



Original research article

Patterns of tree community differences in the core and buffer zones of a nature reserve in north-western Vietnam



Thi Hoa Hong Dao^{a,b,*}, Joachim Saborowski^{c,d}, Dirk Hölscher^a

^a Tropical Silviculture and Forest Ecology, Georg-August-Universität Göttingen, Büsingenweg 1, 37077 Göttingen, Germany

^b Forest Inventory and Planning, Faculty of Silviculture, Vietnam National University of Forestry, Hanoi, Viet Nam

^c Ecoinformatics, Biometrics and Forest Growth, Georg-August-Universität Göttingen, Büsingenweg 4, 37077 Göttingen, Germany

^d Ecosystem Modelling, Georg-August-Universität Göttingen, Büsingenweg 4, 37077 Göttingen, Germany

ARTICLE INFO

Article history:

Received 16 August 2016

Received in revised form 19 September 2016

Accepted 19 September 2016

Keywords:

Conservation

Diversity

Logistic model

Non-timber forest products

Rarity

Timber

ABSTRACT

In tropical forest conservation, areas with full statutory protection are often surrounded by buffer zones. Information on the patterns of tree community structure differences in these zones is helpful to evaluate the conservation efficacy. Our study was implemented within a biodiversity hotspot, in the Ta Xua Nature Reserve of north-western Vietnam, which has a statutorily protected core zone and a buffer zone, where local H'Mong people are permitted low intensity forest use. The forests are rich in tree species (249 observed). Many of these tree species provide non-timber forest products (NTFPs) (48%) or valuable timber (22%), and 18 species are red-listed. Overall tree density was not different in the two zones, but tree diameter and species richness were lower in the buffer zone. At the tree level, logistic regression analysis indicated that red-listed status, large diameter, and low density of conspecifics increased the probability of tree absence from the buffer zone but not the potential use as a NTFP. However, most NTFP species had different densities in the core and buffer zones, and this correlated with signs of human interference. At the species level, the density of species was the most important variable, and rarity strongly increased the probability of species absence. Our results also indicate that rare and red-listed trees were depleted in the buffer zone. In consideration of conservation goals, the future monitoring of these species at the Ta Xua Nature Reserve and other protected areas is needed, and conservation measures most likely need to be improved.

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1. Introduction

Tropical forest conversion and degradation have caused severe losses in biodiversity (Sodhi et al., 2009; Gibson et al., 2011). Thus conservation of tropical forests is urgently needed. Tropical forests are also capable of providing renewable resources, such as timber, non-timber forest products (NTFPs), and other ecosystem services. Forest stewardship intends to unify and further develop both the conservation and production functions of forests (Messier et al., 2015). One approach to tropical forest stewardship and conservation is the establishment of strictly protected core zones, which safeguard remaining habitats and species (Bruner et al., 2001; Joppa and Pfaff, 2010), and surrounding buffer zones, where low impact forest use intensity is presumed. This approach can enhance the conservation value of protected areas and at the same time provide some forest products (DeFries et al., 2005; Chape et al., 2005).

* Corresponding author at: Tropical Silviculture and Forest Ecology, Georg-August-Universität Göttingen, Büsingenweg 1, 37077 Göttingen, Germany. Fax: +49 0 551 39 4019.

E-mail address: tdao@gwdg.de (T.H.H. Dao).

Timber logging and NTFP harvesting are main types of forest use, and these have various impacts on forest biodiversity (Arnold and Pérez, 2001; Ticktin, 2004; Ndangalasi et al., 2007; Clark and Covey, 2012). At low intensity and at a local scale, selective timber logging and harvesting of NTFPs can locally increase floral species richness and may have little impact on the forest tree community (Cannon et al., 1998; Endress et al., 2006; Berry et al., 2010; Putz et al., 2012). However, at high intensity and over a larger scale, both logging and NTFP harvesting may lead to forest degradation and species loss (Arnold and Pérez, 2001; Rosser and Mainka, 2002; Sodhi et al., 2004); (Asner et al., 2006; Gibson et al., 2011; Branch et al., 2013). In particular rare tree species often contribute significantly to the high levels of tree species diversity in tropical forests (Hubbell, 2013; ter Steege et al., 2013), but such species are also prone to high risks of extirpation (Mouillot et al., 2013) or extinction when their habitats are destroyed (Gaston, 1994; Laurance, 1999; Sodhi et al., 2004; Hubbell, 2013). Therefore, the patterns of tree community changes between the core and buffer zones related to tree uses, dimensions, and rarity must be assessed in order to evaluate whether conservation goals are met or need adjustment.

In this context, tropical forests in rural and today remote areas are of utmost importance (Tyukavina et al., 2016). Local human communities traditionally use tropical forests, while also external interests including biodiversity conservation and logging of timber and harvesting of NTFPs are enforcing. The present study was conducted in the Ta Xua Nature Reserve, a protected area in north-western Vietnam within a biodiversity hotspot (Sobey, 1998; Sterling and Hurley, 2005). This nature reserve has a strictly protected core zone of near-natural forest and a buffer zone, where only low intensity traditional forest use by the H'Mong people is permitted. The main goals of this study were to analyze tree community structure in the core zone and the buffer zone and in case of differences, to identify the impact of important variables, such as timber use, NTFP use, tree diameter, tree rarity, and red-listed status, on differences of tree community between the core zone and buffer zone. The expected results will contribute to further develop forest stewardship concepts by pointing to significant influencing factors based on a statistically sound approach.

2. Materials and methods

2.1. Study area

The Ta Xua Nature Reserve ($21^{\circ}13'–21^{\circ}26'N$, $104^{\circ}16'–104^{\circ}46'E$, Fig. 1) was established in 2002. The topography of the region is characterized by high, steeply sloping mountains, ranging in altitude from 320 to 2765 m a.s.l. with inclinations of between 30° and 40° . The climate is humid-tropical and is influenced by the north-east monsoon. At the nearest

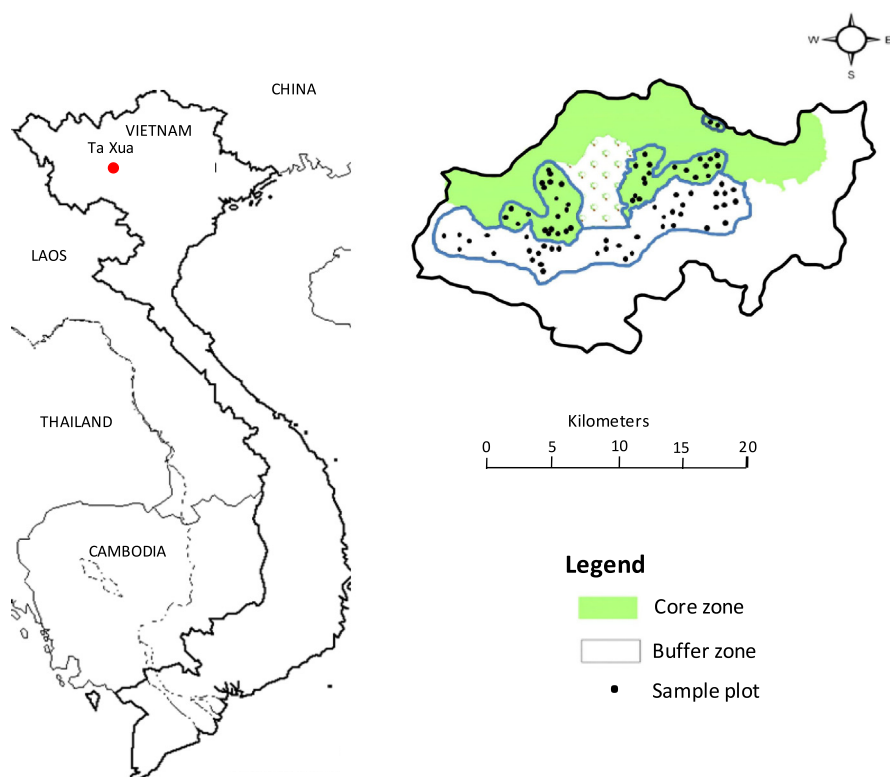


Fig. 1. Vietnam and location of the Ta Xua Nature Reserve (left). The study area is enclosed by blue lines (right; 1000–1700 m a.s.l.). Sample plots (40 in the core zone, 40 in the buffer zone) are indicated by black dots. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

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