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# Ecological effects of small-scale cutting of Philippine mangrove forests

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**Abstract**

Small-scale wood harvesting is one of the most ubiquitous forms of resource-use in the tropics, yet ecologists have barely studied it. This paper examines the effects of small-scale woodcutting on forest structure, composition and regeneration of mangrove forests in the Philippines. Information for the study was obtained through the application of extensive bio-ecological assessments of forests and interviews of forest users. Cut mangrove forests were characterized by smaller trees, less basal area and more canopy gaps. At least two-thirds of all canopy gaps were caused by cutting. In spite of these dramatic structural effects, there was little demographic evidence to suggest that significant changes to current species composition are occurring, although this may, in part, reflect that some species have already been eliminated from study areas by past cutting. Among common species, *Rhizophora mucronata* was the only one that appeared to be negatively impacted from cutting in terms of its relative abundance. Although abundance varied, seedlings of all common species measured were taller in canopy and/or expanded gap compared to understory, with *Sonneratia* spp. showing the greatest and *Avicennia marina* the least response. The particular success of *A. marina* in cut forests may be explained by the ability of its seedlings to better persist in the understory and thereby exploit gaps when these are created by cutting. Among common mangrove species, all but *R. mucronata* appear to be regenerating well in cut forests: *Sonneratia* sp., *A. marina* and *R. apiculata* regenerate well by coppice regrowth into the abundant small canopy gaps found in uncut and especially cut forests. Findings from this study highlight the significance of small-scale cutting disturbance and coppice regeneration as biotic factors in mangrove ecology.


*Keywords:* Anthropogenic disturbance; Traditional resource use; Non-timber forest products; Canopy gaps; Coppice regeneration; Mangroves; Philippines

## 1. Introduction

Anthropogenic disturbance is now regarded by many ecologists as central to understanding the dynamics of ecosystems (McDonnell and Pickett, 1993; Vitousek et al., 1997). In the case of forests, the extent of human alteration worldwide and especially in the tropics is unrivaled in history (Noble and Dirzo, 1997). A plethora of research has examined deforestation and impacts of timber logging on tropical forests (e.g., Uhl et al., 1981, 1991; Kartawinata et al.,

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1989; Brown and Lugo, 1990; Ter Steege et al., 1995; Chapman and Chapman, 1997; Miller and Kauffman, 1998; Lindenmayer et al., 2002; Parrotta et al., 2002). However, remarkably few studies have examined the ecology of small-scale wood use and its impacts on tropical forests. This is a considerable oversight given that hundreds of millions of rural people living in and adjacent to forests in the tropics exploit them for construction materials, fuel wood and other non-timber products (Nepstad and Schwartzman, 1992; Peters, 1996a; Arnold et al., 2003). In fact, the few studies that have been done suggest that small-scale wood harvesting is pervasive and having substantial, often cumulative effects on forest structure, composition and regeneration (Nyerges, 1989; Smiet, 1992; Murali et al., 1996; Rikhari et al., 1998; Uma Shankar et al., 1998a, 1998b; Ramirez-Marcial et al., 2001; Awasthi et al., 2003; Luaga et al., 2004; Ticktin, 2004).

Like other tropical forests, mangroves have been cleared and degraded on an alarming scale during the past four decades, but they remain an important source of wood and other products for many coastal communities (Christensen, 1982; Hamilton and Snedaker, 1984; Aksornkoae et al., 1992; Diop, 1993; Lacerda, 1993). Trends in mangrove research parallel those for other tropical forests in their near-exclusive focus on large-scale, anthropogenic impacts. For example, mangrove deforestation resulting from expansion of aquaculture and other competing land-uses has been extensively studied (Primavera, 1995; Dewalt et al., 1996; Naylor et al., 1998; Walters, 2003). Likewise, research on cutting in mangroves has focused on state-managed forests subject to industrial/large-scale logging (Christensen, 1983; Putz and Chan, 1986; Aksornkoae et al., 1992; Hussain, 1995; Khoon and Eong, 1995). The few studies that have examined small-scale woodcutting of mangroves suggest significant impacts on forest structure, but provide limited information on how cutting might affect forest composition and regeneration (Eusebio et al., 1986; Smith and Berkes, 1993; Barnes, 2001; but see Pinzon et al., 2003).

Research presented here is part of a larger study of human influences on mangrove forests in the Philippines (Walters, 2000b, 2003). Other papers examine differences between natural and planted forests (Walters, 2000a, 2004). A companion paper to this one describes patterns of woodcutting and use of mangroves (Walters, 2005). This paper examines the ecological effects of this small-scale cutting on mangrove forests. It seeks to answer the following questions: (1) Is forest structure substantially altered by cutting? (2) Are mangrove forest species impacted differently by cutting? and (3) Is forest regeneration affected by cutting?

## 2. Study areas and research methods

Fieldwork for this study was conducted in the Philippines between March and December 1997 in North and South Bais Bay and Bindoy, Negros Oriental (9°N/123°E) and on Banacon Island, Bohol (10°N/124°E). Bais Bay is located on the eastern side of Negros Island (Fig. 1). Mean temperatures in Bais vary from 25 to 30 °C and around 1500 mm of rainfalls annually, mostly during a distinct rainy season from July to December. The Bay occupies an area of approximately 5400 ha and is divided into North and South by Daco Island and a constructed causeway that connects Daco to the mainland. The coastal waters of North and South Bais Bay are productive and support a diverse fishery (Luchavez and Abrenica, 1997).

Three-quarters of the nearly 1000 ha of original mangroves in Bais Bay were cleared and developed into fishponds between 1930 and 1980 (Walters, 2003). Fishpond development especially impacted the less frequently flooded mangrove areas since ponds were usually built from the landward side first (Walters, 2003). Today, much of the perimeter of North and South Bais Bay is fringed by narrow bands of frequently flooded and often young forest. Mangrove stands, ranging in area from 3 to 30 ha, are also found at the mouths of each of four rivers that empty into the Bays, and a particularly large and well-developed stand of forest, called Talabong, extends as a peninsula across the seaward front of South Bais Bay. Many coastal residents also plant mangroves in Bais, but the distribution of plantations is patchy. Most plantations in Bais are found immediately adjacent to settlements or along the seaward perimeter of fishponds (Walters, 1997, 2003).

Bindoy is located 20 km north of Bais Bay. An extensive mangrove forest (about 100 ha) is located on