

Conservation of *Commiphora wightii*, an endangered medicinal shrub, through propagation and planting, and education awareness programs in the Aravali Hills of Rajasthan, India

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SUMMARY

In the Aravali hills of Rajasthan (northwest India), community-based approaches were followed to conserve *Commiphora wightii*, an endangered medicinal plant. Efforts were made to increase the effectiveness of wildlife conservation projects in the rural and tribal area of Aravali by promoting community participation through a *C.wightii* propagation and planting scheme, and education programs. Local communities participated and responded very positively to the initiatives. Approximately 3,500, 3-month old *Commiphora* plantlets (each about 30 cm tall) propagated via cuttings, were planted out into their natural habitat.

BACKGROUND

Pressures from urbanization, mass tourism and intensive agriculture have pushed more and more plant species towards extinction. The problem is particularly acute in some arid regions, such as the Aravali hills of Rajasthan (northwest India), which supports numerous plant species endemic to the region. Many serve as sources of food, fuel, fibre, timber and medicine, and function as an integral part of local agricultural production systems. Wild plants of the Aravali hills used for medicinal purposes are receiving ever-increasing attention from the scientific community and commercial enterprises. At the same time, these species continue to support indigenous and local communities that have relied on them for centuries in their traditional medicines. As well as in conservation terms, disappearance of plant species in such regions may be an irreversible loss from a socio-economic and scientific point of view.

Most of the rural communities adjacent to the Aravali hills are poverty-stricken. Poor people, especially those living in areas with low agricultural productivity, rely heavily on wild flora and fauna to support their livelihoods.

Threats to these resources are directly linked to activities such as uncontrolled harvesting (over-exploitation, premature harvesting etc.), over-grazing, burning, shifting cultivation, and other activities leading to deforestation and habitat destruction. Several local tribes of the Aravali hills area lead a nomadic life. Both humans and livestock cause destruction of vegetation during their movements. Goats and cows are the integral components of this production system, but may prevent natural regeneration, threatening the existence of a number of plant species. All these activities are the results of several socio-economic factors such as unclear definition of property rights, cash needs of the local people, illiteracy, lack of conservation knowledge, and increasing market demands for these products.

C. wightii (Arnott) Bhandari (Bursaceae) is an endangered, slow growing, highly branched woody shrub (locally known as guggul) that grows in arid, rocky tracts of the Aravalli range (Fig. 1a). The oleo-gum resin of *C. wightii* (locally known as gum guggul), is mentioned in the classic Ayurvedic literature as an efficacious treatment for bone fractures, arthritis, inflammation, obesity, cardiovascular disease, and lipid disorders (Urizar & Moore

2003; Wang *et al.* 2004). The gum is extracted from the bark by resin tapping (Fig. 1b). A plant generally takes 10 years to reach tapping maturity under the prevailing dry climatic conditions. Thick branches are incised during the winter to extract the gum resin. Overexploitation, slow-growth and associated poor seed set has led to this plant becoming an endangered species (Kumar *et al.* 2003). Guggul is listed in *Data Deficient* category of IUCN's Red Data list because of a current lack of knowledge regarding its conservation status.

Generally the gum resin is collected by tribal people using traditional tapping methods involving making several deep incisions on the stem to extract the maximum amount of gum. They then apply a paste around the incision consisting of horse or wild ass urine, oleo gum resin and copper sulphate. Whilst this crude method increases the amount of gum three to four times over that obtained under normal tapping procedures, the shrub becomes subsequently unfit for tapping for the next couple of years and ultimately plants may die due to the injurious effect of copper sulphate (Kshetrapal & Sharma 1993). It is now believed that such tapping methods to increase gum yield causes mortality of plants.

Indigenous peoples are carriers of ancestral knowledge and wisdom about local biodiversity. Their effective participation in biodiversity conservation programs in protecting and managing natural resources

would result in more comprehensive and cost effective conservation and management of biodiversity in many regions of the world.

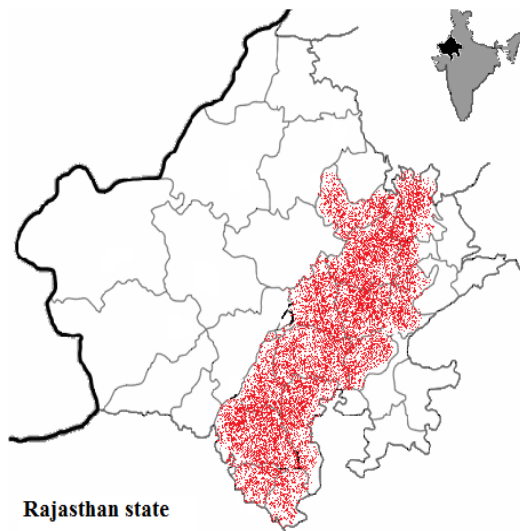
Therefore, in this present study, community-based efforts were made to mobilize and raise awareness amongst local rural and tribal people of the Aravali hills about the importance and conservation of *Commiphora wightii*. Primary aims were to increase the effectiveness of wildlife conservation programs by promoting community participation, and enhance the conservation status of *C.wightii* through a propagation and planting scheme.

ACTION

Field surveys: From mid-January 2008 to March 2008, surveys were conducted to assess the status of *C.wightii* at various localities (in light of the lack of knowledge regarding its conservation status) and use of other medicinal plants in south-eastern Rajasthan (Fig. 2). Questionnaire surveys, participatory observations and field visits were undertaken to elicit information on *C. wightii*. Forestry officials from different district headquarters of Rajasthan state were contacted to make inquiries about the present occurrence of *C. wightii*. In addition, responses from knowledgeable villagers, tribal groups, traditional healers and shepherds were also obtained to gain a preliminary knowledge about *C. wightii* presence and population trends.



Figure 1. (a) A mature *Commiphora wightii* plant growing in the Aravali hills, Rajasthan; (b) exudation of oleo-gum resin from a guggul stem.



Rajasthan state

Figure 2. Map of Rajasthan state showing the study area.



Figure 3. Educational programs in action to raise awareness amongst local rural and tribal people about wildlife conservation and importance of guggul plants.

Education awareness programs and workshops: Conservation education activities are important to raise local awareness. Therefore, a number of relevant activities were identified within the study area under the theme 'Guggal Bachao Abhiyan' (Save Guggal Movement). These were conducted through the close co-operation of the village level communities, who depend on local biodiversity for their livelihoods. To inform local rural and tribes about the importance and conservation of guggul, a series of awareness programs and workshops were organized from mid-March 2008 to March 2009 in 139 villages of Jaipur, Banswara, Udaipur, Pratapgarh, Dungarpur and Chittorgarh districts of Rajasthan (Fig. 3). Community groups were taken into confidence and a network of people of different age groups was formed for long term monitoring of wild *C. wightii* populations. Community groups further assisted in the dissemination of the 'conservation message'.

Propagation and transplanting: During summer (April 2008 to July 2008), guggul plants were propagated through stem cuttings. During first week of April 2008, approximately 35 to 40 stem cuttings (12 cm long each) were taken from mature *C. wightii* growing in natural habitats. The basal portions of the freshly collected cuttings were dipped for 5 seconds in freshly prepared 1,500 ppm aqueous solution of Indole-3-butyric acid solution (Kumar *et al.* 2006). Cuttings were then planted 4 cm deep in plastic bags containing soil and manure (ratio of 1:3) in green-shade nursery (Fig. 4). The nursery was shaded (50%) with green plastic mesh to prevent exposure to extreme temperature. Approximately 3,500, 3-month old, plantlets (each about 30 cm tall) were then transferred and planted in the Aravali hills at a site near Gulta (Jaipur district) with the help of local communities.



Figure 4. *C.ommiphora wightii* plants propagated by cuttings.

CONSEQUENCES

Field survey results: On the basis of the surveys, southern (Udaipur, Banswara, Dungarpur, Pratapgarh, Chittorgarh) and central-eastern parts of Rajasthan (Jaipur, Ajmer) were identified as 'hotspots' for *C. wightii*. It was found that in southern Rajasthan *C. wightii* is facing imminent extinction. During the deliberations with rural villagers, older people told us that during the 1960s-70s, several representatives from companies (with commercial interests) visited, and employed them to collect oleo-gum resin. They provided collectors with 'mitchie golledge' knives coupled with ethephon (2-chloroethyl phosphoric acid, an ethylene releasing synthetic chemical) to enhance gum yield. It is now proven that application of ethephon on tapping cuts enhances guggul gum production several times over that obtained in controls (cutting only); but in the longterm excessive production through this technique exhausts and kills the plant.

Educational awareness programs and workshops: The 'Guggal Bachao Abhiyan' (Save Guggal Movement) received favorable response and strong support from the local villagers and tribes of the Aravali hills. Local communities participated and responded very positively to the awareness programs. The local rural and tribal communities are now aware of the importance and conservation of guggul plants. Rural and tribal people also participated energetically in transplanting of the propagated *C. wightii* plants into their natural habitats (see below).

Vegetative propagation and transplanting: In the present studies, the sprouting of stem-cuttings was achieved within 20 days of planting. High frequency of sprouting was observed in plantlets developed from 0.6-0.8 mm diameter stem cuttings. The development of a root system was observed within 20 to 30 days of planting. Local villagers and shepherds participated actively in transplanting of guggul plants in natural habitats at a site near Gulta (Fig. 5).



Figure 5. Participation of local people in planting of guggul plants in the Aravali hills.

Conclusions: In regions such as those of this study, participation of local people is essential to conservation efforts. Modern science, or government policies, or community participation, in isolation, can never achieve full success. It is essential to have a comprehensive approach with a blend of scientific and managerial principles with full participation of various stakeholders. Efforts should be made to mobilize and support local people to conserve areas of high biodiversity, and thereby improve the natural resource assets of rural populations. By engaging local people to conserve biodiversity that are critically important to their livelihoods, a broad-based, long-term strategy can be formulated for conservation of threatened ecosystems.

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