

Forest Cover, Condition, and Ecology in Human-impacted Forests

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The littoral forests of south-eastern Madagascar possess high degrees of biodiversity and have been identified as a conservation priority, but face pressures from subsistence use of forest resources by local communities, increasing numbers of migrant populations using the forests for charcoal production and large-scale mineral extraction. Despite their conservation importance, little is known regarding how these forests have been impacted by and have responded to different anthropogenic pressures or natural stressors, such as climate, nor how these human and physical factors interact to influence forest integrity.

The forests are divided into three sites referred to as Ste. Luce, Mandena and Petriky, each of which have unique social, physical and ecological characteristics despite their collective classification as a unique littoral forest subtype and their close geographic proximity to one another. An assessment of deforestation patterns, forest condition and tree species composition of remaining forest stands at each site is important for understanding the nature, scale and distribution of human and natural pressures impacting littoral forests and, thus, may help inform forest conservation priority setting throughout the area.

The aims of this study were threefold: to document patterns of littoral forest loss at multiple spatial and temporal scales; to map forest structure across the littoral landscape; and to assess the abundance and diversity of littoral forest tree species valuable to humans and important for conservation. The methods applied included the use of satellite imagery of forest cover and forest loss combined

with ground-based ecological surveys of tree diversity and structure.

Assessments of forest cover change using satellite imagery spanning an 18 year time period illustrated spatially and temporally dynamic patterns of forest loss across each site and, thus, contrast with commonly used linear portrayals of deforestation. The spatially and temporally disaggregated assessment of forest change conducted within this study permitted a site based understanding of the different factors threatening forest cover. This more nuanced depiction of deforestation was supplemented with a quantitative assessment of forest structure across the littoral landscape, which was derived by integrating satellite imagery and ground survey data. These results showed that a combination of physical factors, such as climate, acting at a coarse scale, and anthropogenic factors acting at a site-scale, influence forest basal area, which can be related to forest condition. An understanding of how different human and natural factors interact across the landscape and where anthropogenic pressures are the greatest can help guide which and where management interventions may be most effective.

In order to assess how forest condition may influence community composition, we conducted inventories of tree species diversity and abundance. These surveys revealed a strong relationship between basal area and diversity measures, suggesting pressures influencing forest condition may also affect species composition. Despite considerable human impact on the forests, species richness and diversity of tree species communities remained relatively high

across the landscape. Human impact on species diversity varied across user groups: forest use practices by local people seem to be more sustainable with respect to maintaining diversity and abundance of utilitarian trees than practices such as charcoal making employed by migrant groups. The high overlap between endemic and utilitarian species suggests opportunities for conservationists and local people to work together to meet conservation goals and fulfill human needs across the landscape.

This study has demonstrated that, although humans have had a discernable impact on the littoral forest landscape in south-eastern Madagascar, this impact is variable throughout time and space and is a function of human and environmental factors that interact and differ in intensity across each site. Although, often described as severely degraded, these forests remain repositories of biodiversity and forest resources important for human well being. If these forests are to be conserved in the long-term, management plans must account for the nature, distribution and scale of the different pressures acting upon the littoral system at individual sites and must be designed to adapt to likely changes in these factors over time.

Originally published as:

Ingram J.C. and T.P. Dawson. 2006. Forest cover, condition, and ecology in human-impacted forests, South-Eastern Madagascar. *Conservation & Society* 4: 194-230.

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