erosion and 100 m of land loss were measured at various coastal locations from the landfall area, attesting to the cyclone’s extraordinary strength (Nature News 2008, Fritz et al. 2009). According to official estimates, the cyclone left around 138,400 people dead or missing; however, as a result of development measures undertaken in the delta area in the preceding years, numerous new villages had sprung up and a large number of temporary workers were employed, so the number of fatalities may well be as high as 200,000 (TCG 2008a: 3, Maung Maung Aye 2010). Estimates of the number of people affected by the loss of family members, destruction of livelihoods and critical infrastructure, loss of food reserves and livestock and at least partial collapse of socio-economic structures vary considerably. Many authors put the figure at around 2.4 million people (International Crisis Group 2008: 3, TCG 2008b: 3, Lateef 2009: 106). Based on high-resolution LandScan 2006-GRID data for a small-scale estimate of the population affected by Cyclone Nargis (Kraas 2009), it is possible to extrapolate a figure of at least 1.4 million people, plus an additional but unknown number of migrants, most of whom arrived after 1988 during the development of the delta. The worst storm damage and flooding occurred in the southeast Ayeyarwady Delta to the east of Labutta, particularly in the regions around Bogale, Pyapon and Kyaiklat and in the southwestern regions around megacity Yangon; in the coastal areas which sustained the highest level of damage, 85% of villagers were affected. After the disaster, some 800,000 people had to be resettled, mainly in adjacent regions to the north (International Crisis Group 2008: 3).

LANDSLIDES

Another consequence of heavy precipitation is rainwash on the many steep slopes, particularly in the mountain areas of Chin State and in Shan State, leading to landslides and frequently blocking transport routes and causing damage to farmland and settlements (Kraas 2014a). The damage is especially severe where the vegetation cover has been destroyed, whether through agriculture or cuts made for the construction of transport routes.

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Step-like landslide in Hakha, Chin State in August 2015
ENVIRONMENTAL PROTECTION

RICH BIODIVERSITY

Myanmar is one of the most species-rich regions in the world and is one of 25 global ‘hot spots of biodiversity’ (Myers et al. 2000). It is regarded as the last country in Southeast Asia containing large areas that have not been surveyed for biodiversity, and could harbour ~5% of mammal species (Corbett / Hill, 1992) and ~10% of bird species of the world’ (Hla Naing et al. 2015: 376; also see Avibase 2016). Its spectrum of ecotopes ranges from alpine meadows, dry forests and rainforests to inland lakes, flood plains, river deltas, coasts and estuaries, coral reefs and island archipelagos. The richest biodiversity is found in northern Kachin State (Lasi Bawk Naw 2007), in the forests of Kayin State and across large areas of Tanintharyi Region.

Myanmar is known to have about 7,000 plant species, of which 1,071 are endemic. Recorded number of vegetative species in the natural forests of Myanmar has reached 1,347 species of big trees, 741 species of small trees, 96 species of bamboos, 1,696 species of shrubs, 36 species of rattans and 841 species of orchids’ (MoF 2005: 18). Kress et al. (2003) compiled a plant checklist, which includes 11,800 plant species. The Ministry of Forestry species list runs to more than 300 mammal, 370 reptile and 1,089 bird species, including around 50 mammal, 30 bird and 25 reptile species found on the CITES Checklist (Convention on International Trade in Endangered Species of Wild Fauna and Flora) or the IUCN Red Data List of Threatened Species (Tun Yin 1993: 275, Kyaw Nyunt Lwin/Khin Ma Ma Thwin 2005, Avibase 2016). Examples are wild elephants (protected since 1879; Leimgruber et al. 2011), tigers, leopards, bears, rare species of primates and deer and a large number of bird, reptile and amphibian species, many of them endemic.

LOSS OF FORESTS

Due to population growth and development pressure, including the granting of forest and mining concessions to investors from neighbouring countries, land degradation has occurred across much of Myanmar. Contributory factors are (legal and illegal) forest clearance, growth in fuelwood use, expansion of agricultural land and shifting cultivation, over-grazing, large-scale mining activities, expansion of settlement areas and infrastructure, and industrialisation (albeit mostly small and medium-sized enterprises). The impacts are particularly severe across extensive areas of the once forested mountain regions in Rakhine and Bago Yoma and in Chin, Kachin and Shan State and Tanintharyi Region, with this deterioration being observed mainly since the introduction of a market economy from 1988. The once vast mangrove forests in the southern Ayeyarwady Delta, which still covered 385,930 ha in 1990 (MoF 2005: 11), have shrunk by almost 50% as a result of accelerated development in the Ayeyarwady Delta (Heymann/Löffler 1997; see also: Liu et al. 2015). Key factors include not only the expansion of agricultural land but also mangrove clearance for fuel-
wood: as recently as 1990, 84% of the country’s energy supply for cooking, lighting and small industries came from firewood and charcoal – even in the Yangon metropolitan area (Zin Nwe Myint 2004, MoF 2005: 11).

HISTORY OF PROTECTION AND CONSERVATION

Forest and wildlife conservation was practised to some extent under Myanmar’s kings. In 1752, under King Alaungphaya, all teak trees were declared to be royal property and royalties were demanded for their felling (Mehm Ko Ko Gyi/Saw Win 1997). In 1859, King Mindon ordered that ‘threat-free’ forest areas be created in ‘Yadanapon Nepyidaw’ near Mandalay (in Myanmar: bemetaw) (Tun Yin 1993: 275, MoF 2005: 18, Aung Myint 2007). For religious reasons, the grounds of the monasteries have traditionally served as conservation areas: ‘...in addition to the notified areas as sanctuaries, the monastery compounds and the precincts of the pagodas are likewise declared as sanctuaries which were known as A-ba-ya Hta-na’ (Tun Yin 1993: 275).

Systematic scientific forestry and the introduction of forest conservation measures began under Sir Dietrich Brandis (1824-1907), a German botanist working for the British. As Superintendent of Forests in Pegu from 1856 and head of the British forestry administration in all of Burma from 1858 until 1862, he reformed the system of forestry, reforestation and forest management across what was then British Burma (Hesmer 1975).

Legislation was put in place from the end of the 19th century onwards (an overview of the various laws can be found in Myint Aung 2007: 193). In contrast to the traditional religious principles, wildlife and forest conservation served the purpose of economic utility: the aim was to ‘conserve the animals as game’ (Tun Yin 1993: 275). The Elephant Preservation Act was adopted in 1897, followed by the Burma Forest Act in 1902 and the Wild Birds and Animal Protection Act in 1912. The Burma Wildlife Protection Act, adopted in 1936, was replaced by the new Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law in 1994 (MoF 2005: 19). To some extent, these laws incorporated traditional rules: the Wildlife Protection Act, for example, prohibited ‘hunting within 200 yards of the compound of an inhabited Buddhist monastery or of a religious edifice for which trustees have been appointed’ (quoted from Myint Aung 2007: 189).
The first conservation areas, established from 1918, were the Pyin Oo Lwin Bird Sanctuary and the Shwe U Daung and Pidaung Wildlife Sanctuaries (MoF 2005: 18-19; list of dates of establishment: Myint Aung 2007). However, it was only with the FAO-UNDP National Conservation and National Parks Project (1981-1985) that the foundations were laid for systematic surveys and inventories and the establishment of further national parks and nature reserves, whose purpose, among other things, was to promote more connectivity between 10 biogeographical regions (MoF 2005: 19). In addition, a separate Nature and Wildlife Conservation Division (NWCD) was set up in the Ministry of Forestry. The National Commission for Environmental Affairs (NCEA), an interministerial body responsible for coordinating national environmental policy, was created in 1990 (Myint Aung 2007: 192).

CURRENT PROTECTION

At present, seven national parks, one marine national park, three nature reserves, 29 wildlife sanctuaries and bird sanctuaries have been designated or proposed across the country (41 protected areas are listed in MoPF 2016: 323-325). There are also various wildlife and mountain parks, one wildlife reserve, protected areas and elephant camps. Most conserve terrestrial habitats; very few include inland wetlands, mangrove and marine habitats and caves, with the result that some ecosystems are underrepresented (Myint Aung 2007). In addition to the Botanical Gardens in Pyin Oo Lwin, zoos exist in Yangon, Mandalay and Nay Pyi Taw. The largest conservation area extends across 15,256 square kilometres; however, the majority (14 parks = 42% of all conservation areas) range in size from 51 to 500 square kilometres; only five are larger than 1,000 square kilometres. Moyingyi, Indawgyi and Inle Lake Wildlife Sanctuaries are wintering sites for migratory waterfowl (Myint Aung 2007: 195) but most conservation areas are too small to benefit migratory species.

Special protection arrangements are in place for some species. So far, 39 mammal, 50 avian and nine reptile species have been completely protected, and 12 mammal, 43 avian and six reptile species have been protected (Mehm Ko Ko Gyi/Saw Win 2005: 185). Other species enjoy seasonal protection. Nonetheless, a number of species have now died out, including the Giant Panda (Ailuropoda melanoleuca) and the Rhinoceros (Rhinoceros sondaicus, Rhinoceros unicornis, Dicerorhinus sumatrensis) (Tun Yin 1993: 102, 283).

Most conservation areas are increasingly under threat from the expansion of agriculture, mining and infrastructure. Specific problems include the lack of law enforcement ('paper parks') and management plans, understaffing and inadequate training, (partly illegal) logging and mining, (partly clandestine) hunting of game, poaching, natural and anthropogenic forest fires during the dry season, effects of grazing and removal of forest products, poor border demarcation, underfunding, low level of public awareness to sustainability (Webb et al. 2012 and 2014), low prioritisation of conservation in the context of economic modernisation, the wildlife trade (flora and fauna), mainly across the borders with China, India and Thailand, and, lastly, conflicts in peripheral regions (Hemley/Mills 1999, Myint Aung et al. 2004, Myint Aung 2007: 195-202, Tordoff et al. 2012). New threats include the planned expansion of hydroelectric power generation and several dam projects, posing a risk to riverine landscapes (Taft/Evers 2016), and the challenges associated with climate change (Schmidt 2012, Rao et al. 2013).

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