

Short Communication

***Guaiaacum coulteri*: an over-logged dry forest tree of Oaxaca, Mexico**

James E. Gordon, Marco Antonio González, Jesús Vázquez Hernández, Roberto Ortega Lavariega and Alberto Reyes-García

Abstract Logging history and population structure of the dry forest tree species *Guaiaacum coulteri* are described for Oaxaca, Mexico. We propose that the species has been adversely affected by selective logging, with large individuals now being uncommon. We argue that the species is likely to have undergone similar changes elsewhere in its range and, following IUCN guidelines, propose that it is categorized as Endangered.

Maintenance of *G. coulteri* as an understory shrub may be possible given current land use practices in the area but recovery of populations of large individuals may be more difficult. Suggestions for future research are made.

Keywords *Guaiaacum coulteri*, logging, Mexico, Red List, tropical dry forest, Zygophyllaceae.

Guaiaacum (Zygophyllaceae) is a small genus comprising six tree and shrub species (Mabberley, 1997) of the seasonally dry forests and arid habitats of the tropics and subtropics of the Americas. The species of the genus are characterized by dense timbers (*lignum vitae*) once much in demand by the shipbuilding industry and that continue to be of some economic importance (Grow & Schwartzman, 2001a).

G. coulteri A. Gray is a lesser known member of the genus from Mexico's dry forests (Fig. 1). At the southern extreme of its range the species meets the western extreme of the range of *G. sanctum*, which is a distinct species despite possible hybridization in Guatemala (Grow & Schwartzman, 2001b).

Mexican dry forests have suffered high rates of conversion to a variety of extensive and intensive agricultural uses (Trejo & Dirzo, 2000) and are therefore a conservation priority. One of the few remaining substantial areas of dry forest left anywhere in Mesoamerica is along the coast of Oaxaca in southern Mexico. We describe here the logging history and aspects of the current population structure of *G. coulteri* in the municipality of Santa María

Huatulco, Oaxaca (Fig. 2), and discuss the conservation status of the species and propose a Red List (IUCN, 2003) category.

In Oaxaca the evergreen *G. coulteri* is of variable habit. It can be found as a medium sized tree that can reach the forest canopy (13–15 m) but trees of such size, whose diameter at breast height (DBH) may reach >40 cm, are encountered rarely in these low stature forests, where few individuals of any species reach >60 cm DBH. As an understory shrub it has weak apical dominance, a habit that is exaggerated in individuals found on the dunes between the rocky outcrops along Oaxaca's coast, where it is found as a densely branched and scandent shrub. Yetman *et al.* (2000) also note considerable variation in the species' growth habit in north-west Mexico. Anecdotal evidence suggests that the species is slow growing. Although we know of no work on its growth in natural forests, slow growth rates would be likely for a species that produces such a dense timber, as was suggested by Oldfield *et al.* (1998) for *G. sanctum* and *G. officinale*.

The local history of *G. coulteri* logging in Santa María Huatulco was reconstructed through semi-structured interviews with two informants who participated in the last organized logging of this species in the municipality. They confirmed that outside interests in the late 1950s had systematically mined local forests for export quality *G. coulteri* timber. Felling was by handsaw and transportation out of the region was by road, taking as long as 5 days to move the logs to the Gulf Coast port of Coatzacoalcos. This suggests that the costs of extraction were considerable and that the price obtained for the timber must have been correspondingly high. Our

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Fig. 1 Distribution of *Guaiacum coulteri* in the dry forests along the western coast of Mexico.

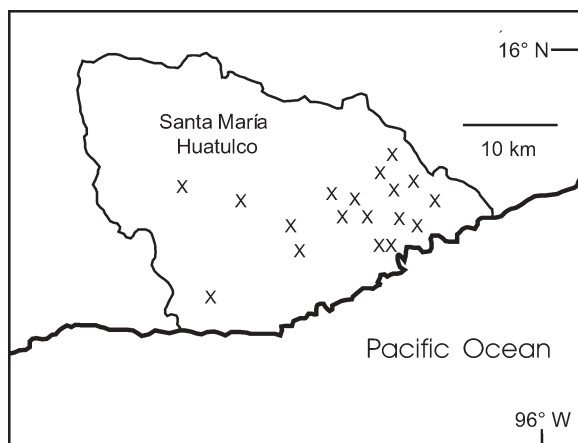


Fig. 2 Location of forest patches (crosses) sampled in southern Oaxaca, Mexico.

informants suggested that the minimum felling diameter was *c.* 80 cm DBH and that trees of >100 cm diameter were common. By the standards of today's populations, such sizes are extraordinary. They also had second hand knowledge, passed down from older relatives, of previous logging of *Guaiacum* in the region, dating back to 1914. The logging operations of which they spoke did not target any other species; there was sufficient merchantable timber of this species alone to make extraction financially viable.

Forest patches in the municipality were sampled using Hall's (1991) multiple nearest tree method. Sampling was

undertaken to quantify the total species diversity of the dry forest trees of the municipality, and hence the choice of forests was made without knowledge of the presence of *G. coulteri* and can be considered unbiased with respect to this species. In each of 18 forest patches sampled, 15 randomly placed plots were surveyed for a total of 225 trees ≥ 5 cm DBH. This revealed *G. coulteri* to be highly patchy in its local distribution. It was absent in 13 of the samples, represented by a single individual in two samples, and in three samples accounted for 10–17 individuals (4.4–7.6% of stems). In these three forests ad hoc searches confirmed that the species was a common understorey shrub. Of the 42 individual trees enumerated in the 18 samples, all were shrubs and none exceeded 25 cm DBH. As *G. coulteri* can take the form of a medium sized canopy tree in these forests (R. Ortega Lavariega, pers. obs.), it appears that the earlier selective logging has been a significant factor in drastically altering the population structure of the species in Oaxaca.

The three forests with abundant *G. coulteri* were not amongst the four youngest forests surveyed. Those four, estimated by visual inspection and by conversation with local residents to be <20 years old, were not found to contain the species either in the survey or in ad hoc searches. This is consistent with *G. coulteri* not being a species of early forest successions (Gordon *et al.*, 2003). In one of the three forests in which *G. coulteri* was common, ad hoc searches revealed two further individuals each

with a DBH of 35–40 cm and whose crowns reached the canopy. These were the largest trees encountered anywhere in the municipality and this observation is consistent with Grow & Schwartzman's (2001b) contention that the species is capable of healthy regeneration in undisturbed forest around larger trees. However, similar searches in the other two forests with common *G. coulteri* revealed no large trees, suggesting that regeneration may not be entirely dependent on such individuals.

In considering ways forward for the conservation of *G. coulteri* several factors have to be considered. The species has a relatively widespread natural distribution with a north to south range of approximately 1,500 km. In some respects it is resilient; it is able to flower and set fruit as a shrub, it is patchily common and it is also sometimes found as an ornamental in Oaxaca. These factors mean that its continued survival as a shrub in Oaxaca may be compatible with the current local land use practices of light forest disturbance for forage and firewood. However, it is possible that recovery of large diameter individuals continues to be inhibited by occasional extraction of poles for local construction (R. Ortega Lavariega, pers. obs.). Balanced against this it must be recognized that the principal habitat of the species, seasonally dry tropical forest, has suffered high rates of deforestation (Trejo & Dirzo, 2000). Further, the once high export value of this species must also have made its extraction from elsewhere in its range highly attractive. We suggest that this has been the case and that throughout much of its range populations containing large individuals of *G. coulteri* have been mined for timber, thus leaving a recovering population largely composed of small individuals. This is supported by Grow & Schwartzman (2001b) who describe the species throughout its range as a shrub or small tree rarely greater than 8 m in height. Revision of those recent specimens of *G. coulteri* in Mexico's National Herbarium (MEXU) whose labels contained relevant information on tree size, revealed that none could have been taken from trees of merchantable timber size. Whilst capable of flowering when still small in size, it is a reasonable assumption that the quantity of seed set by small individuals is a fraction of that which a canopy individual would set. It is therefore debatable whether small individuals should or should not be considered reproductively mature, thus complicating the conservation of the species.

IUCN guidelines for assessing the threat status of species (IUCN, 2001) give considerable latitude for inference. Hence, based on Trejo & Dirzo's (2000) estimate of loss of dry forest in Mexico of nearly 50% and the evidence presented above on the loss of large individuals through logging, we infer that the species has undergone a >50% reduction in population of mature individuals over the last three generations and that the

causes of this reduction, especially habitat conversion, continue. On this basis we propose that the species be categorized as Endangered based on criteria A2c & d (IUCN, 2001) on the IUCN Red List (IUCN, 2003).

The conservation of this species presents a dilemma: is its conservation as a shrub a satisfactory goal, or must populations of large individuals be regained? Its conservation will, however, be dependent on the conservation of its seasonally dry habitat and we therefore caution against initiating costly studies on its regenerative potential when more general habitat level conservation in this biome is urgently required. However, we suggest that the identification and protection of any remaining stands of large canopy individuals be prioritized. Beyond that, recovery of this species will be dependent on whether selective logging and fragmentation have led to reproductively isolated populations that have suffered dysgenic selection in favour of shorter, more highly branched individuals. This would require genetic surveys to determine levels of homozygosity in the species and studies of its breeding system to determine the long-term viability of the remaining populations.

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References

- Gordon, J.E., Barrance, A.J. & Schreckenber, K. (2003) Are rare species useful species? Obstacles to the conservation of tree diversity in the dry forest zone agro-ecosystems of Mesoamerica. *Global Ecology and Biogeography*, **12**, 13–19.
- Grow, S. & Schwartzman, E. (2001a) The status of *Guaiaacum* species in trade. *Medicinal Plant Conservation (Newsletter of the Medicinal Plant Specialist Group of IUCN/SSC)*, **7**, 19–21.
- Grow, S. & Schwartzman, E. (2001b) Review of the taxonomy and distribution of the genus *Guaiaacum* in Mexico. Unpublished presentation, CITES Plants Committee Meeting, Malaysia.
- Hall, J.B. (1991) Multiple-nearest-tree sampling in an ecological survey of Afromontane catchment forest. *Forest Ecology and Management*, **42**, 245–299.
- IUCN (2001) *2001 Categories & Criteria (version 3.1)*. IUCN, Gland, Switzerland [http://www.redlist.org/info/categories_criteria2001.html, accessed 18 August 2004].

- IUCN (2003) *2003 IUCN Red List of Threatened Species*. IUCN, Gland, Switzerland [http://www.redlist.org, accessed 18 August 2004].
- Mabberley, D.J. (1997) *The Plant Book*. 2nd edition. Cambridge University Press, Cambridge, UK.
- Oldfield, S., Lusty, C. & MacKinven, A. (eds) (1998) *The World List of Threatened Trees*. World Conservation Press, Cambridge, UK.
- Trejo, I. & Dirzo, R. (2000) Deforestation of seasonally dry tropical forest: a national and local analysis in Mexico. *Biological Conservation*, **94**, 133–142.
- Yetman, D.A., Van Devender, T.R., Estudillo, L. & Reina Guerrero, A.L. (2000). Monte Mojino: Mayo people and trees in southern Sonora. In *The Tropical Deciduous Forest of Alamos: Biodiversity of A Threatened Ecosystem* (eds R.H. Robichaux & D.A. Yetman), pp. 142–151. University of Arizona Press, Tucson, USA.

Biographical sketches

James Gordon is carrying out research on tree diversity assessment methodologies and perceptions of biodiversity by non-governmental organizations.

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