rangelands and resources that were once owned or managed communally by mobile pastoralists (Fairhead et al., 2012). Over the past decades, there has been a dramatic increase in the number and extent of protected areas established globally (UNEP-WCMC and IUCN, 2016a). Yet the commitments under the Convention on Biological Diversity (CBD) to expand the global network of protected areas so far have been achieved mostly with a preventive and alienating approach by states, violating the rights of mobile pastoralists as has been the case for many other indigenous and local communities (Ykhanbai et al., 2014; Toutain et al., 2004).

When protected areas are established on traditional pastoral rangelands a number of situations can occur:

- Mobile pastoralism continues within the protected area and/or buffer zone (e.g. Monfragüe National Park, Spain)
- Mobile pastoralism continues within the buffer zone only (e.g. Al Shouf Biosphere Reserve, Lebanon)
- Mobile pastoralism continues outside the protected area and/or buffer zone (e.g. Serengeti National Park, Tanzania)
- Mobile pastoralism is stopped, pastoralists are relocated to other areas (e.g. Rajaji National Park, India)
- Mobile pastoralism is stopped, pastoralists are settled and encouraged to adopt new livelihoods (e.g. Hoh Xil World Heritage Site, China)

The above options are mainly decided by protected area authorities.

Because the landscape benefits of mobile pastoralism have been little understood or acknowledged, and because protected areas have often been superimposed

Restrictions to mobility is a significant driver in the decrease of mobile pastoralism (© Barış Koca)

on traditional rangelands with very little or no consultation, the historical relationship between protected areas and mobile pastoralists has, generally speaking, been one of conflict.

In India, the state policy on forests has reaped havoc amongst forest dependent communities (Agrawal, 2014), many of whom are mobile pastoralists and there have been mass evictions from protected areas since 2002 (Ykhanbai et al., 2014). The Van Gujjar tribe of Rajaji National Park (Uttarkhand and Uttar Pradesh) is a pertinent example of the conflict. The Van Gujjars are the only Muslim forest dependent community in the country. Their official classification as a people in the states of Uttarkhand and Uttar Pradesh is 'Other Backward Classes'. Their wintering sites lie within the National Park boundaries and their "*finely tuned transhumance helps to regenerate vegetation in the upper Himalayan stretches*" (Agrawal, 2014). Thousands of Van Gujjars have been relocated far from their traditional lands and it is claimed that remaining families in the park are being "*harassed and beaten by RNP (Rajaji National Park) officials and police…*" (Agrawal, 2014).

Similarly in the recently inscribed World Heritage property of Qinghai Hoh Xil, China, many of the traditional Tibetan herders have been evicted and resettled to work in factories. The management of this World Heritage property on the Tibetan plateau falls under the two administrations of Hoh Xil and Sanjiangyuan National Nature Reserves. Chinese legislation for Nature Reserves prohibits activities such as grazing within park boundaries (Studley, 2019; Stolton & Dudley, in press). Yet the Tibetan herders have always lived in harmony with their natural environment and for the past 30 years have been more formally spearheading species and landscape protection there (Lafitte, 2017).

Some of the world's most emblematic protected areas have been established on rangelands, which for millennia have been home to mobile pastoralists. The Serengeti in Tanzania is a case in point. Heavy-handed evictions of the Maasai from their ancestral lands in the name of nature conservation have led to years of continued clashes (Tanzania Natural Resource Forum, 2011), and heightened conflict with wildlife. Further, after initial evictions from the protected areas, many Maasai have been evicted once again in order to make way for luxury game hunting (The Ecologist, 2015).

Al Shouf Nature Reserve and UNESCO Biosphere Reserve in Lebanon is home to a quarter of the remaining Lebanese Cedar forests, some of which are over 2,000 years old. When the Nature Reserve was established in 1996, an old migration route for mobile pastoralists still ran through the middle of it. In accordance with the protected area thinking of the time, the protected area's management stopped the grazing within the park boundaries, which caused considerable conflict. In time the incidence of forest fires became more important due to the lack of grazing and management decided it was time to re-build relationships with local shepherds. Today grazing is permitted in the buffer zone and development zones of the Shouf Biosphere Reserve and park staff look forward to new collaborations and less conflict (Personal communications with the manager of Al Shouf Nature Reserve and mobile pastoralist shepherds, 25-26 January 2017).

The above incidents were impossible in the case of Monfragüe National Park in Spain because of the long-standing legislation that has protected the country's drove roads since the 13th century. As such when the protected area was established, first as a Natural Park in 1979, then as a Special Protection Area for birds in 1991, subsequently a UNESCO Biosphere Reserve in 2003 and finally a National Park in 2007, there was no question as to what to do with the transhumant shepherds who for centuries have used the *cañada* that runs through it. Today, both the transhumants and the park staff talk of mutual understanding and a collaborative relationship (Personal communications with the manager of Monfragüe National Park and mobile pastoralist shepherds, 6 March 2017). Interestingly Jesus Garzon, who established the Natural Park in 1979, went on to be one of the key propagators of the long distance transhumance renaissance in Spain, arguing that transhumance in Spain is a necessity for the environment.

As is the case with the Monfragüe National Park example, the experience of the global nature conservation movement over the last few decades has resulted in a shift towards recognising that humans, with their cultural diversity, are an integral component of ecosystems (Nakashima et al., 2012). This recognition has been supported by a growing body of evidence on the strong linkage between the maintenance of mobile pastoralism and the protection of rangeland biodiversity considering particularly that rangeland landscapes account for between one quarter and one half of the world land area and are dependent on herbivore action for their maintenance which is mostly ensured by pastoral grazing management (McGahey et al., 2014).

Whether inside or outside protected areas, the many benefits for the environment related to mobile

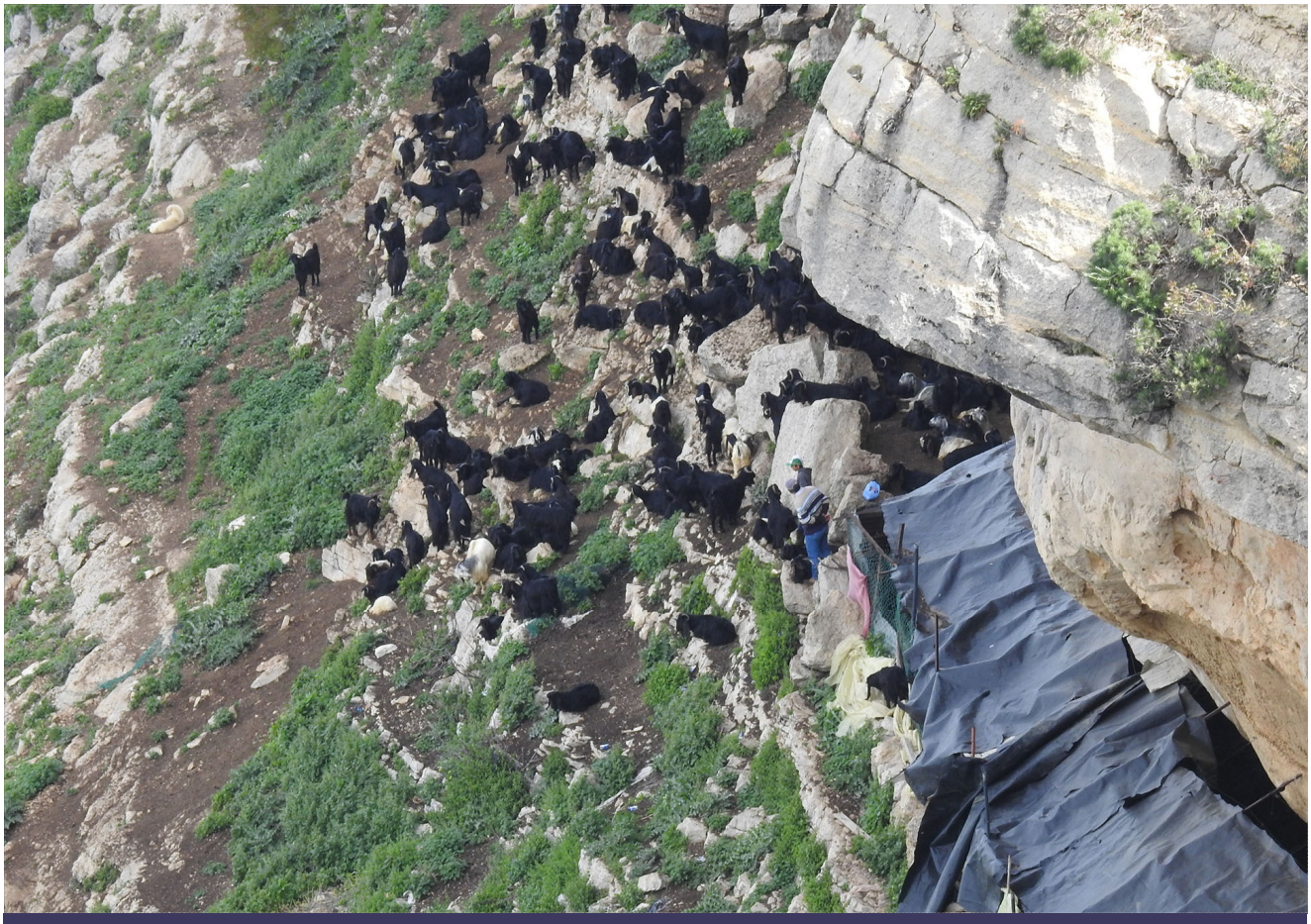
pastoralism can no longer be ignored as more literature and concrete examples emerge (Niamir-Fuller et al., 2012). The migration routes used by mobile pastoralists play a critical role in habitat connectivity (Manzano-Baena & Salguero-Herrera, 2018) and if properly acknowledged could certainly provide protected areas with some bio-cultural solutions to the major problems of fragmentation (Ervin et al., 2010) they currently face. The following section of the paper looks at benefits specific to biodiversity, and then considers the scale of pastoral mobility's role in terms of connectivity.

THE BENEFITS OF MOBILE PASTORALISM FOR BIODIVERSITY

Rangeland ecosystems in arid, semi-arid and mountain regions encompass a wide range of vegetation formations: grassland with or without shrub, bush or woodland cover, savanna woodlands. These systems are the product of continual disturbance through patchy and unpredictable rainfall, fire, grazing, browsing and physical disturbance (Homewood, 2004). In particular, temporal variability shapes virtually all ecological processes in arid and semi-arid rangelands (Hobbs et al., 2008a). Due to insufficient rainfall to sustain agriculture, pastoralism has offered the only sustainable way to turn sunlight into food for people in these areas (Hobbs et al., 2008b).

In response to environmental variabilities and unpredictability in rangeland ecosystems, adaptability, flexibility and opportunism have characterised the evolution of mobile pastoralism and form the basis of their socio-ecological resilience (Niamir-Fuller, 1999; Coughenour, 2008). Moreover it is mobile pastoralists who have been a major agent in the evolution of rangeland ecosystems for thousands of years (McGahey et al., 2014; Reid et al., 2015). Particularly their mobility and the common property systems they depend on have allowed them to access and conserve forage and water resources that are unevenly distributed and vary over time (Reid et al., 2008).

Mobile pastoralists access the complex resources of landscapes, including those that are rare or ephemeral, by moving (Reid et al., 2008). These movements are



Mobile pastoralists, Al Shouf Biosphere Reserve, Lebanon © Marc Hockings

analogous in spatial and temporal scales to a wild herbivore species' movements (Reid et al., 2008; Galvin, 2008; Manzano-Baena & Casas, 2010) and they have very similar effects on ecosystems (Root-Bernstein & Svenning, 2017; Avgar & Fryxell, 2014).

As is the case with wild herbivores, domesticated herbivores exert numerous effects on plant communities and ecosystems (Coughenour, 2008). Among them a major beneficial effect is the generation of spatial heterogeneity (Coughenour, 2008; Manzano-Baena & Salguero-Herrera, 2018).

Certain frequencies and intensities of herbivory and thus movement are required to maintain plant species diversity and rangeland ecosystems that depend upon interactions between herbivores and a variety of resources (Coughenour, 2008). These resources can be assigned to categories such as vegetation types, elevation zones, plant functional groups, and water (Hobbs et al., 2008a).

Thus herbivores cope with temporal variability by exploiting resources that vary in quantity and quality over space and tracking a 'green wave' of nutritious vegetation (Hobbs et al., 2008a). Being central to the process of patch dynamics, this movement of herbivores between patches allows vegetation in previously visited patches to regenerate (Coughenour, 2008).

This is also the case at large spatial scales between seasonal ranges. The mobility of herbivores decreases the interaction frequency between animals and plants and allows the seasonally grazed ranges to recover (Hobbs et al., 2008b). When mobility is restricted, this not only leads to a decrease in heterogeneity but also leads to degradation (Hobbs et al., 2008a). For instance denying access to protected areas within the Ngorongoro Conservation Area in Tanzania, which has been inhabited by pastoralists and abundant wildlife for nearly two thousand years, forced Maasai pastoralists to consistently use the highlands. The diminished ability to compensate temporal variables led to the degradation of these highlands, which were traditionally used only seasonally (Galvin et al., 2008). Similarly, the impact of abandoning grazing in Gran Paradiso Natural Park in north-western Italy had significant effects on vegetation causing shrub encroachment and loss of rangelands and led to an unfavourable conservation status for grazing dependent species such as grassland birds (Laiolo et al., 2004).

Movements create a shifting mosaic of patches in different stages of regrowth or succession in the landscape. As a result, plant species diversity at landscape scales is increased due to the occurrence of plant species with different life history strategies (growth rate, etc.) in disturbed versus recovered patches (Coughenour, 2008). Spatial heterogeneity with diverse plant species promotes diversity of species of different taxonomic groups by increasing available niche space and thus allowing more species to coexist, by providing shelter and refuges from adverse environmental conditions and by increasing the probability of speciation (Stein et al., 2014). This is not only the case for seasonal ranges but also for migration routes. For instance, a study comparing the routes still used by the domestic herbivores of mobile pastoralists versus abandoned routes in Spain suggests a significantly higher level of ant taxonomic diversity on the used routes. It was found that the used routes have a higher potential as functional reservoirs compared to those that were abandoned (Hevia et al., 2013). Particularly in environments where grazing is negligible or absent, the heterogeneity created by mobility along the migration routes creates local but crucial refugia for species (Manzano-Baena & Salguero-Herrera, 2018; Azcárate et al., 2013).

Movement is also central to the maintenance of a diversity of herbivores due to its involvement in grazing succession. Based on their body sizes and dietary differences (grazer, browser, etc.), they create suitable habitats for each other or they force each other to move on to new patches, which is essential for the succession of vegetation with low leaf:stem ratios (more stem, less leaf) or higher leaf:stem ratios (more leaf, less stem) (Coughenour, 2008). Large-bodied herbivores facilitate energy flow to smaller-bodied species by converting the vegetation with low leaf:stem ratio to a vegetation with a higher leaf:stem ratio which smaller-bodied herbivores utilise. Selectively foraging smaller-bodied herbivores may reduce the quality of the patch forcing less selective large-bodied herbivores to move on to new patches (Coughenour, 2008). For instance, the broad-scale separation of the ecosystem, whose shifting landscape mosaic was historically created by the dynamic interaction of pastoralists and elephants, has had important ecological implications for vegetation patterns in Amboseli National Park in Kenya. The distribution and abundance of wildlife at local and landscape scales has also been impacted since the forced removal of the Maasai and their livestock from the protected area. In the absence of livestock (grazers) forcing large-bodied herbivores to move on, the woodlands within the park collapsed, with elephants (browsers) preventing their regeneration. The collapse of the woodlands has resulted in a change of composition of other species and thus a loss of species, such as Coke's hartebeest (*Alcelaphus buselaphus cokii*)

and Gerenuk (*Litocranius walleri*). The decline of woodlands has led to significant shifts in primate distributions and has also certainly had implications for taxonomic groups such as ants, butterflies and birds (BurnSilver et al., 2008).

One other major effect involving movement is related to the role of herbivores in the dispersal of plants by epizoochory (the transportation of seeds attached to animal coats or hooves) and endozoochory (dispersal by ingestion and later defecation). Seeds attached to the fleece of livestock can be transported distances of up to several hundred kilometres in substantial numbers (Manzano & Malo, 2006). Another study reveals that a herd of 1,000 sheep can transport as many as 200 million ingested seeds along the migration routes between seasonal ranges during their 1,500 km migration with a mean dispersal distance of 40 km (Manzano-Baena & Salguero-Herrera, 2018). As the other processes resulting in the occurrence of long seed dispersal distances are ocean drift and tornadoes, dispersal by epizoochory and endozoochory may be critical mechanisms for plant species to escape the effects of global climate change (Manzano & Malo, 2006).

Herbivore movement also plays an important role in soil nutrient cycling, contributing to nutrition transfer across the landscape (Coughenour, 2008). Mineralisation of organic matter in rangeland ecosystems is to a large extent done by bacteria in the dung that dung beetles, ants and termites further help to incorporate into the soil (Manzano-Baena & Salguero -Herrera, 2018). Movement also allows a slow release of nitrogen and other nutrients, therefore preventing water pollution by leaching (Mekonnen & Hoekstra, 2012; Manzano-Baena & Salguero-Herrera, 2018).

The mobility of herbivores also has a direct effect on many scavenger species (Marinković & Karadzić, 1999; Xirouchakis & Nikolakakis, 2002; Mateo-Tomás, 2013), predators and insects with its role in nutrient cycles (Manzano-Baena & Salguero-Herrera, 2018). For instance vulture species, whose populations are in decline all over the world, typically rely on organic tissues from the carcasses of herbivores (Botha et al., 2017).

Additionally the movement of herbivores makes habitats less prone to wildfires by consumption of understory and their migration routes serve as natural firebreaks (Manzano-Baena & Salguero-Herrera, 2018).

All these effects of herbivore movement contribute to an increase of ecosystem resilience by creating mosaics of patches with varied functions necessary to respond to changing environmental conditions (Coughenour, 2008). It is also through movement that this heterogeneity is maintained by the connectivity it ensures (Galvin, 2008), integrating these separated patches (structural connectivity) with the species diversity and movement and ecological processes they support (functional connectivity) into a single functioning system so the patches start to affect each other indirectly (Coughenour, 2008).

Herbivores and their movement therefore play a critical role in maintaining connectivity. In addition to structural and functional connectivity, considering the forced shifting of species' ranges to track suitable conditions due to climate change and other threatening processes (Worboys et al., 2016), migration routes also contribute to evolutionary connectivity for plant species.

As such, in light of declining wild herbivore populations and/or their increasing inability to migrate over long distances, mobile pastoralists and their herds provide substitution for these roles (Manzano & Malo, 2006). The spatial scale of the migration routes functioning as ecological corridors along with the amount of movement between patches determine the scale of ecological interactions. This is central to the structure and functioning of ecosystems and the ecological integrity of landscapes (Hobbs et al., 2008a; Galvin, 2008; Galvin, 2009).

This is also the case with protected areas and other sites of importance for biodiversity such as Key Biodiversity Areas (KBAs) and Important Bird Areas (IBAs). In many cases the landscapes that are so coveted by conservationists have been created and maintained over centuries by the presence and movement of mobile pastoralists and their domesticated herbivores (Biber-Klemm & Rass, 2008; Reid et al., 2015).

The migration routes which function as ecological corridors do not only connect protected areas to each other but also to the wider semi-natural and natural landscapes thereby avoiding their isolation and fragmentation (Manzano-Baena & Salguero-Herrera, 2018). The scale of the connectivity and ecological integrity ensured by the movement of herbivores, with the effects described above, is an integral component of the habitats and species that are conserved by protected areas particularly in arid and semi-arid ecosystems (Coughenour, 2008; Hobbs et al., 2008a).

DROVE ROADS IN SPAIN

In order to assess the scale of connectivity ensured by migration routes through a case study, we have conducted a mapping exercise in Spain[5]. The Spanish case provides us with a good example for several reasons: its rich biodiversity, habitat fragmentation and loss being a significant threat, a long history of mobile pastoralism and the availability of good documentation and cartography.

Spain is a semi-arid country hosting an estimated 85,000 species of animals and plants, representing 54 per cent of the total species inventoried in Europe and could represent more than 5 per cent of the species in the world. Of the total number of 2,233 species assessed in the country more than one fifth are considered threatened and at least 10 per cent are Near Threatened at European level (IUCN, 2013). Being a highly developed country, fragmentation along with habitat loss and degradation are the most significant threats identified for these species (IUCN, 2013).

Spain also has a long history of mobile pastoralism with domestic herbivores inheriting the ancient routes of their wild ancestors and acting as a major agent in the evolution and maintenance of landscapes (Manzano-Baena & Casas, 2010; Bunce et al., 2004).

Due to the importance of this traditional practice, a professional association of breeders, the *Concejo de la Mesta*, was created in the 13th century, which acquired legal recognition and classification of the network of migration routes called drove roads (Manzano-Baena & Casas, 2010; Martin, 2004). Yet as is the case worldwide, mobile pastoralism has experienced a sharp decline since the 19th century in Spain which led to the abandonment and degradation of drove roads (Manzano -Baena & Casas, 2010; Martin, 2004). In response to this trend the Spanish Government passed a law safeguarding the network of drove roads in 1995 (Mangas-Navas, 2004). This legislation and the strong legacy and cultural value of transhumance in the

Monfragüe National Park in Spain is among the protected areas through which the routes cross © Concha Salguero

country has led to better preserved roads than in other countries of the Mediterranean basin (Azcárate et al., 2013).

The main typology of the drove roads network is based on the width of the road: *Cañadas* Reales/Cañadas are 75 metres wide, Cordeles 37 metres and Veredas 20 metres. *Cañadas Red Nacional*, refers to the *cañadas* crossing different regions. The smaller routes connected to these major ones are known by local names (Martin, 2004).

We collected mapping data from official authorities at different levels and compiled the information in ArcGIS®. In addition to the official cartography of the Ministry of Agriculture and Fisheries, Food and Environment, the relevant departments at regional government level were also contacted to collect mapping layers. The drove roads that were used for transhumance on foot in 2017 were identified with the help of the Asociación Trashumancia y Naturaleza (TyN) who contacted transhumant herders to acquire this information. All of the collected data in different formats and scales were georeferenced, homogenised and integrated with the official cartography of the Ministry following the above-mentioned typology (Figure 1). In order to understand the spatial relationship between these transhumance routes and protected areas and Natura 2000 Areas, Key Biodiversity Areas (KBAs) and Important Bird Areas (IBAs), we overlaid these designations with the transhumance routes. The number of protected areas, Natura 2000 Areas, KBAs and IBAs found to intersect

Grazing in dehesa (a type of agropastoral system) only in winter allows regeneration of vegetation, Spain © Engin Yılmaz

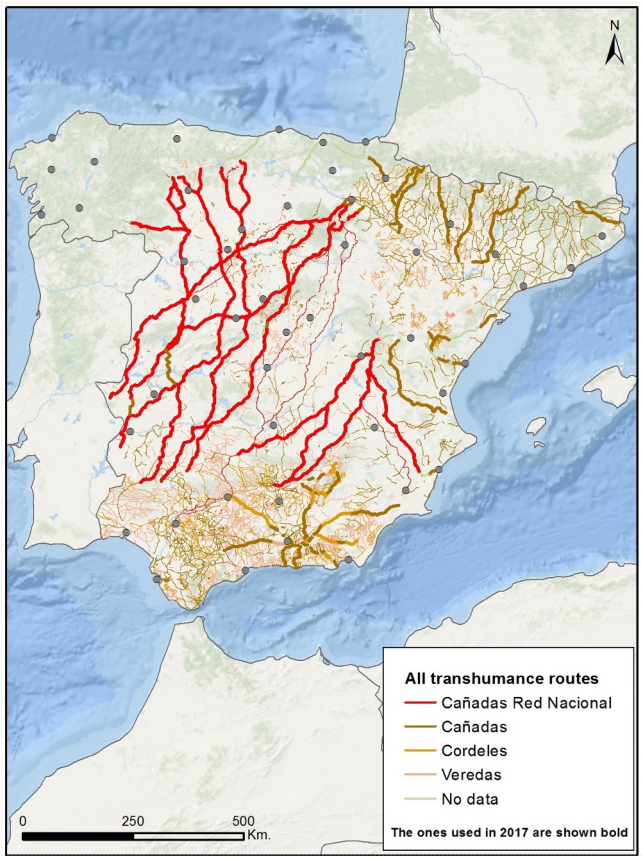


Figure 1. Transhumance routes in Spain

with transhumance routes were computed. The spatial overlapping fragments of route lengths were computed for each area type.

The geographical configuration of the network is coherent with the ecological rationale of mobile pastoralism with major routes beginning in lowland landscapes in the southern parts (or from coastal plains), which are the winter ranges, to summer ranges in highland landscapes in the northern parts of the country (Manzano-Baena & Casas, 2010).

The total length of the routes mapped is 88,296 km. With its fractal structure, the network covers almost the entire territory of the country and forms a matrix connecting various landscapes at very long distances (Azcárate et al., 2013; Manzano-Baena & Casas, 2010).

Despite the sharp decline in the practice in the country, the total length of the drove roads used in 2017 is still very significant at 11,792 km.

Overlay of the GIS mapping data of migration routes with mapping data of protected areas (UNEP-

Table 1. Correspondence of routes used in 2017 with protected areas and other sites of importance for biodiversity

	Total number of areas	Number of areas which routes cross	Percentage	Length of the intersections (km)					
				Total	Cañadas Red Nacional	Cañadas	Cordeles	Veredas	No data
Protected Areas	3,121	331	10.6	2,184.7	1,326.9	632.1	105.1	14.7	105.1
Natura 2000 Areas	1,451	230	15.9	2,153.8	1,314.3	617.4	106.8	16	99.1
Key Biodiversity Areas	214	65	30.4	3,313.7	2,894.6	293.9	110.6	8	6.4
Important Bird Areas	331	102	30.8	4,450.4	3,399.4	760.5	163.2	8	119

WCMC and IUCN, 2016b), Key Biodiversity Areas (BirdLife International, Conservation International and partners, 2011)[6] and Important Bird Areas (BirdLife International, 2016) also reveals the scale of the connectivity that mobile pastoralism ensures between them and with wider landscapes.

The routes used in 2017 (Table 1) cross through 331 protected areas (Figure 2a), 230 Natura 2000 Sites (Figure 2b), 65 KBAs and 102 IBAs (Figure 2c). Even considering the sharp decline of the practice in Spain, these figures show that mobile pastoralism and the migration routes still ensure connectivity at a significant scale and contribute to the maintenance of a connected protected area system integrated into the wider landscape. As the scale of connectivity and heterogeneity are inextricably linked (Hobbs et al., 2008a), the movement of transhumants with their livestock along these routes between winter and summer ranges contributes to habitat heterogeneity against habitat loss and fragmentation and to the diversity of species of different taxonomic groups that this heterogeneity allows in the country.

Considering the low percentage of KBAs covered by the protected areas network globally, which is 19.2 per cent (UNEP-WCMC and IUCN, 2016a), these routes managed by mobile pastoralists not only contribute to well-connected systems of protected areas but also safeguard important places for biodiversity not covered by the protected areas network.

Opportunities for collaboration

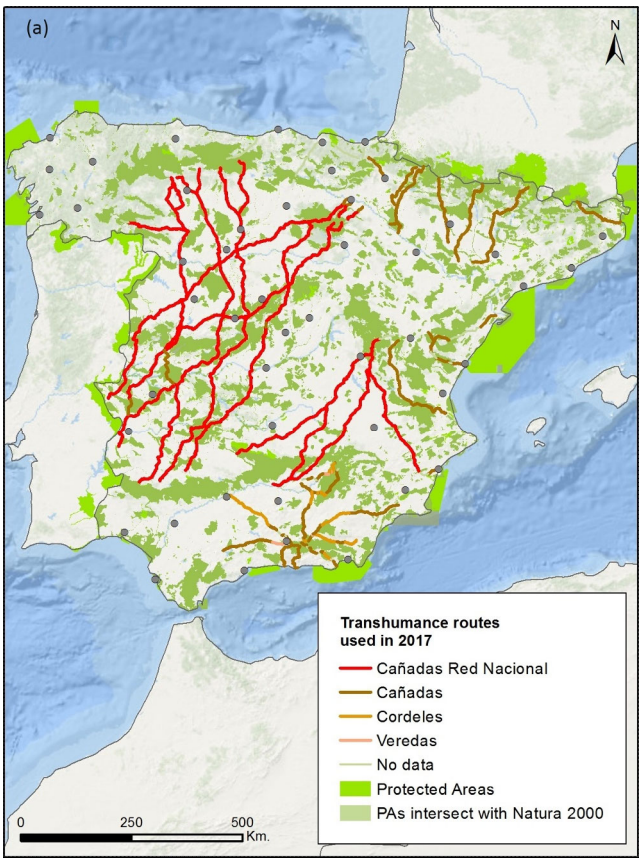
The maintenance of pastoral mobility in the world's rangelands therefore seems critical in the current context of a changing climate and with protected areas becoming less and less viable for biodiversity due to fragmentation and isolation. A number of opportunities for collaboration exist both within the folds of IUCN protected area categories I-VI as well as in new thinking on other types of effective measures to protect landscapes. Some of these are examined below.

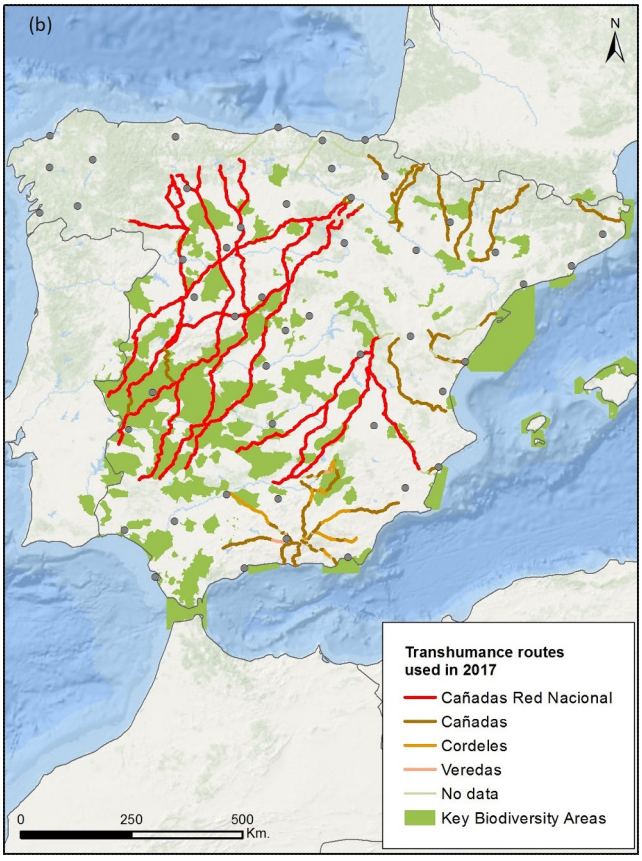
Protected area management

In contrast to the traditional view of conservationists that mobile pastoralists are unconcerned or ignorant of the ecological consequences of their actions (Fernandez-Giménez, 2000), the pastoralists themselves bear the highest costs of a degraded environment (Naimir-Fuller et al., 2012). Thousands of years of experience has created an awareness that their survival and that of future generations depends on the results of their management decisions which leads to a deep sense of responsibility and connectedness to the landscapes they manage (Knapp & Fernandez-Giménez, 2008; Sonneveld et al., 2017).

The practices, strategies, social institutions and evolving knowledge of mobile pastoralists, all based on a constant interaction with the environment and ecological processes (Reid et al., 2008; Hobbs et al., 2008a) culminate in a valuable body of what can be termed traditional ecological knowledge.

Fikret Berkes defines this as "a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment" (Berkes, 2012). This knowledge consists of biophysical observations, skills and





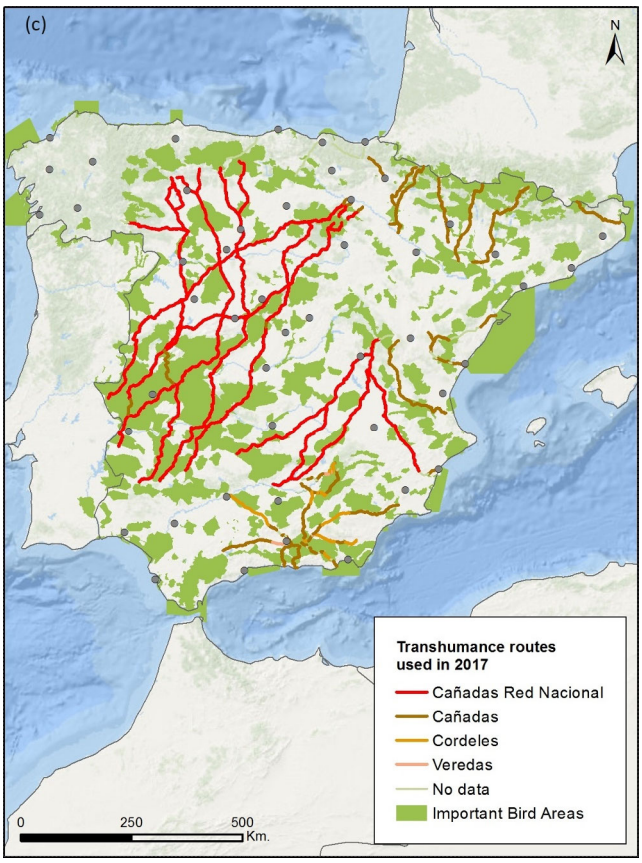


Figure 2. (a) Transhumance routes used in 2017 and protected areas
(b) Transhumance routes used in 2017 and Key Biodiversity Areas
(c) Transhumance routes used in 2017 and Important Bird Areas

technologies, as well as social relationships, such as norms and institutions that structure human-environmental interactions (Fernandez-Giménez, 2000).

Mobile pastoralists hold a rich body of knowledge on ecological processes, the landscapes they live in (Oba, 2012), plant species and rangeland vegetation dynamics (Liao et al., 2016; Kgosikoma et al., 2012), other wildlife populations and changes in their populations (Knapp & Fernandez-Giménez, 2008).

This knowledge is an important source of information that complements conservation research and moves towards a more holistic understanding of rangeland ecosystems (Kgosikoma et al., 2012; Oba, 2012). It is a knowledge set that is culturally transmitted through generations and has the potential to enrich scientific knowledge sets with new variables (Fernández-Giménez & Fillat, 2012). In addition to their knowledge, their mobility and active engagement with different habitats

throughout the year make them very useful partners for systematic observations and monitoring changes at species and ecosystem levels (Niamir-Fuller, 1999; Fernández-Giménez & Fillat, 2012).
Most rangelands of the world have been communally governed and these common property systems have coordinated the activities of each member (Niamir, 1995) and have been devised to efficiently manage the lands by regulating resource use and mobility (Rogers et al., 1999; Butt, 2016), develop collective responses and share risks (Niamir-Fuller, 1999; Butt, 2016), and develop mechanisms to enable negotiation and conflict resolution (Salpeteur et al., 2017).

Given the pastoralists' depth of experience and knowledge in managing rangelands including the strategy of mobility, they have critical contributions to make with context-specific and empirically-grounded recommendations towards constructing robust management structures and mechanisms (Liao et al., 2016; Oba, 2012). The adaptive, flexible and opportunistic character of mobile pastoralists, facilitates adaptive management towards enhancing the resilience of rangeland ecosystems (Liao et al., 2016).

This is also the case with climate change adaptation and mitigation efforts. The consequences of climate change on ecology will vary in different locations and the interactions between climatic changes and non-climate factors, such as land use, are very complex (NRC, 2010; Briske et al., 2015). Therefore, any response to address the effects of climate change at local or global levels calls for a finer scale understanding of the issue. This means taking the diversity of landscapes into consideration and including mitigation and adaptation actions not only at institutional but also at community levels. With their traditional ecological knowledge ensuring attentiveness to environmental variability, shifts and trends, mobile pastoralist communities provide a crucial foundation for protected area managers in researching and responding to climate change and developing geographically-specific adaptation and mitigation strategies (Nakashima et al., 2012; Fernández-Giménez & LeFebre, 2006).

The above-mentioned opportunities for protected area operations are one side of the story. There is also an urgent need to re-evaluate perceived threats to protected areas from mobile pastoralists. When the traditional capability of mobile pastoralists to develop sustainable solutions cannot cope with externally imposed changes such as land appropriation, they either abandon the practice completely or diversify and differentiate their management systems, which can lead to the development of responses that in some cases may create conflict with wildlife or institutionalised conservation mechanisms, for example human-carnivore conflict and overgrazing (Sonneveld et al., 2017; Fernandez-Giménez, 2000). Such cases must be thoroughly investigated to understand the root causes and to develop sustainable responses that solve the problem rather than simply restricting mobility and preventing mobile pastoralists from using their traditional resources – a strategy that has proved counter-productive in many cases.

Other Effective Area-Based Conservation Measures

Aichi Target 11 states that "By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes" (CBD, 2010).

This target of the Convention on Biological Diversity presents a new opportunity for the conservation community to acknowledge the important contribution of mobile pastoralists and the rangelands and migration routes that they manage.

In the voluntary guidance document drafted by the World Commission on Protected Area's Task Force, an OECM (Other Effective area-based Conservation Measure) is described as "a geographically defined area, other than a Protected Area, which is governed and managed in ways that achieve positive and sustained outcomes for the in-situ conservation of biodiversity, with associated ecosystem services and cultural and spiritual values" (CBD, 2018; Jonas et al., 2018).

Mobile pastoralism and the lands they manage fulfil the core elements of the OECM definition. As Jonas et al. (2018) state, the most significant elements that combine to constitute an OECM are:

- a geographically defined space;
- not a protected area;
- governed and managed (including customary governance and management structures);
- positive biodiversity outcomes and effective in-situ conservation; and
- long-term (conservation outcome is expected to

be ongoing).

As evidenced in this paper, the lands and migration routes mobile pastoralists have managed over millennia in protecting threatened species and habitats, ensuring ecological integrity of landscapes and supporting ecological processes, maintaining areas of importance for ecological connectivity, and providing critical ecosystem services such as carbon storage, etc. makes these areas strong candidates to be considered as OECMs.

Given that governments, conservation and other implementing agencies are often under-resourced and understaffed (Jonas et al., 2018), recognition and engagement of mobile pastoralists within the OECM framework could contribute to improved management and restoration of areas that may usefully support the long-term in-situ conservation of biodiversity.

The high incidence of intersection between migration routes and KBAs (30 per cent) as revealed in our mapping study also shows the potential of migration routes as OECMs to contribute to "representativeness and connectivity, and to contribute to conservation in important places such as Key Biodiversity Areas (KBAs), especially in cases where protected areas are not an option" (UNEP-WCMC and IUCN, 2016a) and towards well-connected conservation systems integrated within wider landscapes.

Areas of connectivity conservation

The migration routes of mobile pastoralists can also be considered in the framework of Areas of Connectivity Conservation (ACCs).

IUCN Draft Guidelines for Areas of Connectivity Conservation defines them as:

> "A recognised, large and/or significant spatially defined geographical space of one or more tenures that is actively, effectively and equitably governed and managed to ensure that viable populations of species are able to survive, evolve, move and interconnect within and between systems of protected areas and other effective area based conservation areas. The vision and purpose of an Area of Connectivity Conservation is to connect protected areas and other effective area based conservation areas and to maintain or restore ecosystem function and ecological and evolutionary processes of species and ecosystems across (and between) landscapes, freshwaterscapes or seascapes for biodiversity conservation in areas that may also be used and occupied for a variety of human purposes, so that people and other species are able to survive and to adapt to environmental change, especially climate change" (Worboys et al., 2016).

As put forward in this paper, the declining wild herbivore populations and/or their inability to migrate over long distances as in the past, means that the importance of mobile pastoralists and their herds in maintaining connectivity and therefore the ecological integrity of landscapes is even more critical. In addition, pastoral migration routes serve as areas that maintain or restore ecosystem function and ecological and evolutionary processes of species and ecosystems across and between landscapes.

Our ongoing mapping study, currently being undertaken across the Mediterranean, shows that mobile pastoralism still ensures connectivity at a significant scale despite the strong decline in the practice and can contribute to the maintenance of a connected protected area system, integrated into the wider landscape, even in very developed countries like Spain, where fragmentation poses one of the most significant threats.

CONCLUSIONS AND RECOMMENDATIONS

Recognising the long-standing role of mobile pastoral communities in the maintenance of the world's rangelands and the function of domestic herbivore mobility in connecting landscapes, the lack of proper collaboration in the majority of formal protected area systems seems like a missed opportunity to say the least. Further, acknowledging the rich body of traditional ecological knowledge held by mobile pastoralist communities and their continual interaction and dependence on the landscape, the development of more symbiotic relationships and respectful exchange would almost certainly be mutually beneficial.

Instead of knee-jerk responses to issues of grazing by protected area management, the critical role of mobile pastoralists as 'mobile agents of change in ecosystems' needs to be integrated into protected area strategies in order to ensure connectivity and integration into the broader landscape (Coughenour, 2008). Finding win-win solutions for pastoralists and wildlife should become an urgent priority in the many areas where the two co-exist (Niamir-Fuller et al., 2012).

To ensure the needed shift from conflict to collaboration, the following recommendations are strongly suggested:

- All existing and future protected areas should be managed and established in full compliance with the inherent rights of mobile pastoral communities, especially their land and other natural resources-related rights, avoiding policies

harming the physical, cultural and spiritual integrity of communities such as forced evictions, sedentarisation and restrictions to their mobility.

- Accordingly protected area authorities should develop policies, mechanisms and measures, which ensure effective participation of mobile pastoral communities in the designation and management of protected areas. This approach should also recognise the traditional ecological knowledge of mobile pastoralists including traditional common property systems as an integral part of new collaborations going forwards.
- In line with progressive protected area thinking, a new understanding, based on respect, dialogue, and basic human compassion, addressing the root causes of any conflicts including land degradation in or around protected areas is urgently required in areas where conflict has arisen or has the potential to arise.
- Protected area authorities should be supported in order to find mutually beneficial solutions regarding governance and management in systems of protected areas, starting with the development of good practice guidelines, fully informed by mobile pastoralist communities.
- The role of mobile pastoralists in maintaining rangeland ecosystems and avoiding fragmentation between protected areas and with wider landscapes needs to be better assessed and recognised by the conservation community and concerned states.
- Mobile pastoralists should be supported and empowered to protect their traditional lands and resources and migration routes. New conservation approaches such as OECMs, ACCs and other mechanisms may support these processes.

ENDNOTES

1. Online etymology dictionary: etymonline.com

2. http://www.fao.org/pastoralist-knowledge-hub/pastoralist-networks/regional-networks/south-asia/en/, accessed 18 July 2018.

3. Mediterranean Consortium for Nature and Culture: DiversEarth, MedINA, Society for the Protection of Nature in Lebanon, Trashumancia y Naturaleza, WWF-North Africa, Yolda Initiative, funded by the MAVA Foundation.

4. Roads Less Travelled is a global initiative in support of mobile pastoralists, founded by DiversEarth, Yolda Initiative and Trashumancia y Naturaleza in collaboration with pastoralist communities and their supporting organisations worldwide.

5. This work was initiated within the Mediterranean Consortium for Nature and Culture and is continued within the Roads Less Travelled Global Initiative.

6. BirdLife International, Conservation International, and partners (2011). Global Key Biodiversity Areas. Cambridge, UK and Arlington, VA, USA: BirdLife International and Conservation International. [These data represent the combination of global Important Bird Areas developed and maintained by the BirdLife partnership and Key Biodiversity Areas developed and maintained by Conservation International and partners. For a full list of collaborators and supports please contact science@birdlife.org or data@conservation.org]

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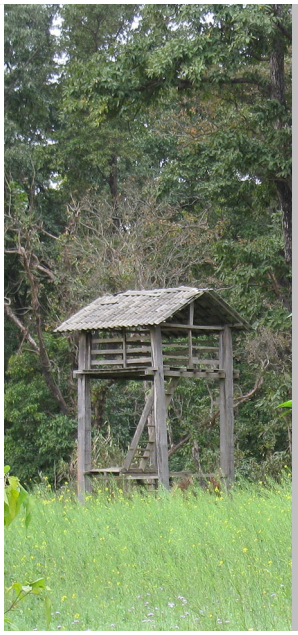
RESUMEN

Durante miles de años, las comunidades de pastores móviles se han estado desplazando por los pastizales con sus rebaños en busca de forraje y agua, impulsados por la necesidad de aprovechar al máximo los escasos recursos disponibles. Esta forma tradicional de cría de ganado ha persistido a través de los siglos debido a su interacción armoniosa con la naturaleza. Sin embargo, irónicamente, la llegada de las áreas protegidas se ha convertido en una amenaza real para las vidas y los medios de subsistencia de los pastores móviles en muchas partes del mundo. En este artículo, los autores abordan los numerosos beneficios del pastoralismo móvil, en particular los relacionados con el movimiento. Las rutas migratorias de los pastores discurren a través y alrededor de las áreas protegidas, formando corredores ecológicos entre los diferentes hábitats y evitando el aislamiento y la fragmentación. A manera de ejemplo, los autores examinan la red de carreteras españolas con nuevos datos sobre la superposición entre estas rutas y las áreas protegidas y otras áreas de alta biodiversidad. El presente artículo plantea algunas cuestiones que llaman a la reflexión de la comunidad de áreas protegidas en relación con la práctica del pastoralismo móvil. Desde temas básicos de derechos humanos hasta el reconocimiento de los servicios que aportan los pastores, se invita a los lectores a reflexionar en torno a una cuestión que no está clara y que exige un análisis más profundo, así como acciones concertadas para mitigar los conflictos y promover la colaboración.

RÉSUMÉ

Depuis des milliers d'années, les communautés pastorales nomades se sont déplacées à travers les terres de parcours avec leurs troupeaux à la recherche de fourrage et d'eau, tirant le meilleur parti des ressources rares. Cette forme traditionnelle d'élevage a persisté au cours des siècles grâce à son interaction harmonieuse avec la nature. Pourtant, paradoxalement, l'avènement des aires protégées est devenu une véritable menace pour la vie et les moyens de subsistance des pasteurs nomades dans de nombreuses régions du monde. Dans cet article, les auteurs considèrent les nombreux avantages du pastoralisme nomade, en particulier ceux liés au mouvement. Les routes de migration pastorale passent à travers et autour des aires protégées, créant des corridors écologiques entre différents habitats, évitant ainsi l'isolement et la fragmentation. À titre d'exemple, les auteurs examinent le réseau des routes migratoires espagnoles, apportant de nouvelles données sur le chevauchement entre ces routes et des aires protégées et d'autres zones riches en biodiversité. Cet article soulève de sérieuses questions qui appellent à une réflexion de la part de la communauté des aires protégées par rapport à la pratique du pastoralisme nomade. Les lecteurs sont invités à réfléchir sur cette question ambiguë qui mérite un dialogue nettement plus large, allant de la notion fondamentale des droits de l'homme à la reconnaissance des services fournis par les pasteurs nomades, en passant par des actions concertées pour atténuer les conflits et promouvoir la collaboration.



PEOPLE'S PERCEPTIONS OF PROTECTED AREAS ACROSS SPATIAL SCALES

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ABSTRACT

The relationships that local communities have with protected areas are important for the success of these areas. However, it is difficult to capture park–people relationships at spatial scales that make them useful for conservation management and planning. To explore the role of scale in people's perceptions of protected areas, we examined the relative contribution of factors at different levels (i.e. village, protected area, country) to people's attitudes and perceptions of protected areas. Based on 3,573 individual surveys from 140 villages around three protected areas in Nepal and four in Myanmar, we found patterns indicating that people's negative perceptions were influenced by factors at the village and protected area levels. In contrast, positive perceptions, such as an appreciation of conservation and ecosystem service benefits and recreational benefits were influenced by factors at the national level. Our results suggest that a multilevel approach can improve the understanding of park–people relationships and contribute to better planning and management, thereby improving park–people relationships. For example, positive perceptions may be fostered with interventions at the national level, such as national media campaigns or national educational curricula, while negative perceptions may be most effectively mitigated through interventions targeted at specific villages and conflicts.

Key words: Nepal; Myanmar; attitudes; perceptions; multilevel

INTRODUCTION

The relationships between local communities and protected areas are an important aspect of protected area management (West & Brechin, 1991). People's positive attitudes towards protected areas are a key indicator of protected area success (Struhsaker et al., 2005) and people's participation in protected area management predicts greater compliance with protected area policies (Andrade & Rhodes, 2012) and better social and ecological outcomes (Oldekop et al., 2016). Finding ways to improve and strengthen park–people relationships is critical to the long-term success of protected areas.

However, it is difficult to capture park–people relationships across the broad scale necessary for planning and management. Park–people relationships are complex and affected by a variety of factors. Much of our understanding of park–people relationships focuses on individual and household characteristics, such as gender, ethnicity, education, wealth and religion (Bragagnolo et al., 2016). Less often considered are variables at other levels that also affect the park–people relationship. For example, at the village level, spatial and social characteristics can shape the relationship. Proximity to a protected area boundary can increase the amount of wildlife conflict and extractive benefits (Mackenzie, 2012; Sarker & Røskaft, 2011), while proximity to forest outside a protected area, such as community or government forest, can decrease people's dependency on protected areas (Thapa & Hubacek, 2011). In terms of social characteristics, people's participation in social organisations (e.g. number of people who belong to local groups) is correlated with people's willingness to participate in conservation programmes (Dolisca et al., 2009). At the protected area level, levels of enforcement (Struhsaker et al., 2005), people's participation in management (Andrade & Rhodes, 2012) and their trust in management (Stern, 2008) can affect the park–people relationship. At the national level, government policies and people's trust in government may impact how people perceive and

interact with protected areas (Gangaas et al., 2015; Karanth & Nepal, 2012).

Thus, an approach that considers scale and the relative contribution of groups of factors that occur at similar levels to a particular outcome (Guerin et al., 2001) may be helpful in understanding park–people relationships. Multilevel approaches have been used to understand human–environment relationships primarily in two contexts: to explore the extent to which individual-level and national-level influences explain individuals' environmental concern using large cross-national surveys (Marquart-Pyatt, 2012; Pampel, 2014) and the extent to which individual-level and village-level influences explain different aspects of human–environment relationships, such as indigenous land use (Gray et al., 2007), farmer forest conservation behaviour (Dolisca et al., 2009) and people's attitudes towards wolves and leopards (Suryawanshi et al., 2014). A multilevel approach can provide insights into the most appropriate scale for management interventions and help to link the park–people relationship to large-scale conservation planning and prioritisation (Mackenzie et al., 2014; Nagendra et al., 2010). It can indicate whether a coarse- or fine-scale resolution is more appropriate to assess park–people relationships. For example, if people's relationships with protected areas within a country are similar, then a similar approach to the park–people relationship might be appropriate for all protected areas. However, if there is a large amount of variability in people's relationships among protected areas, or among villages surrounding one protected area, then management approaches might be tailored at a finer scale to be effective and efficient.

In this paper, we explore the relative contribution of factors at different scales among seven protected areas in two countries, Nepal and Myanmar. Nepal and Myanmar provide a rich context to explore park–people relationships because human densities are high, livelihoods are primarily subsistence-based and biodiversity is rich. However, they also differ in important ways. Nepal has protected a large percentage of its land (>23 per cent), putting it in the top-20 countries globally and second in Asia for the percentage of its surface area that is protected (Chaudhary et al., 2009). It also has one of the more progressive systems of protected areas and community forestry in the world (Allendorf & Gurung, 2016; Bhattarai et al., 2017; Bhusal, 2014; Heinen & Shrestha, 2006; Ryan, 2015). While Myanmar has maintained large tracts of its natural habitats (Bhagwat et al., 2017), only 6 per cent is within protected areas (Aung, 2007). While these forests are among the last strongholds for large mammals such as tigers and elephants (Connette et al., 2017), because Myanmar has weak forest policies and unstable tenure regimes (Lin, 2004; Woods, 2015), it has one of the highest deforestation rates in the world (FAO, 2014). In contrast to Nepal, Myanmar has taken virtually no steps to integrate communities into conservation strategies,

Table 1. Summary description of protected areas studied in Nepal and Myanmar

	Nepal			Myanmar			
	Kaakri Bihaar	Bardia NP	Lumbini	Alaungdaw Kathapa NP	Chatthin WS	Htamanthi WS	Shwe-U-Daung WS
Size	1.76 km^2	968 km^2	1.2 km^2	1,606 km^2	268 km^2	2,151 km^2	326 km^2
Elevation (m)	650-750	152-1441	161	135-1335	165-260	105-2465	180-1845
Year established	1974	1969 (reserve), 1989 (national park)	1995	1984	1941	1974	1918
Entry	Freely	With permit	Freely	Limited	Limited	Limited	Limited
Extraction	Illegal	Thatch once per year	Thatch once per year	Illegal	Illegal	Illegal	Illegal
Resettlement	No	Some villages	Yes	No	Some villages	No	No
Ethnicity/ religion	Hindu (majority), Tharu, Buddhist	Hindu (majority), Tharu	Muslim (majority), Hindu	Burman	Burman	Shan (majority), Chin, Naga	Burman (majority), Shan

Table 2. Characteristics of survey respondents in Nepal and Myanmar

	Nepal			Myanmar			
	Kaakri Bihaar (n=100)	Royal Bardia NP (n=100)	Lumbini (n=100)	Alaungdaw Kathapa NP (n=1167)	Chatthin WS (n=862)	Htamanthi WS (n=886)	Shwe-U-Daung WS (n=359)
Mean age ±SD (years)	35.2±12.3	32.8±13.6	38.0±14.4	44.8±16.0	43.8±16.2	41.1±14.3	45.3±11.8
Female (%)	47	51	25	37	44	29	20
Education ±SD (years)	2.9±4.2	2.6±4.0	3.5±4.2	3.7±2.7	3.3±2.4	3.9±2.7	4.3±2.5
No education (%)	60	64	54	13	13	7	11
Farmer (%)	55	70	80	86	87	64	85
Land ±SD (hectares)	0.6±1.3	1.1±1.7	1.5±1.7	4.0±4.2	6.3±5.8	2.0±2.1	4.5±4.5
Landless (%)	32	21	12	13	18	36	16

and, due to its historic political isolation, has had virtually no nature-based tourism. Environmental education and conservation and development activities have been scarce around Myanmar's protected areas (Aung, 2007; Rao et al., 2002).

METHODS

Study areas

We analysed data from three protected areas in Nepal (Allendorf, 2007) and four protected areas in Myanmar (Allendorf et al., 2006; Allendorf & Allendorf, 2013) (Tables 1 and 2). In Nepal, we conducted surveys around Kaakri Bihaar, a 'natural park' in western Nepal; Bardia National Park (NP) in southwestern Nepal; and the northern section of the Lumbini Development Project, a wildlife sanctuary (Table 1) in south central Nepal. These three areas, one national park, one local park and one development area that incorporated a conservation area, differ more in management than in human population pressure and have different histories and management strategies, including legal access for local residents. All the areas are surrounded by agricultural land with little to no forest. In terms of enforcement, the year the survey was conducted, Bardia NP was relatively well-protected by the military, Kaakri Bihaar had Forest Department guards who were stationed there but did little to stop illegal extraction of fuelwood and other non-timber forest products, and Lumbini was a newly-established area with no official system of protection. In terms of extraction, people were allowed to legally extract thatch once per year for a small fee from Bardia NP while no legal extraction was allowed from either Kaakri Bihaar or Lumbini, although informal extraction from both areas was common.

In Myanmar, we conducted surveys around four protected areas in northern Myanmar: Alaungdaw Kathapa National Park, Chatthin Wildlife Sanctuary (WS), Htamanthi WS and Shwe-U-Daung WS (Table 1). These protected areas represent a range of human population pressure, from relatively low in Htamanthi WS, which is surrounded by extensive intact forest, to high in Chatthin WS and Shwe-U-Daung WS, which are surrounded by agricultural land and severely degraded forest. Alaungdaw Kathapa NP is intermediate in population pressure and surrounded by a mix of agricultural fields and relatively intact forests. Regulations do not officially allow any extraction from these protected areas.

In terms of policy and management changes in the last 20 years since these surveys were conducted, less has changed than might be expected. Nepal remains progressive, with new policies enacted in the 1990s to distribute revenue streams to communities in protected area buffer zones. In Myanmar, although the context is changing rapidly with the advent of democracy, protected area policies have not changed significantly. While we might expect the perception of benefits to have increased and the perception of problems to have decreased in Nepal based on an additional two decades of investment in buffer zone communities (although due to the success of conservation, wildlife conflict is

increasing in some areas), we would not expect perceptions in Myanmar to have changed much yet since policies have not yet changed and management plans for protected areas are just now being written.

Data

We conducted standardised open-ended surveys (Patton, 1990) to determine people's attitudes towards and perceptions of each of the seven protected areas. In Myanmar, the first author trained local schoolteachers to conduct the interviews in each protected area. The teachers conducted 1,167 interviews in 41 villages at Alaungdaw Kathapa NP, 862 interviews in 28 villages at Chatthin WS, 886 interviews in 28 villages at Htamanthi WS, and 359 in 17 villages in Shwe-U-Daung WS. We randomly selected 30 households in each village from ledgers maintained by village chairmen. In villages with fewer than 30 households, we interviewed someone in each household. To assure representation of the perspectives of different residents, we developed a sampling scheme that included age, gender and household position. At the first house in a village the husband was interviewed, the wife at the second, the grandfather at the third, the grandmother at the fourth, the eldest child 18 years or older at the fifth, and the youngest child 18 years or older at the sixth. If the appropriate person was not available, we proceeded through the sequence. The refusal rate was extremely low, only a handful in each area, usually because a person did not have the time to participate.

In Nepal, the first author conducted one hundred surveys in villages adjacent to each of the three protected areas. Because Kaakri Bihaar and Lumbini are relatively small, interviews were conducted in each of the adjacent villages. In Bardia NP, villages were chosen based on their contrasting locations, including distance to the nearest government forest and accessibility to park headquarters. Participants were chosen based on the order in which they were met as the first author

Buffer zone of Bardia National Park, Nepal © Teri Allendorf

walked through the village visiting each house in turn. People were interviewed outside their homes or in adjacent fields. Only one adult in a household was interviewed.

Attitude is defined as a human psychological tendency that is expressed by evaluating a particular entity, called an attitude object, with some degree of favour or disfavour (Ajzen & Fishbein, 1980). Perceptions, or beliefs, are the associations that people establish between the attitude object and the characteristics they attribute to the object that inform their attitude (Ajzen & Fishbein, 1980). For example, in the phrase, "the national park is beautiful", national park is the attitude object and beautiful is an attribute associated with the object.

In the survey, we determined perceptions by asking respondents "Does the area provide benefits?", and, if yes, "What are they?" and "Does the area cause problems?", and, if yes, "What are they?" We determined attitude by asking the respondents "Do you like or dislike the area?" Additional perceptions of benefits and problems were generated by asking respondents "why" they either liked or disliked the protected area. We pooled the "did not like" and "don't know" responses into one category because neither response demonstrates a positive attitude.

We grouped verbatim responses to the questions about benefits and problems and reasons for liking and disliking the protected areas into inductively-created categories (Miles & Huberman, 1994; Patton, 1990). The negative perception categories were: 1) prohibition of resource extraction, such as fuelwood, fodder and non-timber forest products; 2) conflicts with protected area management, such as fines imposed for illegal entry and extraction or cropland reclaimed by protected area management; 3) crop damage or danger to humans by wildlife; and 4) problems with mining in the protected area (only mentioned in Shwe-U-Daung WS). The positive perception categories were: 1) conservation, including protection of wildlife species, forest, and ecosystem services; 2) availability of resources for extraction, such as fuelwood and fodder; 3) recreation and aesthetic, such as taking walks or enjoying the greenness; 4) protected area management activities, such as development and road-building. Dichotomous variables were created for each category. Each respondent was given a one if they gave a response that fell within the respective category and a zero if they did not. For example, a respondent who said that the area allowed them to collect fuelwood was given a one for extraction benefits.

The Nepal data were collected in the mid-1990s and the Myanmar data were collected between 1999 and 2004. While people's perceptions may have changed over time in these protected areas, the dataset provides a unique opportunity to compare multiple protected areas, allowing the exploration of issues of scale. More detailed descriptions of the data collection and perception categories for each country can be found in Allendorf et al. (2006) and Allendorf (2007). Because of the age of the data, it is important to note that we are not trying to describe the current state of park–people relationships in these protected areas, but are instead using a unique dataset that allows us to investigate a novel way to describe and understand people's perceptions of protected areas.

Entrance to Bardia National Park © Teri Allendorf

Analysis

The levels of geographic scale that we examined were village, protected area and country. We identified at which level there was the largest amount of variability for attitude and each perception category. We calculated one variable for each level to compare variability: village proportion, protected area mean proportion, and country mean proportion. Village proportion is the proportion of respondents in each village who liked the protected area (for attitude) or who mentioned a particular category of benefit or problem (for perceptions). For the protected area mean proportion, we averaged all the village proportions for a given protected area. For the country mean proportion, we averaged all the protected area proportions within a country. We then visually compared the variability at each level by looking at the spread of village proportions both within and among protected areas. To supplement the visual comparison, we compared the range of village means, the interquartile range of village means, the range of protected area means and the range of country means (i.e. the difference between the two country means). The interquartile range is the distance encompassing the middle 50 per cent of the data between the 75th and 25th percentiles. We use the interquartile range to reduce the effect of outliers.

RESULTS

The patterns in the proportions of people who liked the protected areas (i.e. their attitude) and their perceptions of problems and benefits suggest some perceptions were influenced more by factors at finer scales while other perceptions were influenced more by factors at larger scales. The wide range of village means within the protected areas for attitude and the perception of extraction problems, compared to the range among the protected areas and between the two countries, indicates that village-level factors were important in influencing them (Figures 1a and 1b, Table 3).

In contrast, wildlife problems (Figure 1c) and management problems (Figure 1f) show a pattern indicating that factors at the village and protected area levels were important. For example, in three protected areas (Alaungdaw Kathapa NP, Htamanthi WS, Shwe-U-Daung WS) people perceived few to no conflicts with wildlife while in the remaining protected areas people perceived higher levels of wildlife conflict (Figure 1c, Table 3). This pattern indicates that factors at the protected area level were important. However, the scattered distribution of the village means within the protected areas that had wildlife conflict indicates that village factors were also important.

People's perceptions of management problems showed a similar pattern to perceptions of wildlife problems. Fewer than 10 per cent of respondents perceived problems with management in two areas in Myanmar and two areas in Nepal, while more than 25 per cent of respondents perceived problems with management in the remaining areas (Figure 1f). However, some of the

Table 3. Interquartile range and range (in parentheses) for village means within each protected area (rows 2-8), protected area means within each country (rows 9 and 10), and ranges for country means (the difference between the two means) (row 11). Country mean range is not given for mining problems because only one protected area mentioned mining problems. Interquartile ranges for countries are not applicable because only two countries were under consideration

	Nepal			Myanmar			
	Kaakri Bihaar (n=100)	Royal Bardia NP (n=100)	Lumbini (n=100)	Alaungdaw Kathapa NP (n=1167)	Chatthin WS (n=862)	Htamanthi WS (n=886)	Shwe-U-Daung WS (n=359)
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Landless (%)	32	21	12	13	18	36	16

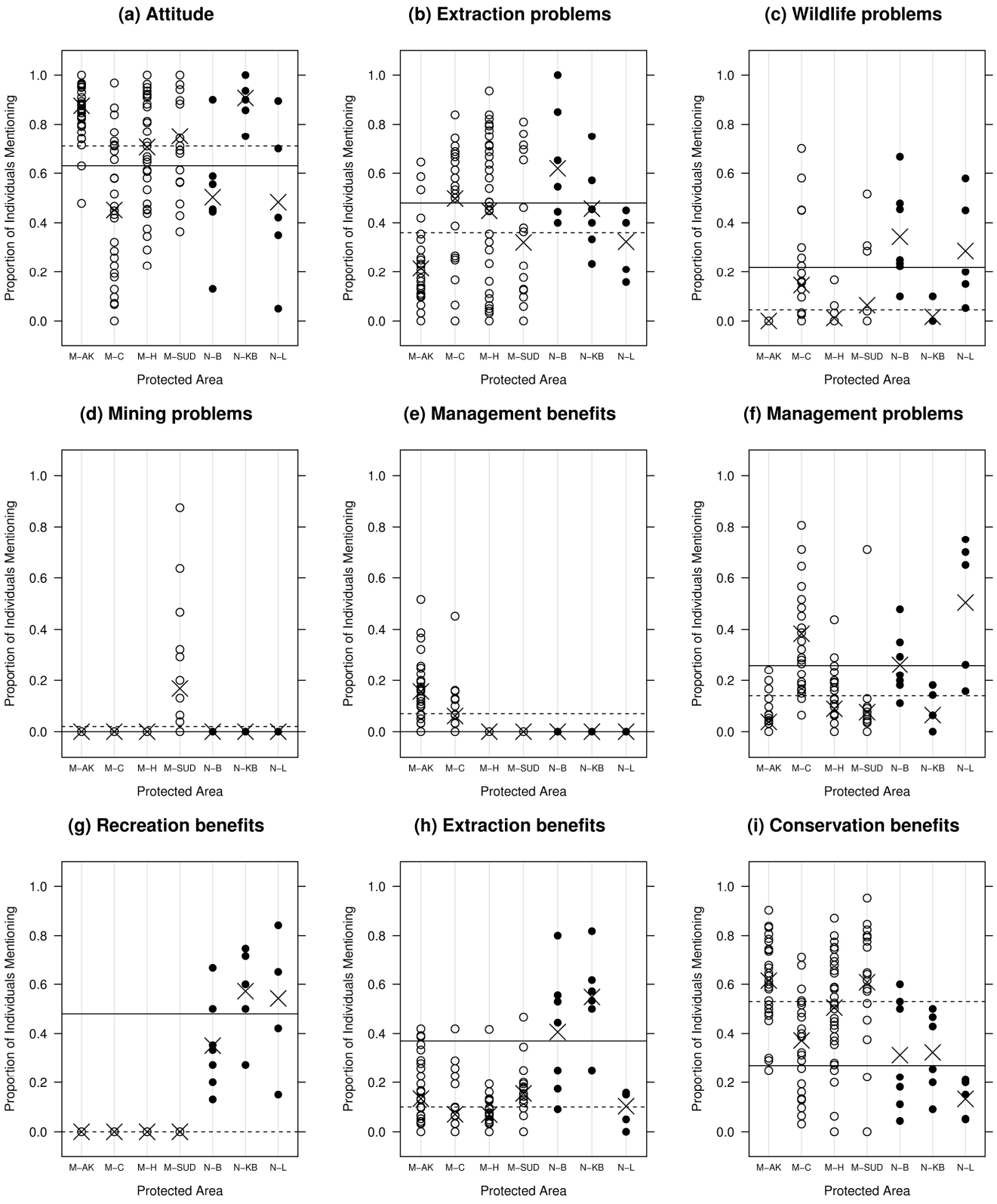

Figure 1. Variability in attitude and perceptions at village, protected area, and country scale. Open circles (○) are Myanmar village proportions; closed circles (●) are Nepal village proportions; X's are protected area mean proportions; dashed lines (--) are country mean proportions in Myanmar; solid lines (–) are country mean proportions in Nepal; M = Myanmar protected area (e.g., M-AK is Alaungdaw Kathapa National Park in Myanmar); N = Nepal protected area (e.g. N-B is Bardia National Park in Nepal)

protected areas also had large variability among villages. For example, in Lumbini, the majority of people perceived problems in all but two villages, where very few people perceived problems. Chatthin WS also showed large variation among villages.

Some perceptions occurred in some protected areas and not others, indicating a protected area effect. For example, people perceived mining problems only in one protected area, Shwe-U-Daung WS (Figure 1d) and management benefits only in two protected areas (Figure 2e), Alaungdaw Kathapa NP and Chatthin WS, indicating that these perceptions were influenced by factors that only occurred in those areas. In terms of mining problems, local businessmen had encouraged people to move into the area around Shwe-U-Daung WS to do small-scale illegal gold-mining inside the sanctuary (Figure 1d). It should be noted that while these factors only occurred in some protected areas, there was a still a village effect, as demonstrated by the wide distribution of means among the villages.

Finally, three of the four positive perceptions show a pattern indicating that factors at the country level were influencing people's perceptions of the protected areas. Only people in Nepal perceived recreation benefits, which indicates that factors at the country scale were driving this perception (Figure 1g, Table 3). Two other positive perceptions, conservation benefits and extraction benefits, were perceived in both countries, but the relatively large difference in the means between the countries indicated that factors at the country level played a role in driving these perceptions (Table 1). Interestingly, the distributions of the two perceptions are mirror images of each other (Figures 1h and 1i), with more people in Nepal perceiving extraction as a benefit and more people in Myanmar perceiving conservation as a benefit. This pattern and large difference in the means indicates that, in addition to protected area factors, factors at the country level were playing a role in people's perceptions of these benefits.

The perception of wildlife problems is an example that demonstrates why we chose not to explicitly estimate the amount of variability at each level. As our results show, the data for wildlife problems is not normally distributed, contains outliers, and cannot be naturally transformed. The variances within spatial levels vary wildly. For example, some protected areas show a range of barely 0.2 across villages, whereas other protected areas have values spread almost over the entire interval from 0.1 to 1.0. We believe these differences in variances have meaningful implications and should not be ignored. In the particular case of problems with wildlife, the variance may be small for a particular protected area because the protected area does not have the type of wildlife that causes conflict or only has small numbers of them, whereas the variance could be large in another area, indicating either a non-uniform distribution of wildlife for that area or some other factor that is driving the perception of wildlife problems.

DISCUSSION

Our results indicate that a multilevel approach to park–people relationships can provide novel insights by identifying the levels at which factors are driving different aspects of the relationship. At these study sites, people's negative perceptions were more influenced by factors at the protected area and village levels, while positive perceptions, such as an appreciation of conservation and ecosystem service benefits and recreational benefits, were more influenced by factors at the national level. In this discussion, we focus primarily on interpreting results in a way that highlights these more generalisable patterns in perceptions. Although the data, because of its age, does not reflect the current situation in each country, the broader patterns in perceptions reveal how the consideration of scale can contribute to understanding park–people relationships in a novel way.

Because attitudes can be thought of as a subjective summation that people make of the positive and negative attributes of an object (Ajzen, 2001), we posit that the relatively high number of people who liked the protected areas is driven by a foundation of positive values towards protected areas and the environment, as reflected in perceptions of benefits. However, people weigh these benefits against the specific problems that they face within the particular context of their household and village, particularly in terms of extraction and wildlife problems, causing wide variation among the means for villages in each protected area.

The high variability among villages in people's perceptions of extraction as a problem may be explained by their access to resources inside and outside the protected areas. Patterns of resource extraction can differ widely from village to village depending on villages' proximity to community and government forest relative to protected areas (Thapa & Hubacek, 2011).

A perception of wildlife problems is influenced by factors at the protected area level because people will only perceive wildlife as a problem if the protected area has wildlife species that cause problems. However, among villages within a protected area, large variability in people's perceptions of wildlife conflicts exists

Chatthin Wildlife Sanctuary, Nepal © Teri Allendorf

because the distribution of wildlife is often highly spatially variable within a protected area (Nagendra et al., 2010). The three protected areas with the lowest levels of wildlife problems were Kaakri Bihaar, which is small with no large resident wildlife, and Alaungdaw Kathapa NP and Htamanthi WS, which harbour wildlife such as elephants that eat crops, but which also have intact surrounding forest that may provide a buffer for wildlife. In Chatthin WS, there are many Eld's deer (*Rucervus eldii*), the sanctuary's primary species of conservation concern, and their suitable habitat is concentrated in the south of the sanctuary, which is where villages are most impacted by deer eating crops (Allendorf et al., 2012). Around Shwe-U-Daung WS, herds of wild elephant roam mainly in the area southwest of the sanctuary. While Lumbini contains nilgai (*Boselaphus tragocamelus*) that eat crops.

In terms of people perceiving problems and benefits from management, it was not surprising that people's perceptions were influenced at the protected area level. A single policy strategy is usually applied relatively evenly across a protected area (Mackenzie et al., 2014) because protected areas are usually treated as one spatially homogenous unit (Nagendra et al., 2010). For each protected area in this study, the villages surrounding it are subject to the same policies. People's perceptions of problems with management primarily occurred in Chatthin WS in Myanmar, and Bardia NP in Nepal, which have the highest density of guards, indicating a relatively high enforcement level of protected area rules and regulations. In Chatthin WS and Alaungdaw Kathapa NP, people also perceived management benefits. However, unlike Chatthin WS, very few people in Alaungdaw Kathapa NP perceived that they also had problems with management. A famous religious site is located inside Alaungdaw Kathapa NP, which thousands of people visit annually on pilgrimage. The warden and staff are responsible for managing this religious site and this may account for

people's perceptions of management benefits, which included tourism facilities and the maintenance of roads. People may also be less likely to have conflicts with management of Alaungdaw Kathapa NP, because it has a more extensive, forested buffer area that provides people with natural resources on which they depend and decreases their need to illegally extract from the national park. Less extraction from the park decreases the chances they will have negative interactions with park staff. Chatthin WS, on the other hand, is an isolated forested area surrounded by agricultural fields, which means that people depend on the sanctuary for natural resources and are more likely to have negative interactions with staff.

However, while management problems differed at the protected area level, with respondents in four of the seven protected areas perceiving few management problems, the large variability among villages indicated that village-level dynamics also affected people's relationship with protected area management. This may be because village distance from headquarters and the protected area boundary can affect how often residents interact with protected area staff and patrol units, in both positive (e.g. access to information and personal relationships, Allendorf et al., 2012) and negative ways (e.g. the likelihood of getting caught illegally extracting, Weladji et al., 2003).

At the national level, people in Nepal may perceive recreational benefits more because they have a culture of going to the forest or a natural spot for picnics with family and friends, similar to other South Asian countries (Robinson, 1972). Their appreciation of the beauty of the forest, the cool breezes and the shade of trees may have been strengthened by the influence of both the government and civil sector, including the media and tourism sector, which have all contributed to a legacy of supporting protected areas and highlighting the important role they play in Nepal's heritage and economy.

The greater appreciation for extraction benefits in Nepal may be influenced by its higher human population densities, which means that more people rely on each unit of protected area for their resources such as fuelwood and fodder. This dependency, in turn, may cause them to be more appreciative of the extractive benefits because they have no alternative other than to extract illegally from protected areas. Two of the Nepalese protected areas in our study were located in the terai, the southern flatlands, and one is located in the hills, in a type of valley called the 'inner' terai. These areas are surrounded by some of the densest human populations in the world (330 people/ km^2), and have relatively little forest outside of the protected areas (Stræde & Treue, 2006; Thapa & Hubacek, 2011). In contrast, two of the areas in Myanmar, Alaungdaw Kathapa NP and Htamanthi WS, have fairly extensive forest outside their boundaries. Protected areas in the northern part of Nepal may show a pattern more similar to Myanmar as they are not as isolated from other forest or as densely populated.

While people's perceptions of conservation and ecosystem service benefits may vary between the countries because people in Myanmar actually are more likely to value conservation and ecosystem services than people in Nepal, this finding may also be explained by methodological issues. Usually people will only give a certain number of responses to open-ended questions and not an exhaustive list (Ajzen, 2001). Thus, the fact that people in Nepal see more types of benefits than people in Myanmar might make them less likely to mention any particular benefit.

Management implications

Our results highlight the potential to manage park–people relationships not only at the protected area level, but across larger and smaller levels. Protected areas are often treated as spatially homogenous, without taking into account dynamics at the village level within a protected area (Nagendra et al., 2010) or at the national level across protected areas. Our results suggest that some perceptions are driven more by factors at the national level, and this means that those perceptions could be influenced by interventions at the national scale such as national media campaigns and educational curricula. However, perceptions driven at finer scales would be more efficiently and effectively addressed with appropriate interventions at those finer scales, rather than blanketing entire protected areas or focusing only on areas closest to headquarters, which often occurs (Ericsson et al., 2006; Mackenzie et al., 2014; Nagendra et al., 2010). For example, community forestry and subsidies for energy substitutes, such as solar or biogas, could be prioritised in villages that depend the most on the protected area for extraction and have the fewest alternatives. Mitigation and compensation for wildlife conflicts should be prioritised in villages with the most conflict (Mackenzie, 2012).

Our results also have implications for how to capture park–people relationships across broad scales. One of the difficulties in incorporating park–people relationships into broader scales of management and planning is that sampling can be prohibitive at larger scales. However, sampling could focus on the scale at which the phenomenon occurs. Perceptions that are

driven at larger scales could be identified and quantified with less sampling while perceptions driven by finer-scale dynamics would require more sampling at finer scales (Ericsson et al., 2006). In the context of this study, for example, our results suggest that when investigating benefits, it would be most efficient to sample many protected areas but relatively few villages around each protected area. In contrast, when investigating problems, it would be necessary to sample more villages around each protected area because of the higher heterogeneity among villages. However, because of the nature of problems, which are primarily related to extraction and wildlife conflicts, it may be possible to reduce the amount of sampling necessary to capture negative perceptions by targeting areas where problems are known to be more severe based on expert knowledge or records of illegal activities.

Our finding that people perceived more problems than benefits with management is in line with other studies that found people's attitudes towards protected areas are often generally positive while their attitudes towards the management of protected areas are often negative (Bauer, 2003; Gillingham & Lee, 1999; Picard, 2003). If explicit strategies were developed by protected area management to articulate and promote the benefits of protected areas they could increase people's perceptions of benefits from the protected area and from management. This strategy was successfully implemented in Chatthin WS based on the results of this survey and the staff were able to significantly improve people's attitudes towards management and the sanctuary (Allendorf et al., 2012).

Finally, the pattern of benefits at larger scales and costs at finer scales that we found both in Nepal and Myanmar has interesting parallels to the idea that protected areas provide global benefits while costs are disproportionally borne by residents around protected areas (Balmford & Whitten, 2003). Our results support the idea that benefits of protected areas are realised at broader scales and costs at finer scales. However, in contrast to the usual interpretation that benefits are only realised by people not living near protected areas, we find that local residents living adjacent to protected areas are aware of and appreciate many diverse benefits from protected areas. This result complements research on ecosystem services that captures and highlights these types of benefits for local communities in terms of poverty alleviation (Andam et al., 2010; Naughton-Treves et al., 2011; Turner et al., 2012).

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RESUMEN

Las relaciones que las comunidades locales tienen con las áreas protegidas son importantes para el éxito de estas áreas. Sin embargo, es difícil capturar las relaciones entre los parques y las personas a una escala espacial que les permita contribuir de forma útil a la gestión y planificación de la conservación. Para explorar el papel de la escala en las percepciones de las personas sobre las áreas protegidas, examinamos la contribución relativa de los factores en diferentes niveles (aldea, área protegida, país) a las actitudes y percepciones de las personas con relación a las áreas protegidas. Sobre la base de 3573 encuestas individuales en 140 aldeas alrededor de tres áreas protegidas en Nepal y cuatro en Myanmar, encontramos pautas que indican que las percepciones negativas de las personas se vieron influenciadas por factores a nivel de aldea y área protegida. En contraste, las percepciones positivas, tales como la valoración de los beneficios de la conservación de la biodiversidad y los servicios ecosistémicos y los beneficios recreativos, fueron influenciados por factores a nivel nacional. Nuestros resultados sugieren que un enfoque de múltiples niveles puede mejorar la comprensión de las relaciones entre los parques y las personas y contribuir a una mejor planificación y gestión, mejorando así las relaciones entre los parques y las personas. Por ejemplo, las percepciones positivas pueden fomentarse mediante intervenciones a nivel nacional, tales como las campañas mediáticas nacionales o los planes de estudio a nivel nacional, en tanto que las percepciones negativas pueden mitigarse más eficazmente a través de intervenciones dirigidas a aldeas y conflictos específicos.

RÉSUMÉ

Les relations que les communautés locales entretiennent avec les aires protégées sont importantes pour le succès de ces zones. Cependant, il est difficile de rendre compte des relations entre parc et habitants à une échelle pertinente pour la gestion et la planification de la conservation. Pour mener cette recherche sur la perception des gens concernant les aires protégées, nous avons examiné la contribution relative que certains facteurs de niveaux différents (village, aire protégée, pays, etc.) ont apporté aux attitudes et perceptions des gens à l'égard des aires protégées. Sur la base de 3573 enquêtes individuelles menées dans 140 villages situés autour de trois aires protégées au Népal et de quatre au Myanmar, nous avons constaté des tendances indiquant que les perceptions négatives de la population étaient influencées par des facteurs au niveau des villages et des aires protégées. En revanche, des facteurs au niveau national ont influencé les perceptions positives, telles que l'appréciation des avantages apportés à la conservation, aux services écosystémiques et aux activités de loisirs. Nos résultats suggèrent qu'une approche multiniveau peut améliorer la compréhension des relations entre parc et habitants et contribuer à une meilleure planification et gestion, favorisant par voie de conséquence les relations entre parc et habitants. Par exemple, des interventions au niveau national, telles que des campagnes médiatiques nationales ou les programmes éducatifs nationaux, peuvent favoriser les perceptions positives, tandis que les perceptions négatives peuvent être atténuées de façon efficace grâce à des interventions ciblées au niveau des villages et des conflits.

NATIONAL PARK ENTRANCE FEES: A GLOBAL BENCHMARKING FOCUSED ON AFFORDABILITY

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ABSTRACT

Setting protected area entrance fees at appropriate levels can be extremely challenging. We provide benchmarking data across a sample of 62 countries and construct an Index of Affordability (IOA), showing protected area entry fees relative to citizens' per capita income adjusted for purchasing power. Using this measure, Australian parks are the most affordable (IOA of 0.10) to citizens, those in Benin are the least affordable (10.69), while Indonesia is closest to the global average IOA of 2.09. protected areas in low-income countries are on average 30 times less affordable to citizens than in high-income countries. This has equity implications, and may supress visitation rates, thereby reducing the degree to which citizens attach value to, and are willing to support, national parks. International tourist fees are lowest in Armenia (US$1.04) and highest in Tanzania (US$43.72), while Costa Rica is closest to the global average (US$11.21), a relatively small proportion of the US$165 average daily spend estimated for European middle to higher income tourists. International tourists to low-income countries pay an average entrance fee of US$20, four times that paid in high-income countries. This is arguably fair, given their far smaller protected area funding bases and much greater reliance on tourism earnings. Our findings support fee differentiation between citizens and international tourists as a means of equating affordability.

Key words: Protected area entrance fees, fee setting, benchmarking, affordability, global review, protected area financing

INTRODUCTION

Globally, it is estimated that protected areas receive around eight billion visits every year, generating as much as US$600 billion of spending and US$250 billion in consumer surplus (Balmford et al., 2015). The level and structure of entrance fees can have a pivotal influence on the financial success of protected areas (PAs) as well as their accessibility and perceived social value. Setting them appropriately, when done thoughtfully, involves the careful balancing of numerous competing objectives. For example, management costs need to be covered and revenues optimised without losing sight of affordability considerations especially for citizens (whose tax payments contribute to protected area funding in the majority of cases). At the same time, pricing is often used as a tool to manage protected area visitor numbers, meaning that relative price levels in other sites (or even countries) are a consideration. Aside from the inherent challenges associated with balancing numerous (sometimes competing, or even conflicting) objectives, protected area managers often have limited guiding information at their disposal to set prices. Filling information gaps can be time consuming and expensive. Among other information, benchmarking data on comparable entrance fees in other countries can be very helpful in assisting with fee setting especially if it is presented in a way that allows for an understanding of the relative affordability of fees in other countries. However, such benchmarking data is generally lacking or not well developed. This article aims to assist in this regard.

Funding shortages are one of the most important barriers to the achievement of the conservation objectives of PAs. Bruner et al. (2001) demonstrate that an increase in funding is the most effective way of ensuring that protected area managers can adequately

mitigate against land clearing and other threats to biodiversity. The indirect or non-market nature of many of the costs and benefits associated with protected areas makes it challenging to make the case for public funding allocations or to consider protected areas in purely commercial terms (Dixon & Sherman, 1991; Walpole et al., 2001). This is especially true in the developing world, where pressing development needs provide strong competition for scarce government resources (Inamdar et al., 1999; Krug, 2000). Shortfalls in funding available to protected areas in the developing world are well documented (see Adams et al., 2008; Bruner et al., 2004). In extreme cases, where these shortfalls are acute, they have resulted in the existence of paper parks – areas which have been set aside for conservation but where no real management occurs (Eagles, 2013).

In most countries, protected areas still depend primarily on government funding, sometimes supplemented with grants and donations from non-governmental organisations, development donors, the general public or the business sector. In Latin America, for example, public budgets account for about 60 per cent of protected area available funding (Flores & Bovarnick, 2016). Yet, not only is this narrow financial base typically totally inadequate to ensure effective conservation management, it is also insecure and risky (Emerton et al., 2006). In Montenegro, for example, not only has public funding to protected areas been steadily falling over time, it is also only sufficient to cover around a half of the estimated costs of basic protected area management (Emerton et al., 2011). Competing budgetary requirements, combined with increased scarcity of and demand for land have placed growing pressure on protected area managers to both justify the existence of protected areas and to reduce their dependence on scarce public budgets (Edwards & Abivardi, 1998).

There are essentially two ways that the latter has been achieved by protected area management authorities (MAs), and with varying degrees of success. The first has been to reduce costs and the second is to increase so -called own revenues or self-generated revenue (primarily from entrance fees and tourism concessions and services such as accommodation, tours and restaurants). For the latter, an important consideration is whether these increased revenues can be retained, earmarked and reinvested in conservation activities (Emerton et al., 2006; Berghöfer et al., 2017). MAs have had varying degrees of success with increasing self-generated revenues. For example, between 2009 and 2015, the South African National Parks Board (SANParks) were able to grow own revenues strongly at annual rates of about 5 per cent above inflation. By 2016, own revenues contributed roughly 55 per cent to overall SANParks revenues with the rest coming from government allocations and donors (SANParks, 2016). There also remains a significant element of cross subsidisation, with only five out of 19 parks in South Africa generating enough own revenues to cover their costs. By contrast, Lindsey et al. (2014) point out that self-generated revenues from national parks in Zambia have remained low particularly when considered relative to their potential.

This reliance on a combination of self-generated and external budget sources is the norm in most countries: Walpole et al. (2001) reviewed the available studies and found that it was only in a few exceptional circumstances that protected area systems were able to generate sufficient own revenue to cover management costs entirely. Reviews such as that of Bovarnick et al. (2010) demonstrate that self-generated revenue usually forms a relatively small part of overall funding for protected area systems. Furthermore, it is a commonly held view that a vision of 'full' financial self-sufficiency is not only unachievable, but is broadly accepted as being also unsuited to protected areas that are essentially public goods being managed in the broader social, economic and conservation interest (Herath, 2000; Buckley, 2003; Hübner et al., 2014). There is, however, general consensus that protected area revenue bases need to be increased, diversified and expanded in order to generate the funding that is required for effective biodiversity conservation.

Entrance fees are probably the most widely used and easily accessible source of self-generated protected area revenues. In addition to the presence of visitors, there are several factors which can be considered when management authorities are determining entrance fees, and these will vary in importance depending on the context within which fees are being set. Concerning the practical considerations relating to protected area entrance fee setting, Lindberg and Halpenny (2001) argue that too often fees are set purely based on considerations surrounding revenue generation. In addition to how much revenue needs to be generated to ensure that management costs are covered, management authorities should consider the following (Oleas, 2008; Banerjee et al., 2017; Watson, 2013; Eagles et al., 2002):

- Ensuring optimal visitor numbers, both to manage the level of ecological impact within the park and to reduce congestion for the sake of visitor satisfaction
- Encouraging more or fewer visits to surrounding substitute sites, or encourage fewer visits during

particular times, such as times of heightened ecological sensitivity

- Achieving a social purpose, such as environmental education or ensuring that people have access to places for recreation
- Aligning fees with those of similar attractions and so matching them with public expectations.

PA planners and managers frequently lack data which would allow them to benchmark fees either against other countries, or relative to price levels in their own country. Yet benchmarking can be a useful tool when setting fees of various kinds. For example, Loomis Hubbell et al. (2002) examine the use of benchmarking to assist in decisions around setting tuition fees for universities. Few studies have provided reviews of protected area entrance fees in a format which allows for benchmarking to be carried out. Lindberg and Halpenny (2001) conducted a global review of protected area entrance fees with a focus on marine protected areas. Spenceley et al. (2017) presented the fees of Tanzanian game reserves and wildlife management areas alongside those charged by national parks, and also looked at fees charged in national parks in South Africa, Botswana, Namibia and Zimbabwe. Given the focus of these papers on marine protected areas and selected African countries respectively, a review of the literature has not revealed any studies which have taken a global perspective on benchmarking terrestrial national park entrance fees.

It should be noted that benchmarking is rarely used in isolation but rather applied alongside other techniques for determining optimal fee levels. It cannot capture essential information about the uniqueness of the protected area 'offering' in a particular country or the

Entrance Gate at the Boulders Penguin Colony Section of the Table Mountain National Park, South Africa ©Hugo Van Zyl

specific characteristics and expectations of visitors that determine their preferences and price points. It is typically used to provide a guide to the initial starting point, or the final point cross-check and validation of the results, of these other studies. Management authorities are increasingly relying on consumer research to determine which fee levels can achieve a balance between public expectations and revenue maximisation. Stated preference techniques (such as contingent valuation and choice experiments) as well as travel cost methods, which look at visitors' willingness to pay, are particularly commonly used to inform protected area pricing. They often also provide information about the potential to introduce other fees, charges or voluntary levies in addition to entrance fees. The issue of consumer surplus is often an important one, as evidenced by the number of studies which have found that people are willing to pay more than the entrance fee that they are charged to enter a given protected area (see review in Spenceley et al., 2017 for examples; Adams et al., 2008; Nogueira & Salgado, 2001).

Affordability is a central issue to consider when setting protected area entrance fees. This is especially true when considering fees for local community members or citizens of that country, given that they will tend on average to have lower incomes than international visitors. In addition to this, national protected area systems will nearly always be at least partially funded by taxpayers and provide wider societal benefits such as environmental education and recreation, which can be maximised when fees are structured in a way that promotes accessibility to all income levels (whilst ensuring conservation objectives are met). It is often argued that there is a distributional dimension to protected area pricing, especially for those sites that receive visitors from different origins (see, for example, Alpizar, 2006; Mendes, 2003). For this reason, many protected area systems have multi-tier pricing structures, which allow them to accomplish differing objectives for differing groupings of visitors. For example, developing nations might have cost recovery or revenue maximisation as a primary objective when setting fees for international tourists, and maximising the provision of learning opportunities as the main objective for local visitors (Lindberg & Halpenny, 2001). Another reason that citizens are often charged less than international tourists is that most national park systems are funded primarily or at least partially by the state, and so citizens will already be contributing to their financing in an indirect way. Many protected area systems will also have special prices for children, students, retirees, disabled people and other groups who are deemed to qualify for reduced prices.

The key objectives of the article are to provide hitherto unavailable benchmarking data and analysis of entrance fees in a sample of countries across the globe. The focus is on the relative amounts charged for entrance fees in different countries and the relative affordability of these amounts. This should assist with the review and setting of entrance fees for both citizens and international tourists by management authorities in combination with other considerations, techniques and processes. Note that the article thus does not attempt to 'explain' any entrance fees amounts as this would require a complex dissection of the role played by these considerations, techniques and processes in arriving at a given fee amount. Where appropriate, key factors that seem to be impacting on fees and especially differences between fees are discussed often with significant caveats and to illustrate how selected factors could be playing a role in observed fee amounts thereby hopefully assisting those tasked with setting fees.

METHODS

The survey focused on National Parks, aiming to ensure that major tourist sites and flagship areas were included (most of which are National Parks) and to increase the level of comparability between countries. While the term 'National Park' corresponds to the International Union for Conservation of Nature (IUCN) Protected Area Management Category II, many countries do not use the term consistently, referring in some cases to protected areas belonging to IUCN Protected Area Management Categories III, V or VI as National Parks. For the purposes of our analysis, only protected areas which correspond to IUCN Protected Area Management Category II were included, regardless of the terminology used by individual countries.

Entrance fee data were gathered for as many countries where such data were reasonably accessible focusing on fees for adult citizens and international tourists in 2018. The primary source for this data was protected area management authority websites, travel blogs, travel information portals and tourism agency websites. Data availability was highly variable between countries. In some instances, it was possible to easily access entrance fee data for all national parks from one source. In others, a number of different sources had to be used. Data coverage was also patchy in relation to the number of national parks per country for which there were data available. Entrance fee data for citizens were found for 51 countries, international tourists' fee data were found for 62 countries while data on both citizen and international tourist entrance fees were available for 51 countries. Countries where entry is free of charge were

excluded from the analysis. These include mostly higher income countries such as UK, France, Denmark, Sweden, Norway and New Zealand (though the latter are considering the introduction of entrance fees).
The focus on comparisons between countries required the estimation of an average entrance fee for all the parks in a given country. An unweighted average for all national parks was used for this purpose as there is no clear or workable basis for weighting one park more or less than another. This was possible because, on the whole, the variability of fees between individual national parks in the same country was low.

Entrance fees for citizens were converted from local currency amounts to international dollars using purchasing power parity (PPP) exchange rates sourced from the World Bank. Purchasing power parity calculations aim to correct for differences in real price levels between countries. They apply an exchange rate that is based on the rate at which the currency of one country would have to be converted into that of another country to buy the same representative basket of goods. Park entry fees are expressed in international US dollars (Int.$). An international US dollar has the same purchasing power as the dollar has in the United States and is a commonly accepted numeraire for cross-country comparisons or aggregations of economic statistics. As international tourists come from a wide variety of countries (which are in most cases not recorded), it is not possible to apply a PPP conversion rate to the fees they pay. Furthermore, as the majority originate from the developed world, it is assumed that there is less variation in purchasing power as compared to international US dollars. Entrance fees for international tourists are therefore expressed in US dollars calculated at market exchange rates.

Entrance fees for citizens were then converted into an index of affordability (IOA) which expresses the protected area entry fee relative to local income levels. This was done by converting the fees into international dollars and dividing them by gross national income (GNI) per person (expressed in PPP $) sourced from the World Bank. This reflects a common approach taken in studies considering the affordability of products, such as Iyengar et al.'s (2016) comparison of the affordability of hepatitis medication across 30 countries, as well as Murakami and Blom's (2008) global comparison of the affordability of tertiary education. Entrance fees for international tourists were compared to average daily tourist spending to get a sense of their relative cost as compared to total holiday costs.

The chief focus of the study was the benchmarking of national park entrance fees at the country level. To

Entrance Sign for Abijata-Shalla Lakes National Park, Ethiopia © Hugo Van Zyl)

expand on this and explore the data further, two additional analysis components were included which involved grouping countries with similar socio-economic conditions. The first entailed clustering countries with similar per capita income levels, using the World Bank categorisation of low-income, lower middle-income, upper middle-income and high-income. Countries were also grouped into regions. Alongside geographical proximity, the main criteria were obvious cultural and governance similarities. Russia and China were included individually as they did not fit into any of the other regional groupings.

RESULTS

Results are presented in two sections. The first focuses on entrance fees for citizens and the second for international tourists. Within each of these sections, results are presented for individual countries as well as for income clusters and regional groups. In each case, results are presented in a way that allows for ranking according to the entrance fee index of affordability for

citizens and then by the entrance fees charged to international tourists.

Fees for citizens

A comparison of the affordability of national park entrance fees for citizens in individual countries is provided in Table 1 and its accompanying map in Figure 1. The columns are arranged according to the way the index of affordability was calculated, by taking the fees in market US$, converting them to international dollars, and then presenting them as a proportion of per capita gross national income for each country (the index of affordability or IOA, expressed in Int.$ x 10^3 / Per Capita GNI Int.$).

The results range from the most affordable fees (IOA of 0.10) for Australia to the least affordable (IOA of 10.69) for Benin. Based on these findings it can be inferred that national park fees are roughly 100 times more affordable for the average local in Australia than they are for the average local in Benin. The average IOA for the 52 countries considered is 2.09.

The results illustrate the relative impact of purchasing power on affordability. For example, Indonesian citizens are charged an average rate of US$6.81 to enter national parks, which is around 60 per cent higher than the global average. When the charge is adjusted to account for Indonesians' purchasing power, it increases to Int.$ 22.17 which is 120 per cent higher than the global average.

Also shown is the relative impact of income levels. For example, China's average entrance fee in international dollars, Int.$ 52.49, is the highest of all the countries considered. But when this fee is considered as a proportion of the average Chinese per capita income, China has an IOA of 3.39, making it only the 9th least affordable country of those considered.

When countries are grouped according to their income levels, the results show stark contrasts in the affordability of entrance fees for citizens. Table 2 shows that national parks of low-income countries have an average IOA of 5.25, which is three times higher than

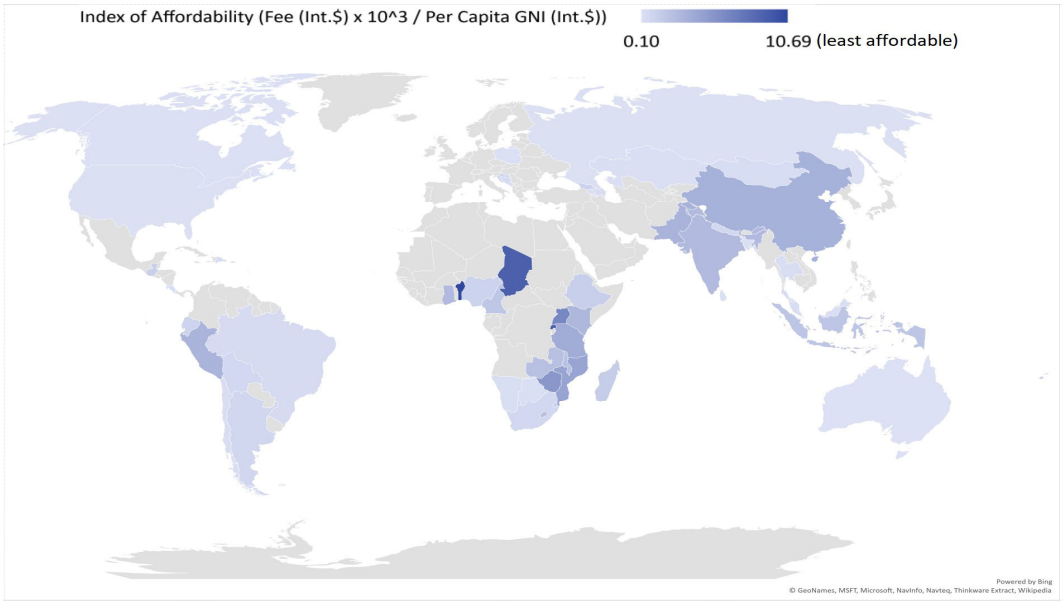

Figure 1 Map of Index of Affordability for citizens per country

Table 2. Affordability of national parks entrance for citizens by income-level groupings

Income Group	Average Fee US$	Average Fee Int.$	Ave PC GNI ($/annum)	Index of Affordability (Ave Fee Int.$ x 10^3 / Per Capita GNI Int.$)	Coefficient of variation
Low income	3.33	9.11	1 756	5.25	0.67
Lower middle income	3.11	8.97	6 829	1.55	0.66
Upper middle income	5.25	10.96	16 319	0.72	1.29
High income	5.46	6.42	39 640	0.17	0.41

Table 1. National park entrance fees for international tourists by country

Rank	Country	Fee (US$)	Fee (Int.$)	PC GNI (Int.$)	Index of Affordability (Fee (Int.$) x 10^3 / Per Capita GNI (Int.$))
1	Benin	8.43	23.20	2 170	10.69
2	Rwanda	6.39	17.35	1 870	9.28
3	Chad	5.90	17.72	1 960	9.04
4	CAR	3.32	6.08	700	8.68
5	Uganda	3.59	11.21	1 790	6.26
6	Zimbabwe	4.79	9.45	1 810	5.22
7	Mozambique	1.59	5.10	1 190	4.29
8	Tanzania	3.25	10.28	2 740	3.75
9	China	27.40	52.49	15 500	3.39
10	Pakistan	4.90	17.89	5 570	3.21
11	Peru	18.27	39.40	12 510	3.15
12	Kenya	4.23	9.19	3 130	2.93
13	Ghana	4.01	11.27	4 160	2.71
14	India	4.56	17.58	6 500	2.71
15	Lesotho	2.72	7.73	3 340	2.32
16	Zambia	2.85	8.83	3 850	2.29
17	Malawi	0.66	2.58	1 140	2.26
18	Indonesia	6.81	22.17	11 240	1.97
19	Cameroon	2.53	6.66	3 550	1.87
20	Madagascar	0.57	2.15	1 450	1.48
21	Ethiopia	0.92	2.33	1 730	1.35
22	Guatemala	5.26	10.10	7 760	1.30
23	Swaziland	3.40	10.24	8 320	1.23
24	Nigeria	2.34	6.31	5 750	1.10
25	Georgia	4.01	10.41	9 530	1.09
26	Fiji	5.25	9.16	8 720	1.05
27	Ecuador	6.00	11.23	11 050	1.02
28	Argentina	9.86	15.83	19 530	0.81
29	Croatia	9.40	18.35	22 930	0.80
30	Nepal	0.53	1.81	2 520	0.72
31	Bolivia	2.17	5.07	7 120	0.71
32	South Africa	3.55	8.90	12 880	0.69
33	Brazil	4.08	7.15	14 840	0.48
34	Bosnia Herz	2.26	5.80	12 350	0.47
35	Mongolia	1.40	4.66	11 450	0.41
36	Montenegro	2.88	7.23	17 900	0.40
37	Azerbaijan	1.25	5.59	16 150	0.35
38	Dominican Republic	2.17	4.92	14 500	0.34
39	Chile	3.81	6.62	23 290	0.28
40	Thailand	1.59	4.57	16 100	0.28
41	Armenia	1.04	2.55	9 040	0.28
42	Namibia	1.13	2.73	10 400	0.26
43	Kazakhstan	1.77	5.82	22 970	0.25
44	Malaysia	2.22	6.47	26 960	0.24
45	Botswana	1.38	3.38	16 710	0.20
46	Costa Rica	2.18	3.07	15 780	0.19
47	USA	10.87	10.87	58 700	0.19
48	Russia	1.49	3.95	22 540	0.18
49	Jamaica	0.80	1.45	8 470	0.17
50	Bangladesh	0.24	0.64	3 790	0.17
51	Canada	5.95	6.21	43 420	0.14
52	Australia	4.99	4.58	45 970	0.10
	Average	4.24	9.91	10 519	2.09

the average IOA of lower middle-income countries (1.55) and 30 times higher than the average IOA of high -income countries (0.17). The coefficient of variation shows how much variation there is between the IOA of the individual countries making up each grouping. It is highest for upper middle-income countries (1.29), very similar for low-income and lower middle-income countries (0.67 and 0.66 respectively) and lowest for high-income countries (0.41). Grouping individual countries into regions revealed that Central, West and

East Africa are the least affordable regions for citizens visiting national parks, while North America, Russia and Central Asia are the most affordable regions (see Table 3). The average IOA for North American countries was 0.16, while the average for Central African countries was 6.53. From this it can be deduced that the average national park in Central Africa is roughly 40 times less affordable to citizens than is the average national park in North America. The coefficients of variation show that there was relatively more variation in the IOA between the countries of regions such as Southeast Asia and Oceania, and less variation between countries in regions like North America and Central Asia.

Fees for international tourists

A comparison of the entrance fees charged to international tourists per country is provided in Table 4 and its accompanying map in Figure 2. The cheapest country for international tourists to visit national parks is Armenia, where fees are an average of US$1.04. The most expensive country is Tanzania, where international tourists are charged an average of US$43.72. The average for the 61 countries considered is US$11.21 with

Table 3. Affordability of national parks for citizens by regional groupings

Region	Average Fee US$	Average Fee Int.$	Ave PC GNI ($/ann.)	Index of Affordability (Ave Fee Int.$ x 10^3 / Per Capita GNI Int.$)	Coefficient of variation
Central Africa	3.92	10.15	2 070	6.53	0.62
West Africa	4.93	13.59	4 027	4.83	1.06
East Africa	3.68	10.07	2 252	4.72	0.66
China	27.40	52.49	15 500	3.39	
Southern Africa	2.26	6.11	6 109	2.02	0.82
South Asia	2.12	7.84	6 074	1.38	1.06
South America	7.36	14.22	14 723	1.08	0.97
Southeast Asia	3.54	11.07	18 100	0.83	1.19
Oceania	5.12	6.87	27 345	0.57	1.17
Caucasus	2.10	6.18	11 573	0.57	0.79
Balkans	4.85	10.46	17 727	0.56	0.38
CAC*	2.60	4.88	11 628	0.50	1.07
Central Asia	1.59	5.24	17 210	0.33	0.33
Russia	1.49	3.95	22 540	0.18	
North America	8.41	8.54	51 060	0.16	0.18

*Central America and the Caribbean

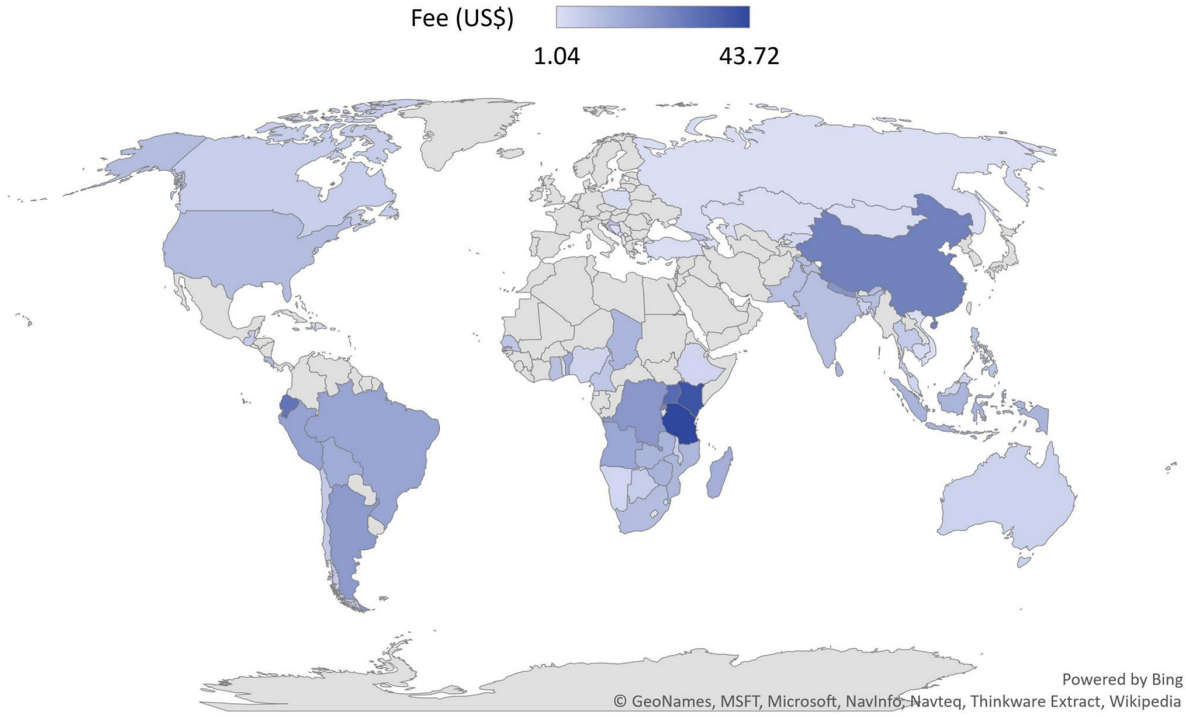

Figure 2. Map of national park entrance fees for international tourists by country

Table 4. National park entrance fees for international tourists by country

Rank	Country	Fee (US$)
1	Tanzania	43.72
2	Kenya	40.18
3	Uganda	33.92
4	CAR	33.20
5	Ecuador	31.00
6	China	27.40
7	Rwanda	25.85
8	Nepal	21.90
9	DRC	21.28
10	Argentina	20.64
11	Peru	18.27
12	Brazil	17.64
13	Angola	17.31
14	Bolivia	15.68
15	Benin	15.18
16	Madagascar	14.88
17	Zimbabwe	13.57
18	Zambia	13.39
19	Sri Lanka	13.24
20	Indonesia	12.96
21	Chad	12.65
22	Mozambique	12.49
23	Costa Rica	11.58
24	USA	10.87
25	South Africa	10.75
26	India	10.34
27	Jamaica	10.00
28	Ghana	9.96
29	Pakistan	9.81
30	Croatia	9.40
31	Philippines	8.69
32	Cameroon	8.43
33	Senegal	8.43
34	Georgia	7.39
35	Thailand	7.18
36	Chile	7.08
37	Guatemala	6.58
38	Botswana	6.42
39	Canada	5.95
40	Malawi	5.42
41	Fiji	5.25
42	Dominica	5.00
43	Australia	4.97
44	Bangladesh	4.97
45	Nigeria	4.45
46	Ethiopia	4.14
47	Malaysia	4.12
48	Namibia	3.63
49	Swaziland	3.40
50	Kyrgyzstan	3.19
51	Montenegro	2.88
52	Bosnia and Herzegovina	2.26
53	Dominican Republic	2.17
54	Cambodia	2.14
55	Mongolia	1.85
56	Kazakhstan	1.77
57	Poland	1.69
58	Vietnam	1.52
59	Russia	1.49
60	Turkey	1.49
61	Azerbaijan	1.25
62	Armenia	1.04
	Average	11.21

Costa Rica's fee at US$11.58 being closest to this average.

These fee amounts are all relatively low when compared with an average daily spend of US$165 for European middle to higher income tourists. This raises the issue of the price elasticity of demand for park visitation. Pagiola et al. (2002) noted that demand for entry to nature-based tourism sites tends to be relatively inelastic (i.e. elasticity between 0 and -1) as they are a small portion of overall trip costs and are influenced by the availability of substitutes (where unique sites are associated with lower elasticities). Tanzania and Kenya would be typical countries where one would expect to find particularly low elasticities among overseas visitors as their iconic national parks offer Big Five safari experiences and as reaching them is generally associated with high total travel costs. The relatively higher fees in these countries are thus consistent with expected elasticities. It goes without saying that there are numerous other factors and nuances at play in determining these fee levels, such as those outlined in the Introduction.

Entrance fees for international tourists show a similar overall pattern to indices of affordability for entrance fees for citizens when countries are grouped by income, but with a lower degree of difference between country groupings. International tourists to national parks in low-income countries pay an average entrance fee of US$20 (Table 5). This is twice as high as the average fee paid in both lower middle and upper middle-income countries (both just under US$10), and four times as high as the average fee paid in high-income countries (US$5). Lower income countries are thus able to generate substantially more revenue per person from entrance fees than higher income countries.

The regional grouping exercise reveals that East Africa (US$29.6), China (US$27.4) and Central Africa (US$20.4) are the three most expensive regions for international tourists entering national parks, while Russia (US$1.5), Central Asia (US$2.1) and the Caucasus (US$2.8) are the three least expensive regions (see Table 6). The latter three regions share a common history as they all belonged to the Soviet Union prior to its dissolution in 1991. Elements of their shared culture, and particularly an emphasis on state provision of public services, may be a key factor influencing fee levels today. The amount of variation within regions is highest in the Caucasus and in Southeast Asia and lowest in Oceania and South America, as evidenced by the coefficient of variation.

Table 5. National park entrance fees for international tourists by income-level groupings

Income group	Average Fee US$	Coefficient of variation
Low income	19.71	0.61
Lower middle income	9.34	0.78
Upper middle income	9.35	1.08
High income	4.91	0.31

Table 6. National park entrance fees for international tourists by regional groupings

Region	Average Fee US$	Coefficient of variation
East Africa	29.56	0.53
China	27.40	
Central Africa	20.44	0.54
South America	18.39	0.42
South Asia	12.05	0.52
West Africa	9.50	0.47
Southern Africa	9.33	0.49
North America	8.41	0.41
CAC*	7.06	0.54
Southeast Asia	6.10	0.72
Oceania	5.11	0.039
Balkans	4.85	0.82
Caucasus	2.79	1.10
Central Asia	2.12	0.45
Russia	1.49	

*Central America and the Caribbean

Rest Hut in Raja Ampat National Park, Indonesia © Hugo Van Zyl

CONCLUSION

The global benchmarking data in this article provides a useful reference point for setting PA entrance fees. As well as giving a basic understanding of what other (potentially competing) countries are charging for entry, such information can be used as an entry point to encourage stakeholder discussion about the various considerations and trade-offs that should guide pricing. The article has also highlighted the issue of affordability, a relatively under-researched yet clearly important consideration in fee setting. The following broad conclusions can be drawn from the analysis:

National park entrance is substantially less affordable to citizens in lower income countries when compared to those in higher income countries. This has equity implications and is one of the factors that may supress visitation rates, thereby reducing the degree to which people are likely to attach value to, and be willing to support, national parks. It also has potential relevance to debates around the extent to which parks should be managed and financed with the interests of citizens in mind.

Entrance fees for international tourists are generally higher for national parks in lower income countries although the variation is not as great as that associated with affordability to citizens. It seems fair that international tourists would incur higher fees visiting national parks in low-income countries as compared to high-income countries, given that low-income countries generally have a smaller tax base from which to fund national parks. This tends to increase their reliance on tourism earnings. It is interesting to note that lower middle-income countries and higher middle-income countries charge, on average, similar levels of fees for international tourists. There may be scope to revise fee structures so that lower middle-income countries charge international tourists relatively more, although this should be investigated on a case-by-case basis and

preferably with the aid of market research including willingness to pay studies.

The findings provide further support for differentiated fees for citizens and international tourists, from a relative affordability perspective. This can be added to the other arguments for differentiated fees such as revenue maximisation and fairness.

While comparative fee levels in other countries and relative affordability for citizens provide useful benchmarks or reference points, it is also important to consider other key factors when setting PA entry fees. Of particular importance is the 'quality' of the PA experiences as compared to visitor demands and expectations, as this increases visitors' willingness to pay and associated price elasticities. If PA entrance fees are being considered as a component of funding and financial sustainability, issues of revenue retention and administration are critical concerns.

ENDNOTES

[1]These are sometimes also referred to as 'site-based' or commercial revenues.

[2]There are very few instances indeed where national protected areas systems receive no budget allocation at all from central government, or are expected to cover all of their own income. This is the case even though public budgets are in many cases extremely low, and many PAs are being increasingly pushed to incorporate cost recovery principles into their pricing and budgets. One region where central government budgets to PAs are very low or non-existent is in former Yugoslavian countries. In Montenegro, for example, PA categories other than national parks receive no transfer at all from national government (Emerton et al., 2011). Until a decade or so ago, a similar situation held in Macedonia; most PAs lacked a dedicated budget for either capital or operational expenditures, and there was no central government allocation to nature protection activities (Emerton, 2010).

[3]According to Buckley (2003: 71): "There are innumerable different mechanisms and models for visitor fees; and optimal fee structures, rates, collection mechanisms and allocation

Trekker Registration Hut in Langtang National Park, Nepal © Hugo Van Zyl

depend on the political, legal, economic and social context in which each park management agency operates."

[4]Some countries charge differentiated fees for non-citizens that are residents (e.g. expatriates) or are citizens of regional country groupings (e.g. SANParks charges lower entrance fees to citizens of Southern African Development Community (SADC) countries in some parks). Where these distinctions were found, data gathering focused on fees applicable to overseas international tourists.

[5]On the whole, we found that collecting this data was substantially more challenging and time-consuming than we expected.

[6]Average daily tourist spending was estimated using data for Europeans travelling abroad (EU, 2017).

[7]Low income = ≤ US$1,005 GNI/Per Capita, upper middle income = US$1,006 – 3,955 GNI/Per Capita, lower middle income = US$3,956 – 12,235 GNI/Per Capita and high income = ≥ US$12,236 in current US$ terms.

[8]Estimate based on a 2015 average in-country spend of EUR 89/ day for Europeans travelling abroad (from EU, 2017) adjusted for inflation and converted to US$115/day plus US$50/day for travel to the destination (total transport cost of US$700 spread over a 14-day trip for the average tourist travelling an average distance to a foreign country). The European in-country average spend was derived from middle-income countries such as Bulgaria, Hungary and Romania as well as higher income countries such as France, Germany and Spain.

[9]An elasticity of -1 implies that any increase in price would result in a proportional decrease in demand and an elasticity of 0 would mean that demand would be unaffected by an increase in price. Some examples of elasticity estimates include a relatively high -0.68 for foreign day-visitors to Costa Rican national parks reflecting the relatively high substitutability between the parks and other areas of natural beauty (Alpizar, 2006) and a lower -0.3 for foreign scuba-divers in Indonesia, Thailand and Malaysia (Pascoe et al., 2014).

[10]Low-income countries include Benin, CAR, Chad, DRC, Ethiopia, Madagascar, Malawi, Mozambique, Nepal, Rwanda, Senegal, Tanzania, Uganda and Zimbabwe. Lower middle-income countries include Angola, Armenia, Bangladesh, Bolivia, Cambodia, Cameroon, Georgia, Ghana, Guatemala, India, Indonesia, Kenya, Kyrgyzstan, Mongolia, Nigeria, Pakistan, Philippines, Sri Lanka, Swaziland, Vietnam and Zambia. Upper middle-income countries include: Argentina, Azerbaijan, Bosnia and Herzegovina, Botswana, Brazil, China, Costa Rica, Croatia, Dominica, Dominican Republic, Ecuador, Fiji, Jamaica, Kazakhstan, Malaysia, Montenegro, Namibia, Peru, Russia, South Africa, Thailand and Turkey. High-income countries include Australia, Canada, Chile and Poland.

[11]Countries categorised under the Balkans include Bosnia and Herzegovina, Croatia and Montenegro. Countries categorised under the Caucuses include Armenia, Azerbaijan, Georgia and Turkey. Countries categorised under Central Africa include Angola, Cameroon, CAR, Chad and the DRC. Countries categorised under Central America and the Caribbean include Costa Rica, Dominica, Dominican Republic, Guatemala and Jamaica. Countries categorised under Central Asia include Kazakhstan, Kyrgyzstan and Mongolia. Countries categorised under East Africa include Ethiopia, Kenya, Rwanda, Tanzania and Uganda. Countries categorised under North America include Canada and the USA. Countries categorised under Oceania include Australia and Fiji. Countries categorised under South America include Argentina, Bolivia, Brazil, Chile, Ecuador and Peru. Countries categorised under South Asia include Bangladesh, India, Nepal, Pakistan and Sri Lanka. Countries categorised under Southeast Asia include Cambodia, Indonesia, Malaysia, Philippines, Thailand and Vietnam. Countries categorised under Southern Africa include Botswana, Madagascar, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe. Countries categorised under West Africa include Benin, Ghana, Nigeria and Senegal.

ABOUT THE AUTHORS

Hugo van Zyl is the founder and director of Independent Economic Researchers, a consultancy focusing on applied environmental resource economics and finance, socio-economic impact assessment and project appraisal. He has extensive international experience contributing to biodiversity conservation programmes, environmental authorisation processes, protected areas ecosystem services valuations, investment cases, cost-benefit analysis and sustainable financing strategies. From a policy perspective, he has provided economic inputs and guidance to biodiversity conservation, climate change, EIAs, mine closure funding and water resource management policy. Key initiatives to which he has contributed include The Economics of Ecosystems and Biodiversity (TEEB), ValuES and the Biodiversity Finance Initiative (BIOFIN).

James Kinghorn conducts research in the field of environmental economics. He has spent the past four years at Independent Economic Researchers, where his focus has been on supporting strategic processes surrounding climate change mitigation and adaptation, biodiversity finance and offsets guidance, as well as project appraisal at various scales, particularly where ecosystem services valuation is required. James is especially interested in novel and experimental approaches to all phases of the research process, including question formulation, data collection and analysis, and the presentation of findings.

Lucy Emerton is an environmental economist specialising in ecosystem valuation, conservation finance and incentive mechanisms. Over the last 30 years she has worked as technical advisor to a wide range of government, non-governmental, private sector, bilateral and multilateral organisations across almost 70 countries worldwide, including establishing and leading IUCN's environmental economics programmes in Africa and Asia. Lucy is currently Conservation Economics and Finance Director of the Environment Management Group, a consultancy group and think-tank providing

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RESUMEN

El establecimiento de tarifas de entrada a las áreas protegidas (AP) en los niveles apropiados puede ser muy desafiante. Proporcionamos datos de referencia en una muestra de 62 países y construimos un Índice de asequibilidad (IOA, por sus siglas en inglés), que muestra las tarifas de entrada a las AP en relación con el ingreso per cápita de los ciudadanos ajustado al poder adquisitivo. Utilizando esta medida, los parques australianos son los más asequibles (IOA de 0.10) para los ciudadanos, los de Benín son los menos asequibles (10.69), mientras que Indonesia es el más cercano al promedio mundial de IOA de 2.09. Las AP en los países de bajos ingresos son en promedio 30 veces menos asequibles para los ciudadanos que en los países de altos ingresos. Esto tiene implicaciones en lo que respecta a la equidad, y puede frenar las tasas de visitación, reduciendo así la medida en que los ciudadanos valoran los parques nacionales y están dispuestos a apoyarlos. Las tarifas para turistas internacionales son más bajas en Armenia (US$1.04) y más altas en Tanzania (US$43.72), en tanto que Costa Rica está más cerca del promedio mundial (US$11.21), una proporción relativamente pequeña del gasto diario promedio estimado de US$165 para los turistas europeos de ingresos medios a altos. Los turistas internacionales que visitan los países de bajos ingresos pagan una tarifa de entrada promedio de US$20, cuatro veces más que en los países de altos ingresos. Podría decirse que esto es razonable, dado que sus bases de financiación para las AP son mucho más pequeñas y su dependencia mucho mayor en los ingresos del turismo. Nuestros hallazgos apoyan la diferenciación de tarifas entre ciudadanos y turistas internacionales como un medio para equiparar la asequibilidad.

RÉSUMÉ

Il peut s’avérer difficile de fixer un tarif approprié pour les droits d'entrée des aires protégées (AP). Nous présentons des données comparatives pour un échantillon de 62 pays et avons constitué un index d'accessibilité financière, indiquant les frais d'entrée des AP par rapport au revenu par habitant, ajustés en fonction du pouvoir d'achat des citoyens. Selon cette mesure, les parcs nationaux australiens s’avèrent les plus abordables pour leurs citoyens (index: 0,10), ceux du Bénin sont les moins abordables (10,69), tandis que l’Indonésie se rapproche le plus de la moyenne de l’index à 2,09. Les AP des pays à faible revenu sont en moyenne 30 fois moins abordables pour leurs citoyens que ceux des pays à revenu élevé. Outre les implications en termes d'équité, cela peut faire décroitre les taux de fréquentation, en affaiblissant l’opinion favorable des citoyens envers leurs parcs nationaux et, par voie de conséquence, leur volonté de les soutenir. Les recettes du tourisme international en Arménie se sont révélés être les plus bas (1,04 USD), les plus élevés étant en Tanzanie (43,72 USD), tandis que le Costa Rica se rapproche le plus de la moyenne mondiale (11,21 USD), ce qui constitue en fait une proportion relativement faible des dépenses quotidiennes moyennes estimées (165 USD) des touristes européens à revenu élevé. Les touristes internationaux paient un droit d’entrée moyen de 20 USD dans les parcs des pays à faible revenu, soit quatre fois plus que dans les parcs des pays à revenu élevé. Cette disparité est sans doute justifiée, compte tenu des sources de financement beaucoup plus réduites des pays à faible revenu et de leur forte dépendance au tourisme. Nos conclusions viennent étayer la mise en oeuvre d’une différenciation dans les droits d’entrée entre citoyens et touristes internationaux en tant que moyen d'égaliser l'abordabilité des parcs.

ENHANCING BIRD BIODIVERSITY THROUGH IMPROVED WATER MANAGEMENT IN A VIET NAM WETLAND NATIONAL PARK

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ABSTRACT

U Minh Thuong National Park, one of the two largest remaining peat swamp, melaleuca forests in Viet Nam is a very Important Bird and Conservation Area because of its diverse wetland habitats. A devastating forest fire in 2002 resulted in a new regime of fire control based on an imposed permanent flooding regime over large areas of the Park that led to severe wetland and forest degradation. This in turn negatively impacted on bird species diversity and populations. In 2009, the Government of Viet Nam and the park authority adopted an improved water management practice. A survey four years later recorded two new species in the list of 159 bird species for the park. Of these, 25 threatened species were using the wetland park and adjacent Buffer Zone for living and feeding habitat. Based on the largest count occurring during three continuous days, the water bird population in the bird colony in 2013 increased by 33 per cent compared to the 2009 level. The positive response of avifauna to the changes in U Minh Thuong with respect to the hydrology of seasonally flooded melaleuca wetland forest indicates the need to understand how the 'normal' wetland processes operate in support of biodiversity conservation before modifying them for fire management.

Key words: Water birds, wetland birds, wetland restoration, hydrological changes, U Minh Thuong

INTRODUCTION

Although wetlands cover only ca. 9 per cent of the world land area, they are globally significant ecosystems for biodiversity conservation of plants and animals, particularly waterfowls (Zedler & Kercher, 2005; Bobbink et al., 2006). However, these natural ecosystems are inadequately protected from land conversion to agriculture, water drainage and fire (Kingsford & Thomas, 2004; Yule, 2010; Hawa et al., 2016). Consequently, over half of these global wetlands have already been lost as a result of human activities, particularly in densely populated regions, where more than 80 per cent of the wetlands have been lost or severely degraded (Bobbink et al., 2006; Davidson, 2014). As a result, wetland biodiversity is under high risk and many species are threatened with extinction (Millennium Ecosystem Assessment, 2005).

The Mekong Delta is a major rice and aquaculture production area in Viet Nam, and was one of the largest natural wetland ecosystems of melaleuca (*Melaleuca cajuputi*) and mangrove forest in the world before 1900 (Thinh, 2003; Biggs, 2005). However, human disturbance through wetland reclamation programmes for agricultural intensification in the Delta resulted in significant loss and fragmentation of the high environment and conservation values of the wetland (Buckton et al., 1999; Thinh, 2003; Buckton & Safford, 2004). In 1998, approximately 94 per cent of the Mekong Delta's natural wetland area had been artificially reclaimed for agriculture and aquacultural production (Thinh, 2003). A study in 2015 found only 1.7 per cent of the total of four million ha of natural wetland in the Mekong had been left (Hoang et al., 2017).

U Minh, one of the three most important wetland regions in the Mekong Delta, was covered by extensive melaleuca forest (Buckton & Safford, 2004; Biggs, 2005). However, since 1980 it has experienced a large

loss of forested area, and wetland degradation through expansion of rice and aquaculture production, and canal development for irrigation (Biggs, 2005; Viet Nam Environmental Protection Agency, 2005). To control this land conversion, wetland protected areas have been established by the Central Government in the Mekong Delta to conserve biodiversity and important wetland bird areas in particular since the 1990s (Buckton et al., 1999; Viet Nam Environmental Protection Agency, 2005).

U Minh Thuong National Park (UMTNP) houses one of the two largest remaining peat swamp melaleuca forests in Viet Nam, a unique ecosystem in the Indochina region and recognised as the most Important Bird and Conservation Area in Viet Nam (Buckton et al., 1999). The park is also the home of the largest water bird colony in the Mekong region (Hoa, 2002). However, the rich avifauna of the park was negatively affected by forest clearance and wildfire. Especially, inappropriate water management practice for fire prevention, which was only focused on preserving tree species based on a deep and permanent flood regime, led to further wetland and habitat degradation in UMTNP (Biggs, 2005; 2011; Dang, 2009; Huong, 2011).

In this article, we present the impacts to avifauna of hydrological changes imposed from water management of UMTNP and management options which might enhance biodiversity conservation and fire prevention in UMTNP and other similar places in the Mekong Delta and the world.

WETLAND MANAGEMENT CHALLENGE IN U MINH THUONG NATIONAL PARK

U Minh Thuong National Park

U Minh Thuong National Park (UMTNP) is located on the upper part of the U Minh region from 9031'16"–9039'45" North and 105003'6"–105007'59" East. It is 365 km southwest from Ho Chi Minh City and approximately 60 km from Rach Gia, the capital city of the Kien Giang Province. The core zone of UMTNP covers an area of 8,038 ha, recognised as a national historical site (Biggs, 2005; Kien Giang Province People's Committee, 2005), an Asian Heritage Park and Ramsar site.

U Minh is a flat region with average elevation of 0.5 m above mean sea level. Soils in the region were formed by deposits of alluvial sediments from the Mekong River 10,000 years ago (Hashimoto, 2001). After initially trapping sediment to form soils, mangrove forests deposited large amounts of organic material gradually raising the ground level so that it was no longer influenced by sea water. Under the now dominant fresh water condition, melaleuca forest was established replacing the mangrove forest while continuing to accrete organic material to the developing soil forming two main soil types – acid sulphate soils and peatland (Care, 2001; Hashimoto, 2001).

Climate and hydrological conditions

Located in the highest rainfall area in the Mekong Delta, U Minh region receives an average of 2,200–2,400 mm annually, but the rainfall is unevenly distributed with a pronounced dry season (from December to April) receiving only about 5 per cent (110–120 mm) of the total annual rainfall, while the evaporation in this period is very high (587–614 mm) due to high daily temperatures reaching to 38°C (Huong, 2011).

The hydrology of the region is characterised by wet seasonal inundation and surface soil drying during the dry season (Ngan & Hien, 1987; Bao, 2011; Anh, 2013). This natural condition is appropriate for establishment and evolution of the wetland ecosystem dominated by melaleuca (*Melaleuca cajuputi*) forests and peatland formation and accumulation (Quynh, 2011). However, it was artificially changed by the creation of an extensive canal system for crop irrigation, transportation and rural development (Biggs, 2005; 2011; Dzung & Co, 2011).

History of forest loss and fragmentation

In the 1930s, melaleuca forest in the U Minh region covered an area of about 142,000 ha (Dzung, 2002; Biggs, 2005). As one of the three biggest bases for the revolutionary forces in South Viet Nam during the Indochina wars, the forest in U Minh was damaged by Agent Orange and Napalm bombs in the second Indochina war (Biggs, 2005), but approximately 100,000 ha of natural melaleuca forest remained until 1975 (Dzung, 2002). After this time, the forest was rapidly cleared to meet the demand for economic development, and agricultural and aquaculture expansion (Dzung, 2002; Biggs, 2005). In 1978, the Kien Giang Province dug an outer dyke and associated canals with a 60 km perimeter to enclose and thereby protect the last area of 21,800 ha of natural melaleuca forest. However, this effort was not effective in stopping illegal deforestation. In 1992, in parallel with establishing the U Minh Thuong Nature Reserve, Kien Giang provincial authority continued to build a second 38 km of inner dykes and canals that ran parallel to the outer dyke (Figure 1). This new dyke system also defined the park's boundary, aimed at strictly conserving the last remaining area of 8,038 ha of wetland and melaleuca forest under the National Protected Area system (Dzung, 2002) .

Pressure from land use conversion

The area between the inner dyke and outer dyke, an area of 14,192 ha, was managed as a buffer zone around the core protected area zone. Most people live along the 22 canals in the buffer zone running between the canals of the inner and outer dyke (Dzung, 2002). In the buffer zone, each household was allocated an average area of 4.0 ha of land by the province and mandated to maintain 2.0 ha for melaleuca plantation, 1.0 ha for fish ponds and 1.0 ha crop production. In 2000, there were 3,022 households with 16,227 people living in the buffer zone (Chandler et al., 2000) and by 2013 there were 3,675 households and 18,852 people (Tuyen, 2013). Although these households received provincial government support for socio-economic development and livelihood improvement, many are still poor forest-dependant people (Dang, 2009; Tuyen, 2013). This posed a significant challenge to the biodiversity conservation of the park due to illegal access for wildlife hunting, fishing and collecting honey (Biggs, 2005; Dang, 2009; Tuyen, 2013; Nuwer & Bell, 2014).

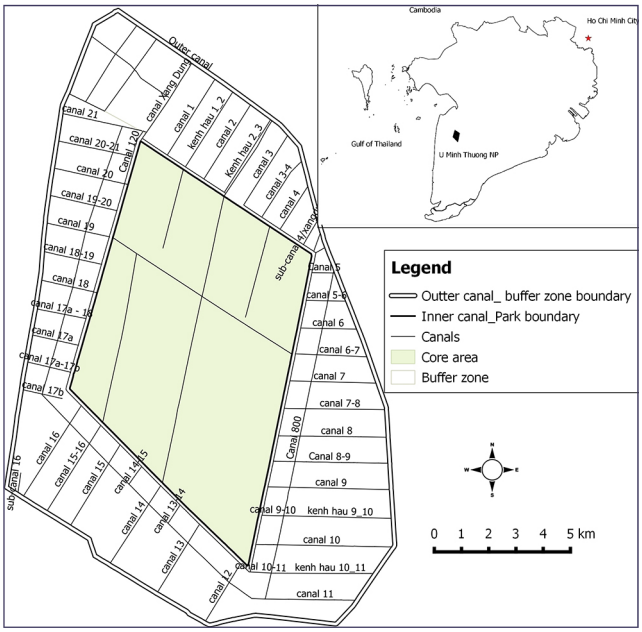


Figure 1. Map of the dense and extensive canal system established by Kien Giang Province in the wetland of the core zone of UMTNP and surrounding buffer zone.

Impacts of forest fire and inappropriate water management

Development of an intensive canal system surrounding a small melaleuca forest area altered the natural hydrological condition in the park and surrounding areas. In the dry season, the depth to the underground water table increased due to the large demand for irrigation and natural evaporation. This resulted in drying out of the peaty soil and made it prone to wildfire (Dzung & Co, 2011; Bao, 2011; Anh, 2013).

In March 2002, only two months after the Nature Reserve was upgraded to National Park status, a devastating fire occurred destroying approximately 3,000 ha of melaleuca forest that represented 80 per cent of the primary forest on the peatland of the park (Dzung & Co, 2011; Thinh, 2011). This fire not only significantly reduced the natural forest area but also destroyed wetland habitat and bird nesting sites (Sanders, 2002). There was also long-term environmental damage to the soil and freshwater ecosystem resulting from the large volume of salt water pumped into the park for firefighting (Sanders, 2002; Dzung & Co, 2011).

This fire event was considered a national disaster and as such the central government, province and conservation organisations paid it great attention. The fear of a repeat

Degraded U Minh Thuong wetland under the permanent, deep flooded condition with extensive floating plants (foreground), and few trees surviving © Chu Van Cuong

fire led to an urgent but ill-considered management decision from the central government to keep a permanent and deep flood regime in the park through upgrading the existing dyke and dam systems. There were no more forest fires, but the park's ecosystems were affected, particularly the melaleuca forest and avifauna (Dang, 2009; Huong, 2011).

Retaining a permanent, flooded water level higher than the normal conditions for fire prevention negatively impacted on the growth, development and regeneration of the normally seasonally inundated melaleuca forest and other wetland habitats. Many dead seedlings and trees were observed in the park along with water pollution with high nutrient concentration as a consequence of ecosystem and forest degradation (Dang, 2009; Thinh, 2011). This quickly led to a bloom of floating exotic plants such as water hyacinth (*Eichhornia crassipes*) and water lettuce (*Pistia stratiotes*) in the canals and open water surface areas in the park. Dense mats of floating exotic plants disturbed the wetland's food web resulting in the death of aquatic species, especially fish (Vinh et al., 2002; Dang, 2009). High flood water levels coupled with the decline of food sources negatively affected wildlife, including birds which rely on the wetland ecosystem for feeding and nesting (Dang, 2009).

Improved water management practice in UMTNP

Evidence of the wetland degradation in UMTNP from the inappropriate water management regime was presented and discussed at the National Workshop in 2009 (Cuong et al., 2011). The workshop provided an opportunity for the decision makers from central and provincial government, ministries, park managers and scientists to talk about the future management solution to achieve biodiversity restoration and fire management. The official decision to revise the water management system allowed an immediate and permanent draining of the flood water out of the park (Figure 2).

Restoration of the hydrological conditions in the park towards the situation prevailing before the fire in 2002 (see Supplementary Online Material Box 1) enabled recovery of the native vegetation and wetland habitats. This attracted the return of birds to the park for foraging and breeding.

METHODS

This bird survey is a 'repeat' of previous surveys undertaken in 2009 and 2011, covering the same areas and bird colony. Other surveys were conducted before and after the fire between 1999 and 2002 by Care International (Hoa, 2002). The survey reported here was conducted in 3 weeks from 27 May to 14 June 2013 by two principal researchers from UMTNP who also undertook the previous surveys. Bird species richness in four main habitats of melaleuca forest, open wetland, grassland and nearby buffer zone was recorded using Timed Species Counts and Point Count methods (Pomeroy & Tengecho, 1986). The number of water birds and populations in the bird colony were investigated using the counting methods from the

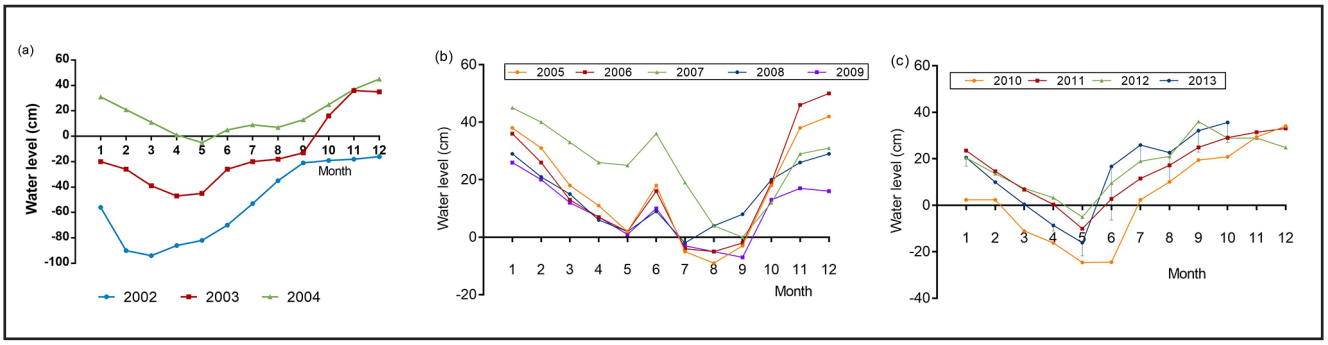


Figure 2. Water level changes in the canals in UMTNP after the fire event in 2002[1]. Figure 2a shows that the water level was reduced to approximately 90 cm below ground level as most water in the park was being used for forest firefighting. The water level in the park increased by the end of 2002 under the government decision to flood the park for fire prevention. However, flooding did not occur till the end of 2004 due to the time taken to complete the water management system. Permanent and high water levels occurred from 2005-2009 (Figure 2b) after dyke and gate building was completed allowing retention of all rain water in the UMTNP. Figure 2c shows changes of flooding condition when flood water in the park was released under improved water management practices since 2010. Under the new water management scheme, only a certain amount (not all) of the rain water in the rainy season was kept in the park and this created an appropriate (not deep) seasonal flooding in the park (from July to January). The flood water level gradually reduces through evaporation and lateral flow through the dyke walls to outside the park (which had a lower water table), in the hot and dry months and creates a non-flooding season (February to June).

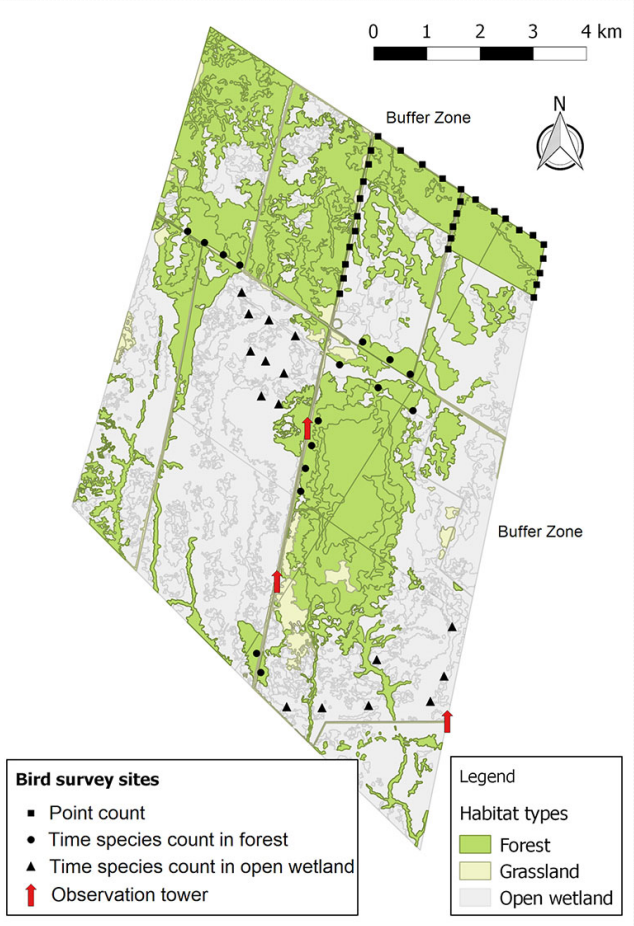


Figure 3. Sites of bird survey in UMTNP and nearby Buffer Zone

observation towers (Figure 3). Bird species were identified and named based on guide books (Quy & Cu, 1999; Robson, 2011; Hung, 2012). Recorded data for bird richness from the survey was compared with previous surveys in 2011 and particularly the 2009 survey to assess how the new water management regime impacted on the bird species richness of UMTNP and the buffer zone.

Timed Species Counts

Timed Species Counts (TSC) were undertaken in 32 sample plots of ca. 0.5 ha (50 x 100 m) that were set up in the 2009 and 2011 surveys in two main habitats of melaleuca forest and open wetland in the core area of UMTNP (16 plots for each survey habitat). TSC was undertaken in the morning between 06:00–10:00 and in the afternoon between 15:00–18:30. To conduct TSC, the observers walk at a slow pace through the study area for one hour and actively search for birds. During the first ten minutes of the walk all bird species seen are recorded, but only once. In the second ten minutes, all bird species not seen in the first ten minutes are recorded but, again, each different species is only recorded once and this process is repeated for each of the subsequent ten minute blocks until an hour watch is completed.

Point Count

The Point Count method was used in the grassland habitat because it was impossible for researchers to walk through this habitat to carry out the TSC method. Thirty point count locations were set up with a 3-metre high aluminium ladder observation platform. Bird species were identified and the number of individuals that were observed within 10 minutes at each counting point recorded in both the core zone and nearby buffer zone.

Counting populations of specific groups

This method was applied to specific groups of birds such as crane and other water bird species which use the wetland of the park for overnight roosting and breeding. It was used to count stork and night resting waterfowl species and their populations in the bird colony inside the melaleuca forest.

Counting the stork population

The population of storks (*Ciconiidae*) was counted four times a day, on 3 continuous days from a 13 m high observation tower in the core zone of the park. The researchers used binoculars to count lesser adjutant (*Leptoptilos javanicus*), the main stork species, from the observation tower when they started soaring out of the forest between 10:00–12:00.

Counting night resting water birds

Water birds were counted in the bird colony inside the melaleuca forest from two main flying directions at two 10 m high observation towers. Counting of birds flying into the colony was conducted over 3 consecutive days, with 3 periods of 15 minutes' observation followed by a 30 minute break between 16:00–18:30 when birds return to the colony and stay overnight after daily foraging elsewhere. Birds were identified and recorded by species name and the total number of individuals for each counting.

RESULTS

Bird diversity

One hundred and fifty-nine bird species belonging to 51 families were recorded in the core zone and buffer zone of UMTNP. Of these, 72 species are waterfowls as classified under the Ramsar Convention, 24 species are wetland forest dependent and 25 are listed as threatened species.

Cotton pygmy-goose (*Nettapus coromandelianus*) was a first time record in UMTNP. Another five previously recorded species, Indian cormorant (*Phalacrocorax*

fuscicollis), greater painted-snipe (*Rostratula benghalensis*), common snipe (*Gallinago gallinago*), red turtle dove (*Streptopelia tranquebarica*) (Safford, 2000) and vinous-breasted starling (A*cridotheres burmannicus*) (Buckton et al., 1999), which were not observed in the previous surveys in 2003, 2009 and 2011, were found in UMTNP in 2013. Significantly, three threatened bird species: Oriental darter (A*nhinga melanogaster*), Asian openbill (*Anastomus oscitans*) and spot-billed pelican (*Pelecanus philippensis*) which were only observed in the buffer zone between 2004 and 2009 have now returned to the park for feeding and breeding.

Within the core zone of UMTNP, open wetland was the most attractive and appropriate bird habitat. It supported the largest species richness (121 species in 2013) of which 17 species were on the threatened list of IUCN (2012) and the Vietnam Red Book (Ministry of Science and Technology, 2007). In contrast, melaleuca forest had the lowest bird species richness but it was home to the largest number of specialist bird species (22 species) which are only adapted to this narrow and typical habitat.

The buffer zone provides feeding and resting habitat for 97 bird species, including 9 threatened species. Notably, Oriental darter, Asian openbill and spot-billed pelican are three large-sized threatened bird species facing local poaching. The close proximity and similarity of the habitat characteristics shared between the buffer zone and two habitats (open wetland and grassland) in the core zone of the park resulted in a large proportion of bird species (95 out of 159 species) that chose both the UMTNP and buffer zone as habitats for finding food and resting (Supplementary Online Material, Figure S1).

Oriental darters (*Anhinga melanogaster*) feeding their chicks. © Tran Van Thang

The number of bird species in the buffer zone increased from 95 species in 2003 to 97 species in 2009 and then was unchanged in the 2011 and 2013 surveys. In contrast, bird species richness in the core zone of UMTNP changed following the hydrological condition over the whole period of 2003–2013 (Figure 4). The permanent and deep flooding scheme applied in the park between 2005 and 2009 led to decreased bird species richness (by 27 species in grassland, 19 species in open wetland and 11 species in melaleuca forest) in 2009 (Figure 5). Nearly two years after the application of the new water management scheme that allowed the release of flood water out of the park, the survey results in 2011 showed that bird species richness generally increased. The most recent survey which recorded the cumulative total of species detected over a 10-day assessment in 2013 found the number of bird species increased by 47 in open wetland, by 29 species in grassland and 19 species in melaleuca forest compared to the 2009 assessment.

Bird colony and waterfowl population

Our study recorded a maximum daily number over a 3-day counting period of 19,164 birds comprising 16 water bird species which rested overnight and were breeding in the 10 ha area of the bird colony located in the southeast of the core zone. Of these 16 species, little cormorant (*Microcarbo niger*), little egret (*Egretta garzetta*), black-crowned night heron (*Nycticorax nycticorax*), great egret (*Ardea alba*) and intermediate egret (*Ardea intermedia*) were the five main species

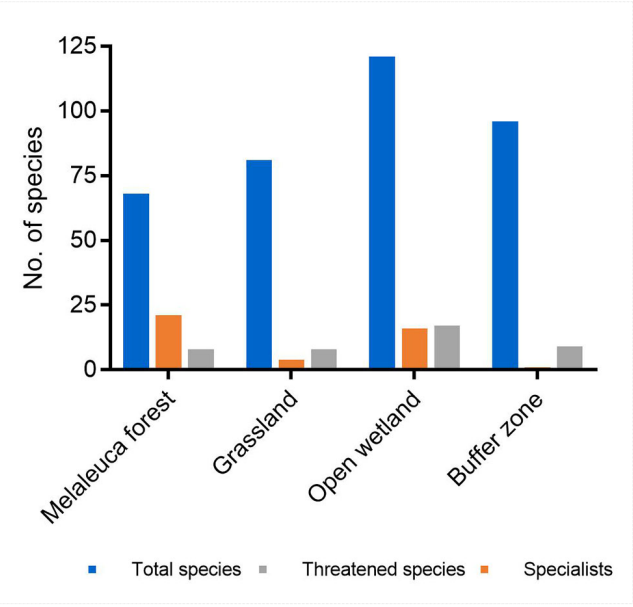


Figure 4. Species composition in each habitat of the core zone of UMTNP and buffer zone

Black drongo (*Dicrurus macrocercus*). © Sharon Brown

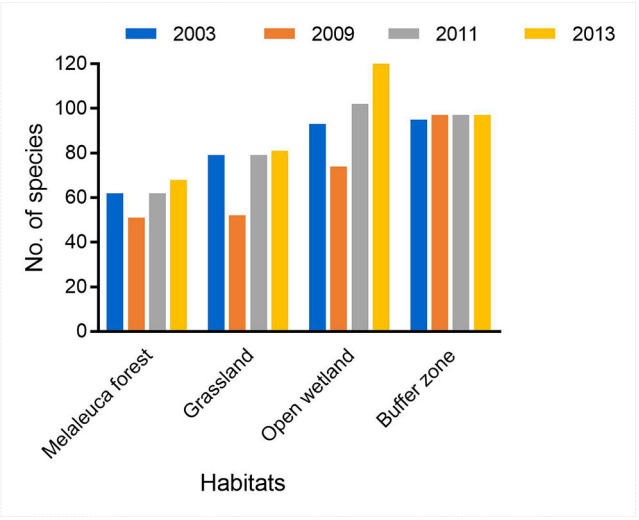


Figure 5. Figure 5. Changes in bird diversity in UMTNP and nearby buffer zone from 2003 until 2013. The histogram shows species richness in different habitats in the park and buffer zone after the wildfire in 2002; at the end of a permanent, artificial flooding period (2005-2009) just before an improved water management regime was applied in late 2009. The surveys in 2011 and 2013 were conducted as the melaleuca, open wetland and grassland habitats recovered much of their original ecosystem characteristics (pre the fire and flooding regime)

commonly observed in the colony (details in Supplementary Online Material, Figure S2).

Waterfowl populations in the bird colony changed following the wildfire and water flooding events. In 2001, 4,418 water birds of 15 species were recorded in the colony (Figure 6). The fire event in 2002 destroyed the colony and nesting places that consequently led to a small decrease in the number of waterfowl species from 15 to 13 with a total bird population decrease from 4,418 to 1,131 birds in 2002. After the fire, all small bird colonies merged into one large colony coupled with an increased area of open wetland that was created with favourable shallows and suitable feeding area as the flooding regime had not yet been instituted. This led to an increase in the bird population of the colony in 2003 to 4,875 waterfowls and a much larger increase in 2004 to a maximum daily total of 23,400 water birds (Figure 6). However, after the long flooding period was instituted in 2005, the waterfowl population decreased by 39 per cent in 2009 compared to 2004 even though the number of species was unchanged. When flood water in the park was released from early 2010 under the new management regime, the water bird population in the colony increased by 26 per cent in 2011 and 33 per cent in 2013 over 2009 levels (Figure 6).

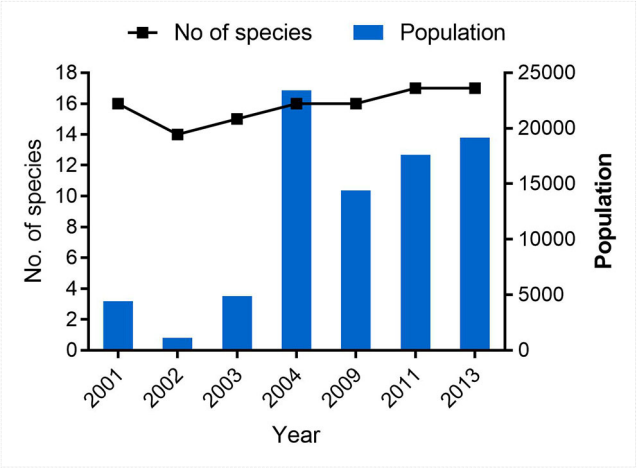


Figure 6. Change of number of waterfowl species and their total population in the bird colony from 2001-2013

Conservation values

Twenty-five species have significant conservation issues (Supplementary Online Material, Table S1), being listed either on the International Union for Conservation of Nature Red List (9 species including 2 Vulnerable and 7 Near-threatened) (IUCN, 2012), in the Viet Nam Red Book of 2007 (1 Endangered and 6 Vulnerable species) (Ministry of Science and Technology, 2007), in the CITES Convention and listed under Decree 32/2006/ND-CP of the Vietnamese Government (11 species) on management of endangered and rare forest plants and animals in Viet Nam (Government of Viet Nam, 2006). Wetlands International (2002) has established criteria for the rareness of water fowl species based on the proportion of species in a habitat as a proportion of the estimated Southeast Asia and world populations. A threshold value of a population of >1 per cent is classified as a significantly large population and hence one of interest in terms of species survival and genetic diversity. Seven species: glossy ibis (*Plegadis falcinellus*), black bittern (*Dupetor flavicollis*), purple heron (*Ardea purpurea*), great egret, intermediate egret, spot-billed pelican and little cormorant in UMTNP reach this significant species level.

DISCUSSION

The diversity of bird species in UMTNP is a reflection of the diversity of habitat types, from melaleuca forest to open wetland, grassland and diversified food sources in the buffer zone. As one of eight legally established inland wetland protected areas in the Mekong Delta, UMTNP plays an important role in providing safe habitat and refuge for birds and wildlife in this rapidly changing wetland landscape. Of the 247 bird species recorded in the Mekong Delta (Buckton & Safford, 2004), UMTNP is home to two-thirds of them. Significantly, the park is home to two-thirds (25 out of 37 species) of the total number of threatened bird species recorded in the Mekong region. However, the disturbance from forest clearance, wildfire and especially the subsequent human imposition of changed hydrological conditions through inappropriate flood water management for fire prevention, negatively impacted bird diversity.

Hydrology plays a vital role in the maintenance of wetland structure and functions (Hollis, 1998; Euliss et al., 2004; Zalewski et al., 2016) and this in turn affects birds that use wetland habitats for feeding, resting and breeding. Like other conservation wetlands in the Mekong Delta (see e.g. Torell et al., 2003; Anh, 2013; Quan et al., 2018), the natural flooding regimes of UMTNP wetland were considerably modified by the establishment of hydraulic infrastructure such as dykes, sluice gates and canals for water management and fire prevention. Fear of wildfire and lack of knowledge about wetland hydrology and dynamics led to inappropriate management decisions which established a permanent flooding regime in the park. The consequence of inappropriate hydrology management practice often leads to wetland restoration failure (Mitsch & Wilson, 1996), and greatly impacts on wetland birds (Bancroft et al., 2002; O'Neal et al., 2008; Hoover, 2009) and UMTNP is no exception.

U Minh Thuong Wetland landscape © Sharon Brown

Wetland avifauna is often negatively impacted as a consequence of long-term flooding regime (Kingsford & Thomas, 2004) and this is the case of UMTNP. A permanent and high flood level established and maintained in the park over a long period from 2005–2009 led to further degradation of the habitats and food sources post the fire. Especially, the high level flood water negatively affected the prey hunting capacity of water birds (Arengo & Baldassarre, 1999; Gawlik, 2002). Consequently, many birds were forced to move out of the park leading to the reduction in bird populations during the flooding regime management period.

When the wetland condition was improved from 2010 by allowing the flood water to move out of the park by lowering the canal water level height in order to develop a shallow and seasonally inundated condition, this provided the opportunity for wetland habitats and native vegetation to recover. The survey in 2013 revealed a significant increase in the growth rate of melaleuca trees and the establishment of a newly regenerated seedling population with a density of 320–860 seedlings/ha from virtually no trees in the forest area surviving the flooding regime (Thang, 2013). Available food sources provided by re-established natural vegetation apparently then made the wetland habitats attractive destinations again for birds (Davis & Bidwell, 2008; Matthews & Endress, 2008). In the case of UMTNP, bird species richness generally increased in the park and typical habitats, and particularly increased in the open wetland areas. This indicates the importance of UMTNP as a safe habitat for birds, being surrounded by the buffer zone habitats which have considerable human disturbance and development activities.

CONCLUSIONS AND MANAGEMENT IMPLICATIONS

The case of UMTNP shows that wetland habitats in the Lower Mekong Delta need the seasonal change of flood water height and a dry season without floodwater, as now occurs again in the natural wetlands of UMTNP, to enable their unique habitats, especially melaleuca forests, to survive and prosper. The positive response of avifauna to the changes in U Minh Thuong indicates the need to understand how the 'normal' wetland processes operate in support of biodiversity conservation before modifying them for fire management. The attempt to save the melaleuca forest failed because the permanent flooded condition killed the trees. Thus, wetland conservation policy and management practice needed to be changed from focusing on an attempt to preserve tree species from fire based on a deep and permanent flood regime, to applying an integrated water and fire prevention strategy.

Fire should be used as an ecological management tool for promoting forest succession and regeneration, and maintaining and conserving a healthy wetland. Although fire is an important ecological factor affecting the development of, and succession within, the melaleuca forest ecosystem (Ngan & Hien, 1987), its use is

prohibited in protected area management in Viet Nam. Thus, implementation of an integrated fire and wetland water management strategy enabling prescribed burning, as was discussed and concluded to be beneficial in the participatory national workshop (Cuong et al., 2011; Quynh, 2011), would facilitate forest regeneration and reproduction that provide food sources for seed eating birds (de Szalay & Resh, 1997). Controlled burning helps to remove and/or decrease plant litter, woody or invasive species, particularly fire-prone grass material such as *Phragmites vallatoria* that grows quickly and accumulates under appropriate tropical conditions, and controlled burning is likely to modify the plant species composition and may develop a habitat that better supports wetland birds (Kirby et al., 1988; Brennan et al., 2005).

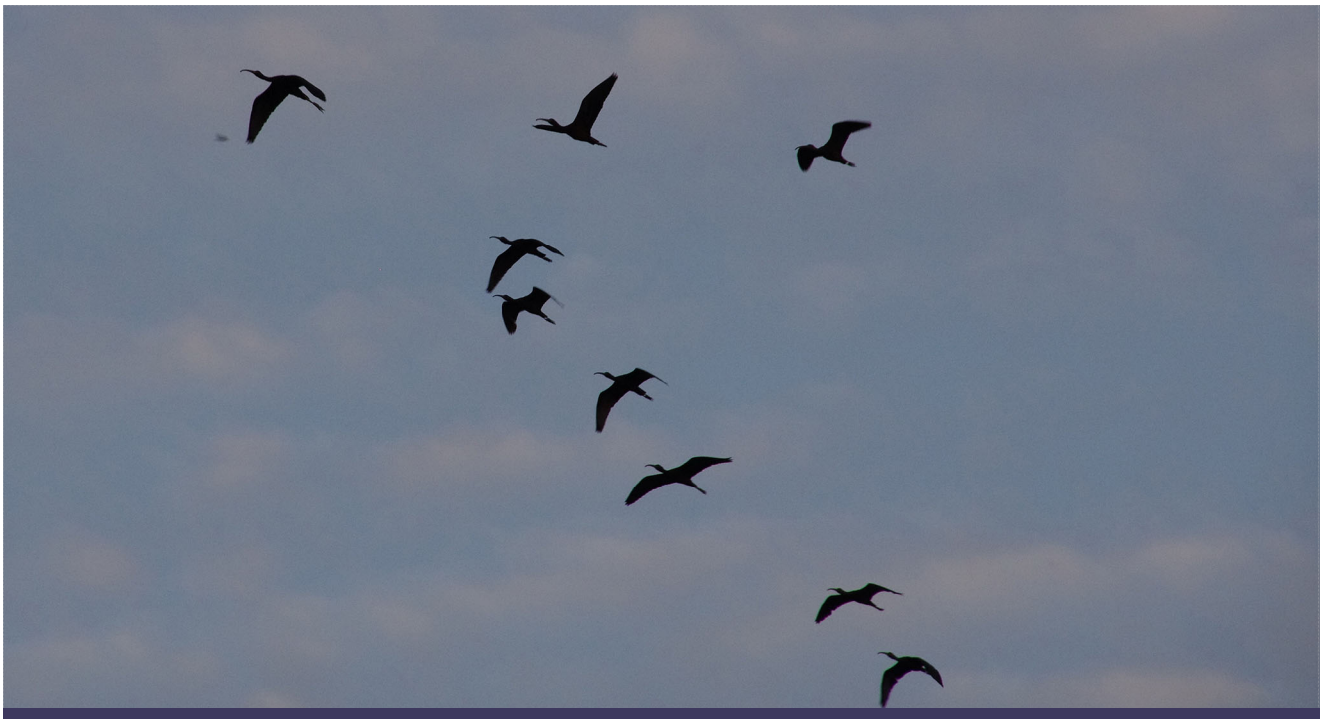
It is necessary to maintain the habitat diversity and appropriate habitat ratio of melaleuca forest, open wetland and grassland within the park for avifauna and wildlife conservation. Although grassland and open wetland are important habitats to support both bird diversity and species of high conservation value, these two habitats are often considered as 'waste land' and are under high risk of disturbance from invasive plants and management intervention such as reforestation. Given that planting trees could assist in restoring wetland vegetation and control exotic plants and grasses, this activity paradoxically often increases the risk of habitat loss and disturbance, and displaces birds (Allan et al., 1997). Consequently, birds will be forced to forage outside of the park (e.g., buffer zones, agricultural and aquaculture land) where they are subject to poaching and could become endangered.

Protection of birds in the protected area wetlands is a highly recommended management strategy (Erwin, 2002), but conservation efforts need to be implemented at landscape level in the park and surrounding agricultural buffer zones. Available food sources from diverse crops and aquaculture production in the buffer zone may make it more attractive for birds, including threatened species to find food there. In contrast to the strict protection level in the park, birds in the buffer zone and farming areas are often under threat from local poaching activity. Thus, conservation in a catchment encompassing a national park or protected area requires implementation of an awareness programme for local communities which outlines the importance of conservation to the overall ecosystem biodiversity and sustainability, and thus the communities' economic long-term wellbeing.

SUPPLEMENTARY ONLINE MATERIAL

Box 1 Improved Water management regime in U Minh Thuong National Park

Figure S1. Multidimensional scaling following the presence and absence of bird species in 5 different habitats



Glossy Ibis (*Plegadis falcinellus*). © Sharon Brown

Figure S2. Number of significant bird colony waterfowl species present at the peak in May 2013

Table S1. Bird species of conservation importance in U Minh Thuong National Park

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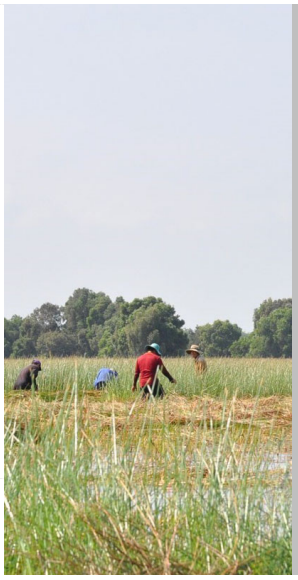
RESUMEN

El Parque Nacional U Minh Thuong, uno de los dos humedales turbosos de Melaleuca más grandes que quedan en Vietnam, es un área de gran importancia para la conservación de las aves debido a sus diversos hábitats de humedales. Un devastador incendio forestal en 2002 dio lugar a un nuevo régimen de control de incendios basado en un régimen permanente de inundación impuesto en grandes áreas del parque que provocó una degradación extrema de los humedales y los bosques. Esto a su vez afectó de manera negativa tanto la diversidad como las poblaciones de especies de aves. En 2009, el Gobierno de Vietnam y la Autoridad del Parque adoptaron una práctica mejorada de gestión del agua. Un estudio realizado cuatro años más tarde registró dos nuevas especies en la lista de 159 especies de aves que habitan en el parque. De estas, 25 especies amenazadas utilizaban los humedales y la zona de amortiguamiento adyacente como hábitat para su desarrollo y alimentación. Con base en el mayor registro ocurrido durante tres días consecutivos, la población de aves acuáticas en la colonia de aves en 2013 aumentó en un 33 por ciento en comparación con el nivel de 2009. La respuesta positiva de la avifauna a los cambios en U Minh Thuong con respecto a la hidrología de los humedales turbosos de Melaleuca inundados estacionalmente, indica la necesidad de comprender cómo intervienen los procesos “normales” de los humedales en apoyo de la conservación de la biodiversidad antes de modificarlos para el control de incendios.

RÉSUMÉ

Le parc national d'U Minh Thuong est l'une des deux plus grandes tourbières marécageuses restantes au Viet Nam, comprenant des prairies saisonnièrement inondées et des forêts de Melaleuca qui constituent une zone très importante pour la conservation des oiseaux en raison de la diversité de ses habitats humides. Un incendie de forêt dévastateur en 2002 a entraîné la mise en place de nouvelles mesures de prévention contre les incendies consistant en un régime obligatoire d'inondation permanente sur de vastes zones du parc, ce qui a entraîné une grave dégradation des zones humides et des forêts. Cela a eu un impact négatif sur les populations d’oiseaux et sur leur diversité. En 2009, le gouvernement du Viet Nam et les autorités du parc ont adopté une pratique améliorée de gestion de l'eau. Le résultat d’une enquête menée quatre ans plus tard a permis d’ajouter deux nouvelles espèces sur la liste des 159 espèces d'oiseaux du parc. Parmi celles-ci figurent 25 espèces menacées habitant et se nourrissant dans les zones humides du parc et la zone tampon adjacente. Selon le plus grand recensement pratiqué sur trois jours consécutifs, la population d’oiseaux d’eau a augmenté de 33% en 2013 par rapport au niveau de 2009. Cette réaction positive de l'avifaune à U Minh Thuong grâce à la pratique améliorée du régime d'hydrologie des forêts de Melaleuca saisonnièrement inondées, souligne la nécessité d’une prise en compte du fonctionnement «normal» des zones humides et de son rôle dans la conservation de la biodiversité, avant toute modification pour la gestion des incendies.



A CROSS-NATIONAL COMPARATIVE STUDY ON COLLABORATIVE MANAGEMENT OF NATIONAL PARKS

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ABSTRACT

National Parks (NPs) are established with the aim of protecting important natural environments. However, numerous conflicts have emerged due to the introduction of park rules restricting local communities from utilising resources within national parks. The aim of this paper is to examine ways in which national parks in various nations employ the collaboration of stakeholders in park management and conflict resolution by focusing on four countries: Germany, Japan, Nigeria and Vietnam. A review of literature available in multiple languages, analysis of administrative documents and informal interview were the methods adopted. We show that challenges hindering co-management in the four countries range from unclear responsibilities of various actors, to weak institutionalised framework, and centralisation of park management. The result implicates that each country can learn different techniques of co-management from other countries, leading to more productive approaches towards national park management and conflict resolution in and around national parks.

Key words: co-management, national park, park volunteers, NGOs, developed country, developing country

INTRODUCTION

One of the objectives of National Parks (NPs) is to protect natural resources within the park while ensuring the needs of local people's livelihoods (Dudley, 2008). However, many NPs have failed in this regard, generating numerous conflicts with local people due to the restrictions imposed on their use of resources within NPs (von Ruschkowski, 2010). To resolve these conflicts, collaborative management (co-management) has been adopted by park administrations as one of the strategies to reconcile conservation objectives with the interests of local communities (De Pourcq et al., 2015). Co-management is a form of shared governance where authority and responsibility are shared among several stakeholders (Dudley, 2008). However, one of the stakeholders has the authority to make decisions but is required to inform or consult other stakeholders either at the time of planning or implementing initiatives (Borrini-Feyerabend et al., 2013).

Co-management of protected areas has been extensively investigated over the last two decades (Fox et al., 2013). Studies have shown that co-management contributes to the sustainable management of natural resources (Andersson & Agrawal, 2011; Gutiérrez et al., 2011); leads to improvements in local livelihoods (Morshed, 2013); and plays a vital role in conflict resolution (De Pourcq et al., 2015). On the other hand, there has been criticism that it has not lived up to expectations (Dressler et al., 2010), but instead has aggravated the conflict that it was intended to solve (Carlsson & Berkes, 2005).

Although the previous studies found mixed results regarding the effect of the co-management of NPs on managing resources, they are mainly focused on local stakeholders' participation in park management. While many countries have a three-layered administrative structure with national, regional and local levels, the role of regional administrations in NP management has not been extensively addressed. Likewise, the roles of sponsors, volunteers and NGOs in NP management have received little attention.

Thus, this paper will examine management structures across national-regional-local levels, and the involvement of local stakeholders, NGOs, volunteers and the private sector in NP management by drawing

Horse carriage tours by local farmers, Wadden Sea National Park © Carolin Funck

cases from Germany, Japan, Nigeria and Vietnam. The rationale for making a comparison across the four countries is that conflicts between local communities and the administrations are said to exist worldwide (von Ruschkowski, 2010). The study aims to identify the strengths and issues that need to be addressed for effective management across different scales and actors of NPs in each country.

METHODS

The study reviewed NP management systems in Germany, Japan, Nigeria and Vietnam. All of them have three levels of administration (national, regional, local), so that the balance between these three scales can be analysed. Furthermore, the four authors have first-hand in-depth knowledge of these countries and their NP management and can analyse documents in the respective languages.

The main methods used for data collection are review of the literature available in English, German, Japanese and Vietnamese, and administrative documents. The literature included journals, books, reports and conference papers on NP and collaborative management in the NPs of the four countries. These were obtained from the Web of Science and Google Scholar search engines. The authors searched: "National park management in the various countries", "management policies and structure", "collaborative management" and "co-management", with "AND" used as a connecting word between keywords for the purpose of retrieving relevant papers, books and reports for the review. Administrative documents on the management of NPs were obtained either directly in each country or through email requests or downloaded from administration homepages. Furthermore, we conducted research in NPs in each country, which provided on-the-ground

background knowledge and helped to clarify issues that were identified from literature and administrative documents. The NPs researched are: Wadden Sea NP, Germany (Funck, 2017); Yakushima NP, Japan (Adewumi, 2017; Nguyen & Funck, 2019); Gashaka-Gumti NP, Nigeria (Adewumi, 2017); and Tram Chim NP, Vietnam[1].

COMPARATIVE RESEARCH ON THE CO-MANAGEMENT OF NATIONAL PARKS

Management structure across national-regional -local levels

Management structure of German NPs

The history of NPs in Germany is quite recent compared to other developed countries, with the oldest park established in 1970 (von Ruschkowski, 2010). As of 2019, 16 NPs exist in Germany, varying in size between 30.7 and 322 km2 and protecting a total area of approximately 10,479 km2 (BfN, 2019). All NPs are secured by state law or ordinance and with the exception of one park, comprise more than 90 per cent of public land owned by the federal, state or local government. Although the first NP was established in 1970, Germany did not have a national nature protection law until 1976. This very basic framework has since been reformed several times, with current law being the Federal Nature Conservation Act (Bundesnaturschutzgesetz, 2010[2]).

German NPs are established under the Federal Nature Conservation Act, but are designated and administered at the regional level by the federal states in which each park lies. This has led to an unsystematic designation of NPs, as each state has chosen areas based on its particular regional and local structure rather than on a national concept that could create an integrated network of large-scale protected areas (Job, 2010). The zoning concept is handled differently in each state too.
Between 2009 and 2012, EUROPARC, an umbrella organisation of protected areas in Germany, conducted an evaluation of NPs (EUROPARC, 2013) in close cooperation with the federal government. The evaluation revealed that park structures depend on the state laws and ordinances under which the parks are created and therefore differ in each state and park. In only eight parks is the NP administration situated directly below the highest nature protection authority, in others it is integrated into different lower agencies (EUROPARC, 2013).

The full financing of the NP is provided by the federal state in each case. However, it was found that only half of the parks had sufficient funds for park management and maintenance (EUROPARC, 2013). The NPs charge no entrance fees but offer some limited services and facilities.

Management structure of Japanese NPs

The first NPs in Japan were established in 1931, and in the same year, Japan's NPs Law was enacted, which was amended in 1957, becoming the Natural Parks Law. As of 2019, there are a total of 34 NPs in Japan covering 21,907 km2 (5.8 per cent) of the total territorial area of Japan (MOE, 2019).

Due to the long history of private land ownership, NPs in Japan comprise state-owned land, local government-owned land and private land (Knight, 2010). The MOE plays a coordinating role in the management of the parks jointly with the state, prefecture and other parties (MOE, 2015). The Forestry Agency or prefectural government manages land in government-owned forests, while the Forestry Agency is essential in the management of private-owned forests within NPs (Yamaki, 2008).

Parks are administered using a system known as "national park management by zoning and regulation" or "multiple-use system" (Hiwasaki, 2005). The zoning system divides the parkland into three different levels of protection, Special Protection, Special and Ordinary Zones (Jones, 2013). While the designation and zoning of NPs is decided at the national level, since 2008, local authorities have the power to designate certain natural resources under the Act on the Promotion of Ecotourism and introduce access restrictions (Funck & Cooper, 2013) both inside and outside NPs. MOE provides NP management funds, but they are inadequate for park operation. Hence, the MOE declared a law in 2015 allowing local communities to collect entrance fees to resolve these problems. Furthermore, some NPs collect donations or voluntary contributions from tourists, which are used for the maintenance of trails, visitor centres and other facilities (Kubo et al., 2018).

Management structure of NPs in Nigeria

Although the initiative to establish NPs in Nigeria started in 1976, it was not until 1979 that the first national park was established. Decree 46 of 1999 which was revised in 2005 as the Nigeria National Park Service (NNPS) Act, is the legal instrument under which NPs are administered. Nigeria has seven NPs, covering a total area of 22,206 km2, about 3 per cent of Nigeria's total land area.

NPs are the preserve of the Federal Government under its exclusive legislative list, and parklands are the property of the government (Amosun & Adedoyin, 2010). NPs in Nigeria are managed and administered by

the Federal Ministry of Environment through the NNPS. Each NP has a Management Committee overseeing the affairs of the park. Since NPs are the sole responsibility of the federal government, they provide funds, tourism businesses and all facilities within the park, and tourists are charged entrance fees.

NPs in Nigeria are divided into zones for the purpose of applying different management principles in each zone that may best ensure the overall management objective for the park. Zoning in the parks consists of management zones (core/wilderness area, buffer zone, multi-use area/enclaves and the support zones) and protection zones or ranges. The aim of the management zone is to facilitate more focused management and proper allocation of park resources and staff to the areas needed while protection zones are operational areas for the protection and monitoring of the park's resources.

Management structure of Vietnamese NPs

The first NP was established in 1962 before the reunification. Vietnam has five main categories of national protected areas that often overlap: special-use forest protected areas, wetlands, marine protected areas, world heritage sites and biosphere reserves. Among these five categories, NPs are considered part of Special-Use Forests (SUFs) protected areas. The SUFs are established under the provisions of the Forest Protection and Development Law of 2004. As of 2016, Vietnam has a total of 31 NPs – equivalent to IUCN Category II – protecting a total area of approximately 10,350 km2, covering about 2.9 per cent of the land area[3] (The Government of Vietnam, 2010, 2014).

The management tasks for protected areas in Vietnam are divided among several agencies. The Ministry of Agriculture and Rural Development (MARD) and its provincial departments are responsible for managing all SUFs, and scientific research and experiment forests[4]. The management policies of NPs follow the regulations for SUFs' management. Currently, Vietnam has two types of NP: first, the cross-provincial parks or nationally important parks under the management of the Forest Protection Department within MARD; second, the within-provincial parks under the administration of the Provincial People's Committee (PPC). Among the 31 NPs in Vietnam, eight are managed by MARD while 23 NPs belong to the provincial level (The Government of Vietnam, 2010).

Although the MARD and/or PPC take full responsibility for the management of NPs, the daily operations and management are the responsibility of the National Park Management Board (NPMB). Basically, each NP has a NPMB, a state-owned organisation, which has the functions and tasks of a forest owner and the state-assured conditions for managing, protecting and developing SUFs. NPMBs are funded by the state, but at a very low level. Hence, entrance fees are charged and many Vietnamese NPs are supported with funds from many NGOs.

NPs in Vietnam are divided into zones for management purposes. According to Decision 186 (The Government of Vietnam, 2006), the zones include the strictly protected zone, ecological restoration zone and service-administrative zone. These functional zonings can be adjusted to the boundaries of each sub-zone based on the characteristics and actual situation of each NP and the purposes of forest management and use.

Co-management: involvement of local stakeholders, NGOs, volunteers, private sector and sponsors

Co-management in German NPs

Stoll-Kleemann (2001) reveals that one of the main conflicts faced by German NPs is that local opposition can be aimed at the park designation and at management plans and practices. This opposition is not so much based on conflicts over resource use or on insufficient knowledge of environmental protection but rather, on emotional drivers (e.g. the impression of facing restrictions on day-to-day decisions) and cultural drivers (e.g. the challenge to traditional values and habits). Adding some evidence for a weak interest in local support on the park management side, von Ruschkowski (2010) reports that only three out of the 14 NPs in Germany had placed high priority on the issue of

Box 1: Stakeholder involvement in co-management in German NPs

A successful example of co-management between several levels of administration and NGOs is EUROPARC Deutschland, established in 1991 to address the shortcomings of the federal structure. Volunteers, nature protection NGOs and local communities play important roles in supporting park administration in Germany. However, voluntary engagements in NPs rely heavily on nature protection NGOs for organisation and recruiting. The involvement of the private sector in NPs is still in the development phase, with only a handful of private companies supporting EUROPARC and partnering with NPs in the tourism sector.

Table 1. Management structure of NPs in the four countries

Category of comparison	Germany	Japan	Nigeria	Vietnam
First NPs	1970	1931	1979	1962
Number of NPs	16 NPs, covering a total area of 10,479 km^2	34 NPs covering 21,907 km^2	7 NPs with a total area of 22,206 km^2	31 NPs covering 10,350 km^2
Land ownership	More than 90 per cent are public land owned by the federal, state or local government	State-owned, local government-owned and private land	Federal Government of Nigeria	The Government of Vietnam
Designation	Established under the Federal Nature Conservation Act, but designated by the federal states	Natural Parks Law	Nigeria National Park Service Acts	Forest Protection and Development Law of 2004, but designated by the GOV
Administration and management	Administered at the regional level by the state in which each park lies	Managed jointly by the state, prefecture and other parties, with MOE playing a coordinating role	Managed by the Federal Ministry of Environment through the Nigeria National Park Service	MARD or PPC through NPMB
Zoning	Parkland is divided into different zones, but zoning is handled differently in each state and, as a result, the number of zones differs.	Zoning is decided on the national level Zoning system divides the parkland into Special Protection, Special and Ordinary Zones	Zoning consists of management zones and protection zones Management zone: core area, buffer zone, multi-use area/ enclaves and support zones	Zoning consists of strictly protected zone, ecological restoration zone and service-administrative zone
Park funding	Full finance is provided by the Federal State No entrance or gate fees are charged	Provided by the MOE Entrance fees, donations and voluntary contributions	Solely provided by Federal Government Entrance fees	Funded by the national government Support from many NGOs Entrance fees

monitoring support among local communities. Ludwig et al. (2012) point out that even when efforts were made to include local communities in decision-making processes on management of deer in the Bavarian Forest National Park, they were not successful due to the underlying territorial discourse. Residents felt that the park in general restricted their home territory and therefore would not accept an offer to cooperate on detailed management questions.

On the other hand, Sieberath (2007) examined acceptance of the relatively new Eifel National Park, which was established in 2004. He concluded that the park in general is well accepted. However, local residents do not feel they have sufficient possibilities to participate in decision-making. He emphasises that NP support organisations that exist in all parks have contributed greatly to a better acceptance of NPs in Germany (Sieberath, 2007). EUROPARC (2013) avers that cooperation with local administration agencies, tourism agencies, educational institutions, support organisations and nature protection NGOs is considered extensive and successful, which has led to an increased acceptance of the parks and their general aims in recent years.

From the above research examples, it can be argued that the issue of acceptance has been neglected in the

development of NPs, especially concerning emotional resistance to restrictions. While some regulations obviously affect economic activities like forestry, others like collection of wild berries and mushrooms restrict traditional ways to enjoy nature. Cooperation with local and regional partners could be an effective strategy for increasing acceptance.

To address the shortcomings of the federal structure, EUROPARC Deutschland aimed to connect professionals from all three categories of large-scale protected areas and nature NGOs. Since 2005, it has branded them together as Nationale Naturlandschaften (national natural landscapes) in cooperation with the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, many of the federal states and more than 20 NGOs[5]. Germany has a highly developed system of charitable organisations. The two biggest national nature protection and environmental NGOs have about 500,000 members each; many others are active on a local and regional level. Branding, evaluation, publicity and research activities by EUROPARC are a successful example of co-management between several levels of administration and NGOs.

Parks try to make up the shortfalls in funds and personnel through long-term volunteers, cooperation with nature protection NGOs and local communities (EUROPARC, 2013). The long-term volunteers offer an important source of young, engaged staff for visitor centres and other educational activities (Funck, 2017). Although the volunteer activity in nature protection in Germany dates back to the 19th century's bird monitoring, it has been given an official role in federal and state law as *Ehrenamt*, an expression that designates honorary officials. Another important form of volunteers are participants in the 6 to 18 month-long Volunteer Ecological Year (*Freiwilliges Ökologisches Jahr*, FÖJ), created in 1993 under federal law but, once again, is run under the responsibility of the states (Haack, 2006). All three forms of voluntary engagement rely heavily on nature protection NGOs for organisation and recruiting. The important role of NGOs might be one of the reasons why private sector involvement in NPs is still in the development phase.

Concerning cooperation with the private sector, the idea of private sponsorship for NPs is relatively weak in Germany. Six private companies support EUROPARC as a national organisation with materials and funds[6] . As a form of mutual benefit, many individual parks have established so-called 'partner-initiatives' with local or regional tourism businesses since 2000. These contracts between park administration and tourism businesses aim to increase environmental awareness among tourists, increase regional acceptance of the parks and promote regional development; businesses benefit from using the NP brand. In 2012, 12 parks established initiatives with 564 partners, mainly in accommodation and gastronomy (Hoffmann, 2014).

Co-management in Japanese NPs

As management of NPs is divided between several types and levels of administrative agents, collaboration and coordination is required between them. However, no institutionalised framework exists for this purpose, except those that are also designated as a World Heritage site. In this case, coordinating structures are established and may include some private sector organisations (Tsuchiya, 2014).

Realising that the mixed-use system of NP management in Japan requires collaboration between stakeholders (Jones, 2013), the Natural Parks Law was amended in 2002 to allow the delegation of park management to local non-profit organisations (NPOs) (Kato, 2003; MOE, 2002). This made it possible for community-based organisations to become more involved in park management (Hiwasaki, 2005), and improved public participation. Local community actors are usually involved in conservation activities, such as park volunteers, local nature guides, interpreters and members of local conservation NGOs. However, negative effects are evident in the case of Yakushima. Enforcement of conservation laws has been difficult due to the existence of conflicting interests among various stakeholders (Adewumi, 2017).

Box 2 Stakeholder involvement in co-management in Japanese NPs

Due to overlapping land ownership, various actors are involved in NP management at local and regional level. However, there exists no institutionalised framework for co-management among these groups. To encourage the involvement of local NPOs in park management, the Natural Parks Law was amended in 2002. This has facilitated the involvement of local actors in park management through activities such as park volunteers, local nature guides, interpreters and members of local conservation NGOs. They are usually responsible for clean-up activities in park sites, providing visitor guidance and supervision, repair and maintenance of facilities, among others.

The involvement of the private sector is becoming increasingly prominent. For example, in the case of Nikko NP, a public-service corporation was established with the aim of park cleaning, providing visitor guidance and supervision, facilities repair and maintenance, and research (Sheppard, 2001). The public-service corporation was established through partnership between prefectures, cities and neighbouring towns, and an electricity company and other related business enterprises were established in support of the park.

Park volunteers play an important role in the management of NPs. The current volunteer system was established in 1985 (Kim & Yui, 2001). The park volunteers fill educational and basic park maintenance roles. About 1,520 volunteers were registered in 38 NPs in 2016 (National Park Research Group & Nature Parks Foundation, 2017). However, the park volunteer system has faced issues of ageing volunteers, lack of funding and heavy responsibilities (Miyamoto & Funck, 2016).

The Natural Parks Foundation, established in 1978 as the Natural Parks Beautification and Management Foundation, plays a significant role in park management. The functions of the foundation are to help: (1) conserve and manage the natural environment of NPs and quasi-NPs; (2) maintain and manage park facilities; (3) provide information to visitors; and (4) support volunteers' activities and the volunteer system (Kim & Yui, 2001; MOE, 2015).

Co-management of NPs in Nigeria

Due to the creation of NPs and especially the enforcement of Decree No. 36 (1991) that prohibits hunting, exploitation of forest resources and trespass into park areas, local people have been deprived of their source of livelihood. This led to illegal exploitation of resources in the park, threatening the existence of the NPs (Adewumi, 2017). An approach was proposed to address the problems associated with excluding human activities from the park. Although the NNPS decree of 1999 states that communities are to be represented on National Park Management Committees and

Local users in Tram Chim National Park © Van Hoang Nguyen

partnerships, it does not specifically give communities rights to forest resources within NPs.

In Nigeria, local people are not fully involved in making decisions because their representatives or the government usually make decisions on their behalf (Eneji et al., 2009). Neither do they benefit directly from tourism within the park. This is evident in Gashaka-Gumti NP where tourism businesses such as chalets, restaurants and souvenir shops are provided by the park, making it difficult for the locals to benefit from tourism and interact with tourists (Adewumi, 2017). In principle, local artefacts should be produced and supplied to the NP by local people so as to serve as a source of revenue for the locals, but this is not the case in Nigeria.

Nevertheless, efforts are being made by each NP to improve the standard of living of communities living within and around the NPs through the community support zone development programme. The community support zone development programme embarked upon by each NP has been one of the approaches employed to achieve the protection and conservation of park resources and attain sustainable development in rural areas (Wahab & Adewumi, 2013). Most NPs in the country provide funds and materials to assist in the completion of community-sponsored projects, provide healthcare services, educational facilities in primary schools, boreholes and reinstate major access roads

Box 3: Stakeholder involvement in co-management in Nigerian NPs

Co-management is a relatively new concept in Nigerian NPs due to the top-down management system adopted in the country. Local communities are not included in decision-making or tourism-related businesses within the parks. To improve the parks' relationships with the host communities, and to support the well-being of the local people, community support zone development programmes were established. NGOs play a significant role in Nigerian NPs by collaborating with the NNPS to support conservation and empowering the local communities. The private sector is rarely involved in park management in Nigeria. Hence, nature conservationists and tourist investors are facilitating private partnership with NPs in the country.

within host communities (Ewah, 2010; Odebiyi et al., 2015). Furthermore, Gashaka-Gumti NP provides a vocational training centre so as to reduce dependence on the illegal exploitation of park resources (Adewumi, 2017), while Kainji Lake NP provides funds for micro-projects to reduce the poverty level of local communities (Wahab & Adewumi, 2013).

NGOs have played a significant role in the establishment and management of NPs in Nigeria. Nigerian Conservation Foundation (NCF), which is Nigeria's oldest conservation NGO, established in 1982, was instrumental in the creation of the NNPS and NPs in the country. A 10-year Memorandum of Understanding between Wildlife Conservation Society (WCS) and NNPS was signed in 2011 to help protect endangered wild animals such as elephants (Loxodonta africana), chimpanzee (Pan troglodytes), gorilla (Gorilla gorilla diehli), Preuss's guenon (Cercopithecus preussi) and Preuss's red colobus monkey (Procolobus preussi). Smaller NGOs such as Pandrillus, the Nigerian Forest Elephant Wildlife Survey and Promotion group (NFEWSPG), the Yankari Initiative, Fauna and Flora International, among others, have helped in the survival of many conservation initiatives in the country. Also, Gashaka Primate Project (GPP), funded by the North of England Geological Society, London, through Chester Zoo, has, since 2000, been supporting the conservation of primates in Gashaka-Gumti NP and been involved in improving public health and empowering the local economy[7].

Although the law governing the NNPS is open to private sector participation, only a few have taken the initiative. This is because only a few private sector companies have the resources to commit sufficient funding to conservation in Nigeria. In 2014, some nature conservationists and tourist investors organised a workshop with the aim to promote private partnership involvement in the Nigerian NPs. Action plans were drawn up to help in (1) reviewing the law establishing the NNPS to ensure the possibilities of a working relationship between the NNPS and potential investors in some parks; (2) collection of data and information on the state of the parks and the production of report findings; and (3) broad stakeholder engagement and development of a mechanism for fund raising among others (NCF, 2014).

Co-management from the perspective of Vietnamese NPs

According to the Law on Forest Protection and Development (The GOV, 2004), the management of Protection and Production Forests could belong to different sectors including state or private sectors, organisations or households. However, the NPMB organises ecotourism development in NPs in collaboration with other institutions and companies from the state or private sectors.

The management model regarding ecotourism and/or recreation activities in protected areas has been developed since 2006. Based on the principle of SUFs policy, the NPMB has the right to manage ecotourism activities within a park under the following three models: (1) the state-management model, in which ecotourism activities are managed by the NPMB; (2) the private-management model, which involves leasing forestland to private groups or companies to organise ecotourism businesses; and (3) the joint-venture model, which includes existing associations and other forms of investment in ecotourism activities (Ly & Xiao, 2016). In the Vietnamese NPs' management system, the state-management model is still dominant although several NPs have started to apply the co-existing management model to meet development and conservation needs.

The involvement of volunteers and the private sector in Vietnamese NPs' management is still new. Recently, Con Dao NP[8] and Nui Chua NP[9] collaborated with International Union for Conservation of Nature (IUCN) to call for volunteers' engagement in sea turtle conservation. Short trips were organised for participants to experience sea turtle conservation in these two NPs.

Box 4: Stakeholder involvement in co-management in Vietnamese NPs

In Vietnamese NPs, stakeholders are mainly involved in park management through ecotourism development activities. Due to the development of the ecotourism management model in 2006, the NPMB often collaborates with other institutions and companies of the state or private sectors for ecotourism development. The involvement of volunteers in Vietnamese NPs management is still new. They are mainly involved in sea turtle conservation in collaboration with NPMB and IUCN. While there has been a long history of NGOs' involvement in Vietnamese NPs, their involvement is mainly related to grants for research and conservation purposes. Local communities are usually involved in running ecotourism ventures developed in the parks and benefit from Sustainable Resource User Groups, allowing the communities to sustainably utilise resources within the park. These involvements are aimed at supporting poor households within the parks.

These activities started in summer 2016 and are ongoing projects that involve volunteers in Vietnamese NPs. A rare case of private sector involvement in Vietnamese NPs' management is that of Phong Nha–Ke Bang NP, where two private companies, Oxalis Company and The Truong Thinh Group, operate tourism activities in the park (Ly & Xiao, 2016).

Many NGOs and other institutions such as IUCN, the World Bank, World Wildlife Fund (WWF), Swedish International Development Cooperation Agency and Danish International Development Agency have been engaged in Vietnamese NPs for the last decades. However, their involvement is mainly related to grants for research and conservation purposes. Tram Chim NP is a good example of the collaboration between the NPMB, local community, private investors and NGOs in ecotourism and sustainable management in the park.

Tram Chim NP established the Centre for Ecotourism and Environmental Education for managing ecotourism activities in 2003. This offered opportunities for people who can invest financially in tourism services in the park under a scheme called the Tourist Boat Investment System (TBIS). The Tram Chim NPMB introduced the TBIS programme in 2014, to facilitate collaboration between local residents, tourism investors and the NPMB1. Investment in the TBIS is open to both local people and the park officers, as "boat investors". Local poor households are employed as both boat drivers and tour guides.

In addition, Tram Chim NP has established six "Sustainable Resource User Groups". With the support of the Coca-Cola Company and WWF, wetland resources are co-managed with local communities. This allows local communities to sustainably utilise resources within the park's boundaries (WWF, 2011). To benefit from these programmes, the following conditions must be met: (1) households living near the park; (2) poor or near poor households; (3) households who contributed to the revolution during the wartime.

Generally, tourism development and sustainable natural resources' exploitation in the case of Tram Chim NP and its policy aim to support the poor and communities surrounding the park. However, the number of

Table 2. Principal challenges hindering co-management in the four countries

Case study	Challenges hindering co-management
Germany	Weak restrictions on use of natural resources in the parks due to weak national influence and strong regional interests The opinions of residents are usually incorporated into planning system at a very late stage
Japan	Multiple and overlapping conservation agencies within the parks Weak restrictions for the protection and conservation of NPs Inharmonious relationship between stakeholders because most of them have different objectives Difficulty in locating responsibilities due to the division of management between different authorities on the national, regional and local levels
Nigeria	Top-down management approach has hampered local level involvement Isolation of NPs from local communities makes them reluctant to accept conservation and hostile to NPs Reluctance to incorporate local people in park projects and management because it is deemed as time-consuming The long process of information transfer from the top to local people might hinder immediate actions from being taken
Vietnam	Responsibilities of organisations engaged in NPs' management seem not to be clearly designated Overlap in management policies of NPs with other protected areas Conflicts between local users and NPs' management hinders co-management

participants in these activities is still relatively small, with only a handful of low-skilled jobs available.

CHALLENGES OF CO-MANAGEMENT IN THE FOUR COUNTRIES

In German NPs, two main barriers to co-management are a weak national constituency and conflicts with local people (Table 2). Although state management allows for the adjustment of management structures to regional conditions, it has hampered restrictions on competing land (and water) uses and led to a lack of funding (Schumacher & Job, 2013), while also carrying the risk of regional actors promoting NPs for mainly economic benefits (Job, 2010). However, the nationwide evaluation conducted by EUROPARC (2013) was a first step in setting common criteria for NP management.
Concerning acceptance of NPs, Schumacher and Job (2013) noted that a high degree of local acceptance is visible in the oldest parks (where economic benefits have become visible over the years), parks in former East Germany (because they contributed to the image improvement of little known areas), and the newest parks that were created with better consensus building. However, von Ruschkowski (2010) emphasises the need for better personal communication with local stakeholders and less reliance on formal requirements for participatory processes. Better regional governance remains an unfinished task, maybe because administrations have been relying on Germany's highly developed regional planning system that does not incorporate residents' opinions until at a very late stage.

The underlying challenge in co-management in Japanese NPs is its multi-use system (Table 2). This system is characterised by conflicts of interest between stakeholders (Hiwasaki, 2007). Likewise, the relationships between MOE and other stakeholders are not harmonious because most of these stakeholders have different objectives. According to Hiwasaki (2007, p. 111), these divergent objectives are obvious in situations where "one agency is intent on conserving the resources in a given area, another may well be busy undermining them under the pretext of regional development". In Yakushima NP where there are overlapping conservation bodies and various government stakeholders, it is obvious that stakeholders are not only poorly organised but also oppose each other at times. This has sometimes led to obstruction and criticism of each other and rebuffing each other's rights (Kato, 2000). The multi-layer management structure of Japanese NPs makes it difficult to allocate responsibilities. Therefore, local stakeholders struggle to find the right person to respond to their calls (Miyamoto & Funck, 2016). Furthermore, the limited land ownership of MOE makes it difficult to impose adequate regulations on NPs. Hence, NPs in Japan have weak restrictions and depend on self-regulation for protection and conservation (Hiwasaki, 2007). Volunteers have to cover the resulting gaps in management without, however, being involved in planning and management decisions (Miyamoto & Funck, 2016).

In the case of Nigeria, co-management has been hindered by the isolation of the NPs from local society (Table 2). The top-down approach adopted by Nigerian parks has hampered local level involvement in planning and development but followed the nation's centralised form of government. As NPs in Nigeria are found within underdeveloped communities that depend on local natural resources for their livelihood, their encroachment into NPs in order to provide for themselves is exacerbated by their exclusion from park management (Ewah, 2010). Similarly, the direct funding of parks by the Federal Government has limited the interest of park managers in communicating with the states, local governments and the communities. This has resulted in the loss of local support for NPs (Hassan et al., 2015).

Another fundamental problem plaguing co-management in Nigeria is the fact that local people often perceive conservation as a hindrance to development. They are reluctant to accept conservation and are hostile to NPs because they see them as a means of depriving them of their livelihood (Adewumi, 2017). Unless the park management actively involves local communities by giving them a certain degree of control, it will be hard for them to view conservation as representing their socioeconomic and cultural interests (Eneji et al., 2009).

In the case of the Vietnamese NPs, management involves several state organisations (Table 2). Therefore, the responsibilities of those engaged in NPs' management seem not to be clearly designated, except the role of the NPMB. Especially since some other types of protected areas such as Ramsar Sites, Marine Protected Areas and Biosphere Reserves often overlap with NPs, so that management policies may overlap or become confused. Since NPs in Vietnam belong to SUFs, private sectors and communities are faced with the barriers of participating in management unless they are offered opportunities in ecotourism projects.

Perhaps, one of the most serious challenges of Vietnamese NPs' management is the conflict between local users and NPs' management staff. Similar to the situation in Nigeria, the control of human activities in NPs is difficult because many people are dependent on

Table 3. Comparing challenges of co-management in the four countries

Co-management challenges	Countries affected by the challenges
Unclear responsibilities due to overlapping conservation agencies within the parks	In both Japan and Vietnam, the responsibilities of conservation bodies engaged in NPs' management are not clear, because other protected areas overlap with the national park. Hence, management policies within the parks also overlap and are sometimes confusing.
Weak institutionalised framework /or national constitution	In Japanese NPs, there is no institutionalised framework for collaboration between the several administrative agents involved, thereby leading to poor organisation among the agents and conflicts of interest. Since the federal states are responsible for park designation in Germany, there is no national system on how to involve other stakeholders in park management.
Weak restrictions for park protection	NPs in both Germany and Japan are faced with the challenges of weak restrictions for park protection and conservation of resources within the parks.
Degree of dependence on local natural resources	Level of community dependence on natural resources within NPs in Nigeria and Vietnam is relatively high, resulting in conflicts between parks and communities and hindering acceptance of conservation and co-management.
Centralised form of park management	The centralisation of park management in both Nigeria and Vietnam has made it difficult for the private sector and communities to directly participate in park management.

natural resources in these areas. Therefore, there have been many cases of illegal logging in NPs in Vietnam. It is necessary to practise and apply suitable alternatives, for which community-based management has been suggested. Recently, co-management in Vietnamese protected areas has been widely discussed. This new method should be broadly applied to NPs throughout the country.

The aim of this paper was to identify forms of co-management in Germany, Japan, Nigeria and Vietnam and discuss the challenges each country faces in achieving co-management of the park by reviewing the existing literature on NP management (Table 3). Characteristics of co-management in the four countries were summarised, with an emphasis on management by national-regional-local government, and how local stakeholders, NGOs, volunteers and private sectors are involved in park management. Co-management in the four countries is affected by factors such as the stakeholders responsible for park management, national policy governing the parks and land ownership.

The most significant difference regarding co-management is that various stakeholders, such as volunteers, NGOs and local communities, play important roles in park management in both Germany and Japan, while NGOs are the main stakeholders involved in Nigeria and Vietnam. In Japan and Germany, park volunteer systems are well established and cover the shortfalls in funding and personnel by supporting park administration. The idea of involving volunteers and the private sector is just starting in Vietnam, with volunteers' involvement limited to sea turtle monitoring and the private sector to ecotourism activities only. Although NPs are established and managed by the national and/or federal state governments, we are of the opinion that incorporating other stakeholders, such as local communities, local governments, NGOs and the tourism industry, can give them a sense of ownership and responsibility. This sense of ownership will make it easier for local people to comply with the policies and guidelines governing the NPs, especially in Nigeria and Vietnam. Just as in the case of Germany where EUROPARC plays a significant role in co-management between several actors, it is recommended that similar conservation agencies be established to encourage collaboration and partnership between community and other stakeholders.

It is important to state that this review was intended to elucidate the successes and challenges in co-management adopted in each case study. The present study may assist other countries in adopting some of the

productive approaches discussed to improve their management system and foster effective conflict resolution in and around NPs.

ENDNOTES

[1]Data were collected based on interviews in December 2015.

[2]Bundesnaturschutzgesetz 2010. http://www.gesetze-im-internet.de/bnatschg_2009/BJNR 254210009.html#BJNR254210009BJNG000100000 (Accessed 28.6.2016)

[3]http://vietnamnationalpark.org/. (Accessed 29.7.2016)

[4]It is also translated into English as "Landscape conservation areas"

[5]EUROPARC Deutschland: Geschichte. http:// www.europarc-deutschland.de/ueber-uns/ geschichte (Accessed 27.6.2016)

[6]EUROPARC Deutschland: Förderer und Sponsoren. http://www.europarc-deutschland.de/ueber-uns/ forderer-sponsoren (Accessed 7.7.2016)

[7]http://www.ucl.ac.uk/gashaka/building/

[8]http://cmsdata.iucn.org/ downloads/20_4__thong_bao_tuyen_tnv_bao_ton_rua_ bien_2016_con_dao.pdf (in Vietnamese, accessed 18.10.2016)

[9]http://cmsdata.iucn.org/ downloads/10_5__chng_trinh_tinh_nguyn_vien_vqg_nui _chua.pdf (in Vietnamese, accessed 18.10.2016)

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RESUMEN

Los parques nacionales se establecen con el propósito de proteger importantes entornos naturales. Sin embargo, han surgido innumerables conflictos provocados por la introducción de regulaciones que restringen a las comunidades locales el uso de recursos dentro de los parques nacionales. El objetivo del presente documento es examinar las formas en que los parques nacionales en varias naciones recurren a la colaboración de las partes interesadas en la gestión de parques y la resolución de conflictos, centrándose en cuatro países: Alemania, Japón, Nigeria y Vietnam. Los métodos adoptados incluyeron una revisión de la literatura disponible en varios idiomas, el análisis de documentos administrativos y entrevistas informales. Mostramos que los desafíos que obstaculizan la gestión conjunta en los cuatro países abarcan desde responsabilidades poco claras de los distintos actores hasta marcos institucionalizados débiles y la centralización de la gestión de los parques. El resultado implica que cada país puede aprender diferentes técnicas de cogestión de otros países con miras a enfoques más productivos hacia la gestión de parques nacionales y la resolución de conflictos en y alrededor de los parques nacionales.

RÉSUMÉ

Les parcs nationaux ont été créés dans le but de protéger les milieux naturels de haute importance environnementale. Cependant, de nombreux conflits sont apparus du fait de l'instauration de dispositions empêchant les communautés locales d'avoir accès aux ressources des parcs. L'objectif de cet article est d'examiner la manière dont des parcs nationaux de divers pays travaillent en collaboration avec les parties prenantes dans la gestion des parcs et la résolution des conflits. Notre étude s'est axée sur quatre pays: l'Allemagne, le Japon, le Nigeria et le Vietnam. Les méthodes retenues comprennent un examen de la littérature disponible dans plusieurs langues, une analyse de documents administratifs, ainsi que des entretiens informels. Nous montrons que les problèmes qui entravent la cogestion dans ces quatre pays sont variés, allant d'un manque de clarté dans les responsabilités des différents acteurs, à la faiblesse du cadre institutionnel, en passant par la centralisation de la gestion des parcs. Le résultat démontre que chaque pays peut apprendre différentes techniques de cogestion provenant d'autres pays, conduisant ainsi à des approches plus productives en matière de gestion et favorisant la résolution des conflits à l'intérieur et autour des parcs nationaux.