

Urgent Need of Special Conservation Efforts for the Critically Endangered species *Commiphora wightii* (Arn.) Bhandari in Sariska Tiger Reserve, Rajasthan (India)

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ABSTRACT: *Commiphora wightii* (Arn.) Bhandari, a polygamous and deciduous shrub or small tree species, locally known as ‘Gugul or Guggul’ belongs to the family Burseraceae. Guggul is an important medicinal plant, highly used in local traditional medicines and its gum-resin is widely used for various purposes since time immemorial, having high market value and worldwide demand. It is included under the Critically Endangered (CR) category of IUCN, Red List. Earlier their populations were abundant in the states of Rajasthan and Gujarat, in tough climatic conditions on open dry hills and other rocky habitats but due to over exploitation, lower percentage of seed germination, slow growth rate, habitat disruption etc., it reduced on large scale and became very scanty. Now their populations are mostly surviving in protected areas. During the exhaustive floristic survey of Sariska Tiger Reserve (ca 1213 km²), it was found that there was significant decline in its population in recent past and now only represented in a few locations with few plants. So, at present there is a big question mark on its future existence in Sariska, which was once known as one of its popular territory in Rajasthan. There is an urgent need to multiply this CR species both at *in-situ* and *ex-situ* conservation level and restore it in its native habitat by species recovery programmes and mass public awareness.

Keywords: Critically Endangered, Gugul, *in-situ* & *ex-situ* conservation, Oleo-gum resin, Sariska.

INTRODUCTION

Sariska Tiger Reserve (hereafter STR) situated in the north-eastern part of Aravalli mountain ranges (27°05'–27°45'N, 76°14'–76°35'E) in the Alwar district of Rajasthan. The vegetation of STR corresponds to the Northern tropical dry deciduous and Northern tropical thorn forests (Champion and Seth 1968). The climate of the area is subtropical, which have a distinct winter, summer, monsoon and post-monsoon seasons. Total geographical area of STR is ca 1213 km². The boundaries of STR are surrounded by thickly populated villages and even inside STR there are 24 villages in core areas and 146 villages are in the periphery of reserve. About 2254 families live in the core area, while about 12000 families live around the critical tiger area (Shekhawat, 2015). This reserve is a human dominated landscape that is subjected to immense anthropogenic pressures (Bhardwaj *et al.*, 2021). The dominant flora of the STR is represented by *Grewia flavescens* Juss., *G. tenax* (Forssk.) Fiori, *Justicia adhatoda* L., *Terminalia pendula* (Edgew.) Gere & Boatwr. [*Anogeissus pendula* Edgew.], *Butea monosperma* (Lam.) Taub., *Ziziphus mauritiana* Lam., *Boswellia serrata* Roxb., *Lannea coromandelica* (Houtt.) Merr., *Vachellia* spp., *Senegalia* spp., *Capparis decidua* (Forsk.) Edgew., *Phoenix sylvestris* (L.) Roxb.,

Mitragyna parvifolia (Roxb.) Korth. etc. along with number of grasses. Except few, majorities are deciduous and not evergreen.

Commiphora wightii (Arn.) Bhandari is a polygamous (Fig. 2 C, D & E) and deciduous armed shrub or small tree (Fig. 1 A, D & E and Fig. 2 A) which is locally known as ‘Gugul or Guggul’. This species belongs to the family Burseraceae. Generally, it is a typical component of *Terminalia pendula* (Edgew.) Gere & Boatwr. forest in Rajasthan. It plays an important role in survivorship of many important herbivores, shrubs including CITES species like *Ceropegia bulbosa* Roxb. (Fig. 1 F). Therefore, have management importance mostly in dry-deciduous and thorny scrub forests. As *C. wightii* (Arn.) Bhandari is a deciduous species, it remains leafless or with small leaves during most parts of the year (Fig. 1 E) and it produces new young shoots and leaves mainly during rainy season (Fig. 2 A & B). The monsoon leaves are broad (Fig. 2 B) and palatable for herbivores like goats and camels. Langurs and some birds consume the ripen drupes. All the observations made here in this communication were purely based on the field survey and collections of STR, Rajasthan.

The epicenter of wild occurrence of this species is restricted mainly to the drier regions of Rajasthan (Shetty and Singh 1987) and Gujarat States of India, and the bordering regions of Pakistan. It has reduced on

large scale and became very scanty after 90's. It grows in tough climatic conditions on dry, exposed rocky habitats in drier regions (Fig. 1 A). Oleo-gum resin, guggulu etc. tapped from the stems of this species are consumed in high volumes by the Indian herbal industries. In STR its population was quite frequent till 1983 (Parmar, 1985). There has been a significant decline in its wild population over the last several decades, as a result of habitat loss and degradation, coupled with unregulated harvesting and excess tapping of oleo-gum resin (Fig. 1 G & H). This species is consequently assessed as Critically Endangered (CR) and enlisted in the IUCN Red List of threatened categories.

ECONOMIC POTENTIAL

Every part of this plant is useful, as the stem, bark, leaves and flowers are widely used for various purposes. If someone will search in internet about the products prepared from *C. wightii* (Arn.) Bhandari, the result carried a long list of products in form of food items, medicine, cosmetics, Pujan or Havan samagri (for worshipping Deity) etc.

Medicinal properties and importance

A pale golden-yellow colour oleo-gum resin (Fig. 1 H), which exudes out as a result of stem tissue injury spread over bark of *C. wightii* (Arn.) Bhandari is the most valuable and highly demanded product of this plant. This oleo-gum resin is a mixture of phytoconstituents like volatile oil which contains terpenoidal constituents such as monoterpenoids, sesquiterpenoids, diterpenoids and triterpenoids; steroids; flavonoids; guggulsterols; lignans; sugars and amino acids (Sarup *et al.*, 2015). It has been used in the traditional Indian Ayurveda since time immemorial for treating wide range of ailments or disorders.

The chemistry of the plant includes Guggul sterol-I, -II & -III, guggul lipid, gum resin, Myricylal and bita-sitosterol. Flowers are having flavons. Plant possesses medicinal properties like expectorant, carminative, aphrodisiac, demulcent, anti-inflammatory, anti-rheumatic and hypocholesterimic activity. It lowers the cholesterol level of the blood. It acts well on increased fibrinolytic activity in ischaemic heart disease patients. Guggul lipid useful in heart diseases, spondilitis and gout. Resin is useful in indolent ulcers and as gargle in pyrrhoea alveolaris, chronic tonsillitis and pharyngitis. Inhalation of fumes from burning gum is recommended in hay fever, chronic bronchitis, nasal catarrh, laringitis and phthisis. It is effective in rhinosinal infection and infective hepatitis. The essential oil present in this plant is antibacterial in nature. Hence, successfully used for treating gout, inflammation, obesity, rheumatism, lipids metabolism etc. (DOMAP, 2006).

Fodder.

Its leaves contribute significantly to the fodder components for grazing animals like goats, lambs and camels.

Threats

Manmade and natural causes:

The major threats for this species include over exploitation, mainly because of the presence of valuable

and highly demanded oleo-gum resin which is a source of many products and byproducts. In STR, personally it has been noticed that in greed of more and more oleo-gum resin plant tissues were damaged to a great extent (Fig. 1 G & H) inviting pathogens to make it disease prone and ultimately reducing the lifespan of plant to many folds. The whole STR (*ca* 1213 km²) is surrounded by large number of densely populated villages. Forest department is facing a big challenge to check the illegal collection of this plant even from protected areas in spite of their best efforts.

Dry, exposed rocky habitats and specialized phyto-sociological requirement of this plant is badly disturbed in natural habitat due to various reasons. Mining whether legal or illegal has brutally impacted the natural habitat of this plant, leading to great fall in population and making it Critically Endangered (CR). For successful generation of seeds in natural habitat, phyto-sociological conditions of plant are utmost requirement (Fig. 1 B & C) but unfortunately nothing is in pristine form leading to a lower percentage of seed germination. Even in nature the slow growth rate of plant has debarred it to a great height from fighting the many challenges. Tough climatic conditions are another factor, which also played harsh role on it. Hence, this species is on the verge of extinction due to several reverse factors which are acting together on it.

MATERIALS AND METHODS

Frequent exhaustive forest survey cum floristic explorations of STR were continuously undertaken from 2016 to 2021 in all pockets of the reserve in such a manner that it should repeatedly cover all the months of the year. During survey phenology, foliage pattern or condition, growth, their availability, uses, ethnobotany and all associated information were recorded to best possible extent. Population study was also carried out by random sampling.

RESULTS AND DISCUSSION

Taxonomic Treatment

Commiphora wightii (Arn.) Bhandari, Bull. Bot. Surv. India 6: 327. 1964; Parmar in B.V. Shetty & V. Singh, Fl. Rajasthan 1: 178. 1987; Chithra & A.N. Henry in Hajra & al., Fl. India 4: 445. 1997; Singh *et al.* in Mao & Dash (Eds.), Fl. Pl. India Annot. Checkl. Dicot. 2: 35. 2020. *Balsamodendron wightii* Arn., Ann. Nat. Hist. 3: 86. 1839. *B. mukul* Hook. ex Stocks in Hooker's J. Bot. Kew Gard. Misc. 1: 259, t. 8. 1849; A.W. Benn. in Hook.f., Fl. Brit. India 1: 529. 1875. *Commiphora mukul* (Hook. ex Stocks) Engl. in DC., Monogr. Phan. 4: 12. 1883 (Fig. 1 & 2).

Deciduous, bushy, much branched, spiny shrub or smaller tree, 1.0–2.5 m high. Bark papery, exfoliate, silvery to pale golden-white; branches crooked, aromatic; younger parts glandular-pubescent. Leaves alternate or fascicled, 1–5 foliolate, exstipulate; leaflets 1–3 paired, rhomboid-obovate, 0.5–4.0 × 0.3–2.25 cm, cuneate at base, crenate-serrate at upper margins with subtire base, obtuse or acute at apex, terminal leaflet much larger than lateral ones, subsessile, whitish-green. Flowers 4-merous, polygamous, solitary or in 2–3

fascicled cymes, 2.5–6.0 mm long, red, pinkish-red, sessile, bracteate; bracts 2, opposite, glandular-hairy. Calyx ca 2 mm long, lobes 3-angular. Petals 4, broadly linear, 4–5 mm long, acute, reflexed. Stamens 8–10, alternating short and long. Disc 8–10 lobed. Ovary 2-locular, ca 3.5 mm long; stigma 2 lobed. Drupes ovoid, 0.75–1.5 × 0.5–0.8, shortly beaked, red when ripe; pyrenes readily splitting into two. Seeds hard, wingless, shining, black.

Flowering & Fruiting: More or less throughout the year but more frequent after rainy season.

Phytosociology and Ecology: During the field explorations of STR, author finds that understanding the phytosociology of *C. wightii* (Arn.) Bhandari is the key point without which it is not possible to conserve the species in its native habitat i.e. *in-situ* conservation (Fig. 1 A, B & C). *C. wightii* (Arn.) Bhandari exhibits strong phytosociological bonding in nature with species like *Terminalia pendula* (Edgew.) Gere & Boatwr., *Euphorbia caducifolia* Haines (Fig. 1 C), *Grewia* spp. [usually *Grewia flavescens* Juss., *Grewia tenax* (Forssk.) Fiori etc.], *Maytenus emarginata* (Willd.)

Ding Hou, *Senegalia catechu* (L.f.) P.J.H. Hurter & Mabb., *Senegalia senegal* (L.) Britton, *Vachellia jacquemontii* (Benth.) Ali, *Vachellia leucophloea* (Roxb.) Maslin, *Cardiospermum halicacabum* L., *Asparagus racemosus* Willd., *Leptadenia pyrotechnica* (Forssk.) Decne. Which provides a safe empyrean (Fig. 1 C) and nutrition for successful germination and growth of its seeds, seedlings and plants in all climatic conditions where maximum temperature reaches close to 50°C during harsh summer and minimum temperature fall drastically close to 0°C during chilling winter. The strong phytosociological environment creates a microclimatic condition and cordons the area in such a manner that allow congenial safeguarding of seeds during unfavorable climatic conditions or dormant stage and promotes successful germination and growth of *C. wightii* (Arn.) Bhandari against the all odds. It was seen that the phytosociology of this plant also gave shelter among its safely covered bushes to rare CITES species like *Ceropegia bulbosa* Roxb. (Fig. 1 F) on dry exposed rocky habitats in this desert state of India.

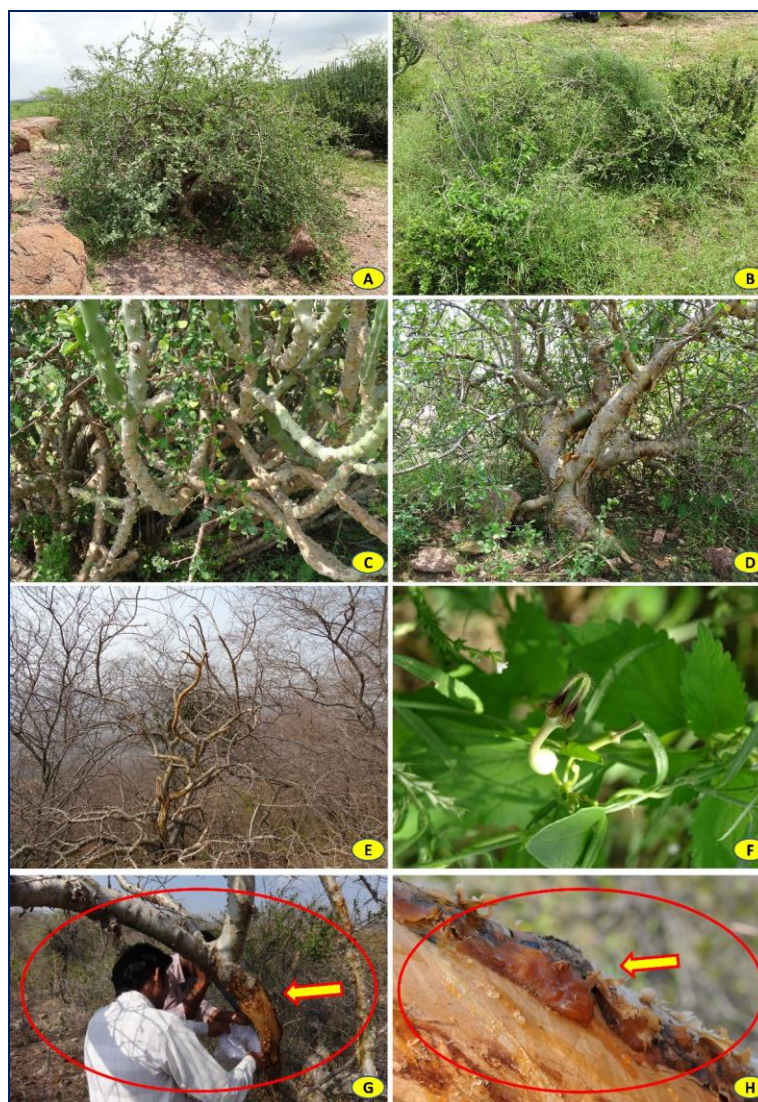


Fig. 1. *Commiphora wightii* (Arn.) Bhandari **A.** Habitat; **B & C.** Phytosociology; **D.** A mature plant; **E.** Plant in deciduous condition; **F.** Providing shelter to *Ceropegia bulbosa* Roxb.; **G & H.** Illegal collection of oleo resin by excess removal of bark.



Fig. 2. *Commiphora wightii* (Arn.) Bhandari **A.** Habit; **B.** Young leaves during monsoon; **C.** Polygamous flower; **D.** Staminate flower; **E.** Dissected pistillate flower; **F.** Twig with young flower and fruits; **G, H & I.** Fruiting stages; **H.** Stem cutting and **I.** Multiplication.

Conservation Status: Critically Endangered as per IUCN Red List (IUCN, 2022). Only few population patches (2-7 plants in group) are left in the present study area (i.e. STR) in dry, exposed rocky habitats of Nilkanth and Balaquila Forest.

Geographical distribution: World: *C. wightii* (Arn.) Bhandari is found in dry areas (arid and semi-arid regions) of India and Pakistan. **India:** In India it is distributed in the states of Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan and Uttar Pradesh.

CONCLUSIONS

There is an urgent need of special conservation efforts to be initiated on large scale with mass public awareness in and around the dwellers of Sariska Tiger Reserve for the Critically Endangered species *Commiphora wightii* (Arn.) Bhandari and restore this CR species in its native habitats by species recovery programme, mass people awareness etc. before they disappear from this world-renowned tiger reserve in

near future. It can be multiplied widely by stem cutting (Fig. 2 J & K) and seed germination techniques both in *in-situ* and *ex-situ*. It shows encouraging result, if multiplied by cutting of 3–5 years old twigs after treating them with IBA solution.

Germination percentage is quite high (60-70%) in cutting methods as compare to seed germination (10-20%). Although multiplication rate by seed germination is poor, time consuming and need extreme care but fortunately health and vigor of plants prepared from seed germination is of high quality. This plant can also be brought under domestic cultivation for its high value and multipurpose oleo-resin. The study also suggests further investigation on its multiplication by convenient methods and framing proper conservational strategies as early as possible, otherwise in near future there will be a question mark on its existence or it may extinct from wild.

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Conflict of Interest. None.

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