbiaceae)
- Euphorbia inequilatera* Sond. (Euphorbiaceae)
- Euphorbia prostrata* Aiton (Euphorbiaceae)
- Euphorbia scordifolia* Jacq. (Euphorbiaceae)
- Euphorbia serpens* Kunth (Euphorbiaceae)
- Euphorbia tuckeyana* Steud. ex Webb (Euphorbiaceae) •
- Fagonia cretica* L. (Zygophyllaceae)
- Fagonia isotricha* Murb. (Zygophyllaceae)
- Fagonia latifolia* Delile (Zygophyllaceae)
- Fagonia mayana* Schlehd. (Zygophyllaceae) •
- Ficus carica* L. (Moraceae)
- Ficus gnaphalocarpa* (v. *Ficus sycomorus* L subsp. *gnaphalocarpa*)
- Ficus sur* Forssk. (Moraceae)
- Ficus sycomorus* L susbp. *gnaphalocarpa* (Miq.) C. C. Bery (Moraceae).
- Foeniculum vulgare* Mill. (Apiaceae)
- Forsskaolea procridifolia* Webb (Urticaceae) •
- Frankenia caboverdeana* (Brochmann, Lobin & Sunding) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte (Frankeniaceae) •
- Frankenia montana* (Brochmann, Lobin & Sunding) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte (Frankeniaceae) •
- Frankenia pseudoericifolia* Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte (Frankeniaceae) •
- Furcraea foetida* (L.) Haw. (Asparagaceae)
- Galinsoga quadriradiata* Ruiz & Pav. (Asteraceae)
- Galium parisiense* L. (Rubiaceae)
- Globularia amygdalifolia* Webb (Plantaginaceae) •
- Gomphrena globosa* L. (Amaranthaceae)
- Grevillea robusta* A.Cunn. ex R.Br. (Proteaceae)
- Grewia villosa* Willd. (Malvaceae)
- Gymnocarpos sclerocephalus* (Decne.) Dahlgren & Thulin (Caryophyllaceae)
- Helianthemum gorgoneum* Webb (Cistaceae) •
- Helichrysum nicolai* N. Kilian, Galbany & Oberpr. (Asteraceae) •
- Heliotropium crispum* Desf. (Boraginaceae)
- Heliotropium curassavicum* L. (Boraginaceae)
- Heliotropium pterocarpum* (DC. & A.DC.) Hochst. & Steud. ex Bunge (Boraginaceae)
- Heteropogon contortus* (L.) P.Beauv. ex Roem. & Schult. (Poaceae)
- Heteropogon melanocarpus* (Elliott) Benth. (Poaceae)
- Hyparrhenia caboverdeana* Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte (Poaceae) •
- Hypodematum crenatum* (Forssk.) Kuhn (Dryopteridaceae)
- Hyptis pectinata* (L.) Poit. (Lamiaceae)
- Indigastrum parviflorum* (Wight & Arn.) Schrire (Fabaceae)
- Indigofera canescens* Lam. (Fabaceae)
- Indigofera senegalensis* Lam. (Fabaceae)
- Indigofera suffruticosa* Mill. (Fabaceae)
- Indigofera tinctoria* L. (Fabaceae)
- Indigofera tinctoria* L. subsp. *microcarpa* (A. Chev.) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte (Fabaceae) •
- Ipomoea asarifolia* (Desr.) Roem. & Schult. (Convolvulaceae)
- Ipomoea batatas* (L.) Lam. (Convolvulaceae)
- Ipomoea cairica* (L.) Sweet (Convolvulaceae)
- Ipomoea eriocarpa* R. Br. (Convolvulaceae)
- Ipomoea kotschyana* Hochst. ex Choisy (Convolvulaceae)
- Jatropha curcas* L. (Euphorbiaceae)
- Kickxia dichondrifolia* (Benth.) Janch. (Plantaginaceae) •
- Kickxia elegans* (G. Forst.) D.A.Sutton (Plantaginaceae) •
- Kickxia webbiana* (J.A.Schmidt) Sunding (Plantaginaceae) •
- Kohautia aspera* (B.Heyne ex Roth) Bremek. (Rubiaceae)
- Lantana camara* L. (Verbenaceae)
- Launaea arborescens* (Batt.) Murb. subsp. *melanostigma* (Pett.) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte (Asteraceae) •

- Launaea gorgadensis* (Bolle) N.Kilian (Asteraceae) •  
*Launaea intybacea* (Jacq.) Beauverd (Asteraceae)  
*Launaea picridioides* (Webb) Engl. (Asteraceae) •  
*Launaea thalassica* N. Kilian, Brochmann & Rustan (Asteraceae) •  
*Lavandula coronopifolia* Poir. (Lamiaceae)  
*Lavandula dentata* L. (Lamiaceae)  
*Lavandula rotundifolia* Benth. (Lamiaceae) •  
*Lemna minor* L. (Araceae)  
*Lepidium didymum* L. (Brassicaceae)  
*Leptochloa panicea* (Retz.) Ohwi (Poaceae)  
*Leucaena leucocephala* (Lam.) de Wit (Fabaceae)  
*Leucas martinicensis* (Jacq.) R.Br. (Lamiaceae)  
*Limonium braunii* (Bolle) A. Chev. (Plumbaginaceae) •  
*Limonium brunneri* (Webb) Kuntze (Plumbaginaceae) •  
*Limonium jovi-barba* (Webb) Kuntze (Plumbaginaceae) •  
*Limonium lobinii* N. Kilian & T. Leyens (Plumbaginaceae) •  
*Limonium sundingii* Leyens, Lobin, N. Kilian & Erben (Plumbaginaceae) •  
*Lobularia fruticosa* (Webb ex Christ) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte (Brassicaceae) •  
*Lobularia spathulata* (J. A. Schmidt) O.E. Schulz (Brassicaceae) •  
*Lotus alianus* J.H. Kirkbr. (Fabaceae) •  
*Lotus arborescens* Lowe ex Cout. (Fabaceae) •  
*Lotus brunneri* Webb (Fabaceae) •  
*Lotus chevalieri* Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte (Fabaceae) •  
*Lotus jacobaeus* L. (Fabaceae) •  
*Lotus jacobaeus* var. *villosus* A. Chev. (Fabaceae) •  
*Lotus latifolius* Brand (Fabaceae) •  
*Lotus purpureus* Webb (Fabaceae) •  
*Lotus villosus* Forsk. (Fabaceae)  
*Macrotyloma daltonii* (Webb) Verdc. (Fabaceae)  
*Malva parviflora* L. (Malvaceae)  
*Malvastrum americanum* (L.) Torr. (Malvaceae)  
*Malvastrum coromandelianum* (L.) Garcke (Malvaceae)  
*Melanoselinum bischoffii* (J.A.Schmidt) A.Chev. (Apiaceae) •  
*Melania ovata* (Cav.) Spreng. (Stwerculiaceae)  
*Melinis grandiflora* (v. *Melinis repens* subsp. *grandiflora*)  
*Melinis minutiflora* P. Beauv. (Poaceae)  
*Melinis repens* (Willd.) Zizka (Poaceae)  
*Melinis repens* subsp. *grandiflora* (Hochst.) Zizka (Poaceae)  
*Mentzelia aspera* L. (Loasaceae)  
*Merremia aegyptia* (L.) Urb. (Convolvulaceae)  
*Micromeria forbesii* Benth. (Lamiaceae) •  
*Misopates orontium* (L.) Raf. (Plantaginaceae)  
*Mollugo cerviana* (L.) Ser. (Molluginaceae)  
*Mollugo nudicaulis* Lam. (Molluginaceae)  
*Mollugo verticillata* L. (Molluginaceae)  
*Momordica charantia* L. (Cucurbitaceae)  
*Nasturtium officinale* R.Br. (Brassicaceae)  
*Nicandra physalodes* (L.) Gaertn. (Solanaceae)  
*Oldenlandia corymbosa* L. (Rubiaceae)  
*Oldenlandia herbacea* (L.) Roxb. (Rubiaceae)  
*Ophioglossum polypodium* A. Braun ex Schub. (Ophioglossaceae)  
*Oxalis corniculata* L. (Oxalidaceae)  
*Panicum laetum* Kunth (Poaceae)  
*Panicum maximum* Jacq. (Poaceae)  
*Panicum tenellum* Lam. (Poaceae)  
*Papaver gorgoneum* Cout. subsp. *gorgoneum* (Papaveraceae) •  
*Papaver gorgoneum* Cout. subsp. *theresias* Kadereit & Lobin (Papaveraceae) •  
*Paraceterach marantae* (L.) R.M. Tryon (Pteridaceae)  
*Parietaria judaica* L. (Urticaceae)  
*Parkinsonia aculeata* L. (Fabaceae)  
*Paronychia illecebroides* Webb (Caryophyllaceae) •  
*Paspalum vaginatum* Sw. (Poaceae)  
*Passiflora edulis* Sims (Passifloraceae)  
*Patellifolia patellaris* (Moq.) A.J. Scott, Ford-Lloyd & J.T. Williams (Amaranthaceae)  
*Patellifolia procumbens* (C. Sm.) A.J. Scott, Ford-Lloyd & J.T. Williams (Amaranthaceae)  
*Pellaea viridis* (Forssk.) Prantl (Pteridaceae)  
*Pennisetum pedicellatum* Trin. (Poaceae)  
*Pennisetum polystachyon* (L.) Schult. (Poaceae)  
*Periploca chevalieri* Browicz (Apocynaceae) •  
*Peristrophe paniculata* (Forssk.) Brummitt (Acanthaceae)  
*Phagnalon melanoleucum* Webb (Asteraceae) •  
*Phoenix atlantica* A. Chev. (Arecaceae) •  
*Phragmites australis* (Cav.) Trin. ex Steud. (Poaceae)  
*Phyllanthus rotundifolius* Klein ex Willd. (Phyllanthaceae)  
*Plantago afra* L. (Plantaginaceae)  
*Polycarpea caboverdeana* Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte (Caryophyllaceae) •  
*Polycarpea gayi* Webb (Caryophyllaceae) •  
*Polycarpon tetraphyllum* (L.) L. (Caryophyllaceae)  
*Polygala erioptera* DC. (Polygalaceae)  
*Polypogon viridis* (Gouan) Breistr. (Poaceae)  
*Portulaca oleracea* L. (Portulacaceae)  
*Potamogeton pusillus* L. (Potamogetonaceae)  
*Prosopis juliflora* (Sw.) DC. (Fabaceae)  
*Psidium guajava* L. (Myrtaceae)  
*Pteridium aquilinum* (L.) Kuhn (Dennstaedtiaceae)  
*Pteris vittata* L. (Pteridaceae)  
*Pulicaria diffusa* (Shuttlew.) Pett. (Asteraceae) •  
*Pulicaria longifolia* (Gamal-Eldin) Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte (Asteraceae) •  
*Rhynchosia minima* (L.) DC. (Fabaceae)  
*Ricinus communis* L. (Euphorbiaceae)  
*Rorippa nasturtium-aquaticum* (L.) Hayek (Brassicaceae)  
*Rottboellia cochinchinensis* (Lour.) Clayton (Poaceae)  
*Ruppia maritima* L. (Ruppiaceae)  
*Ruta chalepensis* L. (Rutaceae)  
*Salvia aegyptiaca* L. (Lamiaceae)  
*Samolus valerandi* L. (Primulaceae)  
*Sarcostemma daltonii* Decne. (Apocynaceae) •  
*Schmidia pappophoroides* Steud. ex J.A.Schmidt (Poaceae)  
*Schoenefeldia gracilis* Kunth (Poaceae)  
*Sehima ischaemoides* Forssk. (Poaceae)  
*Senna bicapsularis* (L.) Roxb. (Fabaceae)  
*Sesbania grandiflora* (L.) Pers. (Fabaceae)  
*Sesbania leptocarpa* DC. (Fabaceae)  
*Sesuvium portulacastrum* (L.) L. (Aizoaceae)  
*Sesuvium sesuviooides* (Fenzl) Verdc. (Aizoaceae)  
*Setaria barbata* (Lam.) Kunth (Poaceae)  
*Setaria pumila* (Poir.) Roem. & Schult. (Poaceae)  
*Setaria verticillata* (L.) P.Beauv. (Poaceae)  
*Sida alba* L. (Malvaceae)  
*Sida cordifolia* L. (Malvaceae)  
*Sida rhombifolia* L. (Malvaceae)  
*Sida salviifolia* C. Presl (Malvaceae)  
*Sideroxylon marginata* (Decne.) Cout. (Sapotaceae) •  
*Solanum nigrum* L. (Solanaceae)  
*Solanum rigidum* Lam. (Solanaceae) •  
*Sonchus daltonii* Webb (Asteraceae) •  
*Sonchus oleraceus* (L.) L. (Asteraceae)  
*Spermacoce verticillata* L. (Rubiaceae)  
*Sporobolus confertus* J.A. Schmidt (Poaceae) •  
*Sporobolus minutus* Link (Poaceae)  
*Sporobolus molleri* Hack. (Poaceae)  
*Sporobolus robustus* Kunth; (Poaceae)  
*Sporobolus spicatus* (Vahl) Kunth (Poaceae)  
*Sporobolus virginicus* (L.) Kunth (Poaceae)  
*Stipagrostis uniplumis* (Licht.) De Winter (Poaceae)  
*Stylosanthes fruticosa* (Retz.) Alston (Fabaceae)  
*Suaeda caboverdeana* Rivas Mart., Lousã, J.C. Costa & Maria C. Duarte (Amaranthaceae) •  
*Tagetes minuta* L. (Asteraceae)

*Tagetes patula* L. (Asteraceae)  
*Talinum paniculatum* (Jacq.) Gaertn. (Talinaceae)  
*Tamarindus indica* L. (Fabaceae)  
*Tamarix senegalensis* DC. (Tamaricaceae)  
*Teline stenopetala* (Webb & Berthel.) Webb & Berthel. subsp. *santoantaoi* Marrero Rodr. (Fabaceae) •  
*Tephrosia bracteolata* Guill. & Perr. (Fabaceae)  
*Tephrosia uniflora* Pers. (Fabaceae)  
*Tetraena gaetula* subsp. *waterlotii* (Maire) Beier & Thulin  
(Zygophyllaceae)  
*Tetraena simplex* (L.) Beier & Thulin (Zygophyllaceae)  
*Tetraena vicentina* Rivas Mart., Lousã, J.C. Costa & Maria C.  
Duarte (Zygophyllaceae) •  
*Tetraena waterlotii* Maire (v. *Tetraena gaetula* subsp. *water-  
lotii*)  
*Tetragonia tetragonoides* (Pall.) Kuntze (Aizoaceae)  
*Tetrapogon cenchriformis* (A.Rich.) Clayton (Poaceae)  
*Thamnobryum alopecurum* (Hedw.) Nieuwl. ex Gangulee  
(Neckeraceae)  
*Themeda triandra* Forssk. (Poaceae)  
*Tolpis farinulosa* (Webb) J.A. Schmidt (Asteraceae) •  
*Trianthema portulacastrum* L. (Aizoaceae)  
*Tribulus terrestris* L. (Zygophyllaceae)  
*Trichodesma africanum* (L.) Sm. (Boraginaceae)  
*Tricholaena teneriffae* (L.f.) Link (Poaceae)  
*Tridax procumbens* (L.) L. (Asteraceae)  
*Tripogon minimus* (A.Rich.) Hochst. ex Steud. (Poaceae)  
*Tripogon multiflorus* Miré & H.Gillet (Poaceae)  
*Typha domingensis* Pers. (Typhaceae)  
*Umbilicus schmidii* Bolle (Crassulaceae) •  
*Verbascum capitis-viridis* Hub.-Mor. (Scrophulariaceae) •  
*Verbascum cystolithicum* (Pett.) Hub.-Mor. (Scrophulariaceae) •  
*Veronica anagallis-aquatica* L. (Plantaginaceae)  
*Veronica becabunga* L. (Plantaginaceae)  
*Wahlenbergia lobelioides* (L.f.) Link (Campanulaceae)  
*Withania chevalieri* A.E.Gonç. (Solanaceae) •  
*Zaleya pentandra* (L.) C.Jeffrey (Aizoaceae)  
*Zinnia pauciflora* Phil. (Asteraceae)  
*Ziziphus mauritiana* Lam. (Rhamnaceae)  
*Zostera* sp. (Zosteraceae)

### 5b. Alphabetic list of Cabo Verde syntaxa

*Actinopterido radiatae-Sarcostemmetum daltonii* ..... (1.2.3)  
*Adiantetalia capilli-veneris* ..... (11a)  
*Adiantetea capilli-veneris* ..... (11)  
*Adiantetum inciso-philippensis* ..... (13.1.1)  
*Adiantetum trifidi* ..... (11.1.1)  
*Adiantion inciso-philippensis* ..... (13.1)  
*Adiantion trifidi* ..... (11.1)  
*Aeonio gogonei-Sarcostemmetum daltonii* ..... (1.1.4)  
*Aristido funiculatae-Tetraenetalia simplicis* ..... (3a)  
*Aristido cardosoi-Tetraenion simplicis* ..... (3.1)  
*Aristido cardosoi-Tetraenetalum simplicis* ..... (3.1.1)  
*Arthrocnemetea franzii* ..... (10)  
*Arthrocnemetum franzii* ..... (10.1.1)  
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### Photographic Annex



**Photo 1 -** *Acacia cabverdeana*



**Photo 3-** *Aeonium gorgonum*

**Photo 2 -** *Actiniopteris radiata*



**Photo 4 - *Artemisia gorgonum***



**Photo 5 - *Aristida cardosoi***



**Photo 6 - *Arthrocnemum franzii***



**Photo7 - *Asparagus squarrosus***



**Photo 8 - *Astericus daltonii***



**Photo 9 -** *Asteriscus smithii*



**Photo 10 -** *Asteriscus vogelli*



**Photo 11 -** *Blutaparon vermiculare*



**Photo 12 -** *Campanula bravensis*



**Photo 13 -** *Campanula jacobaea*



**Photo 14 -** *Campylanthus glaber*



**Photo 15 - *Cistanche brunneri***



**Photo 16 - *Cocculus pendulus***



Photo 17 - *Conyza feae*

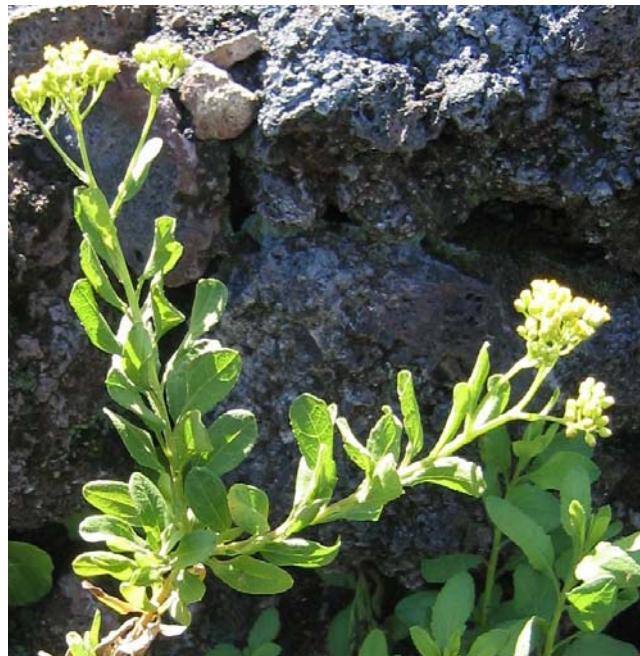


Photo 18 - *Conyza varia*



Photo 19 - *Cressa salina*



Photo 20 - *Cyperus crassipes*



**Photo 21** - *Daucus annuus*



**Photo 22** - *Daucus insularis*



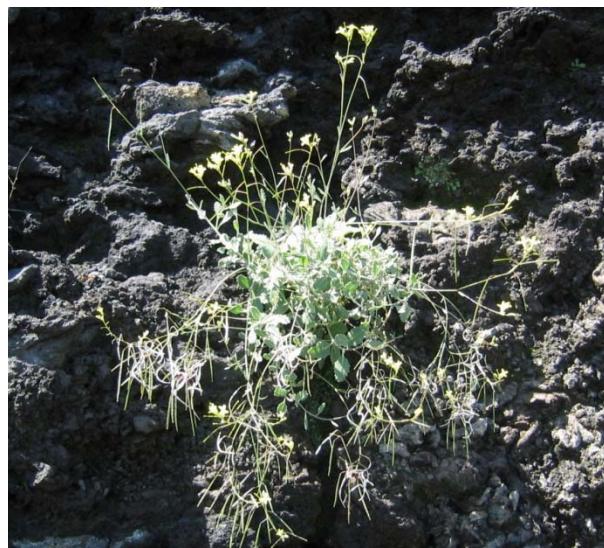
**Photo 23** - *Daucus tenuissimus*



**Photo 24** - *Dichrostachys cinerea* subsp. *platycarpa*



**Photo 25** - *Diplotaxis glauca*



**Photo 26** - *Diplotaxis hirta*



**Photo 27 -** *Diplotaxis varia*



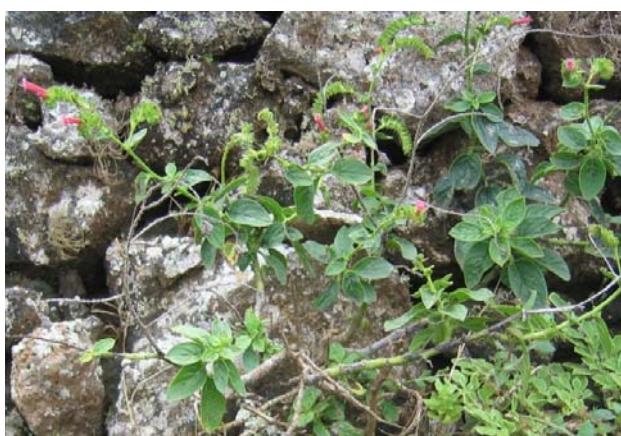
**Photo 28 -** *Dracaena caboverdeana*



**Photo 29 –** *Echium glabrescens*



**Photo 30 -** *Echium hypertropicum*



**Photo 31 -** *Echium stenosiphon*



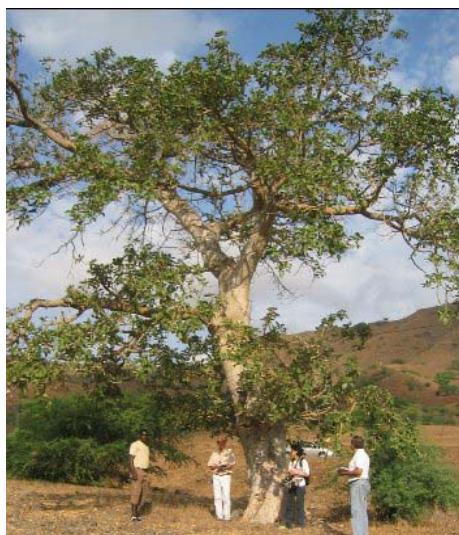
**Photo 32 - *Echium vulcanorum***



**Photo 33 - *Erysimum caboverdeanum***



**Photo 34 - *Euphorbia tuckeyana***



**Photo 35** - *Ficus sycomorus* subsp. *gnaphalocarpa*



**Photo 36** - *Forsskaolea procridifolia*



**Photo 37** - *Frankenia caboverdeana*



**Photo 38** - *Frankenia pseudoerericifolia*



**Photo 39** - *Globularia amygdalifolia*



**Photo 40** - *Helianthemum gorgoneum*



**Photo 41** - *Hyparrhenia caboverdeana*



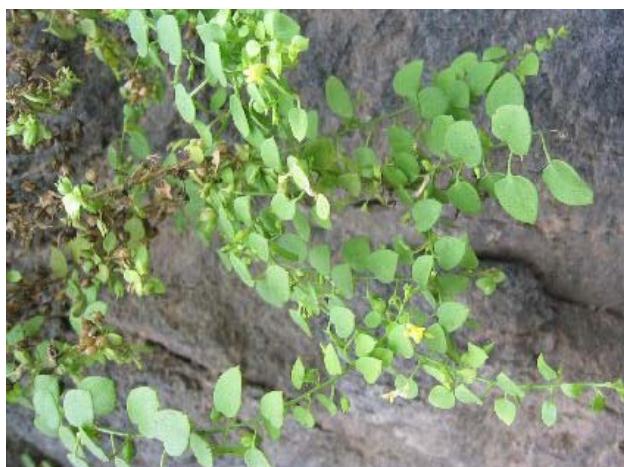
**Photo 42** - *Indigofera tinctoria* subsp. *microcarpa*'



**Photo 43** - *Kickxia elegans* subsp. *dichondrifolia*



**Photo 44** - *Kickxia elegans* subsp. *elegans*



**Photo 45** - *Kickxia elegans* subsp. *webbiana*



**Photo 46** - *Launaea arborescens* subsp. *melanostigma*



**Photo 47** - *Launaea picridioides*



**Photo 48** - *Launaea thalassica*



**Photo 49** - *Lavandula rotundifolia*



**Photo 50** - *Limonium braunii*



**Photo 51** - *Limonium jovi-barba*



**Photo 52** - *Limonium lobinii*



**Photo 53** - *Lobularia fruticosa*



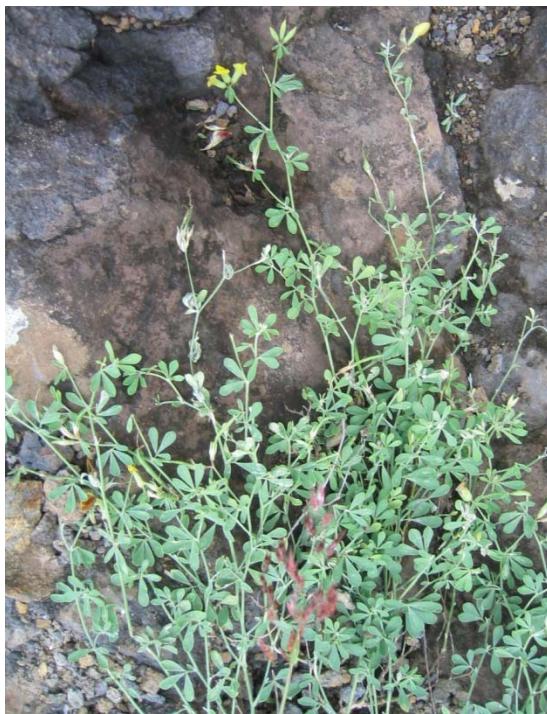
**Photo 54** - *Lobularia fruticosa*



**Photo 56 - *Lotus chevalieri***



**Photo 57 - *Lotus latifolius***



**Photo 58 - *Lotus purpureus***



**Photo 59 - *Melanoselinum bischoffii***



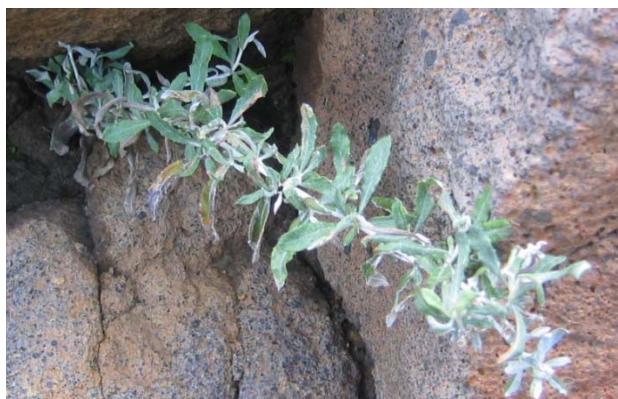
**Photo 60 - *Micromeria forbesii***



**Photo 61 - *Paronychia illecebroides***



**Photo 62 - *Periploca chevalieri***



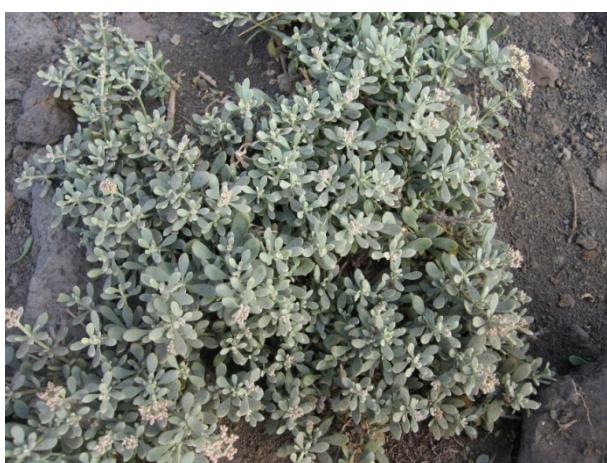
**Photo 63 - *Phagnalon melanoleucum***



**Photo 64 - *Phoenix atlantica***



**Photo 65 - *Polycarpaea caboverdeana***



**Photo 66 - *Polycarpaea gayi***



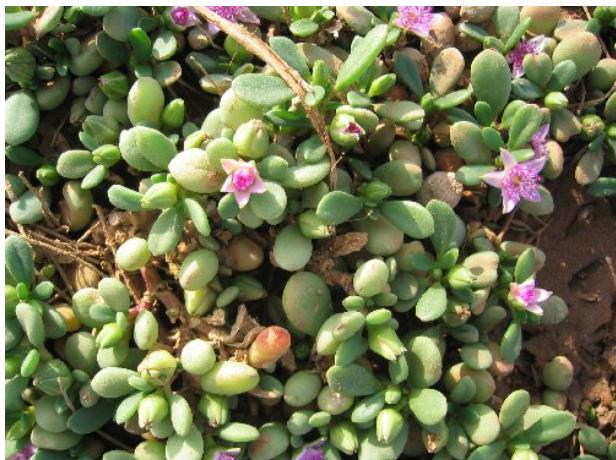
**Photo 67 - *Pulicaria diffusa***



**Photo 68 -** *Sarcostemma daltonii*



**Photo 69 -** *Sehima ischaemoides*



**Photo 70 -** *Sesuvium sesuviooides*



**Photo 71 -** *Sideroxylon marginata*



**Photo 72 -** *Sporobolus spicatus*



**Photo 73 -** *Suaeda caboverdeana*



**Photo 74 - *Tamarix senegalensis***



**Photo 75 - *Tolpis farinulosa***



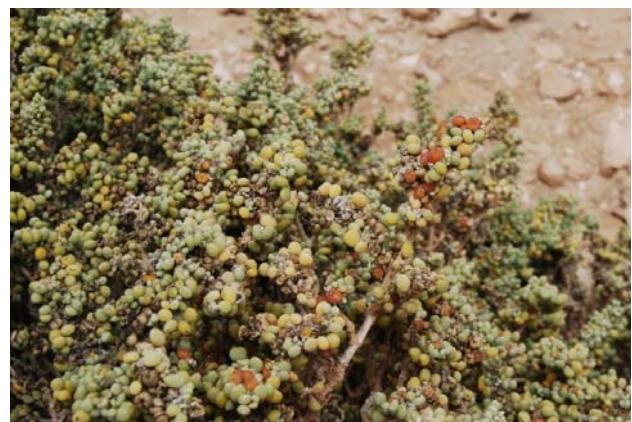
**Photo 76 - *Umbilicus schmidtii***



**Photo 77 - *Verbascum cystolithicum***



**Photo 77 - *Verbascum cystolithicum***



**Photo 79 -** *Ziziphus mauritiana*

**Photo 80 -** *Zygophyllum vicentinum*



**Photo 81 -** *Zygophyllum waterlotii*



**Photo 82 -** *Coccullo pendulae-Sarcostemmetum daltonii*



**Photo 83 -** *Campylanthus spathulatus-Sarcostemmetum daltonii*



**Photo 84 -** *Frankenia caboverdeanae-Aspergegetum squarrosum*



**Photo 85** - *Aeonio gorgoni-Sarcostemmetum daltonii*



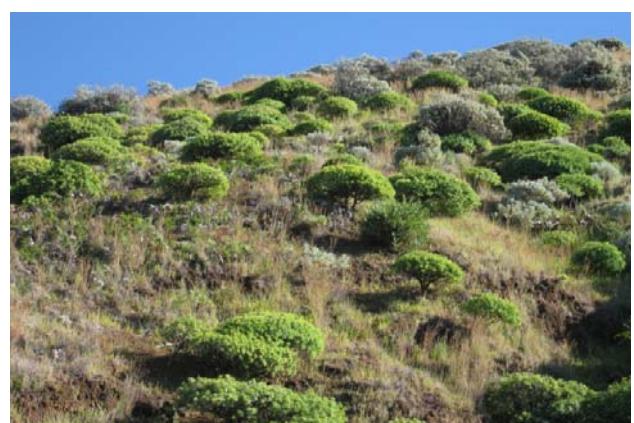
**Photo 86** - *Echio stenosiphonis-Euphorbietum tuckeyanae*



**Photo 87** - *Suaedo caboverdeanae-Asparagetum squarrosii*



**Photo 88** - *Zygophyllo waterlotii-Sarcostemmetum daltonii*



**Photo 89** - *Erysimo caboverdeanae-Periplocetum chevalieri*



**Photo 90** - *Echietum vulcanori*



**Photo 91** - *Actinopterido radiatae-Sarcostemmetum daltonii*



**Photo 92** - *Echio hypertropici-Euphorbietum tuckeyanae*



**Photo 93** - *Launaeo thalassicae-Euphorbietum tuckeyanae*



**Photo 94** - *Loto latifolii-Artemisietum gorgonum*



**Photo 95** - *Melanoselino bischoffii-Globarrietum amygdalifoliae*



**Photo 96** - *Asterisco schmidtii-Euphorbietum tuckeyanae*



**Photo 97** - *Dichrostachyo platycarpae-Acacietaum caboverdeanae acaciетosum caboverdeanae*



**Photo 98** - *Dichrostachyo platycarpae-Acacietaum caboverdeanae periplocetosum chevalieri*



**Photo 99** - *Cocculo penduli-Acacietaum caboverdeanae*



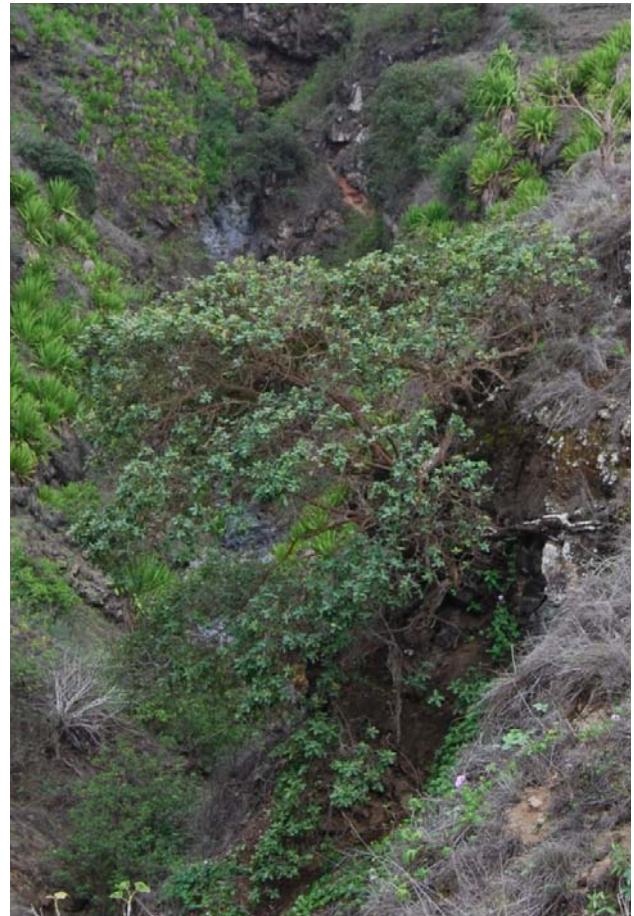
**Photo 100** - *Forsskaoleo picridifoliae-Acacietum caboverdeanae*



**Photo 101** - *Cocculo penduli-Ficetum gnaphalocarpa*



**Photo 102** - *Forsskaoleo picridifoliae-Ficetum gnaphalocarpae*



**Photo 103** - *Sideroxyletum marginatae*



**Photo 104** - *Dracaenetum caboverdeanae*



**Photo 105-** *Cocculo penduli-Phoenicetum atlantidis*



**Photo 106 -** *Cocculo penduli-Tamaricetum senegalensis*



**Photo 107 -** *Dichanthio foveolati-Heteropogonetum contorti*



**Photo 108 -** *Heteropogonetum melanocarpi*



**Photo 109 -** *Bothriochloa bladhii-Eneapogonetum desvauxii*



**Photo 110 -** *Aristido funiculatae-Zygophylletum simplicis*



**Photo 111** - *Polycarpaeo caboverdeanae-Zygophylletum waterlotii*



**Photo 112** - *Zygophylletum vicentinum*



**Photo 113** - *Sporobolo spicati-Cyperetum crassipedis*



**Photo 114** - *Loto brunneri-Pulicarietum diffusae* (top) and  
*Sehimatetum ischaemoidis* (down)



**Photo 115** - *Arthrocnemetum paleotropicalis*



**Photo 116** - *Cressetum salinae* and *Sesuvietum portulacoidis*



**Photo 117** - *Sesuvietum sesuvioideis*



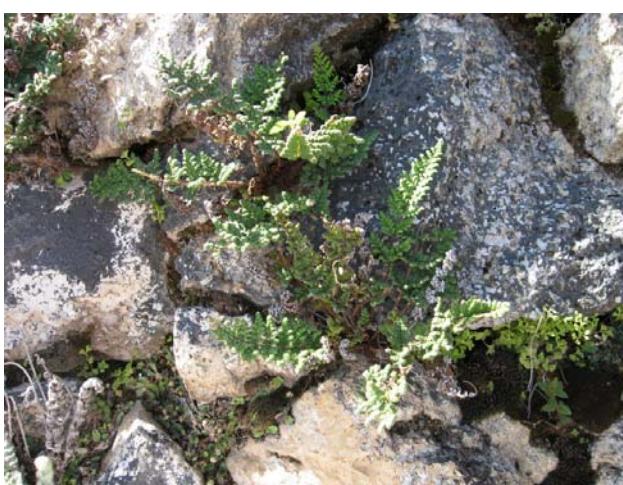
**Photo 118** - *Blutaparonentum vermicularis*



**Photo 119** - *Hypodematio crenati-Campanuletum bravensis*



**Photo 120** - *Diplotaxi hirtae-Kichxietum elegantis*



**Photo 121** - *Umbilico schmidtii-Cheilanthesetum acrosticae*



**Photo 122** - *Campanuletum jacobaeae*



**Photo 123** - *Campanulo bravensis-Launeatum thalassicae*



**Photo 124** - *Trianthemetum portulacastri*