

Major plant communities of warm North American deserts

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Abstract. A syntaxonomic study of the major plant communities in neotropical North American deserts (Sonoran, Mojave and Baja California Deserts) is presented. The field method of the Braun-Blanquet approach was combined with a numerical syntaxonomical analysis (cluster analysis and principal coordinate ordination). 21 associations are described for the first time: *Ambrosio chenopodifoliae-Larreetum tridentatae*, *Acamptopappo sphaerocephali-Larreetum tridentatae*, *Hymenocleo monogyrae-Baccharidetum glutinosae*, *Bergero-cacto emoryi-Agavetum shawii*, *Burseretum hindsianomicrophyllae*, *Cercidio microphylli-Carnegieetum giganteae*, *Bursero microphyllae-Cyrtocarpetum edulis*, *Hymenocleo salsolae-Daleetum spinosae*, *Echinocereo engelmannii-Agavetum deserti*, *Euphorbio californicae-Fouquierietum diguetii*, *Fouquierio splendidis-Larreetum tridentatae*, *Agavo cerulatae-Idrietum columnaris*, *Mascagnio macropterae-Lysilometum candidae*, *Maytenetum phyllanthoidis*, *Opuntio basilaris-Larreetum tridentatae*, *Prosopidetum torreyanae*, *Roso minutifoliae-Aesculetum parryi*, *Opuntio taponae-Agavetum subcerulatae*, *Tidestromio oblongifoliae-Atriplicetum hymenelytrae*, *Eurotio lanatae-Larreetum tridentatae* and *Yucco validae-Fouquierietum diguetii*. Some associations include subassociations. Ecological, biogeographical and floristic bioclimatic data are given for each association.

Keywords: Arizona Desert; Association; Baja California Desert; Classification; Mojave Desert; Ordination; Phytosociology; Sonoran Desert; Syntaxonomy.

Nomenclature: Munz (1973); for Baja California taxa Wiggins (1980); for *Agave* Gentry (1978).

Introduction

North American deserts, spread over an area of 1 277 000 km² in the United States and Mexico, can be climatically divided into two groups: cold deserts and warm deserts (MacMahon 1988). The cold deserts of the central Great Basin, which are Holocene expansions replacing an immense subalpine forest (Wells 1983), are now dominated by *Artemisia tridentata* and *A. arbuscula* (sagebrush) or, in drier basins, by *Atriplex*

confertifolia (shadscale). *Larrea tridentata* (creosote bush) shrubland dominating the warm deserts of North America, also being extensive Holocene expansions, replace Wisconsin pinyon-juniper woodlands (Betancourt et al. 1990). The flora of the warm deserts is derived from subtropical elements and shows affinities with the Neotropics (Daubenmire 1978; Rzedowski 1978; Axelrod 1979; Peinado et al. 1994a).

Ecological and botanical studies of the neotropical North American deserts have been the subject of many scientific publications (see Brown et al. 1982) but a floristic-sociological description is not yet available. Since 1988 the authors have applied the Braun-Blanquet method to analyse several western North American biomes. This paper contains descriptions of the main vegetation types (associations) found in warm North American deserts.

Study area

The study was carried out in desert zones of the United States, mainly Arizona, California, Nevada, New Mexico and Utah, and of Mexico: Baja California Peninsula and northern Sonora (Fig. 1).

Despite big differences in geology and topography, the study area is relatively homogeneous regarding geological structure and climate. According to MacMahon (1988) the most obvious feature in the warm North American deserts is that the land surface is dotted with isolated, block-faulted mountains, rising abruptly from debris-filled basins with internal drainages. This feature creates four major geomorphic surfaces: (1) 'mesas': isolated flat-topped hills bounded on at least one side by a steep cliff and having an extensive summit area; (2) 'pedemontes' or 'roquedos': eroded bedrocks at the base of an abrupt hill slope; (3) 'bajadas': sheet floods formed by coalesced alluvial fans; and (4) 'playas': closed drainage basins in which ephemeral lakes form. Soil particle distribution changes from the top downward to the bottom of the bajadas; coarse materials are found

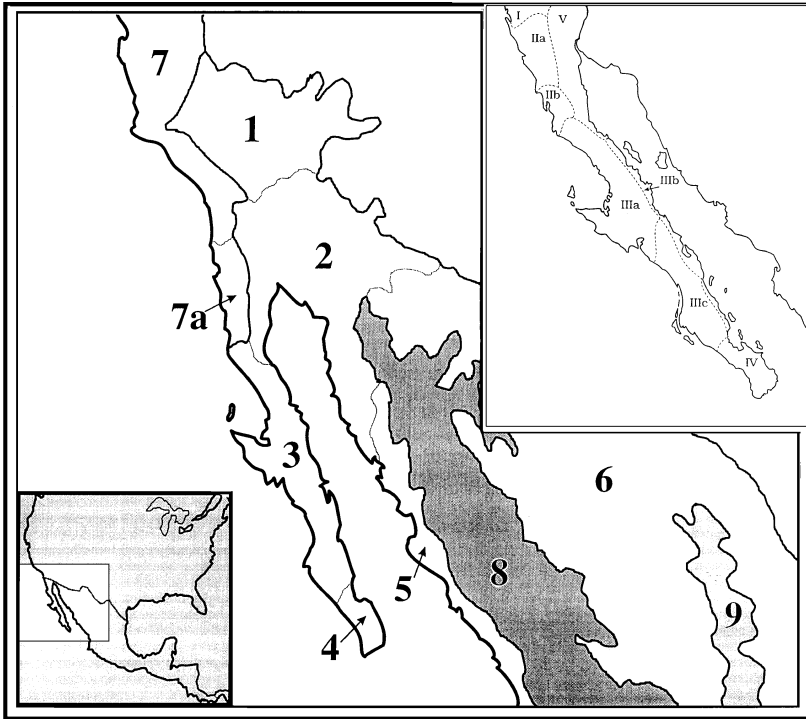


Fig. 1. Biogeography of southwestern North America, modified from Peinado et al. (1994a). Xerofítico-Mexicana (Sonoran) Region: 1. Mojave Province; 2. Colorada Province; 3. Baja Californiana Province; 4. Sanlucana Province; 5. Sinaloo-Sonorensense Province; 6. Chihuahuense Province; 7. Californiana Region (7a. Martirensense Province); Madresan Region: 8. Sierra Madre Occidental; 9. Sierra Madre Oriental. The surveyed area is included in the provinces 1, 2, 3, 4 and 7a. Top right: Biogeography of Baja California, after Peinado et al. (1994a): I, Californiano-Meridional Province, Diegano Sector. II, Martirensense Province: IIA, Juarezense Sector; IIB, Martirensense Sector. III, Baja Californiana Province: IIIA, Vizcaíno Sector; IIIB, Angelino-Loretano Sector; IIIC, Magdalenense Sector. IV, Sanlucana Province, Sanlucano Sector. V, Colorada Province, Sanfelipense Sector.

at the top and finely divided particles (silt) dominate in the valley of floors and playa beds. The bajadas are the prevailing type, covering 75% of the area (Shreve 1942).

Each biogeographical province in the study area is characterized by one or more plant communities inhabiting each of those geomorphic structures. These provinces (Peinado et al. 1994a) are shown in Fig. 1.

Climate data on the surveyed area have been summarized by Turner & Brown (1982). All the warm North American deserts are included in zoniobiome III (Subtropical desert) of Walter (1985). Two bioclimatic belts (Rivas-Martínez 1993) have been recognized: Mesotropical and Thermotropical. The mesotropical belt spreads over the Colorada (including the Arizona Sector) and Mojave Provinces, penetrating into Baja California up to the northern half of the Vizcaíno Sector (28°) where the thermotropical belt begins. Some mesotropical plant species of the Vizcaíno Sector penetrate into the inframediterranean belt of the neighbouring Martirensense Province (Californian Region). This area is a zono-ecotone (Walter 1985) between the subtropical desert and the mediterranean climate zoniobiome.

Methods

The field work was undertaken during seven Spanish-Mexican botanical expeditions to North America between 1989 and 1992. Study sites were selected on

the basis of physiognomy, structure and species dominance. Phytosociological relevés were made according to the Braun-Blanquet method (Braun-Blanquet 1979; Westhoff & van der Maarel 1973). Plots were selected in relatively uniform stands and with a size exceeding the minimum area of this type of vegetation (Westhoff & van der Maarel 1973). Relevés were arranged in phytosociological tables (Braun-Blanquet 1979) and associations were detected and characterized. Locations of type relevés are given in the tables (see below). Additional data on 327 unpublished relevés can be obtained from the senior author upon request.

For the numerical analysis the cover/abundance values in the scale of Braun-Blanquet were transformed into the 1-9 ordinal scale of van der Maarel (1979). Complete linkage clustering was carried out with the programme NCLAS2 (Podani 1988), starting with a matrix that included all 320 vascular taxa recorded in the relevés. With this cluster analysis, results of the preliminary table sorting were improved and some sub-associations and floristical variants detected.

A synoptic table including 21 associations was elaborated (Table 1). In this table, each taxon is entered with percent constancy values for the various associations it occurs in. Taxa which did not reach a constancy of 33% in any association were removed. The resultant matrix with 227 taxa was subjected to Principal Coordinate Analysis based on Euclidean Distance (Podani 1988).

Each association is defined by a combination of

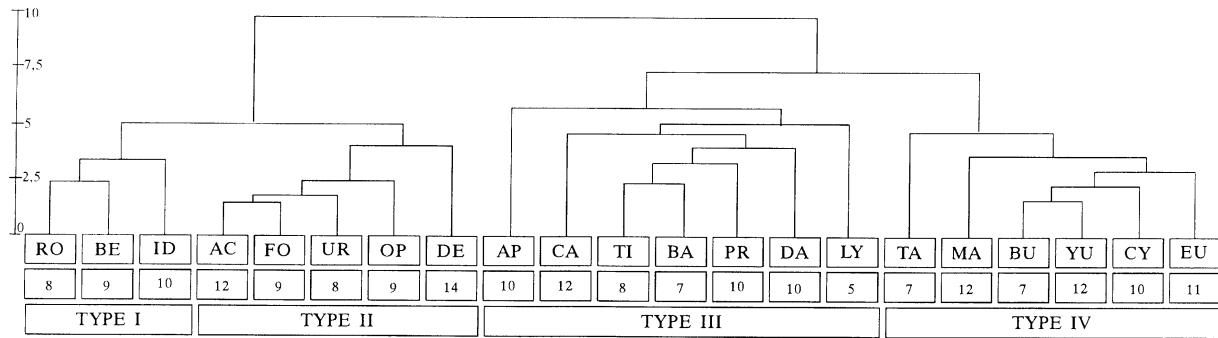


Fig. 2. Dendrogram of the Complete Linkage Clustering (Euclidean distance) showing 21 associations and four main vegetation groups. Numerals indicate the number of relevés in each association. Abbreviations of the associations correspond to Table 1.

characteristic species including character and differential species. Character species of an association have a distribution which is relatively restricted to that association and are indicative of the association's environment. Differential taxa define associations towards others regardless of their fidelity to the association in question. The concepts of character species and differential species are clear in theory but in practice they can only be significant if the regional floristic-sociological system is well-developed. This is not so in our case and therefore most of our diagnostic taxa are differential, used to distinguish between associations. Character taxa are few and include only some endemics whose distribution is restricted to a specific association. In such a case it is useful to adopt the concept of 'differentiating floristic combination' (Beefink 1965), i.e. a group of taxa differentiating a given association towards all other associations where none of the members of the combination need to be a character taxon.

Results and Discussion

Of the 21 associations documented in Table 1, 19 can be assigned to one floristic-sociological class which would include all associations of warm deserts. Knapp (1965) presented a syntaxonomical scheme for desert communities, but he did not publish relevés, so detailed comparisons are not possible. Two associations, which are closely related to the Californian Floristic Region (see below), must be excluded from this class, the *Rosominutifoliae-Aesculetum parryi* and the *Hymenocleomonogryae-Baccharidetum glutinosae*. Taking into account the enormous extension of the North American deserts and the absence of phytosociological studies there, further phytosociological analysis in many areas is required before a syntaxonomical outline can be drawn.

The floristic groups detected by the agglomerative cluster technique (Fig. 2) and the ordination (Fig. 3), can

be grouped into four types, which can be biogeographically, ecologically and climatically characterized.

Type I includes relevés from the Pacific side of the Baja California Peninsula between 31° and 28° N, including the northern half of the Vizcaíno Sector and the infra-mediterranean belt of the Martirens province. The associations of this group are characterized by *Artemisia californica*, *Lotus scoparius*, *Viguiera laciniata*, *Malosma laurina* and *Aesculus parryi* from northern mediterranean-type ecosystems, which are lacking in the other types. Type I also includes many northwestern Baja Californian endemics or near endemics, such as *Bergerocactus emoryi*, *Agave shawii* ssp. *shawii*, *Echinocereus maritimus*, *Ferocactus fordii*, *Harfordia macroptera* and *Cuscuta veatchii*. The distribution area of Type I associations has long been considered a transitional zone between mediterranean and desert ecosystems (Shreve 1936; Mooney & Harrison 1972; Peinado et al. 1994a). Even though the true desert vegetation of the Vizcaíno Sector does not pass 30°N, some mesotropical elements, e.g. *Ambrosia chenopodifolia*, *Euphorbia misera*, *Machaerocereus gummosus*, *Myrtillocactus cochal*, *Mammillaria dioica* and *Simmondsia chinensis* reach further north and are important in the infra-mediterranean associations.

In Type II we find associations which are mainly dominated by *Larrea tridentata* (creosote bush) and *Ambrosia dumosa*, which prevail on the bajadas and well-drained sandy flats of the mesotropical deserts. Because of the combination of high temperature, low precipitation and shallow soils, these associations are typically open and poor in species. The environmental gradient associated with the bajada sequence (Parker 1991) ranges from steep rocky upland sites supporting a diversity of shrubs and cacti - *Echinocereus engelmannii*-*Agavetum deserti* - to alluvial flats strongly dominated by one or two species.

These alluvial flats are occupied by various *Larrea* communities. The physiognomy of these communities

Table 1. (cont.)

Associations	BE	RO	ID	AC	OP	UR	FO	DE	AP	TI	CA	LY	PR	DA	BA	TA	CY	EU	BU	YU	MA
No. of relevés	9	8	10	12	9	8	9	14	10	8	12	5	10	10	7	10	7	11	7	12	12
Type	I	I	I	II	II	II	II	II	III	III	III	III	III	III	III	IV	IV	IV	IV	IV	IV
Thermotropical taxa of Baja Californian communities																					
<i>Opuntia ciribe</i>	.	.	.	.	.	.	.	.	.	.	.	II	.	.	.	IV	V	V	III	V	II
<i>Jatropha cinerea</i>	.	.	.	.	.	.	.	.	.	.	.	II	.	.	.	II	V	IV	II	III	III
<i>Fouquieria diguetii</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	V	V	V	V	II
<i>Jatropha cuneata</i>	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	IV	I	V	V	I	.
<i>Euphorbia • californica</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III	V	.	I	II
<i>Bouyeria sonora</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III	I	I	.	.
<i>Prosopis articulata</i>	.	.	.	.	.	.	.	.	.	.	.	I	.	I	.	I	.	.	I	.	IV
<i>Ruellia peninsularis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	IV	III	I	.	.
<i>Condaliopsis globosa</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III
<i>Echinocereus ferreirianus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II	.	.
Other taxa																					
<i>Larrea tridentata</i>	.	.	IV	V	V	V	III	IV	II	III	.	II	II	.	II	.	V	III	III	.	.
<i>Opuntia • echinocarpa</i>	.	.	II	IV	III	II	III	II	I	I	II	.	.	I	.	V	.	III	IV	.	.
<i>Lophocereus schottii</i>	.	.	IV	III	.	II	I	.	.	.	.	I	.	.	.	I	I	IV	III	III	II
<i>Simmondsia chinensis</i>	IV	II	III	II	.	II	III	.	.	.	I	.	.	.	.	.	I	.	.	I	II
<i>Pachycereus pringlei</i>	I	.	IV	.	.	.	.	.	.	.	.	I	.	.	.	IV	IV	V	IV	III	II
<i>Ambrosia dumosa</i>	.	.	III	III	V	V	V	III	.	I	.	.	.	II	.	.	.	.	.	.	.
<i>Krameria • imparata</i>	.	.	.	.	I	II	I	III	II	.	III	.	I	.	.	III	.	.	I	.	.
<i>Echinocereus engelmannii</i>	.	.	I	II	.	.	.	V	I	.	II	.	.	.	.	V	.	I	I	I	.
<i>Machaerocereus gummosus</i>	III	.	I	.	.	.	.	.	.	.	.	.	.	.	.	V	IV	IV	IV	V	II
<i>Pedilanthus macrocarpus</i>	.	.	I	.	.	.	.	.	.	.	.	.	.	.	.	IV	I	III	II	II	III
<i>Encelia • farinosa</i>	.	.	.	.	.	II	IV	.	.	II	II	.	II	.	II	IV	.	.	I	.	.
<i>Lycium andersonii</i>	.	.	.	II	.	I	II	IV	.	.	.	I	I	.	.	.	.	.	.	.	V
<i>Lemaireocereus thurberi</i>	.	.	.	.	.	.	.	.	.	II	I	.	.	.	.	II	III	II	III	I	.
<i>Cercidium microphyllum</i>	.	.	.	.	.	I	.	.	.	V	V	.	I	.	II	.	.	.	IV	.	II
<i>Bebbia • juncea</i>	.	.	.	I	.	I	.	I	.	I	IV	I	I	.	.	.	.	.	I	.	.
<i>Lycium californicum</i>	III	II	I	I	.	I	.	.	.	.	.	.	.	.	.	I	.	.	.	III	.
<i>Solanum hindsianum</i>	I	.	III	.	.	.	.	.	.	.	.	.	.	I	.	II	II	.	I	II	.
<i>Bursera microphylla</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	V	IV	V	I	IV
<i>Viguiera laciniata</i>	II	I	III	.	II	.	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Opuntia tesajo</i>	.	.	I	.	III	.	I	.	.	.	.	.	.	.	.	I	II	.	II	.	.
<i>Opuntia acanthocarpa</i>	.	.	.	.	I	III	IV	II	.	II	.	.	.	.	.	.	.	.	.	.	.
<i>Yucca schidigera</i>	.	.	.	.	II	III	I	II	III	.	.	.	.	.	.	.	.	.	.	.	.
<i>Ferocactus • gracilis</i>	.	.	IV	III	.	.	.	.	.	.	.	.	.	.	.	IV	.	.	.	II	.
<i>Mammillaria dioica</i>	V	.	III	.	.	.	III	.	.	.	.	.	.	.	.	.	.	.	I	.	.
<i>Eriogonum inflatum</i>	.	.	.	IV	.	.	I	III	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Opuntia prolifera</i>	V	I	.	IV	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Agave • cerulata</i>	.	.	IV	II	.	III	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Agave • shawii</i>	V	IV	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Rosa minutifolia</i>	IV	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Myrtillocactus cochal</i>	III	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III	.	.	.	.	.
<i>Opuntia bigelovii</i>	.	.	.	.	.	III	.	.	.	II	.	.	.	.	.	.	.	.	.	.	.

◆ = subspecies; • = variety, referring to the following taxa: *Agave shawii* ssp. *goldmaniana*; *Agave cerulata* ssp. *nelsonii*; *Agave deserti* ssp. *pringlei*; *Agave cerulata* ssp. *subcerulata*; *Atriplex canescens* ssp. *linearis*; *Atriplex barclayana* ssp. *lurida*; *Bebbia juncea* var. *atriplicifolia*; *Berginia virgata* var. *glandulifera*; *Cercidium floridum* ssp. *peninsulare*; *Coldenia canescens* var. *pulchella*; *Croton californicus* var. *mohavensis*; *Dalea seemannii* ssp. *trochilina*; *Dudleya attenuata* ssp. *orcuttii*; *Encelia virginensis* ssp. *actoni*; *Encelia californica* var. *asperifolia*; *Eriogonum fasciculatum* ssp. *flavoviride*; *Eriogonum fasciculatum* ssp. *polifolium*; *Ferocactus gracilis* var. *coloratus*; *Ferocactus acanthodes* var. *tortulospinus*; *Haplopappus venetus* ssp. *tridentatus*; *Krameria parvifolia* var. *glandulosa*; *Krameria parvifolia* var. *imparata*; *Lotus scoparius* ssp. *brevialatus*; *Mirabilis bigelovii* var. *aspera*; *Opuntia phaeacantha* var. *discata*; *Opuntia violacea* var. *macrocentra*; *Opuntia echinocarpa* var. *nuda*; *Opuntia leptocaulis* var. *tetracantha*; *Opuntia acanthocarpa* var. *thornberi*; *Pachycormus discolor* var. *pubescens*; *Passiflora foetida* var. *longipedunculata*; *Pityrogramma triangularis* var. *viscosa*; *Prosopis glandulosa* var. *torreyana*; *Viguiera deltoidea* var. *chenopodiina*; *Viguiera deltoidea* var. *parishii*; *Viscainoa geniculata* var. *pinnata*.

is simple because of the low species diversity and the wide spacing of the shrubs. Although the creosote-bush vegetation appears as monotonously uniform throughout its area, there are significant regional differences in its floristic composition, most of them related to biogeographical variation, that allow several associations to be distinguished.

Type III is fairly heterogeneous; both multivariate methods place together many associations which, for different reasons, have a low floristic similarity. The *Acamptopappo sphaerocephali-Larreetum tridentatae* association corresponds to a widespread plant community in the Mojave Desert; since the Mojave Desert scrub biome is intermediate between the Great Basin desert scrub and the Sonoran desert scrub (Thorne 1986), the Mojavan association contains several taxa (Table 14) that are lacking in other desert associations.

The *Cercidio microphylli-Carnegieetum giganteae*

is the dominant association of the Arizona Sector (Colorado Province), which is moister than other desert sectors (Turner & Brown 1982). The vegetation has the appearance of a shrubland or low woodland of leguminous trees and giant cacti. Many of these tree species are confined to runnels and washes in more arid provinces, e.g. *Cercidium microphyllum*, *C. floridum*, *Olnya tesota*, *Prosopis* ssp. and *Acacia* spp. As a result, the *Cercidio microphylli-Carnegieetum giganteae* is united with associations restricted to moist places.

The *Tidestromio oblongifoliae-Atriplicetum hymenelytrae* is floristically the poorest association; it grows in the most arid zones of the North American deserts.

Type IV includes six associations based on a very homogeneous group of taxa, i.e. thermotropical taxa as listed in Table 1. All these associations occur in the thermotropical belt of Baja California.

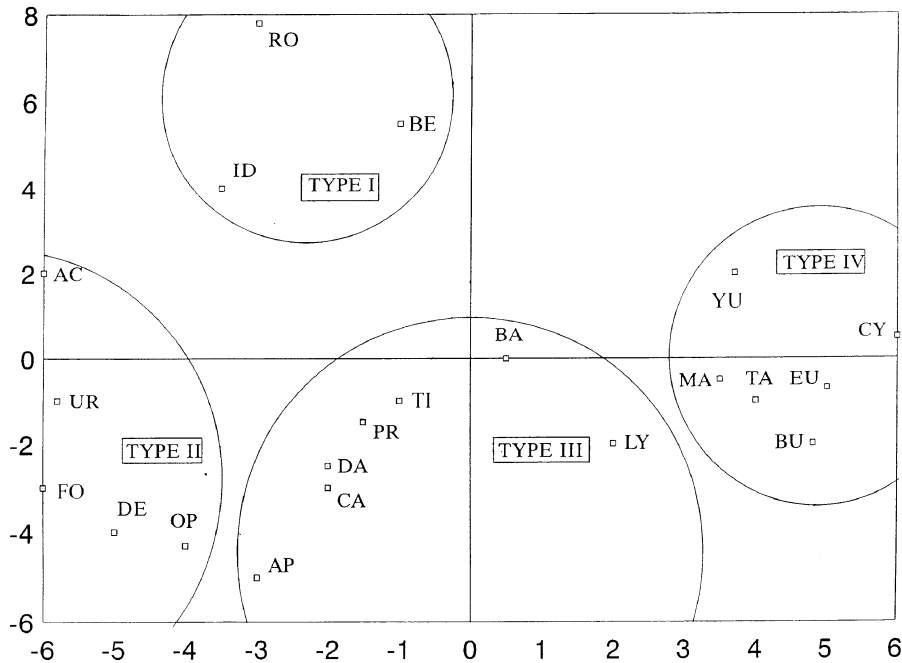


Fig. 3. Principal coordinate analysis showing the position of the associations in the ordination plane of axes 1 and 2. Association abbreviations as in Table 1.

Description of associations

Berberocacto emoryi-*Agavetum shawii* ass. nova; nomenclatural type: Table 2, rel. 2

The association is dominated by succulents such as *Agave shawii* ssp. *shawii*, *Berberocactus emoryi*, *Mammillaria dioica*, *Opuntia prolifera*, *O. littoralis*, *Myrtillocactus cochal* and *Machaerocereus gummosus*, as well as low-growing, shallow-rooted, often aromatic, drought-deciduous shrubs such as *Artemisia californica*, *Eriogonum fasciculatum* ssp. *flavoviride* and *Lotus scoparius* ssp. *scoparius*. It corresponds to the 'coastal succulent scrub' (Axelrod 1978; Westman 1983). The subassociation *idrietosum columnaris* (subass. nova; nomenclatural type: Table 2, rel. 10) forms a transition to the *Agavo cerulatae*-*Idrietum columnaris*; it corresponds to the 'maguey-boojum series' of Turner & Brown (1982).

The association is found in the mesotropical belt of the Vizcaíno Sector and in the infra-mediterranean belt of the Martirens Province as far north as 31° N at Punta Colonet.

Roso minutifoliae-*Aesculetum parryi* ass. nova; nomenclatural type: Table 3, rel. 8

This association is characterized by the floristic combination of deciduous low trees (*Aesculus parryi*) and shrubs (*Rosa minutifolia*), together with succulents such as *Berberocactus emoryi* and *Agave shawii* ssp. *shawii*. This is an infra-mediterranean chaparral association of the Martirens Province. Its main distribution area is the zone between Cabo Colonet and El Rosario, Baja Cali-

fornia. It is also found in the mesotropical desert areas of the Vizcaíno Sector as a permanent community in shady or moist microhabitats. The northern part of the Vizcaíno Desert is considered a chaparral-desert ecotone with several chaparral species penetrating into the desert in habitats with relatively moist soils (Shreve 1936; Turner & Brown 1982).

The *Roso minutifoliae*-*Aesculetum parryi* and the *Berberocacto emoryi*-*Agavetum shawii* associations occur in the infra-mediterranean-mesotropical ecotone forming a topographic mosaic in which the former association occupies relatively wet, shady places, while the latter association regularly inhabits the driest sites, such as sunny hillsides, steep southern slopes covered with thin soil, rocky areas or exposed sea bluffs.

The variant of *Frankenia palmeri* (rel. 3) on alkaline soils, is a transition to the halophilous *Atriplici julaceae*-*Frankenietum palmeri* (Peinado et al. 1994b).

Ambrosio chenopodifoliae-*Larreetum tridentatae* ass. nova; nomenclatural type: Table 4, rel. 4

Like other communities growing on lower bajadas, the *Ambrosio chenopodifoliae*-*Larreetum tridentatae* is a floristically poor association, especially when compared with the bordering piedmont association *Agavo cerulatae*-*Idrietum columnaris*. *Larrea tridentata* and *Ambrosia chenopodifolia* are the dominant species and some Baja California endemics, notably *Opuntia prolifera*, *Agave cerulata* ssp. *cerulata* and *Ferocactus gracilis* var. *gracilis*, are good differential species against other, ecologically similar, associations.

Table 5. *Eurotia lanatae-Larreetum tridentatae* ass. nova. Type relevé: 1, Rancho Sonora, San Agustín area, N Vizcaíno, Baja California, May 6, 1992. Symbols as in Table 2.

Relevé no.	1	2	3	4	5	6	7	8
Altitude (m)	590	550	540	500	470	510	650	550
Area (m ²)	50	50	100	100	50	50	50	50
No. of taxa	14	14	18	10	10	11	13	15
<i>Eurotia lanatae-Larreetum tridentatae</i>: differentiating floristic combination								
<i>Eurotia lanata</i>	1	1	1	1	1	1	2	2
<i>Larrea tridentata</i>	1	1	2	1	1	2	2	1
<i>Psilostrophe cooperi</i>	+	+	1	1	1	2	1	+
<i>Coldenia pulchella</i>	1	1	1	.	.	.	.	1
Baja Californian endemics								
<i>Ferocactus coloratus</i>	1	+	+	+	+	.	+	.
<i>Opuntia tesajo</i>	+	1	.	+	+	1	.	.
<i>Agave cerulata</i>	1	1	+	.	.	.	.	1
<i>Agave goldmaniana</i>	.	1	+	.	.	.	.	.
<i>Yucca valida</i>	.	.	.	.	.	.	1	+
<i>Haplopappus odontolepis</i>	.	.	.	.	+	.	1	.
<i>Opuntia molesta</i>	+	.	.	.	+	.	.	.
<i>Dalea megalostachya</i>	.	.	.	.	.	1	.	.
<i>Krameria parvifolia</i>	.	.	.	.	.	1	.	.
<i>Mirabilis cedrodensis</i>	.	.	.	.	.	.	1	.
<i>Viguiera purissimae</i>	.	.	.	.	.	.	.	+
Other taxa								
<i>Ambrosia dumosa</i>	1	2	2	1	2	2	2	2
<i>Eriogonum flavoviride</i>	+	1	1	1	1	1	1	1
<i>Fouquieria splendens</i>	1	1	2	.	.	.	.	2
<i>Yucca schidigera</i>	1	.	+	+	1	.	.	.
<i>Polygala desertorum</i>	.	.	2	.	.	2	.	1
<i>Krameria imparata</i>	.	+	+	.	.	.	.	1
<i>Viguiera laciniata</i>	.	1	+	.	.	.	.	.
<i>Ephedra californica</i>	.	.	+	.	.	1	.	.
<i>Eriogonum trichopes</i>	.	.	.	.	.	1	1	.
<i>Lophocereus schottii</i>	.	.	+	.	.	.	+	.
<i>Lycium megacarpum</i>	+	.	+	.	.	.	.	.
<i>Opuntia echinocarpa</i>	.	.	.	.	.	.	1	+
<i>Porophyllum gracile</i>	+	.	.	.	.	.	.	1
<i>Simmondsia chinensis</i>	.	1	1	.	.	.	.	.
Additional taxa: <i>Atriplex polycarpa</i> (rel. 4: 1), <i>Lycium californicum</i> (4: 1), <i>Sphaeralcea ambigua</i> (7: 1).								

layers commonly called 'caliche', a kind of soil-holding accumulated calcium carbonate. The association is floristically poor because caliche retards the penetration of water and interferes with the development of the root system, making the habitat arid (Breazeale & Smith 1930; Shreve & Mallery 1933). Although this association is most typical for the Vizcaíno Sector, the differential species for that Sector, *Psilostrophe cooperi* and *Eurotia lanata*, also occur in other Mojave communities, where they always indicate buried layers of caliche (Table 14, rels. 4-6 and 10).

Agave cerulatae-Idrietum columnaris ass. nova; nomenclatural type: Table 6, rel. 5

This species-rich community is dominated by *Idria columnaris*, the succulent, up to 20 m tall, boojum tree, together with 4-5 m tall plants of various growth forms - *Pachycormus discolor* var. *pubescens*, *Pachycereus pringlei* and *Lophocereus schottii* - giving it the appearance of an open succulent woodland. In between these dominants, succulents and shrubs occur such as *Agave cerulata* ssp. *cerulata*, *Larrea tridentata*, *Opuntia cholla*, *Opuntia molesta* and *Harfordia macroptera*. *Pachycereus pringlei*, a giant columnar cactus, is vicariant to

Table 6. *Agave cerulatae-Idrietum columnaris* ass. nova. Type relevés: association: rel. 5, 20 km N of Cataviña, May 6, 1991; subassociation *yuccetosum valida*, rel. 8, Km 278, Transpeninsular road, on sandy soil, July 2, 1992. Both in Baja California. Symbols as in Table 2.

Relevé no.	1	2	3	4	5	6	7	8	9	10
Altitude (m)	80	570	600	640	630	540	120	400	260	140
Area (m ²)	100	100	200	100	100	100	100	100	150	100
No. of taxa	10	18	18	15	19	17	20	19	17	15
<i>Agave cerulatae-Idrietum columnaris</i>: Differentiating floristic combination										
<i>Idria columnaris</i> *	1	2	1	3	2	2	3	1	1	1
<i>Pachycormus pubescens</i> *	2	3	3	.	2	.	3	1	1	+
<i>Agave cerulata</i> *	1	2	.	2	1	1	.	2	.	.
<i>Agave cerulatae-Idrietum columnaris yuccetosum valida</i>										
<i>Opuntia ciribe</i> *	.	.	.	.	.	.	2	1	2	2
<i>Yucca valida</i> *	.	.	.	.	.	.	2	2	+	2
<i>Fouquieria diguetii</i>	.	.	.	.	.	.	1	+	2	.
<i>Jatropha cinerea</i>	.	.	.	.	.	.	.	.	2	.
<i>Jatropha cuneata</i>	.	.	.	.	.	.	.	1	.	.
Baja Californian endemics										
<i>Ferocactus gracilis</i>	.	1	1	1	1	1	.	.	.	.
<i>Agave goldmaniana</i>	2	1	.	.	.	.	1	2	.	.
<i>Viscainoa geniculata</i>	.	.	.	.	1	.	.	2	2	2
<i>Opuntia molesta</i>	.	.	.	.	.	+	1	.	1	.
<i>Ferocactus coloratus</i>	1	.	.	.	.	.	1	.	.	.
<i>Harfordia macroptera</i>	.	1	.	.	.	1	.	.	.	.
<i>Opuntia tesajo</i>	.	.	1	.	.	+	.	.	.	.
<i>Krameria parvifolia</i>	.	.	.	2	.	.	.	.	.	.
<i>Agave nelsonii</i>	.	.	2	.	.	.	.	.	.	.
<i>Cuscuta veatchii</i>	.	.	.	.	1	.	.	.	.	.
<i>Viguiera chenopodiina</i>	.	.	.	.	2	.	.	.	.	.
<i>Encelia asperifolia</i>	.	.	.	.	.	.	.	1	.	.
<i>Ferocactus tortulospinus</i>	.	.	.	.	+	.	.	.	.	.
<i>Mammillaria blossfeldiana</i>	.	.	.	.	.	.	.	.	.	1
<i>Opuntia invicta</i>	.	.	.	.	.	.	.	.	.	+
<i>Viguiera purissimae</i>	.	.	.	2	.	.	.	.	.	.
Other taxa										
<i>Larrea tridentata</i>	.	+	1	+	1	1	1	1	1	1
<i>Ambrosia chenopodifolia</i>	1	1	+	2	2	2	+	1	.	.
<i>Mammillaria dioica</i>	+	1	1	+	.	+	1	+	+	.
<i>Pachycereus pringlei</i>	.	1	.	1	2	+	1	2	1	1
<i>Lophocereus schottii</i>	.	.	+	1	1	1	1	+	+	+
<i>Eriogonum flavoviride</i>	.	1	+	1	2	2	1	.	.	.
<i>Fouquieria splendens</i>	.	.	+	3	1	+	.	.	1	1
<i>Ambrosia dumosa</i>	.	.	1	2	+	.	.	.	1	2
<i>Simmondsia chinensis</i>	.	1	+	.	1	1	+	.	.	.
<i>Machaerocereus gummosus</i>	1	.	.	.	.	.	2	2	.	2
<i>Ambrosia camphorata</i>	.	1	+	.	.	2	.	.	+	.
<i>Pedilanthus macrocarpus</i>	.	+	.	.	.	.	1	1	.	1
<i>Viguiera laciniata</i>	.	.	+	1	.	1	+	.	.	.
<i>Encelia farinosa</i>	.	+	1	.	.	.	.	.	+	.
<i>Opuntia cholla</i>	.	.	.	+	.	1	2	.	.	.
<i>Opuntia echinocarpa</i>	.	1	.	.	.	.	.	+	.	+
<i>Lycium californicum</i>	1	+	.	.	.	.	1	.	.	.
<i>Euphorbia misera</i>	1	.	.	.	.	.	+	1	.	.
<i>Solanum hindsianum</i>	.	.	1	.	+	.	.	.	.	.
<i>Condalia globosa</i>	.	+	+	.	.	.	.	.	.	.
<i>Acalypha californica</i>	.	.	.	.	1	.	.	.	1	.

Carnegiea gigantea, the character-species of the Arizonian *Cercidio microphylli-Carnegieetum giganteae*. The association flourishes on granitic and basaltic soils in mesotropical northern and central Vizcaíno. It corresponds to the 'agave-boojum series' (Turner & Brown 1982),

The *yuccetosum valida* subassociation (*subass. nova*; nomenclatural type: Table 6, rel. 8) occurs in transitional areas between the typical subassociation and the thermotropical *Yucco valida-Fouquierietum diguetii* association. It is found on sandy soils at the southern border of the mesotropical part of the Vizcaíno Sector, and the differential species are thermotropical taxa such as *Yucca valida*, *Opuntia ciribe* and *Fouquieria diguetii*.

Table 7. *Yucco valida*-*Fouquierietum diguetii* ass. nova. Type relevés: association, rel. 3: Between Ejido Mújica and Ejido Vizcaíno, Baja California Sur, July 3, 1992; subassociation *agavetosum goldmaniana*, rel. 9: Track to Santa Rosalilla, Baja California, July 2, 1992. Symbols as in Table 2.

Relevé no.	1	2	3	4	5	6	7	8	9	10
Altitude (m)	100	140	80	70	170	100	80	60	70	90
Area (m ²)	150	150	150	150	150	100	150	150	150	150
No. of taxa	12	18	13	17	13	11	13	11	17	14
<i>Yucco valida</i>-<i>Fouquierietum diguetii</i>: Differentiating floristic combination										
<i>Fouquieria diguetii</i>	2	2	2	1	1	2	2	.	1	1
<i>Yucca valida</i> *	1	1	1	1	2	2	+	1	1	1
<i>Machaerocereus gummosus</i>	2	2	1	1	1	2	2	1	1	+
<i>Yucco valida</i>-<i>Fouquierietum diguetii</i> <i>agavetosum goldmaniana</i>										
<i>Agave</i> ♦ <i>goldmaniana</i> *	.	.	.	.	.	.	2	1	1	1
<i>Echinocereus maritimus</i> *	.	.	.	.	.	.	1	1	1	+
<i>Ambrosia chenopodifolia</i>	.	.	.	.	.	.	2	1	2	.
<i>Pachycormus</i> • <i>discolor</i> *	.	.	.	.	.	.	.	+	2	.
Thermotropical taxa										
<i>Opuntia ciribe</i> *	2	1	1	1	.	2	+	.	1	+
<i>Jatropha cinerea</i>	2	1	+	1	2	2	.	.	+	.
<i>Opuntia invicta</i> *	+	1	1	+	.	.	.	.	.	.
<i>Ambrosia magdalenae</i> *	.	1	.	+	.	.	.	.	1	1
<i>Encelia halimifolia</i>	.	.	1	1	.	1	.	.	.	.
<i>Mammillaria hutchinsoniana</i> *	+	+	+	.	.	.	.	.	.	.
<i>Tillandsia recurvata</i>	.	1	+	.	.	.	.	.	.	.
<i>Atamisquea emarginata</i>	+	.	.	.	.	.	.	.	.	.
<i>Krameria</i> • <i>parvifolia</i> *	.	.	.	.	1	.	.	.	.	.
<i>Pithecellobium mexicanum</i>	.	.	.	.	+	.	.	.	.	.
Other taxa										
<i>Lycium californicum</i>	1	1	2	.	.	2	2	.	.	.
<i>Pedilanthus macrocarpus</i>	.	1	.	+	1	.	.	.	+	.
<i>Pachycereus pringlei</i>	1	1	1	1	1	.	.	.	.	.
<i>Euphorbia misera</i>	.	.	.	.	.	2	1	1	+	1
<i>Larrea tridentata</i>	1	.	+	+	1	.	.	.	1	.
<i>Lophocereus schottii</i>	1	+	+	.	.	1	.	.	.	.
<i>Ferocactus</i> • <i>gracilis</i> *	.	+	.	1	.	.	.	.	1	1
<i>Viguiera</i> • <i>parishii</i>	.	1	.	.	.	.	.	2	.	1
<i>Frankenia palmeri</i>	.	.	.	.	.	.	+	.	1	1
<i>Echinocereus engelmannii</i>	.	.	.	+	+	.	.	.	.	.
<i>Encelia palmeri</i> *	.	+	.	.	1	.	.	.	.	.
<i>Ferocactus</i> • <i>coloratus</i> *	.	.	.	.	.	1	+	.	.	.
<i>Opuntia tesajo</i> *	.	.	.	.	.	.	.	.	+	+
<i>Solanum hindsianum</i>	.	.	.	+	.	.	.	.	.	+
<i>Cercidium microphyllum</i>	.	.	.	+	+	.	.	.	.	.
<i>Lemaireocereus thurberi</i>	.	.	.	+	+	.	.	.	.	.
<i>Atriplex julaceae</i> *	.	1	.	.	.	.	.	1	.	1
<i>Abronia maritima</i>	.	.	.	.	.	1	+	.	.	.
<i>Gasoul crystallinum</i>	.	.	.	.	.	1	1	.	.	.
<i>Atriplex</i> ♦ <i>lurida</i> *	.	1	.	.	.	.	.	1	.	.

Additional taxa: *Dudleya gatesii* * (rel. 8: 1), *Krameria* • *imparata* (4: 1).

Yucco valida-*Fouquierietum diguetii* ass. nova; nomenclatural type: Table 7, rel. 3

The vegetation is rather uniform with 2-4 m tall *Yucca valida* (datilillo) and *Fouquieria diguetii* (ocotillo). The big cacti *Machaerocereus gummosus*, *Lemaireocereus thurberi* and *Lophocereus schottii* are conspicuous members of this association which occurs on the thermotropical coastal sandy plains of the Vizcaíno Sector. This coastal area is often foggy, and the epiphyte *Tillandsia recurvata* and several lichens hang densely from the dominants or even cover the soil surface.

On extensive coastal flats with alkaline soils within the area of this association, the halophytic *Atriplici julaceae*-*Frankenietum palmeri* Peinado et al. 1994 occurs; transitions between both Vizcaíno associations (Table 7, rels. 2 and 10) have been labelled as 'frankeniatilillo-ocotillo series' (Turner & Brown 1982).

The subassociation *agavetosum goldmaniana*

Table 8. *Opuntia taponae*-*Agavetum subcerulatae* ass. nova. Type relevé: 4, track from Transpeninsular road to San Francisco de la Sierra Km 17, Baja California Sur, July 3, 1992. Symbols as in Table 2.

Relevé no.	1	2	3	4	5	6	7
Altitude (m)	160	250	760	540	1040	140	170
Area (m ²)	100	100	100	100	100	100	100
No. of taxa	19	16	21	20	21	22	13
<i>Opuntia</i>-<i>Agavetum subcerulatae</i>: Differentiating floristic combination							
<i>Agave</i> ♦ <i>subcerulata</i> *	1	2	2	2	2	1	2
<i>Opuntia taponae</i> *	+	+	+	2	+	1	1
Thermotropical taxa							
<i>Bursera microphylla</i>	2	2	1	2	+	1	2
<i>Fouquieria diguetii</i>	1	2	1	2	1	1	.
<i>Opuntia ciribe</i> *	1	1	+	+	.	2	.
<i>Jatropha cuneata</i>	.	+	+	+	1	.	+
<i>Bursera hindsiana</i>	1	.	+	+	.	+	.
<i>Opuntia invicta</i> *	+	.	.	1	.	2	.
<i>Euphorbia magdalenae</i> *	.	1	1	.	.	.	.
<i>Jatropha cinerea</i>	+	.	.	.	.	1	.
<i>Pithecellobium mexicanum</i>	.	.	1	.	+	.	.
<i>Mammillaria hutchinsoniana</i> *	1	.	.	.	.	.	+
<i>Jacquemontia abutiloides</i>	1	.	.	.	.	.	.
<i>Alvordia glomerata</i> *	.	.	.	.	2	.	.
<i>Mammillaria capensis</i> *	.	.	.	.	.	1	.
Other taxa							
<i>Machaerocereus gummosus</i>	2	2	1	2	.	2	+
<i>Echinocereus engelmannii</i>	1	.	1	1	2	+	1
<i>Opuntia</i> • <i>echinocarpa</i>	+	+	1	+	+	1	.
<i>Ferocactus</i> • <i>gracilis</i> *	.	+	1	1	+	.	+
<i>Pachycereus pringlei</i>	1	1	+	1	.	2	.
<i>Encelia farinosa</i>	+	2	.	.	.	1	1
<i>Pedilanthus macrocarpus</i>	+	.	.	1	1	1	+
<i>Hibiscus denudatus</i>	1	+	.	+	.	.	+
<i>Krameria</i> • <i>imparata</i>	.	.	+	.	.	+	+
<i>Myrtillocactus cochal</i> *	.	+	+	.	.	.	.
<i>Ambrosia camphorata</i>	.	.	2	2	.	.	.
<i>Viguiera</i> • <i>deltoides</i> *	.	.	2	.	1	.	.
<i>Ferocactus rectispinus</i> *	.	.	+	.	+	.	.
<i>Atriplex</i> ♦ <i>barclayana</i>	.	.	.	.	.	1	+
<i>Larrea tridentata</i>	.	.	.	+	.	1	.
<i>Lemaireocereus thurberi</i>	.	+	.	1	.	.	.
<i>Solanum hindsianum</i>	.	+	.	.	.	1	.
<i>Viguiera purissimae</i> *	.	.	.	2	.	1	.
<i>Cercidium microphyllum</i>	.	.	+	.	.	+	.

Additional taxa: *Calliandra californica* (rel. 5: 1), *Croton californicum* (6: +), *Croton magdalenae* * (5: 1), *Dalea* ♦ *seemannii* (8: 1), *Encelia palmeri* * (1: +), *Ficus palmeri* * (5: +), *Idria columnaris* * (5: 1), *Justicia hians* * (5: 1), *Lophocereus schottii* (3: +), *Trixis angustifolia* * (6: 1), *Viscainoa* • *geniculata* * (1: +).

(subass. nova; nomenclatural type: Table 7, rel. 9) is found on granitic and volcanic soils in the northernmost coastal areas. It is differentiated by mesotropical taxa such as *Ambrosia chenopodifolia* and further by *Agave shawii* ssp. *goldmaniana*.

Opuntia taponae-*Agavetum subcerulatae*; nomenclatural type: Table 8, rel. 4

This association is characterized by some thermotropical Vizcaíno endemics, notably *Agave cerulata* ssp. *subcerulata*, *Opuntia taponae* and *O. invicta*. It occurs on volcanic outcrops which are found inland in the wide sandy plain dominated by the *Yucco-Fouquierietum*. The association can be considered a vicariant of the coastal subassociation *Yucco valida*-*Fouquierietum diguetii* *agavetosum goldmaniana*. It is distributed in the southern half of the Vizcaíno Desert (28-26° N).

Table 9. *Burseretum hindsiano-microphyllae* ass. nova. Type relevé: 4, Santispac, near Bahía Concepción, Baja California Sur, July 4, 1992. Symbols as in Table 2.

Relevé no.	1	2	3	4	5	6	7	8	9	10
Altitude (m)	90	60	70	60	30	220	50	10	320	60
Area (m ²)	150	150	150	150	150	150	150	150	150	150
No. of taxa	13	12	19	11	15	16	18	14	14	11
<i>Burseretum hindsiano-microphyllae</i>: Differentiating floristic combination										
<i>Bursera microphylla</i>	1	1	1	1	2	1	2	1	2	1
<i>Bursera hindsiana</i>	1	1	1	1	1	1	2	2	+	1
<i>Fouquieria diguetii</i>	2	1	1	1	1	1	1	1	2	1
Thermotropical taxa										
<i>Jatropha cuneata</i>	1	1	1	1	1	1	1	2	1	1
<i>Opuntia ciribe</i> *	.	.	2	.	.	.	1	.	2	2
<i>Jatropha cinerea</i>	.	.	+	.	.	.	.	2	2	1
<i>Berginia</i> • <i>glandulifera</i> *	+	.	+	.	+	1	.	.	.	.
<i>Atamisquea marginata</i>	.	.	+	.	.	.	1	.	+	.
<i>Ruellia californica</i>	.	.	+	.	2	1	.	.	.	.
<i>Jacquemontia abutiloides</i>	.	.	+	.	.	+	.	.	.	.
<i>Caesalpinia pinnosa</i> *	.	.	.	.	2	.	.	.	.	.
<i>Condalia brandegeei</i> *	.	.	1	.	.	.	.	.	.	.
<i>Aeschynomene nivea</i> *	.	.	.	.	.	.	.	+	.	.
<i>Castela peninsularis</i> *	.	.	.	.	.	.	.	+	.	.
<i>Cochemia posegeri</i> *	.	.	.	.	.	.	.	+	.	.
<i>Cyrtocarpa edulis</i> *	.	.	.	.	.	.	.	+	.	.
<i>Echinocereus brandegeei</i> *	.	.	.	.	.	.	.	+	.	.
<i>Pachycereus pecten-aboriginum</i>	.	.	.	.	.	.	.	+	.	.
<i>Ruellia peninsularis</i>	.	.	.	.	.	.	1	.	.	.
Other taxa										
<i>Cercidium microphyllum</i>	+	+	1	1	1	1	.	2	.	1
<i>Pachycereus pringlei</i>	1	1	.	1	+	+	.	+	.	1
<i>Machaerocereus gummosus</i>	+	1	1	1	.	.	2	.	2	1
<i>Larrea tridentata</i>	1	1	+	1	.	.	.	.	1	1
<i>Opuntia</i> • <i>echinocarpa</i>	1	+	.	.	.	.	+	+	1	.
<i>Lemaireocereus thurberi</i>	.	1	.	1	+	1	+	.	+	.
<i>Lophocereus schottii</i>	+	1	.	.	.	.	.	.	+	.
<i>Dalea</i> • <i>seemannii</i>	.	.	.	1	2	.	.	1	.	1
<i>Cordia parvifolia</i>	.	.	+	.	1	.	.	.	+	.
<i>Pedilanthus macrocarpus</i>	.	.	+	.	.	.	1	.	1	.
<i>Bebbia</i> • <i>juncea</i>	.	.	.	.	1	.	.	1	.	.
<i>Prosopis articulata</i>	.	.	.	.	.	.	1	2	.	.
<i>Fagonia barclayana</i>	.	.	.	.	1	2	.	.	.	.
<i>Fagonia laevis</i>	.	1	+	.	.	.	.	.	.	.

Additional taxa: *Bourreria sonorae* (rel. 6: 1), *Cissus trifoliata* (6: r), *Echinocereus engelmannii* (1: r), *Encelia* • *farinosa* (5: 1), *Hyptis* • *emoryi* (8: 1), *Janusia californica* (6: 1), *Mammillaria dioica* (3: +), *Pachycormus* • *pubescens* * (8: 1), *Prosopis* • *torreyana* (1: r), *Solanum hindsianum* (3: +), *Viscainoa* • *geniculata* * (8: 1).

Burseretum hindsiano-microphyllae ass. nova; nomenclatural type: Table 9, rel. 4

This thermotropical association is dominated by 3-4 m-high small trees, called torchwoods: *Bursera hindsiana* and *B. microphylla*, by large shrubs: *Fouquieria diguetii*, *Jatropha cinerea* and *J. cuneata*, and by the columnar 'cardón' *Pachycereus pringlei*. It corresponds to the sarcocaulis desert (Wiggins 1980) and the 'torchwood-cardón series' (Turner & Brown 1982). It occurs on deep soils of granitic or volcanic origin in the Angelino-Loretano Sector. *Cercidium microphyllum* can be co-dominant on deep granitic soils, but is absent on the volcanic or eroded hill slopes. A floristical variant with *Cyrtocarpa edulis* (rel. 7) corresponds to the southern disjunction of this association near Bahía de la Paz.

Euphorbio californicae-Fouquierietum diguetii ass. nova; nomenclatural type: Table 10, rel. 7

This desert scrub association has few species in the differentiating combination. The absence of *Bursera hindsiana* is a differential feature toward the *Burseretum*

Table 10. *Euphorbio californicae-Fouquierietum diguetii* ass. nova. Type relevés: association, rel. 7: near Estación microondas El Rifle, July 5, 1992; subassociation *cercidietosum praecox*, rel. 5: El Coyote, July 5, 1992. Both in Baja California Sur. Symbols as in Table 2.

Relevé no.	1	2	3	4	5	6	7	8	9	10
Altitude (m)	240	110	40	30	30	30	110	80	90	20
Area (m ²)	100	100	100	100	100	100	100	100	100	100
No. of taxa	14	23	18	11	19	17	14	9	16	12
<i>Euphorbio californicae-Fouquierietum diguetii</i>: Differentiating floristic combination										
<i>Euphorbia</i> • <i>californica</i>	1	1	1	1	1	1	1	1	1	1
<i>Fouquieria diguetii</i>	2	1	1	1	1	1	2	1	1	1
<i>Ambrosia bryantii</i> *	.	+	2	1	1	.	1	.	2	+
<i>Euphorbio californicae-Fouquierietum diguetii</i> <i>cercidietosum praecox</i>										
<i>Prosopis palmeri</i> *	2	2	2	1	2	.	.	.	.	.
<i>Cercidium praecox</i>	2	1	+	1	2	.	.	.	.	.
<i>Ruellia peninsularis</i>	2	1	1	.	1	.	.	.	.	.
Thermotropical taxa										
<i>Opuntia ciribe</i> *	2	2	1	2	2	1	1	+	1	1
<i>Jatropha cinerea</i>	.	+	1	.	2	1	1	.	1	1
<i>Jatropha cuneata</i>	2	1	1	.	1	1	1	1	1	.
<i>Bursera microphylla</i>	1	1	.	.	.	+	1	1	1	+
<i>Tillandsia recurvata</i>	.	1	+	.	.	+	.	.	.	.
<i>Ferocactus</i> • <i>townsendianus</i> *	.	.	.	.	.	.	+	.	+	.
<i>Mammillaria capensis</i> *	.	+	+	+	.	.	+	.	.	.
<i>Atamisquea marginata</i>	.	1	.	.	1	.	.	.	.	+
<i>Acacia brandegeana</i> *	.	.	.	.	1	.	.	.	1	.
<i>Berginia</i> • <i>glandulifera</i> *	.	.	.	.	1	1	.	.	.	.
Other taxa										
<i>Larrea tridentata</i>	.	1	1	1	2	2	1	1	1	1
<i>Pachycereus pringlei</i>	1	1	1	+	.	+	1	.	1	1
<i>Machaerocereus gummosus</i>	1	1	2	1	1	+	1	.	.	1
<i>Lophocereus schottii</i>	.	1	1	1	1	+	1	.	+	.
<i>Pedilanthus macrocarpus</i>	.	1	1	.	1	.	1	.	.	1
<i>Lemaireocereus thurberi</i>	1	1	.	.	.	.	.	.	1	+
<i>Opuntia</i> • <i>echinocarpa</i>	1	.	.	.	+	+	.	.	+	.
<i>Encelia palmeri</i> *	.	.	.	.	1	1	.	.	.	.
<i>Ambrosia camphorata</i>	.	+	.	.	1	.	.	.	.	.
<i>Euphorbia tomentulosa</i>	1	1	.	.	.	.	.	.	.	.
<i>Lycium megacarpum</i>	.	.	+	.	.	.	.	.	+	.
<i>Eriogonum repens</i> *	.	.	.	.	.	1	.	+	.	.
<i>Janusia californica</i>	1	.	.	.	.	.	.	+	.	.
<i>Krameria</i> • <i>glandulosa</i>	.	.	.	.	.	.	+	.	1	.
<i>Opuntia tesajo</i> *	.	+	.	.	.	.	.	.	+	.

Additional taxa: *Bourreria sonorae* (rel. 3: r), *Cissus trifoliata* (5: r), *Echinocereus engelmannii* (2: r).

hindsiano-microphyllae; the lack of *Yucca valida* and the frequency of *Euphorbia californica* are differential characters toward the *Yucco validae-Fouquierietum diguetii*. It occurs in the Magdalense Sector, in a plain with rainfall generally less than 200 mm/yr.

Besides the typical subassociation, a *cercidietosum praecox* subassociation (subass. nova; nomenclatural type: Table 10, rel. 5) can be distinguished. This subassociation, dominated by microphyllous trees such as *Cercidium praecox* and *Prosopis palmeri*, indicates the presence of clay soils with phreatic water.

The moister mountainous areas of the Magdalense Sector support a related association to be described next.

Mascagnio macropterae-Lysilometum candidae ass. nova; nomenclatural type: Table 11, rel. 4

The main dominant is the white-stemmed tree *Lysiloma candida*, which is known from two areas only: near Bahía San Pedro, Sonora, where it is found in some canyon bottoms, and in Baja California, where it occurs as a character species of the *Mascagnio-Lysilometum*.

Table 11. *Mascagnio macropterae-Lysilometum candidae* ass. nova. Type relevé: 4, Rancho Ascensión, between Rosarito and El Bombeador, Baja California Sur, July 4, 1992. Symbols as in Table 2.

Relevé no.	1	2	3	4	5
Altitude (m)	50	100	350	130	30
Area (m ²)	150	150	150	150	150
No. of taxa	10	15	12	12	15

Mascagnio macropterae-Lysilometum candidae: Differentiating floristic combination

<i>Lysiloma candida</i>	2	2	3	2	3
<i>Bebbia</i> • <i>atriplicifolia</i> *	2	1	2	.	1
<i>Cercidium microphyllum</i>	1	2	2	2	2
<i>Mascagnia macroptera</i>	1	+	2	1	1
<i>Ruellia californica</i>	1	2	2	1	1

Thermotropical taxa

<i>Hyptis decipiens</i> *	2	.	2	.	.
<i>Viscainoa</i> • <i>pinnata</i>	.	1	.	+	.
<i>Passiflora</i> • <i>longipedunculata</i>	+	.	2	.	.
<i>Jatropha cinerea</i>	.	.	.	1	+
<i>Dalea</i> • <i>trochilina</i> *	.	.	2	.	.
<i>Tephrosia palmeri</i>	.	.	2	.	.
<i>Acacia pensinsularis</i> *	.	.	.	.	1
<i>Bursera epinnata</i>	.	.	.	1	.
<i>Caesalpinia panmosa</i> *	.	1	.	.	.
<i>Desmanthus fruticosus</i> *	.	1	.	.	.
<i>Eucnide cordata</i>	.	.	.	.	.
<i>Forchammeria watsonii</i>	.	.	.	1	.
<i>Melochia tomentosa</i> *	.	.	.	.	1
<i>Opuntia ciribe</i> *	.	.	.	1	.
<i>Cissus trifoliata</i>	.	.	.	.	+
<i>Ditaxis brandegeei</i>	.	.	.	.	+
<i>Jacquemontia abutiloides</i>	.	.	+	.	.
<i>Jatropha cuneata</i>	.	.	.	.	+

Other taxa

<i>Zizyphus sonorensis</i>	.	.	2	2	.
<i>Horsfordia newberryi</i>	.	1	1	.	.
<i>Olneya tesota</i>	.	1	.	2	.
<i>Encelia</i> • <i>farinosa</i>	+	+	.	.	.
<i>Hymenoclea salsola</i>	+	+	.	.	.

Additional taxa: *Lemaireocereus thurberi* (rel. 5: +), *Lophocereus schottii* (5: +), *Pachycereus pringlei* (4: +), *Petalonyx linearis* (1: +), *Phytolacca octandra* (2: +), *Prosopis articulata* (2: 1), *Sapium biloculare* (5: 2).

The association thrives on mountain slopes of the Sierra de la Giganta, which form part of the Magdalenense Sector. It occurs above the *Euphorbio-Fouquierietum*, which grows on alluvial plains. A striking feature of this association is the absence of numerous desert taxa, owing to the orographic increase in precipitation, as well as to the influence of the tropical thornscrub of the adjacent Sanlucana Province (Peinado et al. 1994a).

Bursero microphyllae-Cyrtocarpetum edulis ass. nova; nomenclatural type: Table 12, relevé 6

This association is composed of drought-deciduous, often thorny, pinnate-leaved, multi-trunk trees and shrubs from 2 - 7 m in height. The absence or poor representation of many characteristic desert species in part of the relevés, i.e. the ubiquitous *Larrea tridentata*, is also noteworthy. However, some of those taxa appear in a subassociation *larreetosum tridentatae* (subass. nova; nomenclatural type: Table 12, rel. 8), which indicates the northern transition to the *Euphorbio californicae-Fouquierietum diguetii* from the Magdalenense Sector.

Biogeographically, the association forms part of the

Table 12. *Bursero microphyllae-Cyrtocarpetum edulis* ass. nova. Type relevés: association, rel. 6: 4 km S of Las Cabrillas, July 7, 1992; subassociation *larreetosum tridentatae*, rel. 10: Near San Agustín, July 9, 1992. Both in Baja California Sur. Symbols as in Table 2.

Relevé no.	1	2	3	4	5	6	7	8	9	10
Altitude (m)	50	410	230	130	10	20	50	240	210	150
Area (m ²)	150	150	150	150	150	150	150	150	150	150
No. of taxa	27	26	19	24	21	22	20	23	28	14

Bursero microphyllae-Cyrtocarpetum edulis: Differentiating floristic combination

<i>Cyrtocarpa edulis</i> *	2	2	2	2	2	2	2	1	2	2
<i>Ruellia pensinsularis</i>	2	2	2	2	1	2	1	1	1	.
<i>Antigonum leptopus</i>	1	1	+	+	1	1	+	.	.	.
<i>Aeschynomene nivea</i> *	+	+	+	1	1	1	+	.	.	.
<i>Cnidoscolus angustidens</i>	1	+	1	.	.	1	1	+	.	.
<i>Bursera cerasifolia</i> *	+	.	.	1	+	+	.	.	+	.
<i>Melochia tomentosa</i> *	.	.	+	.	.	+	1	+	+	.

Bursero microphyllae-Cyrtocarpetum edulis larreetosum tridentatae

<i>Larrea tridentata</i>	.	.	.	.	.	.	.	1	1	1
<i>Gossypium harknessii</i> *	.	.	.	.	.	.	.	2	1	.
<i>Citharexylum flabellifolium</i>	.	.	.	.	.	.	.	1	+	+
<i>Hibiscus denudatus</i>	.	.	.	.	.	.	.	1	1	.

Thermotropical taxa

<i>Bursera microphylla</i>	2	2	2	2	2	2	2	2	2	1
<i>Opuntia ciribe</i> *	1	+	1	1	1	2	1	1	1	1
<i>Fouquieria diguetii</i>	1	2	2	1	2	2	2	2	+	2
<i>Jatropha cinerea</i>	2	1	2	1	.	2	2	2	+	1
<i>Bursera odorata</i>	2	.	1	.	2	+	.	1	.	.
<i>Euphorbia</i> • <i>californica</i>	.	.	1	1	+	.	1	+	.	.
<i>Yucca valida</i>	.	.	+	1	.	1	+	1	.	.
<i>Bourreria sonora</i>	1	.	.	.	+	1	1	.	+	.
<i>Viguiera tomentosa</i>	+	2	1	+	.	.	.	.	.	.
<i>Ferocactus</i> • <i>towsendianus</i> *	.	+	.	.	.	.	.	1	+	1
<i>Jatropha cuneata</i>	1	.	.	.	2	.	.	+	2	.
<i>Mammillaria capensis</i> *	.	.	.	1	1	.	.	.	1	+
<i>Opuntia</i> • <i>nuda</i> *	.	+	.	+	+	.	.	.	.	.
<i>Merremia aurea</i> *	.	1	.	.	+	.	2	.	.	.
<i>Haematoxylon brasiletto</i>	1	.	.	.	2	1	.	.	.	.
<i>Cochemia poseelgeri</i> *	+	+	.	.	.	.	.	.	+	.
<i>Lysiloma candida</i>	+	.	.	.	.	.	.	.	1	.
<i>Plumeria acutifolia</i>	.	1	+	.	.	.	.	.	.	.
<i>Berginia</i> • <i>glandulifera</i> *	1	.	.	.	.	.	.	.	+	.
<i>Cercidium</i> • <i>peninsulare</i> *	+	.	+	.	.	.	.	.	.	.
<i>Gochnatia arborescens</i>	.	1	.	.	.	.	1	.	.	.
<i>Agave aurea</i> *	.	+	.	+	.	.	.	.	.	.
<i>Agave</i> • <i>datylio</i> *	1	.	.	+	.	.	.	.	.	.
<i>Castela pensinsularis</i> *	.	.	.	.	+	1	.	.	.	.
<i>Condalia globosa</i>	+	.	.	.	.	.	.	.	+	.
<i>Erythrina flabelliformis</i>	.	1	1	.	.	.	.	.	.	.
<i>Forchammeria watsonii</i>	.	.	.	.	.	.	.	+	+	.
<i>Mammillaria hutchinsoniana</i> *	1	.	.	1	.	.	.	.	.	.
<i>Pereskia porteri</i>	.	+	+	.	.	.	.	.	.	.

Other taxa

<i>Machaerocereus gummosus</i>	+	1	1	1	1	1	1	1	1	1
<i>Pachycereus pringlei</i>	1	1	1	1	+	1	+	1	+	1
<i>Lemaireocereus thurberi</i>	+	.	.	1	1	1	+	+	+	1
<i>Pedilanthus macrocarpus</i>	.	.	.	1	.	1	.	1	1	+
<i>Krameria</i> • <i>parvifolia</i>	r	.	.	.	r	.	.	.	.	.

Additional thermotropical taxa: *Acacia cymbispina* (rel. 2: 2), *Atamisquea marginata* (10: r), *Bursera epinnata* (9: 1), *Cercidium praecox* (1: +), *Cissus trifoliata* (2: +), *Coursetia glandulosa* (2: 2), *Lycium berlandieri* (9: 1), *Mammillaria evermanniana* * (4: 1), *Opuntia bravoana* (2: 1), *Pachycereus pecten-aboriginum* (7: 1), *Phoradendron diguetianum* * (6: +), *Prosopis palmeri* * (8: r), *Tecoma stans* (2: 1), *Tillandsia recurvata* (8: r).

Other taxa: *Lophocereus schottii* (2: 1), *Opuntia tesajo* * (4: r), *Simmondsia chinensis* (5: 1), *Solanum hindsianum* (6: 1).

thermotropical belt of the Sanlucana Province, which is floristically connected to the Caribbean Region (Takhtajan 1986). The most representative type of vegetation in the lowlands of this Province has close physiognomical relationships with the Sinaloan thornscrub (Shreve & Wiggins 1964; Brown 1982).

Table 15. *Fouquieria splendens-Larreetum tridentatae* ass. nova. Type relevé: rel. 3: 38 km north of Mexicali, Baja California, April 23, 1989. Symbols as in Table 2.

Relevé no.	1	2	3	4	5	6	7	8	9	10
Altitude (m)	20	30	180	80	560	90	560	600	250	700
Area (m ²)	200	50	200	100	100	100	100	100	100	100
No. of taxa	4	4	6	5	8	4	4	8	6	8

Fouquieria splendens-Larreetum tridentatae: Differentiating floristic combination

<i>Fouquieria splendens</i>	2	1	1	1	1	1	1	1	1	1
<i>Larrea tridentata</i>	2	1	1	1	1	1	2	2	1	1
<i>Ambrosia dumosa</i>	2	1	1	1	1	1	1	1	1	1

Other taxa

<i>Opuntia</i> • <i>acanthocarpa</i>	.	+	+	1	+	.	.	1	+	.
<i>Encelia</i> • <i>farinosa</i>	.	.	2	1	.	.	.	.	.	1
<i>Simmondsia chinensis</i>	.	.	.	.	+	.	1	2	.	.
<i>Opuntia</i> • <i>echinocarpa</i>	.	.	1	.	1	+	.	.	.	.
<i>Hilaria rigida</i>	.	.	.	.	.	.	.	.	1	1
<i>Eriogonum</i> ♦ <i>flavoviride</i>	.	.	.	.	+	.	.	1	.	.

Additional species: *Hyptis* • *emoryi* (rel. 10: 1), *Krameria grayi* (1: +), *Krameria* • *imparata* (9: +), *Lophocereus schottii* (5: +), *Lycium andersonii* (10: +), *Opuntia littoralis* (8: +), *Trixis californica* (10: 1), *Yucca schidigera* (8: 1).

sphaerocephalus, *A. shockleyi* and several species of *Krameria* and *Eriogonum*. *Yucca brevifolia* (Joshua tree) is the best-known species of this association; however, this Mojavean endemic can also be found in many other plant communities (Rowlands 1978). This is a widespread association in the highlands of the mesotropical belt of the Mojave Province, replacing the *Opuntia basilaris-Larreetum tridentatae* in desert mesas and slopes at altitudes between 900 and 1500 m. The subassociation *coleogynetosum ramosissimae* (subass. nova, nomenclatural type: Table 14, rel. 7) is found in the transitional Mojave-Great Basin areas of the highest lands of the Mojave Desert.

In some mountains of Inyo and San Bernardino counties (White and Clark Mountains) there is a floristic variant (rels. 6-8) in which the endemic *Acamptopappus shockleyi* replaces the more common *A. sphaerocephalus*. The variant of *Eurotia lanata* (rels. 4- 6 and 10) indicates soils with caliche layers.

Fouquieria splendens-Larreetum tridentatae ass. nova; nomenclatural type: Table 15, rel. 3

This association is characterized by *Larrea tridentata*, *Fouquieria splendens* and *Ambrosia dumosa*. *Larrea tridentata* is the dominant plant on loamy soils; on sandy soils, the dominance is shared with *Ambrosia dumosa* and the grass *Hilaria rigida*. The uniform stature and spacing of the plants and the floristic simplicity of the association produce a monotonous landscape that dominates plains and lower bajadas surrounding the mountains in the Colorado Province. It occurs in the Lower Colorado Valley, which is the largest and most arid subdivision of the Sonoran Desert (Turner & Brown 1982) and floristically the poorest part. In fact, this is the most widespread and important plant community in the

Table 16. *Echinocereo engelmannii-Agavetum deserti* ass. nova. Type relevé: 4, San Felipe Creek, Anza Borrego, San Diego County, California, May 8, 1991. Symbols as in Table 2.

No. of relevé	1	2	3	4	5	6	7	8	9	10
Altitude (m)	530	600	700	70	550	500	970	1100	740	710
Area (m ²)	100	100	100	100	100	100	100	100	100	100
No. of taxa	15	14	16	19	17	17	17	13	16	19

Echinocereo engelmannii-Agavetum deserti: Differentiating floristic combination

<i>Echinocereus engelmannii</i>	+	1	+	1	1	1	1	+	1	+
<i>Agave</i> ♦ <i>deserti</i>	2	2	2	2	1	1	2	.	.	.
<i>Ferocactus</i> β <i>acanthodes</i>	+	+	1	1	.	+	1	1	1	1

Echinocereo engelmannii-Agavetum desertii variant of *A. pringlei*

<i>Agave</i> ♦ <i>pringlei</i>	2	2	2
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Other taxa

<i>Ambrosia dumosa</i>	1	2	1	1	1	1	1	.	2	2
<i>Fouquieria splendens</i>	1	2	.	1	1	1	.	.	2	2
<i>Opuntia</i> • <i>acanthocarpa</i>	.	.	.	1	1	1	1	1	1	2
<i>Encelia</i> • <i>farinosa</i>	2	2	2	.	.	2	.	.	.	2
<i>Mammillaria dioica</i>	1	.	1	.	+	+	.	.	.	+
<i>Simmondsia chinensis</i>	.	.	+	.	.	.	1	1	.	2
<i>Mirabilis</i> • <i>aspera</i>	.	.	.	1	2	1	1	1	.	.
<i>Opuntia bigelovii</i>	.	.	.	.	1	1	.	.	+	1
<i>Larrea tridentata</i>	.	.	.	2	1	1	.	.	.	2
<i>Krameria</i> • <i>imparata</i>	+	+	.	.	2	2	.	1	.	.
<i>Yucca schidigera</i>	.	.	.	2	.	.	1	1	.	.
<i>Opuntia</i> • <i>echinocarpa</i>	+	+	1	.	.	.	.	.	.	.
<i>Ambrosia deltoidea</i>	1	1	2	.	.	.	.	.	.	.
<i>Trixis californica</i>	.	.	1	.	.	+	.	.	.	2
<i>Krameria grayi</i>	.	.	+	.	.	.	.	.	+	+
<i>Ephedra aspera</i>	+	.	.	2	1	.	.	.	.	.
<i>Hilaria rigida</i>	.	.	+	2	.	.	1	.	.	.
<i>Viguiera</i> • <i>parishii</i>	.	.	.	1	1	.	1	.	.	.
<i>Stephanomeria pauciflora</i>	.	.	.	1	1	+	.	.	.	.
<i>Beloperone californica</i>	.	.	.	.	2	.	.	.	.	2
<i>Eriogonum angulosum</i>	.	.	.	1	2	.	.	.	.	.
<i>Thamnosma montana</i>	1	1	.	.	.	.	.	.	.	.
<i>Opuntia basilaris</i>	.	.	.	.	1	1	.	.	.	.
<i>Prunus fremontii</i>	.	.	.	.	.	.	1	1	.	.
<i>Acalypha californica</i>	.	.	.	.	.	.	.	1	.	1
<i>Aristida parishii</i>	.	.	.	.	.	.	.	1	.	1
<i>Peucephyllum schottii</i>	.	.	+	.	.	.	.	.	1	.
<i>Porophyllum gracile</i>	.	.	.	1	.	.	+	.	.	.
<i>Lycium andersonii</i>	.	.	.	2	+	.	.	.	.	.
<i>Bebbia</i> • <i>juncea</i>	+	+	.	.	.	.	.	.	.	.
<i>Juniperus californica</i>	.	.	.	.	.	.	1	.	+	.
<i>Ditaxis serrata</i>	.	.	.	+	.	.	.	.	.	2
<i>Hibiscus denudatus</i>	.	+	.	.	.	.	.	.	.	1
<i>Salvia mellifera</i>	1	.	+	.	.	.	.	.	.	.
<i>Eriogonum inflatum</i>	+	+	.	.	.	.	.	.	.	.

Additional species: *Acacia greggii* (rel. 7: r), *Agave utahensis* (7: 1), *Cercidium microphyllum* (10: 2), *Dudleya saxosa* (4: 1), *Ephedra californica* (9: +), *Ephedra nevadensis* (7: 1), *Eriogonum fasciculatum* (3: +), *Eriogonum flavoviride* (9: 2), *Galium angustifolium* (7: 1), *Hyptis* • *emoryi* (6: 1), *Lotus brevisalatus* (8: 1), *Nolina palmeri* (3: 1), *Opuntia littoralis* (9: 1), *Opuntia phaeacantha* (8: 1), *Opuntia tesajo* (10: 2), *Sphaeralcea ambigua* (4: +), *Stipa speciosa* (8: 1), *Viguiera laciniata* (2: +).

region, occurring over many thousands of hectares in the wide valleys in the region.

The *Fouquieria Larreetum* is similar in appearance to the geographically adjacent *Opuntia basilaris-Larreetum*, which occurs in the Mojave Province, but it differs in the following way: (1) the absence of *Opuntia basilaris*; (2) the presence of *Fouquieria splendens* (3) the occurrence of a tetraploid form of *Larrea tridentata* in the Colorado Province vs. a hexaploid form in the Mojave (Yang 1970).

In the Arizona Sector, a new subassociation can be described on the basis of the presence of the nearly endemic *Ambrosia deltoidea*.

Table 17. *Tidestromio oblongifoliae-Atriplicetum hymenelytrae* ass. nova. Type relevé: rel. 2, near Badwater, Death Valley, Inyo County, California, June 2, 1992. Symbols as in Table 2.

Relevé no.	1	3	3	4	5	6	7	8	9	10
Altitude (m)	380	-50	0	920	0	10	10	200	-30	-10
Area (m ²)	50	50	50	50	50	50	50	100	50	50
No. of taxa	4	3	2	1	3	2	4	3	3	3

Tidestromio oblongifoliae-Atriplicetum hymenelytrae: Differentiating floristic combination

<i>Atriplex hymenelytra</i>	1	1	1	1	1	1	1	1	1	1
<i>Tidestromia oblongifolia</i>	+	1	.	.	.	1	1	1	1	1

Other taxa

<i>Larrea tridentata</i>	.	+	+	1	+	1
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Additional species: *Bebbia* • *juncea* (rel. 7:1), *Dalea schottii* (5:1), *Echinocactus polycephalus* (1:1), *Euphorbia parishii* (3:1), *Opuntia* • *echinocarpa* (1:1), *Suaeda torreyana* (5:1).

Echinocereus engelmannii-Agavetum deserti ass.nova; nomenclatural type: Table 16, rel. 4

The most characteristic species of this association is the semi-succulent, leathery, thick-leaved shrub *Agave deserti* ssp. *deserti*. Other common plants are the barrel-cactus *Ferocactus acanthodes*, as well as *Echinocereus engelmannii*, *Fouquieria splendens* several shrubs such as *Encelia farinosa*, *Krameria imparata* and *Ambrosia dumosa*. This mesotropical association grows on rocky upland slopes and piedmonts of desert mountains that surround the edges of the Colorado Province. In north-eastern Baja California (Sanfelipense Sector), there is a floristical variant in which the endemic *Agave deserti* ssp. *pringlei* locally replaces ssp. *deserti* (rels. 8-10).

Tidestromio oblongifoliae-Atriplicetum hymenelytrae ass. nova; nomenclatural type: Table 17, rel. 2

The two dominant species of this association are *Tidestromia oblongifolia* and *Atriplex hymenelytra*; they use dew to enhance their water status (Babu & Went 1978). This is an association that endures the most arid conditions of the North American deserts, with a precipitation of less than 50 mm/yr. It is found in the Death Valley and the San Felipe Desert (Mojave and Colorado Provinces) where it grows in open sparse stands on volcanic rocks, pavement soils and gravelly bajadas. *Larrea tridentata* and some cacti, such as *Echinocactus polycephalus* and *Opuntia echinocarpa*, are the only other species capable of enduring the extreme ecological conditions characteristic of this association.

Cercidio microphylli-Carnegieetum giganteae ass. nova; nomenclatural type: Table 18, rel. 4

This is a real association of species because it is based on the well-known interaction between *Carnegiea gigantea* (saguaro) and its nurse plant, the small tree *Cercidium microphyllum* (foothill paloverde) (Turner et al. 1966; Brum 1973; Steenbergh & Lowe 1977). This

Table 18. *Cercidio microphylli-Carnegieetum giganteae* ass. nova. Type relevé: rel. 4, Brownell Mountain, Pima County, Arizona, July 12, 1992. Symbols as in Table 2.

Relevé no.	1	2	3	4	5	6	7	8	9	10
Altitude (m)	450	550	580	750	780	770	400	580	600	580
Area (m ²)	200	200	200	200	200	200	100	100	100	100
No. of taxa	7	11	14	14	16	16	8	9	10	9

Cercidio microphylli-Carnegieetum giganteae: Differentiating floristic combination

<i>Cercidium microphyllum</i>	1	2	2	2	2	1	2	2	2	2
<i>Carnegiea gigantea</i>	+	1	1	1	1	1	2	1	2	2
<i>Ambrosia deltoidea</i>	1	2	2	1	2	2	+	1	2	2
<i>Opuntia fulgida</i>	.	1	1	+	1	+	.	.	1	.
<i>Acacia constricta</i>	.	1	1	2	+	+	.	.	.	.
<i>Oleña tesota</i>	1	+	.	.	2	1	.	.	.	.
<i>Opuntia</i> • <i>thorneri</i>	.	.	+	.	.	+	+	1	.	.

Other taxa

<i>Larrea tridentata</i>	1	1	1	1	1	1	1	2	2	2
<i>Fouquieria splendens</i>	.	1	1	.	1	1	2	1	1	2
<i>Opuntia</i> • <i>discata</i>	.	.	+	+	1	+	.	1	.	.
<i>Krameria</i> • <i>imparata</i>	1	2	1	.	+	+	.	.	.	.
<i>Opuntia arbuscula</i>	.	.	.	+	1	1	.	.	.	.
<i>Opuntia leptocaulis</i>	.	.	.	+	+	+	.	.	.	.
<i>Ferocactus wislizeni</i>	.	.	.	.	+	+	.	.	+	.
<i>Opuntia</i> • <i>echinocarpa</i>	.	1	1	.	.	.	.	1	.	.
<i>Echinocereus nicholii</i>	.	.	.	+	.	.	.	.	+	+
<i>Echinocereus fasciculatus</i>	.	+	1	.	.	.	.	.	.	.
<i>Ferocactus covillei</i>	.	.	+	1	.	.	.	.	.	.
<i>Mammillaria microcarpa</i>	.	.	.	.	+	+	.	.	.	.
<i>Opuntia bigelovii</i>	.	.	.	.	.	.	1	.	.	1
<i>Opuntia</i> • <i>tetracantha</i>	.	.	.	.	+	2	.	.	.	.
<i>Opuntia versicolor</i>	.	.	.	.	.	.	.	.	1	1
<i>Ambrosia dumosa</i>	1	.	.	.	.	.	.	+	.	.

Additional species: *Acacia greggii* (rel. 4: 1), *Encelia* • *farinosa* (7: 1), *Ephedra viridis* (3: +), *Lemaireocereus thurberi* (10: +), *Opuntia imbricata* (8: 1), *Opuntia* • *macrocentra* (9: +), *Prosopis velutina* (4: 2), *Psilostrophe cooperi* (4: 1).

mesotropical association also includes *Oleña tesota* (ironwood) and shrubs such as *Larrea tridentata*, *Ambrosia deltoidea*, *A. dumosa* and several cacti, some of them endemic or nearly endemic to Arizona, e.g. *Opuntia fulgida* and *O. thorneri*. It is the most widespread plant community in the Arizona Sector of the Colorado Province. The association occupies mountain slopes and upper bajadas above the *Fouquieria splendens-Larreetum tridentatae*.

Hymenocleo salsolae-Daleetum spinosae ass. nova; nomenclatural type: Table 19, rel. 4

This species-poor association is dominated by the small smoke tree *Dalea spinosa* that grows along periodically flooded water courses and on gravelly drainage ways subjected to sporadic and violent torrential rains and flash floods. It occurs in the Colorado Province.

Prosopidetum torreyanae ass. nova; nomenclatural type: Table 20, rel. 4

This association has only one constant and dominant species, the small, microphyllous tree *Prosopis glandulosa* var. *torreyana*, a phreatophyte that inhabits sandy soils, mainly in dunes, where runoff water accumulates. Since this association indicates buried phreatic layers lying beneath plains and playas, it usually forms patches

Table 19. *Hymenocleo salsolae-Daleetum spinosae* ass. nova. Type relevé: rel. 4, Rancho La Estrella, Desierto de San Felipe, Baja California, November 12, 1990. Symbols as in Table 2.

Relevé no.	1	2	3	4	5	6	7	8	9	10
Altitude (m)	180	160	600	10	180	220	900	400	400	850
Area (m ²)	100	100	100	100	50	100	100	100	100	100
No. of taxa	5	4	3	9	4	7	8	11	6	9
<i>Hymenocleo salsolae-Daleetum spinosae</i>: Differentiating floristic combination										
<i>Dalea spinosa</i>	2	2	3	3	3	3	3	3	2	2
<i>Hymenoclea salsola</i>	2	2	1	1	2	2	2	2	1	1
Other taxa										
<i>Larrea tridentata</i>	1	+	+	1	.	.	.	.	.	.
<i>Ambrosia dumosa</i>	.	.	.	1	+	.	.	.	1	.
<i>Encelia</i> • <i>farinosa</i>	.	.	.	2	+	.	+	.	.	.
<i>Petalonyx thurberi</i>	.	.	.	1	.	.	1	1	.	.
<i>Prosopis</i> • <i>torreyana</i>	.	.	.	+	.	.	.	+	2	.
<i>Cercidium</i> • <i>floridum</i>	2	+	.	.	.	.	.	.	.	.
<i>Isomeris arborea</i>	.	.	.	.	.	.	.	+	.	1
<i>Hyptis</i> • <i>emoryi</i>	.	.	.	.	.	.	1	2	.	.
<i>Viscainoa</i> • <i>geniculata</i>	.	.	.	.	.	.	1	1	.	.
<i>Bebbia</i> • <i>juncea</i>	.	.	.	.	.	.	1	1	.	.
<i>Phoradendron californicum</i>	.	.	.	.	.	.	.	.	+	1
<i>Prosopis articulata</i>	.	.	.	.	.	2	.	.	.	.
<i>Salvia mellifera</i>	.	.	.	+	1	.	.	.	.	.
<i>Acacia greggii</i>	.	.	.	.	.	.	+	+	.	.

Additional species: *Acalypha californica* (rel. 7: 1), *Atriplex polycarpa* (1: +), *Cercidium microphyllum* (8: 2), *Chilopsis linearis* (9: +), *Coldenia plicata* (4: +), *Cucurbita palmeri* (4: +), *Dalea fremontii* (9: 1), *Lycium andersonii* (9: +), *Lycium cooperi* (9: +), *Opuntia* • *echinocarpa* (9: +), *Palafoxia linearis* (6: 1), *Solanum hindsianum* (7: +), *Tamarix aphylla* (6: +).

in areas dominated by other different associations such as the *Opuntia basilaris-Larreetum tridentatae* and *Fouquierio splendidis-Larreetum tridentatae*.

The association occurs in mesotropical desert areas, especially in the Colorado Province.

Hymenocleo monogyrae-Baccharidetum glutinosae ass. nova; nomenclatural type: Table 21, rel. 6

This is a riparian shrubland association mainly characterized by the two species occurring in the name. It occupies the margins and riverbeds of some rivers and water courses in transitional mediterranean-desert areas of northern Baja California, i.e. the thermomediterranean and infra-mediterranean belts of the Martirensis Province and the mesotropical belt of the Vizcaíno Sector. The Mediterranean tree *Tamarix pentandra* is common in this association and it is ecologically similar to the Mediterranean riparian shrubland.

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Table 20. *Prosopidetum torreyanae* ass. nova. Type relevé: rel. 4, Valle de la Trinidad, Baja California, November 11, 1990. Symbols as in Table 2.

Relevé no.	1	2	3	4	5	6	7	8	9	10
Altitude (m)	770	650	750	740	20	10	10	740	0	0
Area (m ²)	100	100	100	100	50	50	50	100	50	50
No. of taxa	8	2	1	3	6	2	6	1	1	7
<i>Prosopidetum torreyanae</i>: Differentiating floristic combination										
<i>Prosopis</i> • <i>torreyana</i>	3	4	4	4	4	4	3	5	5	3
Other taxa										
<i>Distichlis spicata</i>	1	+	.	.	1	.	.	.	.	+
<i>Phoradendron californicum</i>	1	.	.	.	.	.	1	.	.	1
<i>Larrea tridentata</i>	.	.	.	1	.	.	1	.	.	.
<i>Lycium cooperi</i>	1	.	.	.	+	.	.	.	.	+
<i>Suaeda torreyana</i>	1	.	.	.	+	.	.	.	.	+
<i>Atriplex</i> • <i>canescens</i>	1	.	.	.	1	.	.	.	.	1
<i>Haplopappus tridentatus</i>	1	.	.	.	.	.	.	.	.	1
<i>Gutierrezia bracteata</i>	.	.	.	.	1	.	.	.	.	.

Additional species: *Beloperone californica* (rel. 6: 1), *Atriplex polycarpa* (6: 1), *Adolphia californica* (7: 1), *Hymenoclea salsola* (1: +), *Lycium andersonii* (7: +), *Krameria grayi* (4: r).

Table 21. *Hymenocleo monogyrae-Baccharidetum glutinosae* ass. nova. Type relevé: rel. 6, Arroyo El Rosario, Baja California, May 20, 1992. Symbols as in Table 2.

Relevé no.	1	2	3	4	5	6	7
Altitude (m)	520	780	260	200	220	15	250
Area (m ²)	10	20	50	50	50	50	40
No. of taxa	4	4	4	6	6	8	7
<i>Hymenocleo monogyrae-Baccharidetum glutinosae</i>: Differentiating floristic combination							
<i>Hymenoclea monogyra</i>	1	3	4	3	1	3	3
<i>Baccharis glutinosa</i>	3	.	1	1	3	1	1
<i>Tamarix pentandra</i>	+	.	1	1	.	1	1
<i>Nicotiana glauca</i>	.	.	1	.	.	1	1
Other taxa							
<i>Baccharis sarothroides</i>	.	.	.	2	1	+	.
<i>Salsola pestifera</i>	.	1	.	.	.	.	+
<i>Cynodon dactylon</i>	.	1	.	.	.	.	1
<i>Salix lasiolepis</i>	.	.	.	1	1	.	.
<i>Rhus diversiloba</i>	.	.	.	.	1	.	+

Additional species: *Datura discolor* (rel. 1: +), *Encelia californica* (6: +), *Platanus racemosa* (5: +), *Prosopis* • *torreyana* (2: +), *Ricinus communis* (6: +), *Salvia mellifera* (6: +), *Sambucus mexicana* (4: 1).

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