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# PLANT ASSOCIATIONS OF EL VIZCAÍNO BIOSPHERE RESERVE, BAJA CALIFORNIA SUR, MEXICO

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ABSTRACT—This vegetation study describes the plant associations of El Vizcaíno Biosphere Reserve (Baja California, Mexico) as determined by the Braun-Blanquet method and supported by cluster analysis. Twenty-two associations were identified, 7 of which are described for the first time (*Camissonio crassifoliae-Encelietum ventori, Encelio phenocodontae-Atriplicetum polycarpae, Lycietum brevipedis, Errazurizio benthamii-Pachycormetum veatchianae, Merremio aureae-Lysilometum candidae, Opuntio taponae-Burseretum microphyllae,* and *Suaedo taxifoliae-Allenrolfeetum occidentalis*). Ecological, biogeographical, bioclimatic, and floristic data are provided for each of these new associations.

RESUMEN—Se estudia la vegetación de la Reserva de la Biosfera de El Vizcaíno (Baja California, México) describiendo las asociaciones a través del método de Braun-Blanquet apoyado en análisis de cluster. Se identificaron 22 asociaciones, de las cuales 7 se describen por primera vez (*Camissonio crassifoliae-Encelietum ventori, Encelio phenocodontae-Atriplicetum polycarpae, Lycietum brevipedis, Errazurizio benthamii-Pachycormetum veatchianae, Merremio aureae-Lysilometum candidae, Opuntio taponae-Burseretum microphyllae* y *Suaedo taxifoliae-Allenrolfeetum occidentalis*). Para cada una de estas nuevas asociaciones se aportan sus características ecológicas, biogeográficas, bioclimáticas y florísticas.

El Vizcaíno Biosphere Reserve (Fig. 1), covering 25,400 km$^2$ of Baja California Sur, Mexico, is one of the largest protected areas in Latin America. The reserve was created in 1998 under the UNESCO MAB program in an effort to include the so-called ''matorral xerófilo'' (xerophilous brushland) in the Mexican System of Natural Protected Areas. This brushland represents the most widely distributed biome in Mexico (Rzedowski, 1978). Because of its extent, geographic situation, and isolated nature, the Vizcaíno region significantly contributes to the flora and fauna of the Baja California peninsula, long known to be an area of considerable biogeographical differentiation (Baird, 1860; Cope, 1873; Dice, 1943; Wiggins, 1969; Peinado et al., 1995*c*). The flora of Baja California is characterized by an unusually large number of local endemics, and El Vizcaíno is not an exception. Besides the endemic plants and endemic plant associations mentioned in this paper, the Vizcaíno biogeographical sector includes 183 taxa endemic to Baja California, 89 of which do not exist elsewhere on the peninsula (Peinado et al., 1994*c*).

The Biosphere Reserve lies within the Baja Californian biogeographical province (Peinado et al., 1994*c*), where it extends southward from 28°N to 26°30′N and contains 2 sectors, Vizcaíno and Angelino-Loretano. The former extends from the Pacific Ocean east to the crest of the drainage, and the latter to the east from this crest to the Gulf of California (Gulf Basin). The physiography of the western portion of the reserve (in the Vizcaíno sector) is marked by a large coastal plain (75% of the reserve), almost wholly without relief as it extends from the Pacific shore to the base of the mountains that form the crest of the peninsular divide. The largest mountains of this plutonic and volcanic backdrop are Sierra San Borja and Sierra San Francisco, both belonging to the Sierra de La Giganta range.

The broadest expanses of low relief in the reserve occur within the Vizcaíno Cape and its eastern extensions, the Llano Berrendo and Desierto de El Vizcaíno. This sandy plain has little relief between the Pacific shore and the mountainous peninsular backbone. The most

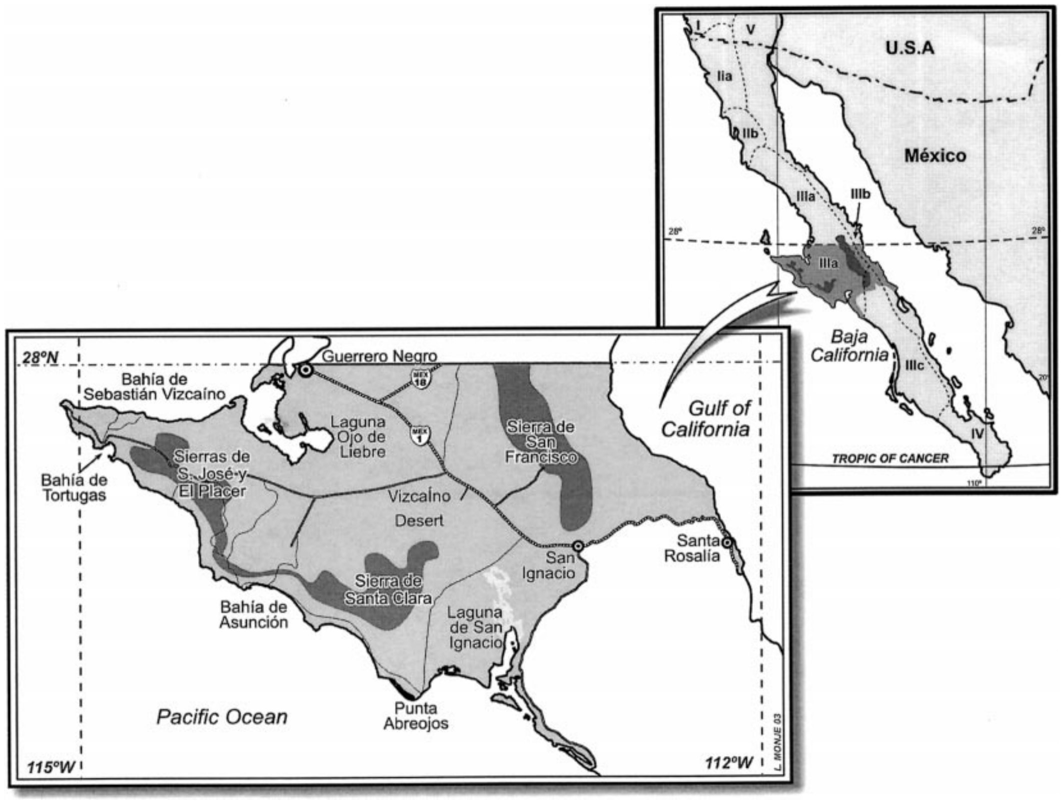


FIG. 1—Map of the El Vizcaíno Biosphere Reserve. Top right: biogeography of Baja California, after Peinado et al. (1994*c*): I = Californiano-Meridional Province, Diegano Sector. II = Martirense Province: IIa = Juarezense Sector; IIb = Martirense Sector. III = Baja Californiana Province: IIIa = Vizcaíno Sector; IIIb = Angelino-Loretano Sector; IIIc = Magdalenense Sector. IV = Sanlucana Province, Sanlucano Sector. V = Colorada Province, Sanfelipense Sector.

significant mountains are Sierra de San José de Castro and Sierra del Placer, formed by sedimentary Lower Cretaceous materials, which extend 160 km parallel to the coast along the southwestern side of the Vizcaíno Cape. Lying between these ranges and the peninsular divide, the Vizcaíno plains, a large endorrheic basin roughly at sea level, is mainly comprised of sandstones and conglomerates of marine Tertiary origin, which are usually buried by huge deposits of sand transported by Pacific winds.

In many areas of the Vizcaíno plains, calcium salts form a cement-like hardpan layer (''caliche'' or petrocalcic horizon) below the sandy surface, restricting water and root penetration. Along with these petrocalcic aridisols, eutric regosols and solonchaks are the dominant soil types of the plains (Maya and Troyo-Diéguez, 1991). In contrast, associations of lithosols, aridisols, and regosols predominate on mountains, lava beds, and volcanoes. Incipient vertisols also occur in some mountainous areas of the Sierra de la Giganta, where rainfall increases due to an orographic effect and dry tropical thornscrub occurs. Fluvisols, supporting Sinaloan thornscrub, are relatively common along mountain drainages (Anonymous, 1995).

The western exposure of the reserve to the Pacific and its shielding in the east from the influence of the warm Gulf by a mountainous ridge produce the prevailing temperature regime. Because of the cooling effect of the Pacific waters, mean summer temperature in the Vizcaíno biogeographical sector is 5 to 6°C lower than that recorded in the remaining Sonoran Desert sectors. Using station annual

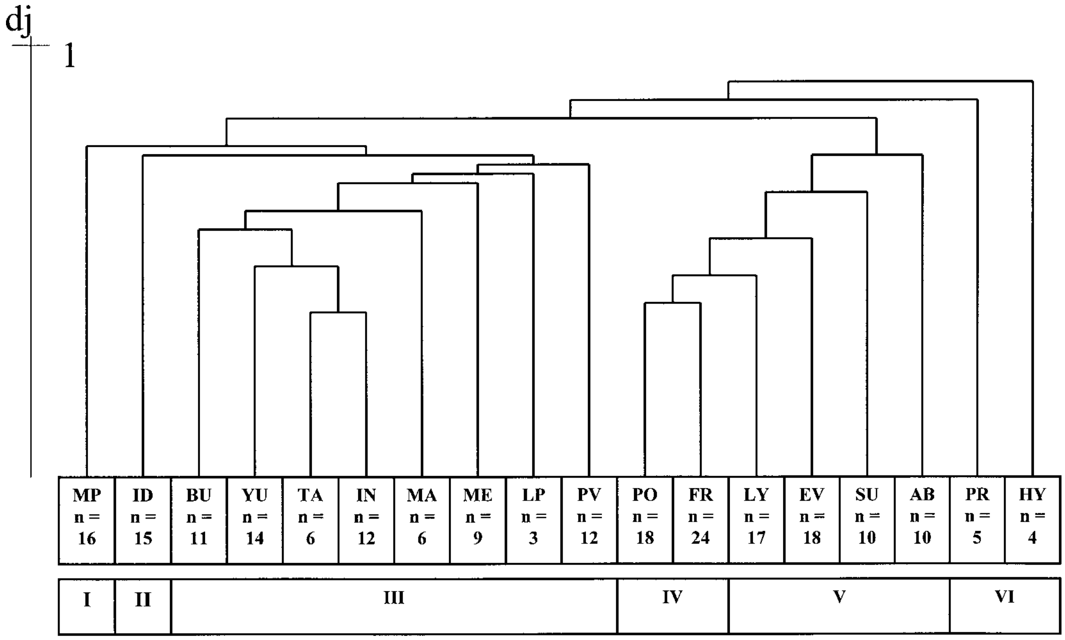


FIG. 2—Average clustering dendrogram (Euclidean distances) including 211 relevés sampled from upland vegetation of El Vizcaíno, Mexico, showing 18 associations (abbreviations as in Table 1) and 6 large clusters (Roman numerals). $n$ = the number of relevés for each association.

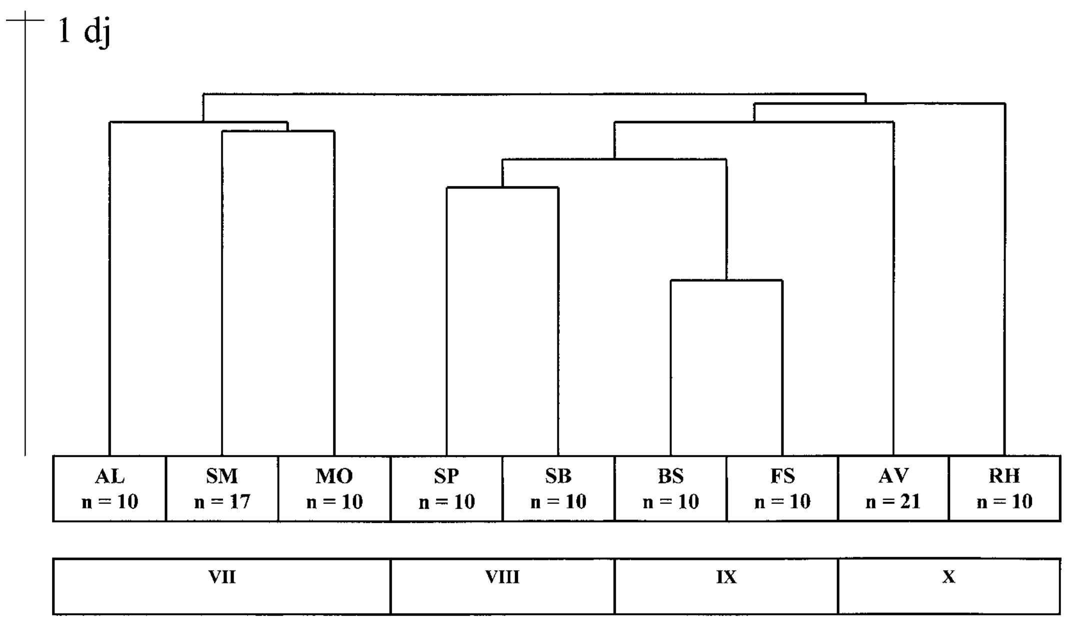


FIG. 3—Average clustering dendrogram (Euclidean distances) including 115 relevés sampled from El Vizcaíno, Mexico, coastal vegetation, showing 9 associations (abbreviations as in Table 1) and 4 large clusters (Roman numerals). $n$ = the number of relevés for each association.

TABLE 1—Floristic composition of the surveyed plant associations of El Vizcaíno Biosphere Reserve, Baja California, México. Scores are percentage classes of Braun-Blanquet (1979) scale.

| Associations | MP | ID | BU | IN | TA | YU | MA | ME | LP | PV | PO | FR | LY | EV | SU | AB | PR | HY | AL | SM | MO | SP | SB | BS | FS | AV | RH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of relevés | 14 | 15 | 11 | 12 | 6 | 14 | 6 | 9 | 3 | 12 | 18 | 24 | 17 | 18 | 10 | 10 | 5 | 4 | 17 | 17 | 10 | 10 | 10 | 10 | 10 | 21 | 10 |
| Cluster | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 5 | 5 | 5 | 5 | 6 | 6 | 7 | 7 | 7 | 8 | 8 | 9 | 9 | 10 | 10 |
| Maytenetum phyllantoidis (MP) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Maytenus phyllantoides* | V | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Lycium andersonii* var. *andersonii* | V | — | — | III | — | — | — | I | — | I | II | I | I | I | I | — | III | — | — | — | — | — | — | — | — | — | — |
| Agavo cerulatae–Idrietum columnaris (ID) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Agave cerulata* ssp. *cerulata* | — | V | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Idria columnaris* | — | V | I | — | I | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Ambrosia chenopodifolia* | — | V | — | I | — | II | — | — | — | II | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Eriogonum fasciculatum* var. *flavoviride* | — | III | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Simmondsia chinensis* | I | III | — | — | — | I | — | — | — | I | — | — | I | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Burseretum hindsiano–microphyllae (BU) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Bursera hindsiana* | — | — | V | II | IV | — | — | II | — | II | I | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Bursera microphylla* | II | — | V | V | V | — | I | V | IV | I | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Berginia glandulosa* | — | — | III | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Opuntia echinocarpa* var. *echinocarpa* | — | I | IV | — | V | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Opuntio invictae–Burseretum microphyllae (IN) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Opuntia invicta* | — | — | — | V | III | — | — | — | — | II | I | I | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Opuntia cholla* | II | II | — | IV | — | — | — | — | — | I | I | I | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Ferocactus towsendianus* var. *towsendianus* | I | — | — | IV | — | III | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Krameria paucifolia* | — | I | I | III | — | — | — | I | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Opuntio taponae–Agavetum subcerulatae (TA) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Agave cerulata* spp. *subcerulata* | — | I | — | — | V | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Echinocereus engelmannii* | — | I | I | — | V | II | — | II | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Encelia farinosa* var. *farinosa* | — | I | I | III | V | — | II | — | II | — | — | I | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

TABLE 1—Continued.

| Associations | MP | ID | BU | IN | TA | YU | MA | ME | LP | PV | PO | FR | LY | EV | SU | AB | PR | HY | AL | SM | MO | SP | SB | BS | FS | AV | RH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of relevés | 14 | 15 | 11 | 12 | 6 | 14 | 6 | 9 | 3 | 12 | 18 | 24 | 17 | 18 | 10 | 10 | 5 | 4 | 17 | 17 | 10 | 10 | 10 | 10 | 10 | 21 | 10 |
| Cluster | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 5 | 5 | 5 | 5 | 6 | 6 | 7 | 7 | 7 | 8 | 8 | 9 | 9 | 10 | 10 |
| *Opuntia tapona* | — | — | — | — | V | — | — | I | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Ferocactus acanthodes* v. *acanthodes* | — | — | — | — | IV | — | — | — | — | — | — | I | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Myrtillocactus cochal* | — | — | — | — | III | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Yucco validae–Fouquierietum diguetii (YU) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Yucca valida* | — | II | — | II | — | V | — | — | II | I | I | I | — | I | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Mascagnio macropterae–Lysilometum candidae (MA) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Lysiloma candida* | — | — | — | — | — | — | V | V | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Mascagnia macroptera* | — | — | — | — | — | — | V | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Merremio aureae–Lysilometum candidae (ME) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Merremia aurea* | — | — | — | — | — | — | — | V | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Agave sobria* | — | — | — | — | — | — | — | III | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Lemaireocerus thurberi* | — | — | — | — | — | — | I | IV | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Community of Larrea tridentata–Pachycormus pubescens (LP) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Pachycormus discolor* var. *pubescens* | — | I | — | — | — | — | — | — | V | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Horsfordia newberryi* | — | — | — | — | — | — | — | — | IV | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Errazurizio benthamii–Pachycormetum veatchianae (PV) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Pachycormus discolor* var. *veatchiana* | — | — | — | — | — | — | — | — | — | V | I | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Euphorbia misera* | — | I | I | — | — | III | — | — | — | V | I | III | I | I | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Errazurizia benthamii* | — | — | — | I | — | — | — | — | — | V | — | I | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Encelio phenocodontae–Atriplicetum polycarpae (PO) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Encelia farinosa* var. *phenocodonta* | — | — | — | — | — | I | — | — | — | I | V | I | — | I | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Atriplex polycarpa* | — | I | — | I | — | I | — | — | — | II | V | I | — | — | — | — | — | II | I | — | — | — | — | — | — | — | — |
| Atriplici julaceae–Frankenietum palmeri (FR) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Atriplex julacea* | — | I | — | — | — | — | — | — | — | II | II | V | II | I | II | — | — | — | — | — | — | — | — | — | — | — | — |
| *Frankenia palmeri* | — | — | — | — | — | — | — | — | — | III | III | V | — | II | III | — | — | — | I | — | — | — | — | — | — | — | — |

TABLE 1—Continued.

| Associations | MP | ID | BU | IN | TA | YU | MA | ME | LP | PV | PO | FR | LY | EV | SU | AB | PR | HY | AL | SM | MO | SP | SB | BS | FS | AV | RH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of relevés | 14 | 15 | 11 | 12 | 6 | 14 | 6 | 9 | 3 | 12 | 18 | 24 | 17 | 18 | 10 | 10 | 5 | 4 | 17 | 17 | 10 | 10 | 10 | 10 | 10 | 21 | 10 |
| Cluster | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 5 | 5 | 5 | 5 | 6 | 6 | 7 | 7 | 7 | 8 | 8 | 9 | 9 | 10 | 10 |
| Lycietum brevipedis (LY) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Lycium brevipes* | — | — | — | — | — | — | — | — | — | — | — | I | V | I | I | — | — | — | — | — | — | — | — | — | — | — | — |
| *Ephedra californica* | — | I | — | — | — | — | — | — | — | — | — | — | III | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Camissonio crassifoliae–Encelietum ventori (EV) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Encelia ventorum* | — | — | — | — | — | — | — | — | — | — | I | — | I | V | — | I | — | — | — | — | — | — | — | — | — | — | — |
| *Camissonia crassifolia* | — | — | — | — | — | — | — | — | — | — | III | II | I | IV | II | — | — | — | — | — | — | — | — | — | — | — | — |
| *Atriplex canescens* ssp. *canescens* | — | — | — | — | — | — | — | — | — | — | — | — | I | IV | II | — | — | — | — | — | — | — | — | — | — | — | — |
| Suaedo taxifoliae–Allenrolfeetum occidentalis (SU) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Suaeda taxifolia* | — | — | — | — | — | — | — | — | — | — | — | — | I | — | IV | — | — | — | I | — | — | — | — | — | — | — | — |
| Abronietum maritimae (AB) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Abronia maritima* | — | — | — | — | — | — | — | — | — | — | — | — | — | I | I | V | — | — | — | — | — | — | — | — | — | — | — |
| Prosopidetum torreyanae (PR) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Prosopis glandulosa* var. *torreyana* | — | I | I | — | — | — | — | — | — | — | — | — | — | — | — | — | V | — | — | — | — | — | — | — | — | — | — |
| *Atriplex canescens* ssp. *linearis* | I | — | — | — | I | — | — | — | — | — | I | — | II | — | — | — | V | II | — | — | — | — | — | — | — | — | — |
| *Distichlis spicata* | — | — | — | — | — | — | — | — | — | — | — | — | I | — | — | — | III | — | — | I | I | — | — | — | — | — | — |
| Community of Bebbia atriplicifolia–Hymenoclea pentalepis (HY) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Hymenoclea pentalepis* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | V | — | — | — | — | — | — | — | — | — |
| *Hyptis emoryi* var. *emoryi* | — | — | I | — | — | — | — | — | — | — | — | — | — | — | — | — | — | IV | — | — | — | — | — | — | — | — | — |
| *Bebbia juncea* var. *atriplicifolia* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | IV | — | — | — | — | — | — | — | — | — |
| *Menzelia cordata* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | IV | — | — | — | — | — | — | — | — | — |
| Allenrolfeetum occidentalis (AL) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Allenrolfea occidentalis* | — | — | — | — | — | — | — | — | — | — | — | I | I | — | V | — | — | — | V | I | — | — | — | — | — | — | — |
| Suaedetum moquinii (SM) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Suaeda moquinii* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | I | V | — | — | — | — | — | — | — |

Table 1—Continued,

| Associations | MP | ID | BU | IN | TA | YU | MA | ME | LP | PV | PO | FR | LY | EV | SU | AB | PR | HY | AL | SM | MO | SP | SB | BS | FS | AV | RH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of relevés | 14 | 15 | 11 | 12 | 6 | 14 | 6 | 9 | 3 | 12 | 18 | 24 | 17 | 18 | 10 | 10 | 5 | 4 | 17 | 17 | 10 | 10 | 10 | 10 | 10 | 21 | 10 |
| Cluster | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 5 | 5 | 5 | 5 | 6 | 6 | 7 | 7 | 7 | 8 | 8 | 9 | 9 | 10 | 10 |
| Monanthochloo–Arthrocnemetum subterminalis (MO) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Arcthrocnemum subterminale* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | I | V | — | — | — | — | — | — |
| *Monanthochlöe littoralis* | I | — | — | — | — | — | — | — | — | — | — | I | I | — | I | I | — | — | I | — | V | — | — | — | III | I | — |
| Salicornietum bigelovii (SB) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Salicornia bigelovii* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | V | I | — | III | — | — |
| Batido maritimae–Spartinetum foliosae (SP) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Batis maritima* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | I | I | — | II | V | V | V | V | — |
| *Spartina foliosa* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | II | V | I | — | — | — |
| Batido maritimae–Sarcocornietum pacificae (BS) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Sarcocornia pacifica* | — | — | — | — | — | — | — | — | — | — | — | I | — | — | — | — | — | — | — | — | II | II | I | V | V | I | — |
| Frankenio salinae–Sarcocornietum pacificae (FS) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Frankenia salina* | — | — | — | — | — | — | — | — | — | — | — | — | I | — | — | — | — | — | — | I | II | — | — | I | IV | — | — |
| *Jaumea carnosa* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | I | IV | — | — |
| *Suaeda esteroa* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | I | — | — | I | — | I | IV | I | — |
| *Cuscuta salina* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | III | — | — |
| *Limonium californicum* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | II | — | — | — | III | — | — |
| Lagunculario racemosae–Avicennietum germinantis (AV) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Avicennia germinans* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | I | — | V | I |
| Lagunculario racemosae–Rhizophoretum mangle (RH) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Rhizophora mangle* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | I | V |
| *Laguncularia racemosa* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | I | — | III | IV |
| Other taxa | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Fouquieria diguetii* | II | II | V | V | V | V | I | IV | IV | V | II | II | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Stenocereus gummosus* | II | II | IV | IV | V | V | — | II | II | I | — | I | — | I | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Jatropha cinerea* | II | — | III | IV | II | III | II | II | — | II | I | I | — | I | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Larrea tridentata* | I | IV | IV | V | II | III | — | — | V | II | I | — | — | — | — | — | — | III | — | — | — | — | — | — | — | — | — |
| *Pachycereus pringlei* | I | IV | IV | V | — | III | II | IV | II | I | I | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

TABLE 1—Continued.

| Associations | MP | ID | BU | IN | TA | YU | MA | ME | LP | PV | PO | FR | LY | EV | SU | AB | PR | HY | AL | SM | MO | SP | SB | BS | FS | AV | RH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of relevés | 14 | 15 | 11 | 12 | 6 | 14 | 6 | 9 | 3 | 12 | 18 | 24 | 17 | 18 | 10 | 10 | 5 | 4 | 17 | 17 | 10 | 10 | 10 | 10 | 10 | 21 | 10 |
| Cluster | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 5 | 5 | 5 | 5 | 6 | 6 | 7 | 7 | 7 | 8 | 8 | 9 | 9 | 10 | 10 |
| *Lycium californicum* | — | II | — | I | I | III | — | — | — | II | III | II | — | I | I | — | — | — | — | I | II | — | — | — | — | — | — |
| *Lophocereus schotii* | I | III | III | — | I | III | I | III | — | I | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Opuntia ciribe* | — | I | III | III | V | V | II | II | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Cercidium microphyllum* | I | — | IV | V | II | — | V | III | — | — | — | — | — | — | — | — | — | II | — | — | — | — | — | — | — | — | — |
| *Stenocereus thurberi* | — | — | III | I | II | I | — | II | II | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Jatropha cuneata* | — | — | V | V | IV | I | I | V | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Pedilanthus macrocarpus* | II | II | III | IV | IV | II | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Ambrosia dumosa* | — | III | — | — | — | — | — | — | IV | III | II | I | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Prosopis articulata* | II | — | I | I | I | — | I | III | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Bebbia juncea* var. *juncea* | — | — | I | — | — | — | IV | III | — | I | I | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Trixis californica* | — | I | — | I | — | — | — | — | II | III | — | — | — | — | — | — | — | II | — | — | — | — | — | — | — | — | — |
| *Hibiscus denudatus* | — | — | — | IV | III | — | II | II | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Ruellia californica* | — | — | II | I | — | — | V | III | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Ferocactus gracilis* var. *gracilis* | — | III | — | I | — | II | — | — | — | I | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Viguiera microphylla* | — | I | — | — | — | — | — | — | — | III | II | I | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Ruellia peninsularis* | — | — | I | I | — | — | — | III | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Echinocereus brandegeei* | — | — | — | III | — | — | — | II | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

means as a measure of aridity, the Vizcaíno would seem to be the most arid region of the Sonoran Desert, with annual rainfall of only 99 mm (Turner and Brown, 1982). However, it is less dry than is apparent from rainfall alone, because fog precipitation from the Pacific Ocean supplies an unknown amount of additional water. Furthermore, extended periods of cloudiness and fog also reduce evaporation. Climate changes leeward of the peninsular divide crest. While winter cyclonic storms dominate the western plains of the reserve, summer and autumn hurricanes affect the coastal Gulf fringe. Thus, winter rains prevail in the west and summer rains predominate on the Gulf coast.

A thermotropical and arid bioclimatic belt prevails in the reserve. Northern communities (*Agavo-Idrietum columnaris*) that indicate the occasional existence of a mesotropical bioclimatic belt exist only in a few high mountainous areas of the Sierra de La Giganta. The presence of dry thornscrub (*Merremio aureae-Lysilometum candidae*) also suggests the existence of higher rainfall amounts.

El Vizcaíno Biosphere Reserve lacks any previous floristic-sociological descriptions, and its plant communities have been little studied. This report describes the main vegetation types (floristic associations) of the reserve. The reader is referred to general descriptions of the vegetation of the Vizcaíno by Shreve and Wiggins (1964) and Turner and Brown (1982), descriptions of its zonobiomes and vegetation formations by Peinado et al. (1994*a*), and a checklist of its flora by León et al. (1995).

Methods—*Data Collection and Analysis*—From 1996 to 2001, 326 phytosociological relevés were sampled according to the Braun-Blanquet method (Braun-Blanquet, 1979) in sites selected on the basis of physiognomy, structure, and species dominance. Relevés were established in each plant community, from salt marshes to forests. Depending on the community, plot sizes ranged from 500 $m^2$ (open stands and thornscrub) to 2 $m^2$ (salt marsh). Environmental data collected at each site included elevation, exposure, appearance, and geological substratum. Soil data also were estimated (soil texture, thickness of sandy cover, depth to petrocalcic layer). Our relevés were classified by numerical and phytosociological analysis to the association level (Peinado et al., 1995*a*, 1998). Cover data for all vascular species were recorded using the Braun-Blanquet (1979) scale. Nomenclature follows Wiggins (1980), except for *Agave* (Gentry, 1978) and *Suaeda* (Hickman, 1993). Anonymous (1995) was used for soil names.

For numerical analysis, cover-abundance values on the Braun-Blanquet scale were transformed into the 1 to 9 ordinal scale of van der Maarel (1979). Numerical classification was performed on 2 groups of relevés: 1) upland vegetation (211 relevés and 258 taxa), and 2) coastal salt marshes and mangroves (115 relevés and 31 taxa). Complete linkage clustering was performed using the SYN-TAX 5.0 program (Podani, 1993). Euclidean distances were used for classification.

Clusters were subjectively defined by major discontinuities. Twenty-seven clusters were identified in the resultant final classification. To identify the floristic composition of these groupings, we developed a synthetic phytosociological table by scoring species as percentages or constancy classes according to the Braun-Blanquet (1979) scale. Each grouping was then phytosociologically analyzed for the occurrence of diagnostic taxa (characteristic and differential), including studies on the distribution of each species and on the available climatological, edaphological, and topographical data (Anonymous, 1995).

Results and Discussion—*Cluster Results*—Clustering the 211 upland vegetation relevés resulted in identification of 18 groups or floristic associations (Fig. 2). These groups also could be gathered into 6 large clusters organized by different floristic and ecological parameters. The floristic compositions of the different associations in Table 1 were obtained by scoring species as percentage classes (indices in Roman numerals) according to the Braun-Blanquet (1979) scale. To limit the size of this table, only taxa with indices of III, IV, or V in at least one group are listed.

Clusters I and II closely corresponded to the associations *Maytenetum phyllantoidis* and *Agavo cerulatae-Idrietum columnaris,* respectively. Cluster III included 8 associations of the thermotropical plants that generally dominate the climax vegetation of the reserve. However, 2 edaphic associations (*Mascagnio macropterae-Lysilometum candidae* and the community of *Larrea tridentata-Pachycormus discolor* var. *pubescens*) were within this cluster because they shared some codominant taxa (e.g., *Lysiloma candida, Larrea tridentata*) with climax associations. Cluster IV encompassed 2 associations on alkaline soils. Cluster V was comprised of 4 psammophilous associations that flourish on maritime dunes and beaches. Finally, Cluster VI was residual and heterogeneous because it grouped 2 associations that not only lacked floristic or ecological relationships, but also were unrelated to the rest of the upland associations.

Clustering of the 115 salt marsh and mangrove relevés (Fig. 3) separated them into 9 floristic associations and 4 large clusters. Cluster VII grouped 3 associations living in the upper region of the salt marshes. Cluster VIII corresponded to the intertidal zone dominated by *Spartina foliosa,* and Cluster IX to the lower and middle zones of the coastal saltmarshes dominated by *Sarcocornia pacifica.* Finally, Cluster X closely corresponded to mangrove associations.

*Syntaxonomical Results—Descriptions of New Associations*—Based on the phytosociological study of the 326 relevés recorded in El Vizcaíno Biosphere Reserve and neighboring areas, we propose 7 new associations and 4 new subassociations, described according to the Code of Phytosociological Nomenclature (Weber et al., 2000). An additional 15 communities identified were associations previously described by us for Baja California. For each new association and subassociation, we provide a short description and a complete phytosociological table, including the Typus relevé.

Each association is defined by a combination of character and differential species. The character species of an association show a distribution relatively restricted to that association and are indicative of the environment of an association. Differential taxa define associations regardless of their fidelity to the association in question. The concepts of character and differential species are clear in theory, but in practice, they can only be of significance if the regional floristic-sociological system is well developed. This was not so in our case, and thus, most of our diagnostic taxa were differential and can only be used to distinguish associations. Character taxa were few and included only some endemics whose distribution was restricted to a specific association. In such a case, it is useful to adopt the concept of ''differentiating floristic combination'' (Beeftink, 1965), i.e., a group of taxa differentiating a given association from all other associations where none of the members of the combination need to be a character taxon. This premise was applied to our phytosociological tables (Tables 2 through 9). For previously described associations, we provide the relevant reference with a short description (Appendix 1).

*Camissonio crassifoliae-Encelietum ventori* association nova; nomenclatural typus: Table 2, relevé 8—Open shrubland, physiognomically dominated by the twisted woody stems (1.5 to 5 m high) of *Encelia ventorum,* endemic to the sandy soils and dunes of the El Vizcaíno coastal plains. *Camissonia crassifolia* and some isolated shrubs (*Haplopappus sonorensis, Viguiera chenopodina,* and *V. lanata*) generally occurred on open sites because the copious dead leaves of *E. ventorum* form a humus that seemed to inhibit the growth of other species. The frequent presence of *Frankenia palmeri* and *Atriplex julacea* was an indication of solonchaks under sandy surface layers.

*Camissonio crassifoliae-Encelietum ventori* is a thermotropical, psammophilous, and xerophytic association that occurred on eutric regosols formed by inland deposition of wind-transported sands. The subassociation *atriplicetosum canescentis* (subassociation nova; nomenclatural typus: Table 2, relevé 15) indicated petrocalcic layers buried by sand accumulation. The subassociation *lycietosum brevipedis* (subassociation nova; nomenclatural typus: Table 2, relevé 17) corresponded to coast dunes, where the usually erect *E. ventorum* was reduced to progressively shorter, flagged, shrubby forms. In these dunes, massive populations of *Lycium brevipes* formed an intricate belt protecting *E. ventorum* from abrasive ocean winds. Within coastal dune zonation, *Camissonio crassifoliae-Encelietum ventori* usually occurred in the wind shadow of the foredunes, in areas away from the immediate coast, generally inland behind *Lycietum brevipedis.*

*Suaedo taxifoliae-Allenrolfeetum occidentalis* association nova; nomenclatural typus: Table 3, relevé 1—A chamaephytic and halophilous association that grows on the strongly alkaline foredunes of the most arid coasts of El Vizcaíno. The association occurred on sites of extreme salinity and drought, intolerable for other psammophytes. Along the shoreline of El Vizcaíno, this association interspersed with *Abronietum maritimae,* which replaced it on beaches and windward foredunes, and with *Camissonio crassifoliae-Encelietum ventori,* which replaced it inland over the oldest and most stabilized dunes.

TABLE 2—*Camissonio crassifoliae-Encelietum ventori* association nova. Typus relevés: association, relevé 8: 280235N-1140140W, 27 March 1997; subassociation *atriplicetosum canescentis*, relevé 15: 270842N-1141219W, 6 August 1997; subassociation *lycietosum brevipedis*, relevé 17: 270909N-1141432W, 24 March 1997. * Baja California endemic; ** Vizcaíno endemic. Scores are cover-abundance values of Braun-Blanquet (1979).

| Relvevé number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Elevation (m) | 30 | 30 | 15 | 20 | 30 | 5 | 0 | 3 | 15 | 40 | 25 | 10 | 15 | 0 | 5 | 10 | 5 | 5 | 5 |
| Cover (%) | 40 | 40 | 50 | 40 | 60 | 50 | 40 | 80 | 80 | 30 | 40 | 70 | 60 | 50 | 60 | 50 | 80 | 60 | 70 |
| Area ($m^2$) | 100 | 100 | 100 | 100 | 50 | 100 | 100 | 50 | 50 | 100 | 100 | 100 | 200 | 20 | 100 | 50 | 100 | 20 | 100 |
| Number of taxa | 5 | 6 | 6 | 8 | 8 | 4 | 4 | 3 | 2 | 7 | 9 | 5 | 6 | 2 | 5 | 2 | 3 | 4 | 3 |
| Differentiating floristic combination | | | | | | | | | | | | | | | | | | | |
| *Encelia ventorum*** | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 5 | 4 | 1 | 2 | 3 | 3 | 2 | 3 | 3 | 4 | 2 | 4 |
| *Camissonia crassifolia*** | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | | 2 | 1 | | 1 | | + | | | 1 | |
| *atriplicetosum canescentis* | | | | | | | | | | | | | | | | | | | |
| *Atriplex canescens* ssp. *canescens* | | | | | | | | | | 1 | 2 | 2 | 1 | 2 | 2 | 1 | | | 2 |
| *lycietosum brevipedis* | | | | | | | | | | | | | | | | | | | |
| *Lycium brevipes* | | | | | | | | | | | | | | | | | 3 | 2 | 2 |
| Other taxa | | | | | | | | | | | | | | | | | | | |
| *Haplopappus sonorensis* | + | + | 2 | 1 | 2 | | | | | 2 | 2 | | | | | | | | |
| *Viguiera deltoidea* var. *chenopodina** | 2 | 1 | 1 | 1 | | 1 | | | | 1 | | | | | | | | | |
| *Frankenia palmeri* | | | | | 2 | | 1 | | | | | + | | | + | | | 2 | |
| *Dalea mollis* ssp. *mollis* | | 1 | | | | 1 | | | | 1 | + | | | | | | | | |
| *Encelia farinosa* var. *phenocodonta* | 1 | | | 1 | | 1 | | | | | | | | | | | | | |
| *Stillingia linearifolia* | | | | | 1 | | | | | | 1 | | + | | | | | | |
| *Encelia laciniata* | | | 2 | + | | | | | | | 1 | | | | | | | | |
| *Sarcostemma arenarium** | | | | 2 | | | | | | | + | | 1 | | | | | | |
| *Lupinus concinnus* var. *brevior* | | 1 | | 1 | | | | | | + | | | | | | | | | |
| *Sphaeralcea fulva** | | | + | | | | | | | | | 2 | 2 | | | | | | |
| *Atiplex julacea* | | | | | 1 | | 1 | | | | | | | | | | | | |
| *Lycium californicum* | | | | | | | | | | | 2 | + | | | | | | | |
| *Yucca valida*** | | | | | | | | | | | 1 | | + | | | | | | |
| *Abronia maritima* | | | | | | | | + | | | | | | | | | 2 | | |

Additional taxa: Relevé 5: *Euphorbia misera* 1, *Jatropha cinerea* 1; relevé 9: *Isocoma menziesi* var. *vernonoides* 1; relevé 15: *Errazurizia megacarpa**2.

TABLE 3—*Suaedo taxifoliae-Allenrolfeetum occidentalis* association nova. Typus relevé: relevé 1: 271143N-1131723W, 26 March 1997. ** Vizcaíno endemic. Scores are cover-abundance values of Braun-Blanquet (1979).

| Relevé number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Elevation (m) | 10 | 5 | 0 | 5 | 5 | 0 | 5 | 0 | 0 | 0 | 1 |
| Cover (%) | 100 | 100 | 80 | 60 | 80 | 80 | 90 | 80 | 100 | 100 | 100 |
| Area ($m^2$) | 20 | 20 | 20 | 50 | 50 | 20 | 20 | 20 | 20 | 20 | 20 |
| Number of taxa | 3 | 5 | 5 | 5 | 5 | 2 | 5 | 5 | 2 | 5 | 4 |
| Differentiating floristic combination | | | | | | | | | | | |
| *Allenrolfea occidentalis* | 4 | 3 | 4 | 3 | 5 | 4 | 5 | 5 | 5 | 5 | 5 |
| *Suaeda taxifolia* | 2 | 1 | 2 | 1 | 1 | 1 | 1 | + | 1 | + | |
| Other taxa | | | | | | | | | | | |
| *Frankenia palmeri* | | 1 | + | 1 | | | 2 | + | | 1 | |
| *Atriplex julacea* | 1 | 1 | 1 | 1 | 1 | | | | | | |
| *Atriplex canescens* ssp. *canescens* | | | | | 3 | | 3 | | | | + |
| *Camissonia crassifolia*** | | 1 | 1 | | 1 | | | | | | |
| *Lycium californicum* | | | | 1 | | | | | | 2 | |
| *Abronia maritima* | | | | | | | + | 1 | | | |
| *Monanthochlöe littoralis* | | | | | | | | | | 3 | |
| *Lycium brevipes* | | | | | | | | | | | 2 |
| *Atriplex barclayana* ssp. *barclayana* | | | | | | | | 1 | | | |
| *Isocoma menziesii* var. *vernonioides* | | | | | | | | | | | 1 |

*Abronietum maritimae* association nova; nomenclatural typus: Table 4, relevé 5—An association exclusively dominated by the prostrate perennial beach sand verbena, *Abronia maritima,* whose strong, spreading root system and salt spray tolerance make it the only embryonic hillock-former on beaches, as well as on partially stabilized moving dunes and exposed foredunes. Vegetative reproduction in *A. maritima* gives rise to large colonies, which form an interlaced system of buried roots and stems that bind the sand and reduce wind erosion. The association occurred along the Pacific Coast of Baja California from El Vizcaíno north to San Diego County, California.

*Lycietum brevipedis* association nova; nomenclatural typus: Table 5, relevé 9—Thorny shrubland, physiognomically dominated by the intricate stems of *Lycium brevipes,* which thrives in coastal dunes where there is a more or less direct salt-spray influence. This dune association generally occurred inland from the pioneer dune association *Abronietum maritimae* on considerably more stable soils, which had more organic matter, retained more water, were more fertile, and had a lower salt content than soils of pioneer dune associations. The coastal area was often foggy, and several lichens (mainly *Niebla* species) hung densely from stems of *Lycium* or covered the soil surface, giving rise to a thin, fragile surface layer that bound the sand particles together.

Communities dominated by *L. brevipes* inhabited coastal dunes from northwestern Baja California south to the tip of the Baja California peninsula. In northern areas, under a Mediterranean climate, *Ephedra californica* was a common codominant, characterizing the subassociation *ephedretosum californicae* (subassociation nova; nomenclatural typus: Table 5, relevé 8), which colonized inframediterranean and thermomediterranean dunes of the Martirense biogeographical province. Despite the occurrence of *E. californica* in El Vizcaíno (León et al., 1995), we never observed this species alongside *L. brevipes* in the reserve.

*Errazurizio benthamii-Pachycormetum veatchianae* association nova; nomenclatural typus: Table 6, relevé 8—This thermotropical and arid association corresponded to the sarcocaules-

TABLE 4—*Abronietum maritimae* association nova. Typus relevé 5: 280235N-1140140W, 27 March 1997. ** Vizcaíno endemic. Scores are cover-abundance values of Braun-Blanquet (1979).

| Relevé number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cover (%) | 90 | 60 | 80 | 50 | 70 | 80 | 60 | 50 | 50 | 50 | 30 |
| Area ($m^2$) | 5 | 50 | 10 | 5 | 50 | 5 | 4 | 10 | 15 | 10 | 50 |
| Number of taxa | 3 | 1 | 3 | 3 | 2 | 2 | 1 | 2 | 3 | 4 | 2 |
| Differentiating floristic combination | | | | | | | | | | | |
| *Abronia maritima* | 5 | 3 | 4 | 2 | 4 | 5 | 5 | 2 | 1 | 2 | 2 |
| Other taxa | | | | | | | | | | | |
| *Cakile maritima* | | | | | | | | 3 | 3 | 2 | |
| *Atriplex barclayana* ssp. *barclayana* | | | 1 | 2 | | | | | | | |
| *Atriplex watsonii* | | | | | | | | | + | + | |
| *Encelia ventorum*** | | | | + | + | | | | | | |
| *Sporobolus virginicus* | | | | | | | | | | | 1 |
| *Salsola kali* sp. *tragus* | | | | | | | | | | 1 | |
| *Camissonia cheiranthifolia* ssp. *suffruticosa* | + | | | | | | | | | | |
| *Carpobrotus aequilaterus* | | | | | | + | | | | | |
| *Mesembryanthemum nodiflorum* | | | + | | | | | | | | |
| *Monanthochlöe littoralis* | + | | | | | | | | | | |

cent desert of Wiggins (1980) and occurred in the western mountains (Sierra de San José de Castro and Sierra del Placer) on sedimentary Lower Cretaceous rocks, mainly on lutites and sandstones that developed on regosols and lithosols and were usually covered by stony layers on hill slopes. In the sandy soils of the El Vizcaíno plains, it was replaced by the association *Yucco validae-Fouquierietum diguetii.* The association was physiognomically dominated by the short, thick, twisted, elephantinely swollen boles of the endemic *Pachycormus discolor* var. *veatchiana,* a characteristic exclusive to this association, together with *Errazurizia benthamii.* Among these dominant plants occurred succulents and shrubs, such as *Euphorbia misera, Fouquieria diguetii, Ambrosia dumosa, Bursera hindsiana,* and *Agave vizcainoensis.* The presence of *Atriplex julacea* and *Frankenia palmeri* was indicative of the alkalinization process common to most arid areas of El Vizcaíno, and of the existence of solonchaks covered by stony layers.

*Opuntio invictae-Burseretum microphyllae* association nova; nomenclatural typus: Table 7, relevé 9—This association was dominated by torchwood trees (*Bursera microphylla*) 3 to 4 m high, large shrubs (*Fouquieria diguetii, Jatropha cinerea, J. cuneata, Larrea tridentata*), many cylindrical succulents (*Ferocactus* and *Opuntia*; the spherical colonies of *O. invicta* were characteristic of this association), and columnar cacti (*Lophocereus schotii, Stenocereus gummosus,* and the ''cardón'' *Pachycereus pringlei*). *Cercidium microphyllum* can be a codominant plant in deep soils, but was unable to colonize eroded hill slopes. The association occurred on west-facing slopes of the Sierra de San Francisco under the influence of relatively wet Pacific winds and away from the effects of the drier Gulf, where the vicariant association *Burseretum hindsiano-microphyllae* occurred. The absence of *Bursera hindsiana* and presence of *O. invicta* were differential features with *Burseretum hindsiano-microphyllae. Opuntio invictae-Burseretum microphyllae* inhabited stony haplic soils arising from basic extrusive rocks. On the western slopes of the Sierra de San Francisco, but on lithosols of intensely steep slopes, the association *Opuntio taponae-Agavetum subcerulatae* (Peinado et al., 1995*a*) also occurred.

Community of *Larrea tridentata-Pachycormus discolor* var. *pubescens*—The elephant tree, *Pachycormus discolor,* endemic to Baja California, was represented by 3 varieties that seem to correspond to 3 edaphic ecotypes: 1) *P. discolor*

TABLE 5—*Lycietum brevipedis* association nova. Typus relevés: association, relevés 9: 270231N-1140316W, 26 March 1997; subassociation *ephedretosum californicae,* relevés 6: 302208N-1155136W, 23 March 1997. * Baja California endemic; ** Vizcaíno endemic. Scores are cover-abundance values of Braun-Blanquet (1979).

| Relevé number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Elevation (m) | 50 | 50 | 15 | 20 | 50 | 10 | 35 | 10 | — | 5 | 10 | 10 | 55 | 10 | – |
| Cover (%) | 80 | 90 | 100 | 50 | 90 | 80 | 100 | 90 | 100 | 50 | 90 | 100 | 60 | 90 | 40 |
| Area ($m^2$) | 100 | 80 | 60 | 40 | 100 | 50 | 100 | 20 | 50 | 100 | 50 | 50 | 100 | 100 | 20 |
| Number of taxa | 5 | 5 | 6 | 5 | 8 | 6 | 2 | 3 | 3 | 6 | 5 | 2 | 5 | 2 | 4 |
| Differentiating floristic combination | | | | | | | | | | | | | | | |
| *Lycium brevipes* | 2 | 4 | 3 | 4 | 3 | 5 | 5 | 5 | 5 | 1 | 4 | 5 | 3 | 4 | 2 |
| *ephedretosum californicae* | | | | | | | | | | | | | | | |
| *Ephedra californica* | 3 | 2 | 2 | 2 | 3 | 2 | 2 | | | | | | | | |
| Other taxa | | | | | | | | | | | | | | | |
| *Allenrolfea occidentalis* | | | | | | | | | | | | 2 | | | 1 |
| *Atriplex canescens* | 2 | 3 | | | 2 | 1 | | 1 | 3 | | | | | | |
| *Atriplex julacea* | | | | 1 | 1 | | | | + | 1 | | | 1 | 3 | |
| *Isocoma menziesii* var. *vernonioides* | 1 | 2 | | | | 2 | | | | | 1 | | + | | |
| *Camissonia crassifolia*** | | | | | | 1 | | | | 1 | 1 | | 1 | | |
| *Dudleya lanceolata* | | | 1 | + | + | | | | | | | | | | |
| *Simmondsia chinensis* | 1 | | + | | 2 | | | | | | | | | | |
| *Helianthus niveus* ssp. *niveus* | | | | | | 1 | | | | | | | 1 | | |
| *Euphorbia misera* | | | | | | | | | | 1 | + | | | | |
| *Opuntia littoralis* | | | 1 | | 2 | | | | | | | | | | |
| *Cynanchum peninsulare** | | + | + | | | | | | | | | | | | |

Additonal taxa: Relevés 4: *Dudleya attenuata* 1; relevés 5: *Sarcostemma arenarium** 2; relevés 8: *Suaeda taxifolia* +; relevés 10: *Frankenia palmeri* 2, *Jatropha cinerea* 2; relevés 11: *Encelia ventorum*** 1; relvés 15: *Frankenia salina* 1, *Monanthoclöe littoralis* 2.

var. *discolor,* a typical element of sandy and rocky granite soils, was endemic to the peninsular batholitic outcrops of the Central Desert; 2) *P. discolor* var. *veatchiana,* endemic to El Vizcaíno and Isla Cedros, growing on sedimentary rocks (lutites and sandstones); and 3) *P. discolor* var. *pubescens,* a pioneer plant in open sparse stands that colonized large lava beds and basalt blocks arising from recent Plioquaternary volcanic activity. These pioneer stands were physiognomically dominated by elephant trees and by a heterogeneous ensemble of shrubs, the most common of which was the ubiquitous *Larrea tridentata.*

Community of *Bebbia juncea* var. *atriplicifolia*-*Hymenoclea pentalepis*—Community dominated by the shrub *Hymenoclea pentalepis* that grew along periodically flooded water courses and gravely drainageways subjected to sporadic and violent torrential rains and flash floods. In some eastern areas of El Vizcaíno, mainly along drainageways from Sierra de La Giganta, the presence of plants such as *Hymenoclea salsola, Dalea spinosa,* and *Olneya tesota* seemed to indicate the association *Hymenocleao salsolae-Daleetum spinosae* (Peinado et al., 1995*a*), which was common on the Gulf slopes.

*Encelio phenocodontae-Atriplicetum polycarpae* association nova; nomenclatural typus: Table 8, relevé 3—Physiognomically, this association often was composed of near uniform stands of gray-leaved shrubs about 1 m tall. The dominant plant was usually saltbush, *Atriplex polycarpa,* associated with other broad-leaved and drought-deciduous shrubs, such as *A. canescens* ssp. *linearis, Encelia farinosa* var. *phenocodonta, Viguiera deltoidea* var. *chenopodina,* and *V. microphylla.* The halophyte *Lycium californicum* was a conspicuous member of this association, which, along with the usual presence of *Atriplex julacea* and *Frankenia palmeri,* reflected the soil salinity this association was able to endure.

TABLE 6—*Errazurizio benthamii-Pachycormetum veatchianae* association nova. Typus relevé: relevé 8: 272705N-1142546W, 6 August 1997. * Baja California endemic; ** Vizcaíno endemic. Scores are cover-abundance values of Braun-Blanquet (1979).

| Relevé number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Elevation (m) | 160 | 175 | 300 | 5 | 40 | 90 | 190 | 75 | 175 | 110 | 285 | 285 |
| Cover (%) | 30 | 30 | 50 | 30 | 40 | 60 | 50 | 40 | 50 | 50 | 40 | 50 |
| Area ($m^2$) | 100 | 100 | 100 | 100 | 100 | 200 | 200 | 400 | 200 | 200 | 200 | 200 |
| Number of taxa | 10 | 8 | 9 | 12 | 8 | 14 | 12 | 11 | 14 | 14 | 11 | 12 |
| Differentiating floristic combination | | | | | | | | | | | | |
| *Pachycormus discolor* var. *veatchiana*** | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 1 | 2 | 2 | 2 | 2 |
| *Errazurizia benthamii*** | + | + | 1 | 1 | + | 1 | 2 | + | 1 | 2 | 2 | 1 |
| *Euphorbia misera* | 1 | 1 | 1 | 1 | 2 | 1 | + | 1 | 1 | + | 1 | + |
| *Fouquieria diguetii* | 1 | 1 | 1 | + | 1 | 2 | 2 | 2 | 1 | 2 | | 1 |
| *Ambrosia dumosa* | | | 2 | | 2 | 2 | 1 | 1 | 1 | 1 | | + |
| Other taxa | | | | | | | | | | | | |
| *Viguiera microphylla*** | 1 | | 2 | 1 | | | | | + | + | | 2 |
| *Atriplex julacea* | + | 1 | | 1 | | | | 1 | | 2 | | |
| *Frankenia palmeri* | 1 | 1 | | 1 | 1 | | | | + | | | |
| *Trixis californica* | | | 2 | 1 | | | | | 1 | + | | 1 |
| *Agave vizcainoensis*** | | + | | | | | | | 1 | + | 1 | |
| *Ambrosia chenopodifolia* | | 1 | | 1 | | | | | | | 2 | 2 |
| *Bursera hindsiana* | | | | | | 1 | 1 | + | | + | | |
| *Larrea tridentata* | | | | | | 2 | 1 | | 1 | + | | |
| *Opuntia invicta** | | | | | | + | 1 | + | 1 | | | |
| *Lycium californicum* | 1 | | | 1 | + | + | | | | | | |
| *Atriplex polycarpa* | | | | | | | | 2 | | 1 | | 1 |
| *Encelia farinosa* var. *phenicodonta* | 1 | | | | | | | 1 | | | + | |
| *Jatropha cinerea* | + | | | | | 1 | | | | + | | |
| *Lycium andersonii* | | | | | | | | 2 | | | | 2 |
| *Krameria parvifolia* var *glandulosa* | | | 1 | | | | | | | | 1 | |
| *Stenocereus gummosus* | | | | | | | | | 1 | | 1 | |
| *Euphorbia magdalenae** | | | | | | | 1 | | + | | | |
| *Ferocactus chrysacanthus** | | | | | | | | | | | 1 | + |
| *Bursera microphylla* | | | | | | | + | | + | | | |
| *Simmondsia chinensis* | | | | + | | | | | | | | 1 |
| *Ephedra aspera* | | | + | 1 | | | | | | | | |

Additonal taxa: Relevé 3: *Petalonix thurberi* +, *Solanum hindsianum* 1; relevé 5: *Suaeda taxifolia* +; relevé 6: *Acalipha californica* +, *Lophocereus schottii* +, *Pachycereus pringlei* +, *Yucca valida*** +; relevé 7: *Bebbia juncea* var *juncea* +, *Opuntia cholla* +; relevé 10; *Cardiospermum corindum* +; relevé 11: *Atriplex barclayana* +, *Echinocereus maritimus** +.

*Camissonia crassifolia* generally occurred on sites where sandy surface layers were deposited by winds.

Saltbush scrub stands occurred mostly on soils with a high soluble salt content. Sites where these soils occurred were mostly broad desert plains, endorrheic depressions, and beds of ancient lakes. The soils of these areas often had an impervious claypan or ''caliche'' (petrocalcic regosols). Thus, the habitats of this association were topographically defined and scattered throughout the reserve, mainly on gently sloping land, valleys, and plains with available groundwater high in minerals. Formerly, and even today, these lands were subject to flooding, although this occurs infrequently. Generally, the calcaric regosols where this association thrives were finer textured than those

TABLE 7—*Opuntio invictae-Burseretum microphyllae* association nova. Typus relevé: relevé 9: 272054N-1130843W, 6 August 1997. * Baja California endemic; ** Vizcaíno endemic. Scores are cover-abundance values of Braun-Blanquet (1979).

| Relevé number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Elevation (m) | 150 | 155 | 120 | 385 | 140 | 220 | 205 | 250 | 125 | 125 |
| Cover (%) | 40 | 40 | 60 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| Area ($m^2$) | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| Number of taxa | 20 | 21 | 22 | 21 | 14 | 14 | 20 | 21 | 17 | 15 |
| Differentiating florsitic combination | | | | | | | | | | |
| *Bursera microphylla* | + | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 |
| *Opuntia invicta** | 1 | 1 | 1 | 1 | 1 | 2 | + | + | 1 | 1 |
| *Fouquieria diguetii* | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| *Larrea tridentata* | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 |
| *Pachycereus pringlei* | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| *Cercidium microphyllum* | + | | + | 1 | + | + | + | + | 1 | 1 |
| *Opuntia cholla* | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| *Pedilanthus macrocarpus* | | 1 | 1 | 1 | + | | 1 | 1 | 1 | 1 |
| *Stenocereus gummosus* | 1 | | 1 | 1 | 1 | | 1 | 1 | 2 | 1 |
| *Jatropha cuneata* | 2 | 1 | 2 | 1 | 2 | 1 | 1 | 1 | | 1 |
| Other taxa | | | | | | | | | | |
| *Jatropha cinerea* | 2 | 2 | | 2 | | | 1 | 2 | 1 | 1 |
| *Hibiscus denudatus* | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| *Opuntia ciribe** | 1 | 1 | | 1 | | | 1 | 1 | | 1 |
| *Ferocactus towsendianus* var. *towsendianus** | + | | + | + | + | | 1 | + | | |
| *Echinocereus brandegeei* | | | + | 1 | | | 1 | 1 | | 1 |
| *Krameria paucifolia* | | | 1 | 1 | | 1 | | 1 | | + |
| *Encelia farinosa* | + | + | | | | + | 1 | | | 1 |
| *Yucca valida*** | 1 | 1 | 1 | | | | | | 1 | |
| *Lophocereus schottii* | | | | 1 | | | 1 | 1 | | |
| *Lycium andersonii* | | | | | | | 1 | + | 2 | |
| *Mammillaria capensis** | 1 | | | | | + | | + | | |
| *Opuntia molesta*** | | 1 | | | | 1 | 1 | | | |
| *Tillandsia recurvata* | | 1 | | | | | | | 1 | |
| *Bursera hindsiana* | 1 | 1 | | | | | | | | |
| *Mammillaria dioica* | | + | 1 | | | | | | | |
| *Lycium californicum* | + | + | | | | | | | | |
| *Atriplex polycarpa* | 1 | | | | | | | | + | |

Additional taxa: relevé 1: *Opuntia ganderi* 1, *Mammillaria albicans** +; relevé 2: *Cucurbita cordata* +, *Dalea megalostachya** +, *Euphorbia xanti** +; relevé 3: *Atriplex barclayana* ssp. *sonorae* +, *Errazurizia benthamii*** 1, *Opuntia alcahes** +, *Trixis californica* +; relevé 4: *Mammillaria hutchinsoniana** 1, *Mammillaria insularis** +, *Olneya tesota* 1, *Ruellia californica* +; relevé 5: *Fagonia laevis* +, *Prosopis articulata* +; relevé 6: *Agave cerulata* ssp. *subcerulata*** 2: relevé 7: *Ambrosia brianthii*** 2; relevé 8: *Ambrosia chenopodifolia* 1, *Ferocactus gracilis* ssp. *gracilis* +, *Stenocereus thurberi* +; relevé 9: *Ambrosia camphorata* 2, *Hilaria rigida* +, *Pitecellobium confine* +.

of the climax association *Yucco validae-Fouquierietum diguetii,* and the water retention capacity was therefore greater. This feature decreased water penetration in lands occupied by the association, and much of this soil was under cultivation, except where *A. polycarpa* was stunted, indicating extreme salt levels.

Gradients between several associations, including *Encelio phenocodontae-Atriplicetum polycarpae,* often occurred around alkali sinks, occupying the borders of playas and shallow salty lakes. The saltpan or playa of any endorrheic depression or dry lake was usually salt encrusted and devoid of plants. Towards the edge of the playa, scattered patches of halophytes occurred on soil mounds raised a few centime-

Table 8—*Encelio phenocodontae-Atriplicetum polycarpae* association nova. Typus relevé: relevé 3: 272613N-1140513W, 24 July 1996. * Baja California endemic; ** Vizcaíno endemic. Scores are cover-abundance values of Braun-Blanquet (1979).

| Relevé number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Elevation (m) | 35 | 60 | 40 | 20 | 45 | 40 | 75 | 10 | 0 | 75 | 5 | 0 | 30 | 0 | 80 | 5 | 5 |
| Cover (%) | 50 | 50 | 60 | 60 | 60 | 50 | 50 | 50 | 80 | 60 | 50 | 50 | 60 | 80 | 30 | 50 | 70 |
| Area (× 10 $m^2$) | 5 | 20 | 10 | 10 | 20 | 20 | 20 | 20 | 20 | 20 | 10 | 10 | 10 | 10 | 10 | 10 | 5 |
| Number of taxa | 3 | 10 | 10 | 10 | 10 | 7 | 7 | 5 | 4 | 9 | 10 | 10 | 10 | 7 | 4 | 7 | 6 |
| Differentiating floristic combination | | | | | | | | | | | | | | | | | |
| *Atriplex polycarpa* | + | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | 4 |
| *Encelia farinosa* var. *phenocodonta* | | 2 | 1 | 2 | 2 | 2 | 2 | | | 1 | 2 | 2 | 1 | 1 | 1 | 2 | + |
| *Lycium californicum* | | + | | 1 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | | | | 1 | |
| Other taxa | | | | | | | | | | | | | | | | | |
| *Camissonia crassifolia*** | 2 | 1 | 1 | 2 | 1 | | + | 1 | | | | | | | | 1 | 1 |
| *Frankenia palmeri* | | | | 1 | 2 | 2 | | + | | | 1 | 2 | | | | + | + |
| *Stillingia linearifolia* | | | + | 1 | 1 | 1 | | | | | | + | | | | 1 | |
| *Atriplex julacea* | | 1 | 1 | | | | | | | | | + | 1 | 1 | | 1 | |
| *Ambrosia dumosa* | | 1 | | | + | | + | | | | | | 1 | | | | |
| *Fouquieria diguetii* | | 1 | | | | | | | | + | | 1 | 1 | | | | |
| *Larrea tridentata* | | | | | | | 2 | | | 2 | 2 | | | | + | | |
| *Viguiera deltoidea* var. *chenopodina*** | 2 | | 1 | 1 | 2 | | | | | | | | | | | | |
| *Viguiera microphylla** | | + | | | | | 1 | | | | 1 | | | + | | | |
| *Errazurizia megacarpa** | | | 2 | | | | | | | | | | + | | | | |
| *Nicolletia trifida* | | | | + | 1 | + | | | | | | | | | | | |
| *Lycium andersonii* | | | | | | | | | 2 | | | | + | 2 | | | |
| *Euphorbia eriantha* | | | + | | + | | | | | | | | | | | | |
| *Euphorbia misera* | | 1 | | | | | | | | | | | 1 | | | | |
| *Ambrosia magdalenae** | | 1 | + | | | | | | | | | | | | | | |
| *Haplopappus sonorensis* | | | | | | | | | 1 | + | | | | | | | |
| *Jatropha cinerea* | | | | | | | | | | | | + | | + | | | |
| *Lophocereus schottii* | | | | | | | | | | 1 | | | | + | | | |
| *Lupinus concinnus* var. *brevior* | | | 1 | 1 | | | | | | | | | | | | | |
| *Pachycereus pringlei* | | | | | | | | | | 1 | | 1 | | | 1 | | |
| *Sphaeralcea fulva* | | | | | | | | | | | 1 | | | | | | |
| *Yucca valida*** | | | | | | | | | | 2 | | 1 | | | | | |
| *Atriplex canescens* ssp. *linearis* | | | | + | | 1 | | | | | 1 | | | | | | |

Additional taxa: relevé 8: *Encelia ventorum*** +; relevé 11: *Atriplex barclayana* ssp. *barclayana* 1, *Phaseolus atropurpureus* var. *atropurpureus* 1; relevé 13: *Bebbia juncea* var. *juncea* 1, *Solanum hindsianum* 1; relevé 17: *Atamisquea emarginata* 2, *Lycium brevipes* 2.

TABLE 9—*Merremio aureae-Lysilometum candidae* association nova. Typus relevés: association, relevés 4: 255759N-1112941W, July 16, 1996; subassociation *pachycereetosum pecten–aborigini*, relevés 10: 234836N-1100354W, August 2, 1997. * Baja California endemic. Scores are cover-abundance values of Braun-Blanquet (1979).

| Relevé number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Elevation (m) | 85 | 18 | 38 | 44 | 44 | 30 | 250 | 25 | 240 | 48 | 32 | 41 |
| Cover (%) | 40 | 40 | 60 | 50 | 60 | 40 | 70 | 50 | 70 | 70 | 70 | 60 |
| Area ($m^2$) | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 100 |
| Number of taxa | 13 | 18 | 13 | 18 | 19 | 18 | 17 | 15 | 12 | 16 | 17 | 12 |
| Differentiating floristic combination | | | | | | | | | | | | |
| *Lysiloma candida** | 1 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 2 | 3 | 2 | 2 |
| *Merremia aurea** | 1 | + | 1 | 1 | 1 | + | 1 | 1 | 1 | + | + | 1 |
| *pachycereetosum pecten-aborigini* | | | | | | | | | | | | |
| *Cnidoscolus angustidens* | | | | | | | | | | 1 | 1 | 1 |
| *Lysiloma divaricata* | | | | | | | | | | + | + | 2 |
| *Pachycereus pecten-aborigenum* | | | | | | | | | | 1 | + | 1 |
| *Tecoma stans* | | | | | | | | | | 2 | | 2 |
| *Tetracoccus capensis** | | | | | | | | | | 2 | + | |
| *Antigonum leptopus* | | | | | | | | 2 | | 1 | | 1 |
| Other taxa | | | | | | | | | | | | |
| *Fouquieria diguetii* | | | + | 2 | 2 | 1 | 2 | 1 | 2 | 1 | | 1 |
| *Jatropha cuneata* | 1 | 2 | + | 2 | 1 | 1 | + | | 3 | | | |
| *Bursera microphylla* | 1 | 2 | 2 | 1 | 1 | 1 | | 1 | 3 | | | |
| *Jatropha cinerea* | | | 2 | | 1 | 1 | | | | 2 | 1 | 2 |
| *Prosopis articulata* | 2 | 2 | | | + | 1 | 1 | | | | | |
| *Lemaiocereus thurberi* | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | |
| *Pachycereus pringlei* | 1 | | + | 1 | 1 | 1 | + | | | | | |
| *Cercidium microphyllum* | 2 | | | 1 | 1 | 1 | | | 2 | | | |
| *Agave sobria** | | 1 | 1 | 1 | 1 | | | | | | | |
| *Ruellia peninsularis* | | | | 1 | | | 2 | 2 | 1 | | | |
| *Ferocactus towsendianus* var. *towsendianus** | | + | | + | + | | | | + | | | |
| *Hibiscus denudatus* | 1 | 1 | | 1 | | | | | | | 1 | |
| *Ruella californica* | | 1 | 2 | | 1 | 1 | | | | | | |
| *Lophocereus schottii* | 1 | 1 | + | | | 1 | | | | | | |
| *Bebbia juncea* var. *atriplicifolia* | | | 2 | | 1 | | 1 | 1 | | | | |
| *Acacia brandegeana** | 2 | 1 | | | 1 | | | | | | | |
| *Crotalaria eriocarpa* | + | + | | + | | | | | | | | |
| *Stenocereus gummosus* | | | | 1 | | | 2 | | | | 2 | |
| *Stenocereus thurberi* | | | | | | | | 1 | + | | 1 | |
| *Echinocereus brandegeei** | | + | | | 1 | 1 | | | | | | |
| *Mammillaria capensis** | | | | 1 | | | + | + | | | | |
| *Opuntia ciribe** | | + | | | 1 | 1 | | | | | | |
| *Prosopis palmeri** | | 1 | | | | 1 | | | | | | |
| *Acalipha californica* | | + | | + | | | | | | | | |
| *Bursera hindsiana* | | | | | | | + | 1 | | | | |
| *Cercidium peninsulare** | | | | | | | | | | + | | + |
| *Echinocereus engelmannii* | | | | | | | + | + | | | | |
| *Bursera odorata* | | | | | | | 1 | | | | 1 | |
| *Cardiospermum corindum* | | | 1 | | | | | 1 | | | | |
| *Cochemia poselgeri** | | | | + | | | | | | | + | |
| *Condalia globosa* var. *globosa* | | + | | | | + | | | | | | |

Table 9—Continued.

| Relevé number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Elevation (m) | 85 | 18 | 38 | 44 | 44 | 30 | 250 | 25 | 240 | 48 | 32 | 41 |
| Cover (%) | 40 | 40 | 60 | 50 | 60 | 40 | 70 | 50 | 70 | 70 | 70 | 60 |
| Area ($m^2$) | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 100 |
| Number of taxa | 13 | 18 | 13 | 18 | 19 | 18 | 17 | 15 | 12 | 16 | 17 | 12 |
| *Opuntia brevispina** | | | | | | | | | 1 | | | + |
| *Opuntia ganderi** | | | | 1 | + | | | | | | | |
| *Abutilon pringley* | | | | | | | 1 | + | | | | |

Additional taxa: relevés 1: *Krameria parvifolia* var. *glandulosa* 2; relevés 5: *Sapium biloculare* +; relevés 6: *Opuntia clavellina* 1, *Opuntia tapona** +; relevés 7: *Ibervillea sonorae* var. *peninsularis** +, *Krameria paucifolia* 2, *Passiflora foetida* var. *longipedunculata* 1; relevés 8: *Euphorbia xanti** +, *Jacquemontia abutiloides* var. *abutiloides*** 1; relevés 9: *Lycium andersonii* +, *Solanum hindsianum* 1; relevés 10: *Acacia cimbispina* 1, *Cassia villosa* 1, *Condalia brandegeei** 1, *Karwinskia humboldtiana* 2, *Rhus* aff. *tepetate* 2; relevés 11: *Yucca capensis** +, *Bursera epinnata* +, *Bursera filicifolia** 1, *Cyrtocarpa edulis** +, *Ruellia leucantha* 1; relevés 12: *Solanum xanti* var. *xanti* 1.

ters above playa level. *Allenrolfeetum occidentalis* dominated these habitats of a fully saline profile and heavy soil (solonchak). Farther away from the playa center, on soils raised a few decimeters above playa level, *A. occidentalis* gave way to *Atriplici-Frankenietum palmeri* (on solonetzs), and this was replaced by *Encelio phenocodontae-Atriplicetum polycarpae* (on petrocalcic regosols), which, in turn, was replaced outside of the depression by the salt-intolerant climax association *Yucco validae-Fouquierietum diguetii* (on eutric regosols).

*Merremio aureae-Lysilometum candidae* association nova; nomenclatural typus: Table 9, relevé 4—This association can be regarded as a northern extension of the Sinaloan thornscrub described by Brown (1982), and corresponded to the leguminous floristic complex in the Sierra de La Giganta Region (Wiggins, 1980:24). These drought-deciduous communities, tended toward an irregularly layered overstory 2 to 8 m in height, typically comprised of spinose, microphyllous, and succulent plant forms, and occupied the transition zone between desertscrub and woodland or forest. Two white-stemmed trees (''paloblancos''), *Lysiloma divaricata* and *L. candida,* were typical components of the Baja Californian thornscrub. The former is codominant in some deciduous forests of the Sanlucana biogeographical province, located at the southern tip of the peninsula (León et al., 2000). In these forests, which flourish within the thermotropical belt under a dry climate, *L. candida* can be an important codominant species. Northward, within the thermotropical belt but under drier rainfall conditions, *L. divaricata* did not occur, whereas *L. candida* thrived in 2 habitats: 1) under arid conditions, it was restricted to the hygrophilous association, *Mascagnio macropterae-Lysilometum candidae,* which occurred on fluvisols in sporadically flooded areas, such as canyon bottoms, arroyos, and drainageways; and 2) when rainfall increased, *L. candida* was the dominant tree of the climax association *Merremio aureae-Lysilometum candidae* and lived on clayey vertisols formed on mountain slopes by the alteration of Tertiary extrusive rocks (rhyolites, andesites, and basalts). Both associations shared several plants, but in the *Merremio aureae-Lysilometum candidae* association, *L. candida* was taller (5 to 8 m), and *Merremia aurea* replaced *Mascagnia macroptera* as a climbing vine. Many characteristic Sonoran Desert species (e.g., *Larrea tridentata, Ambrosia dumosa, A. chenopodifolia*) were absent or were poorly represented in both associations, indicating their water dependence and preference for more humid habitats.

*Merremio aureae-Lysilometum candidae* was a climax association found on foothills and gentle slopes of the Sierra de la Giganta Region, which covered a 30,000-$km^2$ area from 25 km south of Bahía de la Concepción to the southern end of the range, including the northern tip of Bahía de La Paz (Sanlucan biogeographical province). Table 9 shows 3 relevés for this area corresponding to the subassociation *pachycereetosum pecten-aborigini* (subassociation nova; nomenclatural typus: Table 9, relevé 10), which was endemic to the foothills of Sierra de la Laguna.

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APPENDIX 1—A short list of the previously described associations found in El Vizcaíno (Peinado et al., 1994*b*, 1995*a*, 1995*b*).

*Batido maritimae-Spartinetum foliosae*. Perennial pioneer vegetation of saline mud flats.

*Salicornietum bigelovii*. Annual pioneer vegetation of periodically flooded mud flats and intertidal pools.

*Batido maritimae-Sarcocornietum pacificae*. Chamaephytic association of the lower zone of the coastal salt marshes.

*Frankenio salinae-Sarcocornietum pacificae*. Chamaephytic association of the middle zone of the coastal salt marshes.

*Monanthochloo littoralis-Arthrocnemetum subterminalis*. Chamaephytic association of the upper zone of the coastal salt marshes.

*Suaedetum moquinii*. Association found in disturbed areas of the upper saltmarsh zone.

*Allenrolfeetum occidentalis*. Association found on strongly alkaline saltmarshes.

*Lagunculario racemosae-Rhizophoretum mangle*. Mangrove vegetation that grows in the lower tidal zone.

*Lagunculario racemosae-Avicennietum germinantis*. Mangrove vegetation that grows in the highest tidal zone.

*Atriplici julaceae-Frankenietum palmeri*. Chamaephytic vegetation of alkaline deserts.

*Opuntio taponae-Agavetum subcerulatae*. Sarcocaulescent vegetation occurring on steep rocky outcrops.

*Agavo cerulatae-Idrietum columnaris*. Association dominated by giant sarcocaulescents (*Idria columnaris, Pachycereus pringlei*) occurring on granite and basalt soils in mesotropical northern and central areas of El Vizcaíno.

*Burseretum hindsiano-microphyllae*. Sarcocaulescent desert of the arid thermotropical Gulf coast.

*Mascagnio macropterae-Lysilometum candidae*. See text.

*Maytenetum phyllantoidis*. Association almost exclusively dominated by *Maytenus phyllantoides,* which occurs on sea-exposed slopes with the immediate influence of salt spray.

*Prosopidetum torreyanae*. Association almost exclusively dominated by the phreatophyte *Prosopis glandulosa* var. *torreyana,* which inhabits sandy soils, mainly dunes, where runoff water accumulates.