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Population structure of *Dioon purpusii* Rose in Oaxaca, Mexico

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Abstract

Cycads are currently suffering significant habitat loss from deforestation, agricultural expansion, and illegal harvesting. *Dioon purpursii* Rose has restricted distribution and small populations, which until now are endemic in the state of Oaxaca in Mexico, and it has been included in the category of threatened and vulnerable. Three sites with *D. purpusii* plants were located in the state of Oaxaca. Structural and dendrometric characteristics of the population and physiognomic, floristic and environmental characteristics of the forest community at each site were determined. Dendrometric variables were evaluated by an analysis of variance (ANOVA), and a similarity analysis between sites was applied to all characteristics, followed by a cluster analysis to express the relationships between sites. The population structure of the three sites is typical of species in which a great frequency of seedlings and juveniles suggests optimal microhabitat conditions for initial establishment. The results of the ANOVA showed that the most developed plants were found at Site 3, followed by Sites 1 and 2. The floristic composition corresponded to the type of tropical deciduous forest vegetation in the region, where *D. purpusii* formed part of the tree, shrub and herb layers. The phenogram resulting from the similarity and cluster analyses showed that Sites 1 and 2 are more similar (0.97), and Site 3 less similar to the other two (0.84). Although the population structure of *D. purpusii* at the three sites is similar to that found for other cycad species, the main threats are the small number of reproductive individuals, harvesting of leaves, and the constant threat of habitat alteration, like construction of roads, contributing to extinction.

Key words: cycadas, *Dioon purpusii*, population structure, physiognomy, conservation, Oaxaca, Mexico.

Introduction

Mexico's natural resources are in decline, which makes of systems for managing, protecting and making the most of it a necessity. A balance should be sought between supplying satisfiers and not destroying the productive capacity of the country's natural resources (Ortiz Solorio, 1992). If ecosystems are to continue and function adequately, plans for conservation and the proper use of resources must provide the continuance of essential ecological processes and existing diversity in both wild and domesticated species (Castro and Martínez, 1999).

Cycads have survived since remote geological times, but are currently suffering significant habitat loss from deforestation and agricultural expansion, and from

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illegal harvesting of endangered species to supply the black market (Vovides and Peters, 1987). *Dioon purpursii* Rose is a species with restricted distribution and small populations, which until now has been endemic in the state of Oaxaca, Mexico (Jones, 1993). Section 3.2.3 of the Official Mexican Standard (NOM-059-ECOL-2001) includes it in the list of wild species native to Mexico, in the category of threatened (A) and endemic to Mexico. The official standard defines threatened species as "those species, or their populations, which could come to be in danger of disappearing in the short or medium term if the factors impacting negatively on their viability, causing their habitat to deteriorate or change, or directly decreasing the size of their populations, continue to operate" (SEMARNAT, 2002). This category overlaps with the IUCN "vulnerable" classification. The species is classified as vulnerable on the IUCN red list, as it is considered to be at high risk of extinction in its natural habitat [VU B1ab (III, IV, V); C1] (Donaldson, 2003). The size of its range is estimated as less than 20000 km^2. The area is severely fragmented, and the quality of the habitat, number of locations or subpopulations, and number of mature individuals are all in steady decline. The estimated population size is less than 10000 mature individuals, defined as the total number of mature individuals of the taxon, and may be decreasing continuously by at least 10% in each generation (IUCN, 2001).

It is therefore extremely important to study the population of this vulnerable species in order to understand the mechanisms, patterns of natural selection and adaptive responses involved in regulating a plant population (Piñero *et al*., 1977). Pérez Farrera and Vovides (2004) mention that ecological aspects, such as life history and population structure of endangered or threatened taxa, provide valuable information for the establishment of conservation and management action plans. Although there have been ecological studies of the habitat and distribution of different cycad species (Negrón-Ortiz and Breckon, 1989), few have examined their population in terms of size (number of individuals), structure (age and sex) and dynamic (change over time) (Flores Gallardo, 1986). Some studies that have been carried out on cycads populations were those on *Lepidozamia peroffskyana* (Ornduff, 1989), *Cycas media* (Ornduff, 1991), *Cycas armstrongii* (Watkinson and Powell, 1997) and *Cycas arnhemica* (Griffiths *et al*., 2005), in Australia; *Zamia chigua* (Maturana Mendoza and Palacios Lloreda, 2003) in Colombia; *Z. skinneri* (Clark and Clark, 1987) in Costa Rica; *Z. roezlii* (Nicolalde, 2001) in Ecuador; *Z. debilis* (Negrón-Ortiz and Breckon, 1989) and *Z. amblyphyllidia* (Negrón-Ortiz *et al*., 1996) in Puerto Rico; *Cycas seemannii* (Keppel, 2001) in Fiji, New Caledonia, Vanuatu and Tonga; and *Z. pumila* (Ornduff, 1987) in Dominican Republic. Particularly in Mexico have been analyzed populations of *Ceratozamia mexicana* (Alejandre Rosas *et al*., 1990), *Dioon edule* (Vovides, 1990), *Zamia furfuracea* (Vázquez Torres *et al*., 2001) and *Z. loddigesii* (Aguirre Fey, 2004) in the state of Veracruz; and *Ceratozamia matudai* (Pérez Farrera and Vovides, 2004) and *C. norstogii* (Pérez-Farrera and Tejeda Cruz, 1995) in the state of Chiapas. Pérez Farrera and Vovides (2004) suggest the importance of demographic characterization of different species at the meta-population level in order to understand species variation and behavior within and among populations in the range of habitats where they occur. In the south of the state of Oaxaca, Mexico, three sites were located where the species *Dioon purpusii* is distributed. These sites show disturbance, due mainly to the effects of human activity, putting at risk the survival of the species in its natural habitat. The present study was designed to describe and understand variation among populations structure of *Dioon purpusii* Rose and the habitat where they occur in the south of the state of Oaxaca.

Materials and Methods

The study area is located in the Southern Sierra Madre floristic province in the state of Oaxaca, Mexico (elevation 1020 m a.s.l.) (Figure 1). It is characterized

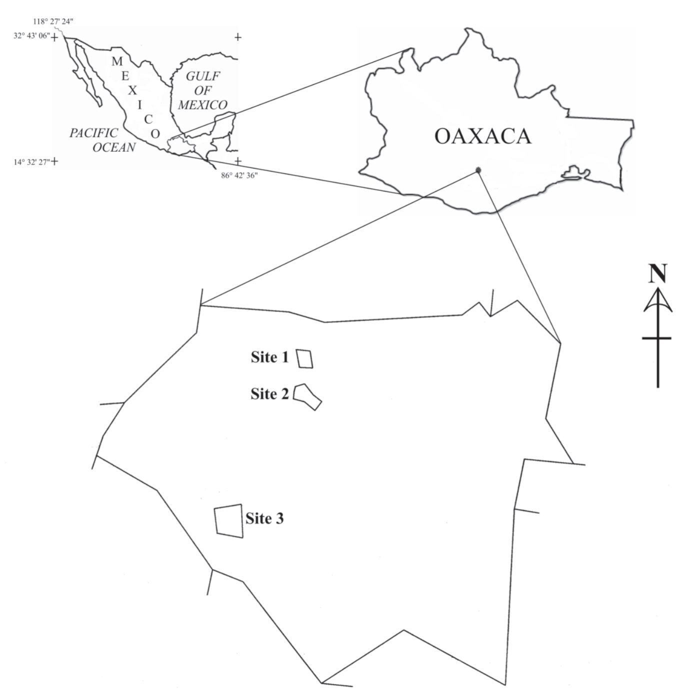

Figure 1. Location of the study area and the study sites in Oaxaca, Mexico.

by extrusive igneous rock with acid tuff and shallow medium-textured soil (depth less than 10 cm) (INEGI, 1988). The climate is hot and dry. Mean annual precipitation is 349 mm, and mean annual temperature 23ºC (García, 1988). The dominant vegetation is tropical deciduous forest, with some populations of oak and pine species. The flora of the study area contains a rich diversity of plants used for medicine, timber and livestock forage, and for pasturing cattle, and shows a high degree of endemism (López, 1980).

Complete populations of *Dioon purpusii* occuring at each of the three study sites were included in the study, then the boundaries of located sites were geo-referenced using a GPS device (Maguellan 320) and they represented irregular polygons (Figure 1). The characteristics of each site are given in Table 1. A certain degree of erosion and disturbance was observed, due to the study area being used for pasturing cattle.

The structural characteristics of the population were determined by classifying all individual plants occurring at each site according to observed characteristics at least four times along two years, rather than by age, which was unknown. *Dioon purpusii* mature plants are arborescent with erect stems, but in older plants sometimes reclining, 1-5 m long, 25-40 cm in diameter. Leaves are numerous, rigid, upright, 0.8-1.6 m long, 16 cm wide, arranged in a crown, i.e., in the apex of the stem, usually covered with protective bracts through which leaves emerge at intervals. Male and female cones are solitary and erect, produced at each reproductive cycle, male cones are 20-36 cm long and 7-13 cm in diameter, and female are ovoid, 44-53 cm long and 20-25 cm in diameter near the base (Whitelock, 2002). Life stages were classified as: (1) seedlings, individuals with no visible stem, one to few leaves not arranged in a crown; (2) juveniles, non-reproductive individuals with no visible stem or barely visible, and leaves arranged in a well-developed crown or more crowns; and (3) adults, reproductive individuals with a visible erect stem and one or more crowns. Adult individuals were classified as male or female from observation of the mature or immature cones, or their vestiges in the stem.

The following dendrometric variables were measured directly for each individual in the three sites: stem diameter at 0.30 m above ground level,

Table 1. Physical characteristics of the three sites in the study area.

Site	Surface (ha)	Elevation* (m)	Orientation	Slope (%)
1	1.84	1580	SW	75
2	13.32	1520	NE	65
3	20.64	1400	N	50

*designated in the centre of the delimited polygonal

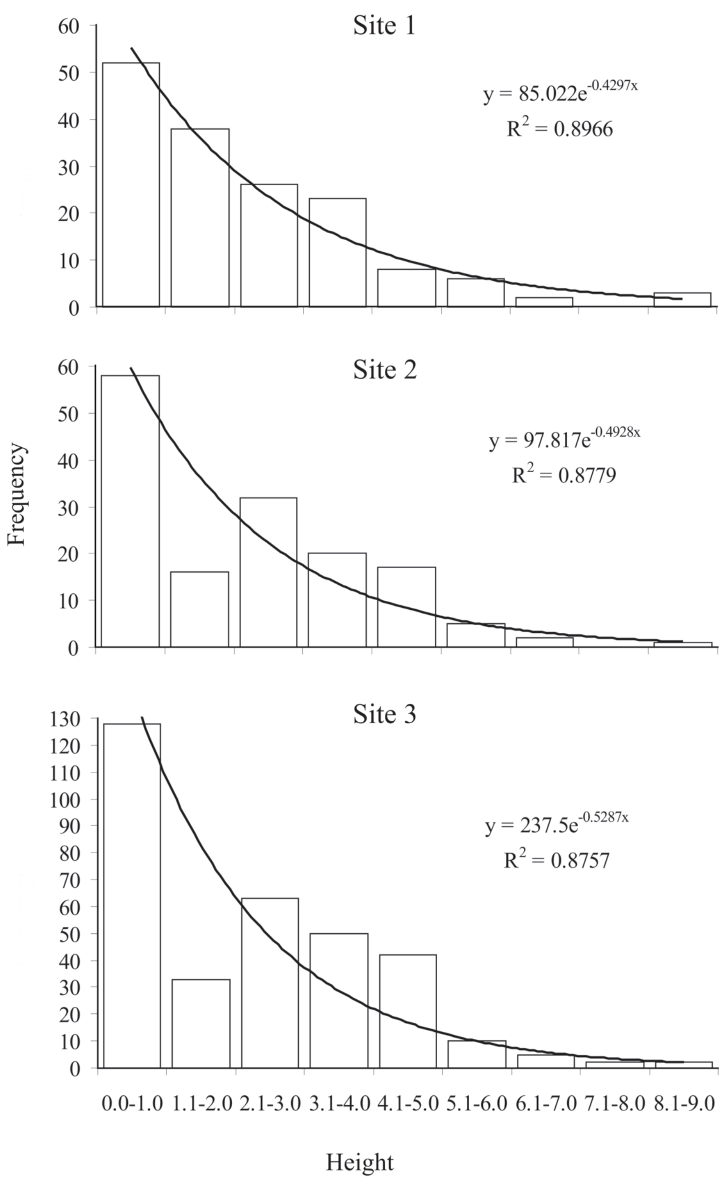

Figure 2. Population structure of *Dioon purpusii* by height classes at the study sites.

Table 2. Density of cycad species studied in Mexico and other countries.

Species	Density(plants ha^{-1})	Vegetation type	Country	Reference
Dioon purpusii	37	Tropical dry forest	Mexico	
Dioon edule	4633	Tropical dry forest	Mexico	Vovides, 1990
Ceratozamia mexicana	2862	Montane cloud forest	Mexico	Alejandre Rosas *et al*., 1990
Ceratozamia matudai	3300	Pine forest	Mexico	Pérez Farrera and Vovides, 2004
Ceratozamia matudai	1000	Montane cloud forest	Mexico	Pérez Farrera and Vovides, 2004
Zamia furfuracea	103	Shoreline	Mexico	Vázquez Torres *et al*., 2001
Zamia furfuracea	38	Shoreline sandbanks	Mexico	Vázquez Torres *et al*., 2001
Zamia chigua	40	Tropical rain forest	Colombia	Maturana Mendoza and Palacios Lloreda, 2003
Zamia lodigessi	401	Tropical dry forest	Mexico	Aguirre Fey, 2004
Zamia gentryi	22	Tropical rain forest	Ecuador	Nicolalde, 2001
Zamia skinneri	471	Tropical rain forest	Costa Rica	Clark and Clark, 1987
Cycas arnhemica	1630	*Eucalyptus* open forest	Australia	Griffiths *et al*., 2005
Ceratozamia norstogii	1238	Oak forest	Mexico	Pérez Farrera and Tejeda Cruz, 1995
Cycas armstrongii	1056	*Eucalyptus* open forest	Australia	Watkinson and Powell, 1997

Table 3. Duncan multiple comparison test for dendrometric mean values (±Standard Deviation) of *Dioon purpusii* Rose in the three sites.

Site	Stem diameter (cm)	Stem heigth (m)	Stem basal area (m^2)	Stem volume (m^3)	Crown diameter (m)	Crown volume (m^3)	Plants measured n
1	24.61 (±2.2)^a	3.05 (±1.6)^a	4.80 (±0.9)^a	9.84 (±8.8)^a	2.35 (±0.3)^a	4.84 (±1.6)^a	96
2	22.89 (±2.6)^b	3.36 (±1.3)^{ab}	4.17 (±1.0)^b	9.52 (±7.6)^a	2.41 (±0.2)^a	5.56 (±1.5)^b	88
3	24.61 (±3.4)^a	3.46 (±1.4)^b	4.85 (±1.3)^a	11.76 (±9.0)^a	2.40 (±0.3)^a	5.45 (±1.8)^b	198
d.f.	2	2	2	2	2	2	
F	11.22	2.78	10.71	2.76	1.49	5.22	
p<	0.0001	0.0632	0.0001	0.0643	0.2256	0.0058	

Means with the same letter are not significantly different

crown length and diameter, and total plant height.

The density and coverage of *D. purpusii* individuals at each site were also determined. Coverage is the proportion of the site area occupied by the perpendicular projections of the aboveground portions of the individuals of the species under consideration (Matteucci and Colma, 1982).

The physiognomic-structural description is meant to produce a graphical or summary representation of the population, enabling visual comparisons. The profile diagram is strictly physiognomic-structural, and is designed to describe little-known plant populations (Matteucci and Colma, 1982). Profile diagrams were produced in the present study, taking a representative 10 m by 20 m rectangle of vegetation inside each one of the three irregular polygon sites, and drawing to scale all plants contained in it. The most significant parameters of all trees and bushes sharing the rectangle with the cycad *Dioon* were measured (stem diameter, total height, stem height up to the lower limit of the crown, and crown diameter) to prepare the scaled profile drawing. Botanical samples of all species were also collected for entry into a herbarium for later identification.

The environmental variables recorded for each site were slope, exposure, soil type and vegetation type. Slope was measured using a clinometer (Suunto). Statistical significant differences between dendrometric variables at different sites were evaluated by an analysis of variance (ANOVA), and significant differences between means were compared and segregated using Duncan's test ($p<0.05$) (SAS Institute Inc, 1989). A similarity analysis between sites was applied using the Pearson product-moment correlation coefficient for mixed data (continuous numeric and binary variables), followed by a cluster analysis with pair-group means (UPGMA) to express the relationships between sites (NTSYS v. 2.01). For the similarity analysis, each site was considered as a unit operating on the 14 dendrometric and environmental variables and species presence.

Results

The population structure and survivorship based on *D. purpusii* plant height is a reverse "J" curve, or Deevey type III at the three sites (Figure 2). The total number of plants at Site 1 was 148, 146 at Site 2 and 443 at Site 3. Figure 3 shows the distribution of individuals of *Dioon* at the three sites by life stage. The proportion of seedlings exceeded 35% at Sites 1 and 2, and was also greater than the proportion of juveniles and adults. At Site 3, the proportions of seedlings and male adults were similar (28–29%).

The proportion of adult female plants was less than that of male adults, juveniles or seedlings at all three sites. The phenology of the species is

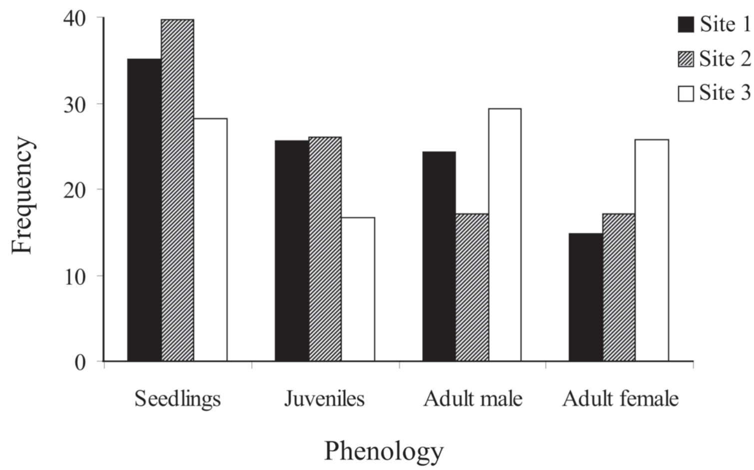

Figure 3. Population structure of *Dioon purpusii* by life stages at the study sites.

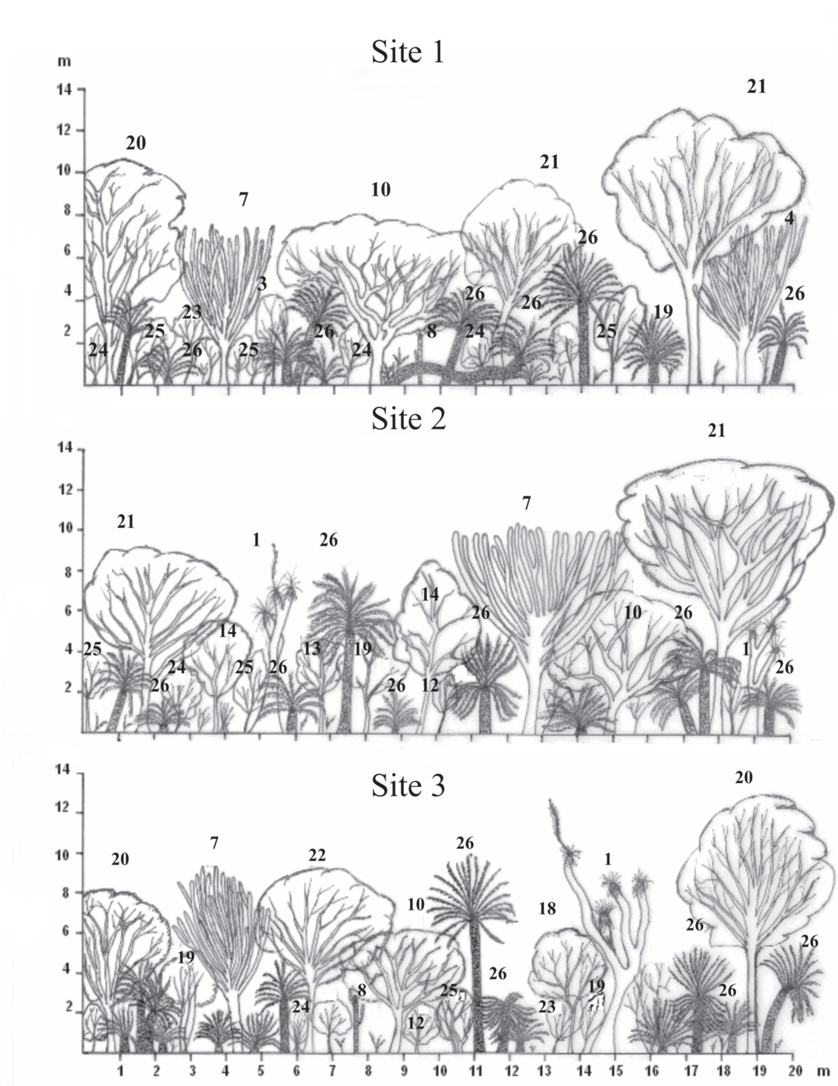

Figure 4. Semi-realistic profile of the trees and bushes associated to *Dioon purpusii* at the study sites. The numbers correspond to the Table 4 list of species; horizontal scale = 1:100; vertical scale = 1:200.

unknown except that it has been reported by Medina and Dávila (1997) determining that it is reproductive in September. One-hundred anf fifty to 200 seeds per cone were observed (n = 3). The mature seed sarcotesta averages 4.28 cm long and 3.78 cm wide. The proportion of male plants was greater at all three sites, particularly at Site 3, where a proportion similar to that of seedlings and female plants was found. The male-female sex ratio was 1:0.6 at Site 1, 1:1 at Site 2, and 1:0.9 at Site 3. The density of *D. purpusii* was 80 ha^{-1} at Site 1, 11 ha^{-1} at Site 2 and 21 ha^{-1} at Site 3. Table 2 compares the mean density of *D. purpusii* with that found for other species in Mexico and other countries, showing that it is much lower than *D. edule* and *Cycas* spp., but similar to *Zamia furfuracea*, *Z. chigua*, and *Z.gentryi*. Coverage was 2.3% at Site 1, 0.3% at Site 2 and 0.4% at Site 3.

The results of the ANOVA applied to dendrometric variables showed that, while there were no statistical differences for crown diameter and stem volume, statistically significant differences between the three sites were observed for the variables total height, stem diameter, basal area and crown volume (Table 3). On the average, the most developed plants were found at Site 3, followed by Sites 1 and 2.

Table 4 shows the most important trees and bushes species found at the three sites. Thirteen families were represented. Figure 4 presents the semi-realistic profile at the three sites, showing the structure of the vegetation with which *D. purpusii* interacts. The species were represented in each of the three main strata of the population; the tree, shrub and herb layers.

The phenogram resulting from the similarity and cluster analyses (Fig. 5) show that Site 3 was quite similar to Sites 1 and 2, with a coefficient of 0.84. Sites 1 and 2 were similar with a coefficient of 0.97. Since a higher value of the correlation coefficient corresponds to greater similarity, Sites 1 and 2 were more similar (i.e.,

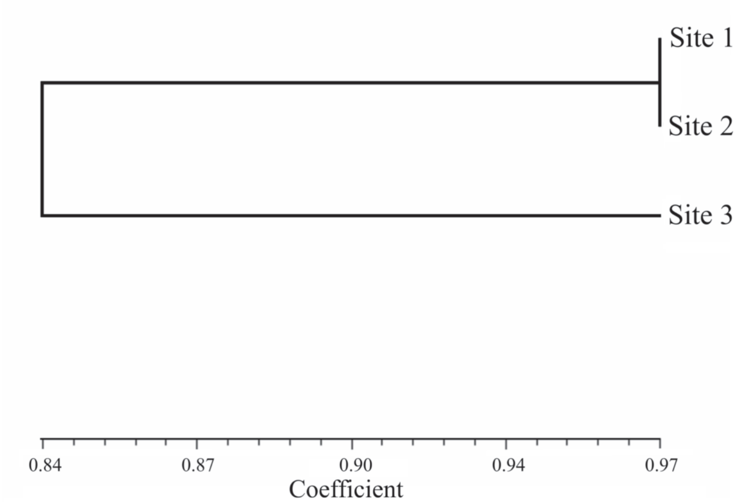

Figure 5. Phenogram resulting from the similarity and cluster analyses applied to the environmental, floristic, dendrometric, physiognomic and structure characteristics of the population in each of the three study sites.

connected to the same node), and Site 3 less similar to the other two. Site 3, located approximately 4.6 km from Site 2 and 5.3 km from Site 1, shows 84% similarity to Sites 1 and 2 in terms of structural, dendrometric, environmental and floristic characteristics.

Discussion

The population structure of the three sites is typical of tropical shade-tolerant tree species, in which a greater frequency of seedlings and juveniles suggests optimal microhabitat conditions for germination and initial seedling establishment. Similar curves have been described for *Dioon edule, Ceratozamia mexicana*, *Zamia debilis* and *Cycas seemani* (Alejandre Rosas *et al*., 1990; Pérez Farrera and Vovides, 2004; Keppel, 2001).

The proportion of seedlings was small in light of the mean 175-seed production of a *D. purpusii* cone. This may be due to the seed dispersal method (autochory), which generally leads to synchronized seedling germination and clustering, resulting in strong intraspecific competition and thus becomes a determinant of the number of seedlings, as in *Ceratozamia mexicana, C. norstogii*, *Dioon edule* and *Zamia lindenii* (Alejandre Rosas *et al*., 1990).

A reduction in the proportion of juvenile plants was observed, also as in *Ceratozamia mexicana* (Alejandre Rosas *et al.,* 1990), *C. norstogii* (Pérez-Farrera and Tejeda Cruz, 1995) and *Cycas* (Ornduff, 1991; Watkinson and Powell, 1997). This could be due to the influence of factors that limit water, light and nutrient intake, among others, motivating intraspecific competition. In addition, there could be factors due to anthropogenic effects in operation at the sites (wood harvesting, pasturing, construction of roads and forest breaks), and their potential effects on the dynamics of the population structure. In *Zamia chigua* (Maturana Mendoza and Palacios Lloreda, 2003), a greater proportion of juveniles (48%) and a smaller proportion of adults (12%) were observed, which is characteristic of the genus, as populations sporadically produce small quantities of seed, resulting in a smaller proportion of seedlings (Nicolalde, 2001).

At Sites 2 and 3, the sexes were balanced, similar to what was observed for *Zamia pumila* 1:1 (Ornduff, 1987*), Z. furfuracea* 1:1.1 and *Z. skinneri* male biased (Clark and Clark, 1987). In contrast, at Site 1, an imbalance was observed, with proportionately fewer females, as in *Ceratozamia norstogii* male-female ratio 2:1, meaning that the population was altered. Adverse habitat conditions, mainly in terms of shade, moisture and soil depth, have been related to disproportion in the sexes, and this could be explained because coning episode for a female is energetically more costly than for a male, and as environmental conditions decline in quality, frequency of coning of individual females likewise decline (Ornduff, 1987).

It is remarkable how species growing in open forests dominated by *Eucalyptus,* pines or oaks*,* as well as in moist forest presented higher density than those species growing in tropical rain or dry forest, the coastline or sandbanks, except for *Dioon edule* growing in tropical dry forest.

Particularly for *D. purpusii* density at Site 1, was higher or more significant than at the other sites, which may be due to the population dynamic. Other biotic and abiotic factors were probably acting at Site 1 to group together and protect individuals in a microhabitat. This site was observed to have inhospitable conditions for other angiosperm species, except Cactaceae, as the soil was poor, scanty, and interrupted by rocky outcrops. This can be compared with the findings on distribution patterns in natural populations of *Dioon edule* in the state of Veracruz (Vovides, 1990). The author found that plants were distributed grouped in habitats with poor soil and rocky outcrops. This pattern of distribution was attributed to other plants winning the competition for water, soil nutrients, and/or seed dispersal by rodents.

It is clear that *D. purpusii* coverage is less than that of other species, as the greater part of the distribution space in all three sites was occupied by other angiosperm species characteristic of tropical deciduous forest. The only other data found on coverage was for *Zamia chigua* in the understory of the tropical rainforest in Colombia, at 12.6%. Although both species presented similar density, coverage was higher in *Z. chigua*, which could be

Table 4. List of the principal species associated to *Dioon purpussi* Rose in the three sites.

No.	Family	Scientific name	Site 1	Site 2	Site 3
1	Agavaceae	*Yucca sp.*		*	*
2	Agavaceae	*Agave angustifolia* Haw.	*		
3	Apocynaceae	*Plumeria rubra* L.	*		
4	Cactaceae	*Stenocereus pruinosus* (Otto) Buxbaum.	*	*	*
5	Cactaceae	*Stenocereus stellatus* (Pfeiffer) Riccobono		*	
6	Cactaceae	*Escontria chiotilla* (Weber) Rose			*
7	Cactaceae	*Myrtillocactus schenckii* (Purpus) Britton & Rose.	*	*	*
8	Cactaceae	*Cephalocereus totolapensis* (Bravo & MacDougall) Buxbaum	*	*	*
9	Cactaceae	*Stenocereus treleasei* (Vaupel) Backeberg.	*		
10	Burseraceae	*Bursera morelensis* Ramírez	*	*	*
11	Burseraceae	*Bursera* sp.	*	*	*
12	Euphorbiaceae	*Croton morifolius* Willd.	*	*	*
13	Euphorbiaceae	*Hippomane mancinella* L.	*	*	
14	Euphorbiaceae	*Euphorbia cotinifolia* L.		*	*
15	Scrophulariaceae	*Scoparia dulcis* L.		*	
16	Flacourtiaceae	*Casearia nitida* (L.) Jacq.	*	*	
17	Anacardiaceae	*Amphipterygium adstringens* Schiede ex Schldl.		*	
18	Leguminosae	*Acacia pennatula* (Schldl. &Cham.) Benth.			*
19	Leguminosae	*Eysenhardtia polystachya* (Ort.) Sarg.	*	*	*
20	Leguminosae	*Lysiloma microphylla* Benth.	*		*
21	Leguminosae	*Lysiloma divaricata* (Jacq.) Macbride	*	*	*
22	Leguminosae	*Lysiloma acapulcense* (Kunth) Benth.			*
23	Malpighiaceae	*Malphigia mexicana* Juss.	*		*
24	Sterculiaceae	*Melochia tomentosa* L.	*	*	*
25	Sapindaceae	*Dodonaea viscosa* (L.) Jacq.	*	*	*
26	Zamiaceae	*Dioon purpusii* Rose	*	*	*

* Presence of the species in the site

explained because usually presents profuse crowns.

Of the dendrometric variables observed, diameter varied little between the three sites, averaging 25 cm, due mainly to cycad growth habit (Stevenson, 1980), although individuals measuring up to 45 cm in diameter were observed.

Sites 2 and 3 had taller *Dioon* individuals, averaging above 3 m, while individuals at Site 1 barely reached 3 m. This difference may be due to the fact that Site 1 was located in an area with shallow soil, steep slopes and a southerly exposure, which considerably limit the height of *Dioon.* Height barely varied between individuals of the same sex, indicating that reproductive efforts of the female plants do not decrease the reserves designated for growth in height (Clark y Clark, 1987; Ornduff, 1989).

Plants at Site 3 had greater mean volume than those at the other sites, as environmental conditions were the most favourable. Site 3 had a larger area of distribution, a northerly exposure, deeper soil, a gentler slope and more abundant vegetation than the other two sites.

The floristic composition corresponds to the type of tropical deciduous forest vegetation distributed in the region, particularly in the driest zone, as confirmed by the predominance of the Leguminosae and Cactaceae families at the three sites (Acosta *et al.*, 2003). Of the species observed, 11 were common to all three sites, indicating 42.3% similarity in floristic composition. The species *Escontria chiotilla*, *Stenocereus stellatus*, *Stenocereus treleasei*, *Myrtillocactus schenckii* and *Dioon* are endemic to the state of Oaxaca (Acosta *et al.*, 2003)

Acosta *et al*. (2003) state that the influence of human activity in the study zone is significant in the outskirts of villages and along dirt roads, as these eliminate the species accompanying *Escontria chiotilla*, increasing their dominance and enabling collection of their fruit. In the case of *D. purpusii*, leaves are harvested for religious festivals, which can damage the reproductive capacity of the female plants.

The similarity value obtained for Sites 1 and 2 reflects a 97% similarity in terms of dendrometric, environmental and floristic characteristics. This is mainly due to the fact that these two sites are closer (about 790 m apart), divided only by a canyon, and their physiographic and environmental features (exposure, climate, soil) are quite similar. Their separation by a canyon and a dirt road suggests that the flow of germplasm between the two sites is limited. Although Site 3 is located some 4,600 m from Site 2 and 5,280 m from Site 1, it is quite similar in terms of dendrometric, environmental and floristic characteristics. This is understandable, as Site 3 is located in the same range of elevation and has the same type of vegetation as the other sites. The difference in environmental conditions favours Site 3; hence its plants are more developed.

Based on the results, the site determined to be the most stable and undisturbed for *D. purpusii* is Site 3, as this site showed higher values for plant development. It should be noted that Site 1 is located in an area of thin soil, and the abundance of rocks appears to constitute a favourable microhabitat for *D. purpusii*. The propensity shown by this species to occupy sites with these characteristics in the study area is consistent with the findings of Vovides (1990) for *Dioon edule* populations, where its distribution in poorer soils is attributed to competition from other angiosperm species for deeper soils, pushing it to more hostile areas with rocky outcrops and poor soils, which can be colonized by cycads and other xerophytic species.

According to the results of this study, although the population structure of *D. purpusii* at the three sites is similar to that found for other cycad species, the sex ratio indicates that Site 1 is the most disturbed and Site 3 the most preserved, consistent with the dendrometric characteristics recorded. The main threats to *D. purpusii* are the small number of reproductive individuals, harvesting of leaves, construction of roads and the constant threat of habitat alteration, which favours the dominance of *Escontria chiotilla* in the region. This situation acquires relevancy because fragmentation of the habitat is also an important factor contributing to extinction (Aguirre Fey, 2004).

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