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Managing mistletoes: The value of local practices for a non-timber forest resource

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Abstract

Sustainable harvesting of non-timber forest products (NTFPs) and associated livelihood security can be affected by forest disturbances additional to harvesting. Amla (*Phyllanthus emblica* and *Phyllanthus indofischeri*) is a locally and nationally significant NTFP in India, exploited for its fruit. We examined the infection of these two species by a hemiparasitic mistletoe and investigated two alternative management approaches.

Forest surveys, mistletoe removal experiments and seed deposition surveys were employed to assess the prevalence of mistletoe infection, characteristics of infection in relation to resource value and the appropriateness of local versus institutional management approaches. The results suggest mistletoe infection is widespread in the study site, affecting over half of the Amla population, and in particular those reproductive trees important for population persistence. Infection characteristics and resource values differ between the two *Phyllanthus* species, having significant implications for Amla collectors. Institutional perspectives on the management of this species conflict with local practice. Cutting of branches by collectors has previously been considered destructive, but may in fact have management benefits in terms of increased productivity through re-sprouts and reduced risk of mistletoe infection. However, neither mistletoe removal by hand, nor branch cutting appear to offer a viable control strategy in isolation. A multifarious strategy including new approaches to management is needed to safeguard the role of this resource in local livelihoods.

Keywords: Amla; India; Livelihoods; Mistletoe; Non-timber forest product; NTFP; *Phyllanthus emblica*; *Phyllanthus indofischeri*; Traditional management

1. Introduction

The impacts of over-harvesting on non-timber forest product (NTFP) sustainability has received considerable attention (e.g. Boot and Gullison, 1995; Bernal, 1998; Peres et al., 2003; Ticktin, 2004; Endress et al., 2006), but despite growing threats to forest habitats and increasing human disturbance in many exploited forests (e.g. Laurance and Peres, 2006; FAO, 2007; Muller-Landau, 2007) resource susceptibility to natural or semi-natural threats such as fire, diseases and invasive species are rarely integrated with assessments of over-harvesting or other human impacts (for exceptions see Sinha and Brault, 2005 and Ticktin et al., 2006). We present an example of one such threat, explore its characteristics and consider its implications for an NTFP harvesting system.

Amla is a non-timber forest product of significant livelihood importance in southern India and of wider economic importance throughout the rest of the country. Collected from two congeneric species, *Phyllanthus emblica* L. and *Phyllanthus indofischeri* Bennet. (Euphorbiaceae), an average of about 90 tonnes of fruit are harvested each year in the 540 km^2 Biligiri Rangaswamy Temple (BRT) Wildlife Sanctuary, contributing over 10% of the cash income of the resident indigenous Soligas (Hegde et al., 1996). In the BRT sanctuary, many Amla trees are heavily infested by the mistletoe *Taxillus tomentosus*. Trees suffering from heavy infestation show defoliation and death of branches distal to the infection site, and many trees die as a consequence of these infections. Previous studies have documented the impacts of mistletoe infection on Amla including significant reductions in growth (Sinha and

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Bawa, 2002) and productivity (Sinha and Bawa, 2002; Setty, 2004) and increased tree mortality (Setty, 2004). These studies have not, however, attempted to establish the full extent or severity of the problem within the sanctuary and its implications for livelihoods, or to investigate the effectiveness of existing, or potential future, management responses.

The Karnataka Forest Department (KFD) receives revenue from the Amla harvest through contracts sold for its collection from state-owned forest land, such as the BRT Wildlife Sanctuary. The KFD advocates removal of mistletoes by hand, and has promoted this strategy to local harvesters. This promotion is targeted at the annual Amla harvest, though the KFD does not offer collectors any payment for the time or effort invested in mistletoe control. Harvesters consider removal by hand to be both impractical and ineffective. Removal by hand is physically difficult and time intensive, and mistletoes frequently re-sprout from tissue remaining within the infected branch (L.R., personal observation).

Many fruit collectors cut branches while harvesting and claim that, in addition to facilitating collection, this strategy has management benefits. Collectors cite enhanced productivity in future years through coppicing and reduced risk of mistletoe infection from the removal of outer branches, the preferred perching sites for seed dispersing birds. Indeed, some harvesters specifically cut branches to remove mistletoe infections, both during the harvest period and from high yielding trees at other times (L.R., personal observation). The KFD has strongly discouraged the cutting of branches during the Amla harvest believing this practice leads to tree mortality, and in the past tensions have arisen over this issue. Previous studies have suggested that this harvesting method is, indeed, destructive, and is motivated by a desire to maximise short term economic gains in terms of income from fruit collection (Sinha and Bawa, 2002; but see Setty, 2004), but there has been little consideration of alternative motivations for this behaviour. This harvesting technique has also been suggested to increase the risk of mistletoe infection by providing sites for germination and establishment of mistletoe seeds on the cut surfaces of branches (Sinha and Bawa, 2002).

We assessed the distribution of mistletoe infection in relation to host species, and individual tree attributes. We also carried out experimental removal of mistletoes, surveys of seed deposition on cut and uncut branches, and we assessed coppicing rates of cut branches. Using these studies, we explored the following specific questions; are *P. emblica* and *P. indofischeri* the main hosts of *T. tomentosus*? Is mistletoe infection equally prevalent and intense in these two species? How does infection differ with height and age of trees? Is hand removal of mistletoes effective? Does branch cutting reduce risk of infection and is this an improvement on removal by hand?

In answering these questions, we consider the implications of observed infection patterns for the Amla resource, specifically for population regeneration. With a clearer understanding of the limitations of contrasting management approaches we provide valuable information for ongoing participatory management at BRT which we expect to be generalisable to Amla production in other protected areas or reserve forests in Karnataka state and southern India.

2. Methods

2.1. Study site and species

The Biligiri Rangaswamy Temple (BRT) Wildlife Sanctuary (11.40–12.09°N and 77.05–77.15°E) is located in the state of Karnataka, India on the easternmost ridge of the Western Ghats, a global hotspot of biodiversity. The 540 km^2 protected area ranges in altitude from 600 to 1800 m and consequently has a rich diversity of vegetation types ranging from scrub to evergreen forest. Dry deciduous and scrub forests predominate, together constituting almost 90% of the total area of the sanctuary (Ganesan and Setty, 2004). The scrub forest is dominated by *Acacia chundra*, *Diospyros melanoxylon* and *Chloroxylon swietenia*; and the deciduous forest by *Anogeissus latifolia*, *Terminalia crenulata* and *Terminalia bellirica* (Ganesan and Setty, 2004).

P. emblica Linn. and *P. indofischeri* Bennet. (Euphorbiaceae), commonly known as Amla, and locally as Nelli, are small to medium sized trees usually attaining a height of between 5 and 13 m. The two species are found in distinct forest types; the taller *P. emblica* dominates in deciduous forest and *P. indofischeri* in scrub forest. Harvesting takes place between December and February and lasts for about 2 weeks. Collection and sale is organised by a cooperative known as LAMPS (Large-scale Adivasi Multi-Purpose Societies). Family-based groups harvest from pre-selected areas and return to a central collection point at the end of the day for weighing and collection of fruits. The Soligas prefer the larger 'Ittu' Nelli (*P. indofischeri*), but fruits from both species are pooled for trading. Amla, the Indian gooseberry, is an important medicinal plant species, its fruit being used extensively in the traditional Indian medicine system, Ayurveda. The Amla fruits (Nelli kai) are also used for making pickles, jams and cosmetics and are also an important food resource for a number of ungulate species.

The mistletoe *T. tomentosus* (Roth.) Var. Tiegh (Loranthaceae) is a hemiparasite on *Phyllanthus* species and several other tree species in the region. It is found across India and Sri Lanka (Keeble, 1896), but is referred to locally as Uppilu. Amla harvesters believe that this mistletoe has undergone a recent population expansion due to change in the fire regime (L.R., personal communication with harvester communities).

2.2. Host–mistletoe surveys

Between September 2005 and April 2006, sixty 500 m^2 plots were surveyed for tree abundance and infection characteristics, thirty in deciduous, and thirty in scrub forest. Plot locations were selected using a staggered hierarchical sampling regime in a nested forest survey (Pettitt and McBratney, 1993). All trees greater than 4 cm diameter at