PATTERNS AND EXTENT OF THREATS TO THE PROTECTED AREAS OF BANGLADESH: THE NEED FOR A RELOOK AT CONSERVATION STRATEGIES

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ABSTRACT

The protected areas of Bangladesh are subject to a range of threats, making the country's biodiversity conservation programme fragile. Understanding the type, pattern, and extent of these threats is a crucial step towards effective protected area management. This study attempted to assess the relative severity of threats to protected areas and the degree of susceptibility of protected areas to those threats. 102 officials from the 34 protected areas were interviewed electronically. Ten potential threats were identified. The most severe threats were: fund shortages and policy level disorganization; illegal tree cutting; unsustainable forest resource extraction; forestland encroachment; and wildlife poaching and smuggling. The findings indicate that protected areas throughout the entire ecosystem are at risk, and that threats vary geographically. One-third of the protected areas were susceptible to 80 per cent of the threats. Protected areas in the tropical moist evergreen and semi-evergreen forests of hilly regions were highly subject to illegal wood cutting; while those in tropical moist deciduous forests of plain land area were prone to encroachment for settlement and agriculture, and those in mangrove forests of littoral zones were extremely vulnerable to wildlife poaching. Developing rapid strategies to mitigate for these threats, with multi-sectorial coordination and stakeholder involvement, is essential to managing protected areas properly and to reduce the continuing loss of biodiversity in Bangladesh.

KEYWORDS: threat analysis, illegal wood cutting, encroachment, poaching, Bangladesh, protected areas

INTRODUCTION

Halting biodiversity loss is considered a comprehensive global environmental challenge (Brashares et al., 2004; Cardinale et al., 2012; Craigie et al., 2010; Cuthbert, 2010; Krause & Zambonino, 2013). Habitat loss and over-exploitation of wildlife, and other forest resources, are universally acknowledged as the leading causes of biodiversity loss (Baldus, 2008; Brooks et al., 2002), the situation is most severe in the tropical regions (Leuschner et al., 2013). Human population growth, particularly in developing countries, has profound effects on consumption patterns of land and wild resources, and is an indirect driver of biodiversity loss (Kideghesho, 2009; Michel, 2008). The role played by humans, both in Bangladesh and around the globe, in the extinction or reduction of many species of plants and animals is commonly recognized (Grignolio et al., 2011). The fight against biodiversity loss has become a priority for both governments and nature conservation organizations worldwide (Lambooy & Levashova, 2011), and various approaches to tackle the drivers of biodiversity loss have emerged in the past few decades (Vatn et al., 2011).

Bangladesh is a signatory party of the Convention on Biological Diversity (CBD) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and thereby, has been undertaking efforts in biodiversity conservation (MoEF, 2014). Declaration of forests, or parts of forests, as protected areas in Bangladesh dates back to 1960s under the provision of the Forest Act 1927 and the later comprehensive legislative instrument, the Bangladesh Wildlife (Preservation) Order 1973 (Chowdhury et al., 2009). Conservation was further articulated in the
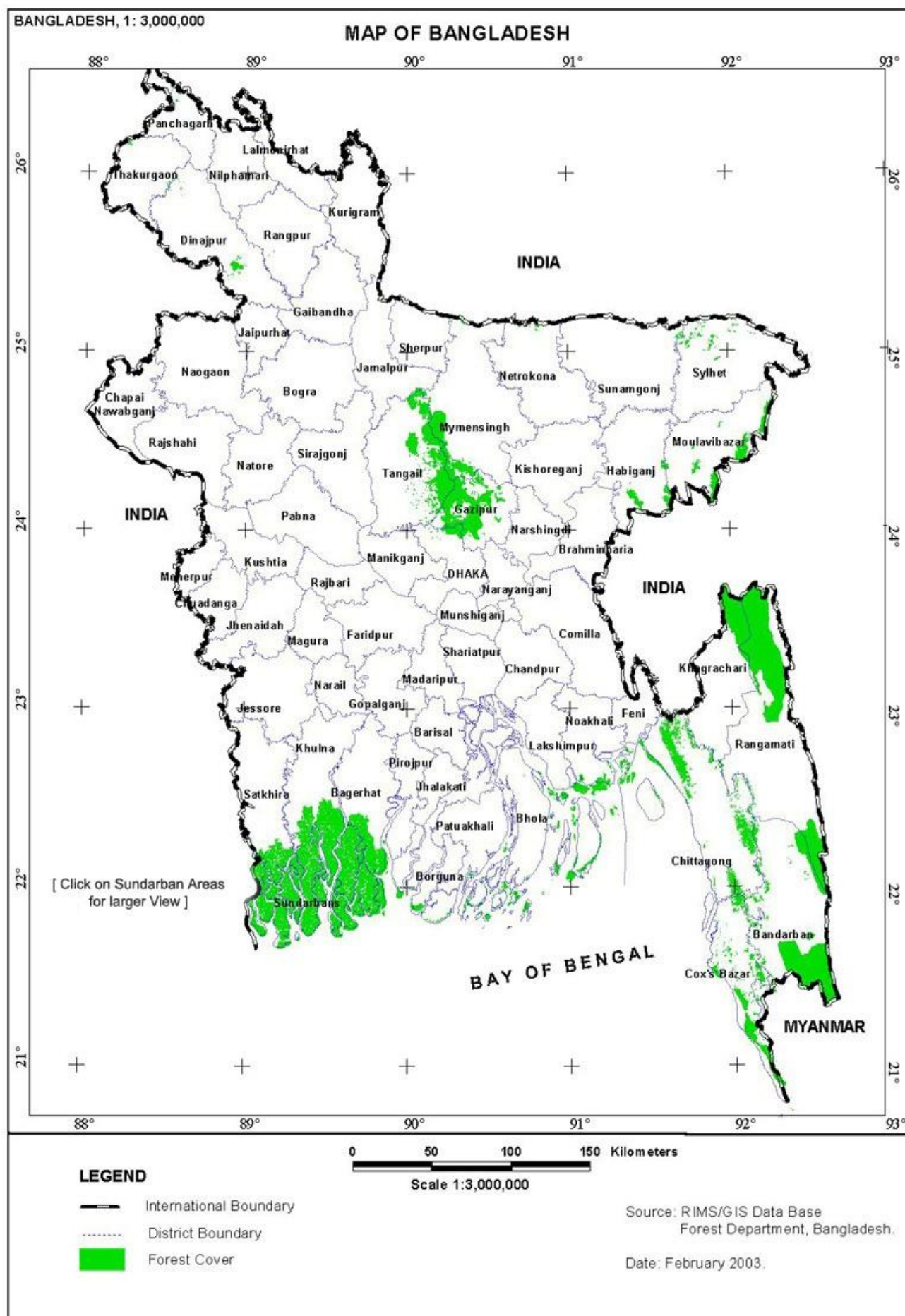
Figure 1. Map of Bangladesh showing the distribution of protected areas (marked green)

Spotted deer (*Axis axis*) in Sundarbans WS © Arunabha Rahman Anjan

Wildlife (Preservation and Protection) Act 2012, in which the approach of co-management was emphasised (BFD, 2013). Despite the challenges associated with protecting forest habitat in such a densely populated country as Bangladesh, where around 85 per cent of the rural population are dependent on forest resources, the government is showing a commitment to biodiversity conservation (Balasinorwala et al., 2008; Chape et al., 2008). Currently there are 34 protected areas in Bangladesh encompassing all forest and ecosystem types in the country (Figure 1). Among those, 17 are national parks (NPs) and 17 are wildlife sanctuaries (WS) (BFD, 2013). In addition, there are a number of eco-parks and safari parks, which are extremely small by comparison to the scheduled protected areas, and are designed to serve 'nature recreation' needs rather than large scale conservation needs (Chowdhury et al., 2009). Historically, protected areas in Bangladesh have been managed using approaches that exclude local people, whose interests have been viewed as incompatible with the conservation of these areas (Sarker & Roskaft, 2011). As noted by Bengtsson et al. (2003), protected areas are subject to both natural and human-induced disturbances at various scales, but it is the intensification of disturbance arising from human activity that is their principal threat (Chape et al., 2005), and can be well expressed by the term 'anthropogenic threats'. Mannigel (2008) argued that if this human-induced threat could be minimized, by active involvement of people in the management process, the protected area system for

biodiversity conservation would become effective. Kainer et al. (2009) also considered the involvement of local communities in conservation projects as a key issue for the success of programmes aiming to promote biodiversity protection.

People's participation in forestry activities started formally in Bangladesh in the 1980s with a forestry extension programme on public forestlands (Rana et al., 2007). As an alternative to traditional state forest management, people-oriented forestry has been introduced in Bangladesh to increase the country's forest cover (Muhammed et al., 2008) and community-based forest management using the co-management approach (Borrini-Feyerbund, 1996) was introduced in Bangladesh's protected areas in 2004 (Chowdhury et al., 2011). Sarker & Roskaft (2011) commented that this approach has grown out of attempts to find new solutions for the failure of the so-called 'fences and fines' approach to conservation in the country. As a result there has been a slow but visible change towards co-management in protected areas of Bangladesh (Rashid et al., 2013). However, despite these positive moves there are still a number of multi-dimensional constraints in the system (Chowdhury et al., 2013), which often pose serious threats to conservation efforts (Holmern, 2003).

Understanding the type, pattern and extent of the threats to protected areas is a crucial factor in controlling their magnitude and improving the performance of biodiversity conservation programmes. The parties to the CBD adopted a definition for protected area threat in 2004, in the Programme of Work on Protected Areas (PoWPA), as "any human activity or related process that has a negative impact on key biodiversity features, ecological processes or cultural assets within a protected area" (CBD, 2004). This paper reports the findings of a comprehensive assessment of threats to biodiversity conservation initiatives in the protected areas of Bangladesh.

METHODOLOGY

Information on threats to the protected areas of Bangladesh was collected from field-level protected area managers, who were contacted through an informal letter with the help of the central authority of the country's Forest Department. Managers were asked to list potential threats to the protected areas of Bangladesh, according to their judgments (from their own protected areas and others if they knew them).The results were a variety of statements, many denoting the same kind of threat. By analyzing these 'raw' statements, we summarized the information into a total of ten threats (see table 1). A more in-depth follow-up survey was

Table 1: Threat factors in the protected areas (PAS)

Threat factors identified by PA managers	No. & relative frequency of PAs where threat factors exist	Mean score of the threat factors	Relative severity index of the threat factors
1. Shortage of funds impairing the materialization of the long-term visions and commitments of PA-based biodiversity conservation	34 (100%)	4.70 ± 0.19	0.92
2. Illegal cutting of trees and black market trade of timbers resulting in denudation of forests	30 (88%)	4.10 ± 0.12	0.87
3. Unsustainable and non-scientific harvesting of forest resources by local communities living in and around PAs	28 (82%)	3.84 ± 0.20	0.80
4. Current expansion of real estate business inducing land grabbers to encroach forestlands	10 (29%)	3. 74 ± 0.17	0.78
5. Poaching of selected mammals by smugglers resulting in their decline	21 (62%)	3. 60 ± 0.24	0.72
6. Non-cooperation from local communities for implementation of PA activities that arises from human-wildlife conflicts	18 (53%)	3.20 ± 0.20	0.65
7. Apathetic mindset against eco-tourism that appears hostile to the biodiversity and its habitat	17 (50%)	2.96 ± 0.18	0.63
8. Unnecessary delay in legal procedures regarding land litigation that encourages encroachment	23 (68%)	2.80 ± 0.21	0.56
9. Lack of integration at policy level that hampers the implementation of any new project in Forestry sector	34 (100%)	2.46 ± 0.14	0.42
10. Corruption of the FD authorities resulting in the collaborative deterioration of forests with the ruffians	15 (44%)	1.84 ± 0.22	0.39
Mean		**3.32 ± 0.12**	**0.64 ± 0.09**

conducted for all 34 protected areas, using a brief structured questionnaire. The questionnaire was sent electronically to respondents, and completed over a period of three months from March to May 2013. The respondents were field-level managers and researchers (three from each protected area), such as Assistant Conservators of Forest, Forest Rangers, and Scientific Officers who were considered to be knowledgeable key informants because of their long acquaintance with the protected areas and their surrounding environment. Respondents from each protected area were asked to score each of the ten key threats numerically from 1 as the lowest threat level to 5 as the highest. They were asked to score the threats independently and were only asked to score threats to the protected areas where they have been working officially.

Data analysis: Data was analysed using the methods of Okunlola & Tsujimoto (2009), threat indicators were calculated as follows:

- Protected Area Susceptibility Index (PASI) = The number of threats mentioned for each protected area, divided by 10 (the total number of threats listed), to provide the proportion of threats mentioned for that protected area

- Mean score of each threat factor = Sum of all the scores for that particular threat / Total number of the respondents (102)

- Relative Threat Factor Severity Index (RTFSI) = Mean score for a particular threat / The highest possible score (5)
- Protected Area Relative Threatened Index (PARTI) = Total score of all the threat factors from the respondents of a given protected area / Total responses (30)
- The ranking system based on RTFSI shows the severity of the threats, while the ranking based on both PASI and PARTI shows the vulnerability of protected areas to the identified threat factors. It was assumed that the higher the scores, the more vulnerable the protected area is. A comparison of protected area vulnerability in terms of the forest types they exhibit, and the geographical location they belong to was performed by a non-parametric Kruskal-Wallis test (Zar, 1999).

RESULTS

Protected areas in Bangladesh are prone to a range of threats (Table 1). The threat 'shortage of funds' scored the highest among the ten given threats. Indeed, this threat and 'lack of policy level integration' were reported in all the 34 protected areas, while 'illegal cutting of trees' was reported in 30 sites (88 per cent of the country's total protected areas) followed by 'unsustainable and non-scientific harvesting of forest products' (28 protected areas, 82 per cent of the total). Fourteen protected areas, constituting over 40 per cent of the country's total, were susceptible to eight or more threats. The protected area ranks are shown in Table 2 overleaf, based on the susceptibility index (PASI).

When the relative threatened index (PARTI) is taken into consideration, it was revealed that 10 protected areas (29 per cent of total) had an index of 0.6 and above, and eight (24 per cent of total) had an index of 0.7 and above. Four protected areas (12 per cent of total) had the highest index of 0.8 and above, while only one (3 per cent) had the lowest index (0.38) (Table 2). The protected areas are also ranked based on the relative threatened index (PARTI) and shown in Table 2.

Among the 16 tropical moist evergreen forests in the hilly regions, 14 were found most vulnerable (having both the PASI and PARTI of 0.60 - >0.80). In this category, the most threatened protected areas are Teknaf WS, Chunati WS, and Kaptai NP with the PASI and PARTI of over 0.80. Among the eight protected areas belonging to tropical moist deciduous forests in the plain lands, only two were found most vulnerable (having the PASI of over 0.80 and PARTI of over 0.70). These are Bhawal NP and Modhupur NP. Among the 11 mangrove protected areas

in littoral geographical region, six were extremely susceptible and threatened by the identified threat factors (having both the PASI and PARTI of over 0.7). These are Sundarban East, West & South, Chadpai WS, Dhangmari WS, and Nijhum Dweep NP. Of the total protected areas, only six were found with both PASI and PARTI of less than 0.50. These are Ramsagar NP, Nobabgonj NP, Shingra NP, Kadigarh NP, Dudhmukhi WS, and Sonarchar WS.

The Kruskal-Wallis test showed that, for both PASI and PARTI, threat scores were higher in tropical moist evergreen and semi-evergreen forests, followed by mangrove forests and then tropical moist deciduous forests (see Table 3).

DISCUSSION

In Bangladesh's protected areas, many aspects of forest resource utilization have been identified as responsible for their degradation (Chowdhury & Koike, 2010a), posing serious threats to the biological diversity. Of the 10 threats identified in this study, five (illegal tree cutting, harvesting NTFPs, forestland grabbing for real estate business, wildlife poaching, and environmentally non-friendly tourism) were directly or indirectly related to resource utilization.

Because of large human population (1,174 people/km²), Bangladesh's forests (17.08 per cent of total land area) are under threat from extreme anthropogenic pressure (World Bank, 2011). Encroachment of forestland (3.3 per cent of evergreen hill forests, 31.9 per cent of deciduous plain land forests), for housing and agriculture, is responsible for much of the observed loss of biodiversity (Muhammed et al., 2008; Alam et al., 2008). In this study, encroachment was reported as a threat in almost one-third of all protected areas, and in about 63 per cent of protected areas within tropical moist deciduous forests distributed in plain lands. Among them Modhupur NP is suffered the worst (scoring the PARTI of 0.78), probably because of easy accessibility and its proximity to the country's capital city. These results correspond with the findings of other studies (e.g., Alam et al., 2008; Islam & Sato, 2012; Muhammed et al., 2008). Marcovchik-Nicholis et al. (2008) argued that habitat loss and fragmentation due to urban development may have the most serious consequences to wildlife, because it results in permanent and irreversible changes to the environment, with little chance of restoration and recovery.

Illegal logging is one of the major threats to forests in tropical developing countries, which have long been subjected to rapid deforestation and degradation driven

Table 2. Relative threat index, geographical location, forest type, area and establishment date of protected areas of Bangladesh

Protected Areas		No. of threats exist	PASI (rank)	PARTI (rank)	Geography	Forest Type	Area (ha.)	Date of Establishment
National Parks (NP)	Bhawal NP	8	0.80 (2)	0.74 (4)	Hilly	TMDF	5022.00	May 11, 1982
	Modhupur NP	8	0.80 (2)	0.78 (3)	Plain	TMDF	8436.00	Feb. 24, 1982
	Ramsagar NP	6	0.60 (4)	0.38 (18)	Plain	TMDF	27.75	Apr. 30, 2001
	Himchari NP	6	0.60 (4)	0.54 (13)	Hilly	TMEF	1729.00	Feb. 15, 1980
	Lawachara NP	8	0.80 (2)	0.60 (10)	Hilly	TMEF	1250.00	July 07, 1996
	Kaptai NP	8	0.80 (2)	0.80 (2)	Hilly	TMEF	5464.00	Sept. 09, 1999
	Nijhum Dweep NP	5	0.50 (5)	0.74 (4)	Littoral	MNGF	16352.23	Apr. 08, 2001
	Medha-Kachhapia NP	6	0.60 (4)	0.72 (5)	Hilly	TMEF	395.92	Aug. 08, 2008
	Satchari NP	7	0.70 (3)	0.68 (6)	Hilly	TMEF	242.91	Oct. 15, 2005
	Khadim Nagar NP	7	0.70 (3)	0.64 (8)	Hilly	TMEF	678.80	Apr. 13, 2006
	Baraiyadhala NP	5	0.50 (5)	0.62 (9)	Hilly	TMEF	2933.61	Apr. 06, 2010
	Kuakata NP	5	0.50 (5)	0.52 (14)	Littoral	MNGF	1613.00	Oct. 24, 2010
	Nobabgonj NP	4	0.40 (6)	0.42 (16)	Plain	TMDF	517.61	Oct. 24, 2010
	Shingra NP	4	0.40 (6)	0.48 (15)	Plain	TMDF	305.69	Oct. 24, 2010
	Kadigarh NP	4	0.40 (6)	0.40 (17)	Plain	TMDF	344.13	Oct. 24, 2010
	Altadighi NP	4	0.40 (6)	0.52 (14)	Plain	TMDF	264.12	Dec. 24, 2011
	Birgonj NP	4	0.40 (6)	0.55 (12)	Plain	TMDF	168.56	Dec. 24, 2011
Wildlife Sanctuary (WS)	Rema-Kalenga WS	9	0.90 (1)	0.66 (7)	Hilly	TMEF	1795.54	July 07, 1996
	Char Kukri Mukri WS	6	0.60 (4)	0.58 (11)	Littoral	MNGF	40.00	Dec. 19, 1981
	Sundarban East WS	7	0.70 (3)	0.78 (3)	Littoral	MNGF	31226.94	Apr. 06, 1996
	Sundarban West WS	7	0.70 (3)	0.80 (2)	Littoral	MNGF	71502.10	Apr. 06, 1996
	Sundarban South WS	7	0.70 (3)	0.78 (3)	Littoral	MNGF	36970.45	Apr. 06, 1996
	Pablakhali WS	7	0.70 (3)	0.62 (9)	Hilly	TMEF	42087.00	Sept. 20, 1983
	Chunati WS	8	0.80 (2)	0.80 (2)	Hilly	TMEF	7763.97	Mar. 18, 1986
	Fashiakhali WS	6	0.60 (4)	0.62 (9)	Hilly	TMEF	1302.43	Apr. 11, 2007
	Dudh Pukuria-Dhopachari WS	6	0.60 (4)	0.66 (7)	Hilly	TMEF	4716.57	Apr. 06, 2010
	Hazarikhil WS	7	0.70 (3)	0.62 (9)	Hilly	TMEF	1177.53	Apr. 06, 2010
	Sangu WS	6	0.60 (4)	0.58 (11)	Hilly	TMEF	2331.98	Apr. 06, 2010
	Teknaf WS	8	0.80 (2)	0.82 (1)	Hilly	TMEF	11615.00	Mar. 24, 2010
	Tengragiri WS	5	0.50 (5)	0.62 (9)	Littoral	MNGF	4048.58	Oct. 24, 2010
	Dudhmukhi WS	5	0.50 (5)	0.48 (15)	Littoral	MNGF	170.00	Jan. 29, 2012
	Chadpai WS	5	0.50 (5)	0.78 (3)	Littoral	MNGF	560.00	Jan. 29, 2012
	Dhangmari WS	6	0.60 (4)	0.78 (3)	Littoral	MNGF	340.00	Jan. 29, 2012
	Sonarchar WS	4	0.40 (6)	0.42 (16)	Littoral	MNGF	2016.48	Dec. 24, 2011

TMDF= Tropical Moist Deciduous Forest, TMEF= Tropical Moist Evergreen Forest, MNGF= Mangrove Forest

largely by poverty and complex socio-political settings (Kaimowitz, 2003). In Bangladesh human-induced removal of woody biomass, in the form of timber and fuel wood, is considered the principal cause of forest loss in the protected areas (Chowdhury et al., 2009). While several other studies (e.g., Mazumder et al., 2007; Rashid et al., 2013) claim that the rate of illegal logging in protected areas has diminished following the adoption of a co-management program in Bangladesh, it was still reported as one of the severe threats in this study with a relative severity index (RTFSI) of 0.87. In Bangladesh the increase in timber demand (6 per cent) is much higher than the increase in forest cover (1 per cent) exhibiting a gap between production and demand of

Table 3. The PASI and PARTI values of protected areas based on the forest types and geographical locations

Categories		PASI	K-W test value	p value	PARTI	K-W test value	p value
Forest types	TMDF	0.52 ± 0.04			0.55 ± 0.02		
	MNGF	0.65 ± 0.03	9.88	p = 0.0059	0.69 ± 0.03	13.78	p = 0.0023
	TMEF	0.72 ± 0.03			0.71 ± 0.01		
Geographical locations	Plain	0.48 ± 0.02			0.42 ± 0.02		
	Littoral	0.55 ± 0.02			0.66 ± 0.02		
	Hilly	0.74 ± 0.03	17.04	p < 0.001	0.72 ± 0.01	20.01	p < 0.001

TMDF= Tropical Moist Deciduous Forest, TMEF= Tropical Moist Evergreen Forest, MNGF= Mangrove Forest

timber; thus, an imbalanced demand–supply cycle is making the country's forest resources even more vulnerable (Rahman, 2012).

Another severe threat to Bangladesh's protected areas was the over-exploitation of forest resources (RTFSI 0.80). Since rural households are vulnerable to a wide range of stresses and shocks that affect their livelihoods (Debela et al., 2012), and forest-rich protected areas are the fundamental sources of various livelihood options for the local communities (Chowdhury & Koike, 2010b), over-exploitation is common. This over-exploitation can result in the decline and disappearance of biodiversity, e.g. Odisha *Cycas* in India (Singh & Singh, 2011), populations of black colobus (*Colobus satanas*) in the Congo Basin, spider monkeys (*Ateles* sp.) and woolly monkeys (*Lagothrix* sp.) in the Amazon basin (Kumpel et al., 2010), and the wolf populations of the Pamir region of Kyrgyzstan and Tajikistan (Watanabe et al., 2010). Loss of biological diversity within already established protected areas indicates a distinct institutional/administrative weakness, especially when they have governmental support, legal protection and formal governing organization (Oestreicher et al., 2009).

Local communities living in the forested regions of Bangladesh extract both plant and animal products from the neighbouring forests (Chowdhury et al., 2007; Miah & Chowdhury, 2004), and wildlife is used as a source of protein and income. Hunting wild animals for bush meat is prevalent in the tropical moist evergreen and semi-evergreen forests of hilly protected areas where some indigenous communities inhabit (Chowdhury et al., 2014). Wildlife is often an open access resource, and the cost of its production is often lower than the cost of raising livestock (Fa & Brown, 2009). Poaching of selected mammals for smuggling is prevalent in mangrove protected forests of the littoral zone, mainly the Sundarbans, where the Royal Bengal Tiger (*Panthera tigris tigris*) is the iconic species (Uddin et al., 2013) and subject to poaching because of the high demand for its skin and other body parts in international black markets. Robinson & Bodmer (1999) identified such unsustainable hunting and poaching of wildlife as a major global threat to biodiversity in tropical forests. Uncontrolled hunting may also undermine climate change mitigation efforts, as a reduction in the abundance of seed-dispersing animal species has been shown to, in turn, reduce the density of key carbon-storing tree species (Krause & Zambonino, 2013). Many of the animals of Bangladesh have either become extinct or are at risk of extinction; 40 mammal species, 41 bird species, 58 reptiles and eight amphibians are categorized as vulnerable or above in the IUCN Red List (IUCN, 2000).

Human-wildlife conflict, which is a function of human population increase and encroachment into protected areas, is a major concern in biodiversity conservation programmes. The present study discovered that conflict is prevalent in the protected areas of hill and mangrove forests; and mostly arises from the damage of crops and houses by elephants and attacks on humans by tigers. Human-wildlife conflict in hilly regions arises from specific problems such as crop raiding, destruction of homes, and fear of collecting water and firewood in the evening because of wild elephants (Sarker & Roskaft, 2011). Barlow (2009) estimated a mean of 76 human deaths/year over the last 130 years in the Sundarbans, which is the highest rate within the tiger's current range. Controlling 'problem animals' could be a solution to help

Bamboo extraction by locals in Rema-Kalenga WS © Sharif Ahmed Mukul

reduce the number of human deaths. The hunting of 'problem animals', however, is not currently legally acceptable or in line with conservation objectives to preserve tiger population in Bangladesh. On the contrary, the 2-3 tigers killed each year in and around the Sundarbans due to attacks on human or livestock, plus an unknown number poached, could threaten the long-term viability of the tiger population (which is estimated at about 150 adult females). Controlling 'problem animals' due to human-wildlife conflict is a global issue, and includes conflicts with Amur Tiger (*Panthera tigris altaica*) in the Far East provinces of Russia (Goodrich et al., 2011), wolves in the Pamir regions of Kyrgyzstan and Tajikistan (Izumiyama et al., 2009; Watanabe et al., 2010), lions in Masai region of Kenya and Tanzania (Okello & Hadas, 2000). Tiger conservation in Bangladesh must take into account the local socio-economic conditions of which human-tiger conflict is an important feature (Barlow, 2009). Tigers cause considerable stress to local communities that rely on the

forest for their livelihoods. More than 3.5 million people living around the Sundarbans are directly or indirectly dependent on its various ecosystem services (Giri et al., 2007; Uddin et al., 2013). Working in the forest is the only potential source of income for many people living along the forest border, and those killed are normally the main providers of income for a family (Azad et al., 2005; Gurung et al., 2008). Moreover, human-tiger conflict also strains relationships between local communities and the authorities, and may impede management activities in protected areas. In this study the threat of 'non-cooperation from local communities for implementation of protected area activities' scored a severity index of 0.65. Increasing safety measures and compensation amounts would reduce the negative attitudes of local people to the conservation issues.

Many studies have shown that measures to reduce the threats to protected areas are more likely to succeed when local communities are socio-economically

empowered and actively involved in the protected area management process (e.g., Bostrom, 2012; Egbuche et al., 2009; Hjortso, 2004; Idrissou et al., 2013; Kothari, 2006; Marshall et al., 2007; Okech, 2010). Although a participatory approach under the 'co-management programme' has been adapted in Bangladesh's protected areas (Chowdhury et al., 2009), significant involvement of the different stakeholders (including local communities), in terms of planning and decision making, still remains largely to be accomplished (Chowdhury et al., 2013; Rashid et al., 2013). Stakeholder participation in the stages of forest planning and decision making is essential to get long-lasting and viable solutions regarding the mitigation of the threats (Bruna-Garcia & Marey-Perez, 2014). Because the nature of conflicts between people and protected areas varies regionally and according to the communities social values and economic status, it is imperative to design participatory protected area programmes to suit local needs (Sarker & Roskaft, 2011). It must be recognized that the state has an important role to play in protected area governance and that these roles will often be more strategic, instrumental and, to a degree, controlling in nature, in order to ensure the fulfillment of obligations to legal institutions such as the CBD and related regional and national policies, as well as related obligations to wider society and future generations (Jones, 2013). At the same time, effective co-management through a 'statutory partnership' between the state and multi-level stakeholders is necessary to overcome significant governance challenges and multi-dimensional threat factors. To achieve success in such programmes, the behaviour of the official organizations should be more pro-people, and the resentment and distrust against the administration by the local communities should, in turn, decline.

Delays in legal procedures for land titling have also increased the threat of illegal encroachment, or 'land-grabbing'. Borras Jr. et al. (2011) estimated 45 million hectares exchanged hands globally in the form of land grabs between 2005 and 2009. In Bangladesh, more than 0.6 million ha of land was scheduled for reservation under the existing Forest Act (Choudhury & Hossain 2011). However, some cases were delayed by the official gazettement process for decades. These delays diluted the Forest Department's claim to the title and provided opportunities to vested interest groups to make counter claims. These groups then acquired land and filed title suits, leading to numerous legal disputes with the Forest Department. The sub-judicial ownership of the land under title suits, and questionable ownership of the land that was due to be gazetted, present serious hurdles in implementation of conservation programmes in Bangladesh. Land-grabbing is a major threat to

biodiversity conservation and has resulted in serious conflicts in many regions of the world (Borras Jr. et al., 2011). In Bangladesh, big business (e.g., real estate, shrimp culture etc.) use a wide variety of market and non-market, economic and extra-economic, as well as legal and illegal mechanisms to establish control over lands held by the state forest authority or poor people (Adnan, 2013). Processes leading to forest loss within protected areas are thus different to those that drive habitat loss on other land tenure arrangements that lack such formalized government property rights status (Petursson et al., 2013). Controlling encroachment and associated activities is a difficult endeavour unless there is a strong and effective political commitment from the government.

Lack of integration at policy level was reported to be a threat to biodiversity conservation, hampering the implementation of any new projects in the forestry sector, and within protected areas. During field implementation of forestry programmes, overlapping sectorial policies in some cases lead to contradictions, conflicts and confusion (Muhammed et al., 2008). In addition, many protected areas and other forest units lack management plans (Choudhury & Hossain, 2011). This lack of management planning is not unique to Bangladesh; more than two-thirds of the world's protected areas lack a management plan, and where such plans exist, they very rarely address issues associated with sustainable livelihoods or ecosystem services (Ervin, 2011). In addition to such policy level disorganization, the implementation of conservation programmes is further constrained by institutional corruption. As with many other developing countries, corruption is a common problem for the Forest Department in Bangladesh. TIB (2000) reported incidences of cutting and selling of trees by timber traders and smugglers and killing of animals by poachers with the direct cooperation of forest officials through bribery, embezzlement and misuse of administrative power. Corruption thus seriously impairs the sustainability of forest conservation and protected area implementation in Bangladesh (Choudhury & Hossain, 2011; Isalm & Sato, 2012).

The highest ranked threat in this study was the paucity of funds. All protected areas are facing the acute threat of fund shortage, hampering the sustainability of forest protection and biodiversity conservation. Bangladesh is a developing country and, having extreme resource constraints, its government cannot allocate sufficient funds from the public budget to the forestry sector, because of other priorities. (Mulongoy et al., 2008). In Bangladesh, in the 1970s and 80s, almost 95 per cent of the Forest Department's budget was met by the exchequer. However, in the last two decades this has

Phayre's leaf monkey (*Trachypithecus phayrei*) in Rema-Kalenga WS © Mohammed Abu Sayed Arfin Khan (left); Capped leaf monkey (*Trachypithecus pileatus*) in Modhupur NP © Sharif Ahmed Mukul (right)

completely turned around, and presently over 80 per cent of expenditures is met from donor-funded projects. Therefore, when there is no externally funded project, there is no funding for forestry activities. The flow of development funds is often short term (4 – 5 years) and unreliable and cannot be the basis for a long-term national programme, such as the protected area network of Bangladesh. This funding model is the most serious problem for the forestry sector, frustrating the long-term visions and commitments of biodiversity conservation in the country (Choudhury & Hossain, 2011). Suggested solutions include the creation of a 'Trust Fund' for Bangladesh's protected area network, which could be established by international donors (Baldus, 2008), and given appropriate checks to prevent misuse of funds.

Another potential source of funds for protected area management comes from eco-tourism, for those protected areas with magnificent scenic beauty and biodiversity (EWI, 2009). Since the 1990s, many developing countries rich in biodiversity have been vigorously promoting eco-tourism as a conservation and development tool in their protected areas (He et al., 2008). From a community perspective, eco-tourism can provide benefits (e.g. revenues from lodging, food, guiding and transportation to tourists) that ultimately enhance local support for the conservation of natural resources due to the direct link between biodiversity conservation and local development (Rana et al., 2010; Lambooy & Levashova, 2011; Anup & Parajuli, 2014). The collected revenues from visiting a protected area could support its preservation. However, when inadequately managed, visitors' activities can result in degradation of the landscape, and have negative impacts on wild plants and animals (Kimura, 2011), including impacts on the socio-psychological behaviour of wildlife,

as evident from the behaviour of elephants in the Rajiv Gandhi National Park, India resulting from the severe anthropogenic interference (Ramchurjee, 2013). Sometimes, this industry encourages encroachment into forestlands as is the case in Costa Rica where land clearance for the construction of large hotels without any proper spatial planning has become a major problem (Koens et al., 2009). The national parks of Himchari, Lawachara, Kaptai, Satchari, Khadim Nagar, Kuakata and the wildlife sanctuaries of Rema-Kalenga, Sundarbans (East, West and South), Chunati, Sangu, and Teknaf are the protected areas most negatively affected by tourism.

CONCLUSION

With limited land and a large population, Bangladesh is facing a range of anthropogenic threats to its forest resources. Administrative procrastination and corruption encourage unlawful activities, which in turn, affects biodiversity both directly and indirectly. The types and patterns of the threat factors in Bangladesh's protected areas are complex. These findings suggest that existing strategies relating to biodiversity conservation are inadequate. Efforts to reduce the threat factors need to be fully integrated into the forest conservation and development programmes driven both by the government and the donors. Systematic and concerted attention is required to make the recently adoption of co-management programmes successful. Proper and functional partnership between multi-sectorial stakeholders such as the government, forest user groups and local communities, donor agencies, and civil society groups is a pre-requisite for success. The authors hope that the findings of the present study provide useful information for policy makers developing new programmes of biodiversity conservation in Bangladesh.

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RESUMEN

Las áreas protegidas de Bangladesh están expuestas a una serie de amenazas que fragilizan el programa de conservación de la biodiversidad del país. Uno de los pasos cruciales para la gestión eficaz de las áreas protegidas consiste en entender el tipo, modelo y alcance de estas amenazas. El estudio evaluó la gravedad relativa de las amenazas a las áreas protegidas y su grado de susceptibilidad a ellas. Ciento dos funcionarios de las 34 áreas protegidas fueron entrevistados por vía electrónica. Se identificaron diez amenazas potenciales. Las amenazas más graves son: la escasez de fondos y la desorganización existente a nivel de políticas, la tala ilegal de árboles, la extracción no sostenible de recursos forestales, la invasión de bosques y la caza furtiva y el contrabando. Los resultados indican que las áreas protegidas a través de todo el ecosistema se encuentran en riesgo, y que las amenazas varían geográficamente. Una tercera parte de las áreas protegidas están expuestas al 80 por ciento de las amenazas. Las áreas protegidas en los bosques tropicales húmedos de hoja perenne y semiperenne de las regiones montañosas son muy propensas a la tala ilegal de madera, mientras que los bosques caducifolios tropicales húmedos de superficie terrestre llana son propensos a la invasión para el asentamiento y la agricultura, y los bosques de manglar de las zonas litorales son extremadamente vulnerables a la caza furtiva. El desarrollo de estrategias rápidas para mitigar estas amenazas, con la coordinación multisectorial y la participación de los interesados, es esencial para la gestión adecuada de las áreas protegidas y para reducir la pérdida constante de la biodiversidad en Bangladesh.

RÉSUMÉ

Natura 2000 constitue la première et la seule approche régionale de la biodiversité des aires protégées au monde. Au cours de ses 20 ans d'existence, elle a été une force positive pour la conservation, mais elle est néanmoins sujette à certaines limites. Ce document évalue quelques unes de ses forces et ses faiblesses du point de vue d'un praticien. Dans l'ensemble, l'évaluation est positive, car sans cette initiative l'appauvrissement de la biodiversité aurait probablement été plus conséquent, sans compter que son approche transnationale est unique. Les aspects positifs identifiés sont donc le cadre biogéographique, la classification paneuropéenne des espèces et des habitats, ainsi que la volonté politique de la mettre en œuvre. Les aspects négatifs sont en revanche son approche statique de la conservation des espèces et de l'habitat, le fait que l'approche Natura de la préservation de la biodiversité est constamment compromise par des subventions aux effets pervers provenant d'autres mécanismes européens de financement, résultant en particulier de la Politique Agricole Commune, et enfin les effets qu'a le développement sur la fragmentation des habitats. En outre, dans la pratique, on a constaté une carence dans la mise en œuvre de mesures plus extensives touchant à l'environnement et à la connectivité. Nous tentons d'en tirer des leçons pour d'autres parties du monde.