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Current Status of Asian Elephants in Myanmar

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Introduction

The vast teak forests and elephants of Myanmar are legendary and have played critical roles in the country's history, culture and economy. Elephants are highly revered and are a symbol of power and good fortune. Elephants also have been a significant workforce in the country's logging industry.

Elephant protection was initiated through the Elephant Preservation Act of 1879, and expanded by subsequent laws including the Burma Wildlife Protection Act of 1936 (revised 1956), and the Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law in 1994. Wild elephants are now considered a completely protected species (Lair 1997; Myint Aung 1997; Uga 2000).

Although Myanmar's forests have long been considered an Asian elephant stronghold (e.g. Santiapillai & Jackson 1990), recent assessments revealed that this perception probably was overly optimistic and that populations have declined considerably during the last century (Table 1). In 2004, the Nature and Wildlife Conservation Division (NWCD) and the Smithsonian Institution organized a workshop to assess the current status of wild elephants and compile the most recent data (Leimgruber & Wemmer 2004). Together with a range-wide mapping workshop hosted by the IUCN Asian Elephant Specialist Group in 2008 in Phnom Phen (Hedges *et al*. 2009) these two assessments provide the most recent information on Myanmar's elephants, their status and distribution.

Wild elephants

Past elephant distribution

Historically most of Myanmar constituted prime elephant habitat, as the country was relatively sparsely populated with vast stretches of forested areas. Traditional shifting agricultural practices likely represented habitat improvements for elephants that generally prefer feeding in lightly disturbed forests (Fernando & Leimgruber 2011). The only elephant-free areas must have been restricted to densely populated settlements such as Mandalay and Yangon.

British occupation and colonization efforts in the 1800s and 1900s that placed high emphasis on large-scale timber and teak extraction resulted in the first significant pressures on wild elephant populations. During this period wild elephants were captured for use as draft animals in logging operations.

As many as 100-400 wild elephants were transferred from the wild for use in the logging industry annually (Toke Gale 1974; Olivier 1978; Caughley, 1980; Lair 1997; Myint Aung 1997; Leimgruber *et al*. 2008) utilizing traditional capture methods, mostly Keddahs. During a Keddah, wild elephants are driven into a funnel-shaped enclosure and then transferred one-by-one to a crush to be broken in (Williams 1950; Toke Gale 1974), usually through a combination of physical restraint, beatings, and food deprivation. Though we do not know of any published data on capture mortalities during a Keddah, it must be assumed to be high, probably at least 30%

(Myint Aung 1997), and potentially higher for adult elephants that resist.

Despite such significant removals of wild elephants for logging camps, wild populations were large in the early 1900s and, based on expert estimates, remained high well into the 1960s and 1970s (Table 1). However, recent efforts to model viability of wild and captive elephants in Myanmar suggest that removals at such pre-war levels are not sustainable, especially not if populations are declining from habitat loss and other development pressures (Leimgruber *et al*. 2008). This is supported by more data that indicate significant declines in Myanmar's wild Asian elephants (Myint Aung 1997; Leimgruber *et al*. 2008).

Table 1. Estimates of Myanmar's wild Asian elephant population from 1933-2004.

Year	Estimate		Source	Cited by
1933	3000		A	B
1935	10,000		C	B
1935	5000		D	B
1945	6250	*	C	B
1945	6000		E	
1956-1960	9057		F	G
1960-1961	9660		H	
1962	6500	#	B	
1962	9050	*	I	B
1962	9057		F	H
1969-1970	7340		H	
1972	6000		J	
1974	8500		B	
1977	5000		B	B
1980	6008±1000		K	L
1980	3000		J	
1980-1981	5508		H	
1982	6560		M	G
1982	6560		N	O
1982	6520		P	Q
1990	3000-10,000		Q	
1990-1991	4639	º	R	
1991-1992	4115		R	
1996	5000		S	G
1999-2000	<4000		R	
2002	6000		T	
2003	4000-5000		U,V	
2004	<2000		W	

*Extrapolation; #Official figure as quoted by Hundley; ºExcludes Kayah State.

A = Peacock (1933); B = Olivier (1978); C = Tun Yin (1959); D = Smith (1944); E = Williams (1950); F = Wint (1962); G = Uga (2000); H = Tun Aung & Thoung Nyut (2002); I = Tun Yin (1973); J = Caughley (1980); K = Hundley (1980); L = Salter (1983); M = Thet Htun (1982); N = Ministry of Agriculture and Forests; O = Sukumar (1989); P = SRUB/MAF/WPSB (1982); Q = Santiaillai & Jackson (1990); R = Myint Aung (1997); S = Forest Department (1996); T = Mar (2002); U = Lynam (2003); V = Sukumar (2003a); W = Leimgruber & Wemmer (2004).

Current distribution

A range-wide assessment of remaining elephant habitat in 2003, demonstrated that Myanmar has more potential elephant habitat remaining than any other range country (~170,000 km^2, Leimgruber *et al*. 2003). However, relatively little of this habitat (7%) is protected and Myanmar's elephants live predominantly outside protected areas.

Although there seems to be abundant elephant habitat, elephant densities are very low throughout Myanmar. Indirect recce-surveys at Alaungdaw Kathapa National Park (AKNP) and Htamanthi Wildlife Sanctuary (HWS) showed that these protected areas support only 0.001-0.024 and 0.019-0.085 elephants/km^2, respectively. The total population estimate for AKNP ranged from 2 to 41 elephants and for HWS it was between 40 to 183 elephants. Estimates were based on three-years of data from fixed width recce-dung surveys and accompanying dung decay experiments. This observation is further supported by the difficulty of finding and observing wild elephants throughout Myanmar.

Areas with increased human-elephant conflict (HEC), such as parts of the Bago Yoma or Thabeikkyin Township near Shwe-U-Daung Wildlife Sanctuary (SWS) and Gwa Township south of Rakhine Yoma Elephant Sanctuary, may be the best places to observe elephants during the harvest season when aggregations of elephants take to regular crop raiding. It is not clear whether low elephant densities throughout Myanmar are a result of lower habitat quality, habitat loss, poaching, or removal of elephants for the logging industry. The lack of adequate comparative data

from other deciduous forest regions in adjacent range countries such as Thailand also makes it difficult to assess what the baseline for wild population levels should be.

To more systematically assess the status of wild elephants and to develop a national survey and action plan for the species, the Smithsonian Institution and the Nature and Wildlife Conservation Division jointly hosted the first *National Elephant Symposium and Workshop* in 2004 (Leimgruber & Wemmer 2004). The goal of the workshop was to bring together Myanmar's elephant experts to discuss and evaluate the status of the species, and to develop an action plan for the species. The workshop's 35 experts included park wardens and rangers, foresters, university researchers, elephant veterinarians and managers from Myanma Timber Enterprise (MTE), private elephant owners, and conservationists from national and international organizations. All experts had extensive experience in finding, observing and managing wild elephants as part of their work or research. The experts collaborated to delineate an updated range map for elephants in Myanmar and estimate population numbers based on their best knowledge.

The results from this workshop overlap with the results from the more recent IUCN range-wide mapping workshop for elephants, with one distinct difference. The 2004 workshop only included areas that experts agreed had elephants and had first-hand experience in observing elephants. Experts' assertion that elephants exist in the area was considered a confirmation. The IUCN workshop improved on these methods by also recording information about the quality of the range estimate (i.e. confirmed, possible, doubtful, former and recoverable). However, the results from both workshops did not differ much and we cannot find much indication that the geographic distribution has shrunk, though population levels within range areas may have declined.

Despite low densities, elephants are still widely distributed throughout Myanmar and are found in many of the hill regions surrounding the large central plains of the Ayeyarwaddy. However, overall population seemed to have declined significantly over recent decades and the total estimate provided by the expert group during the workshop was less than 2000 wild elephants. The best areas for elephants may be the far north and south of the country where also the fewest people are found.

SOUTHEAST: There are several known elephant populations (Fig. 1; Table 2). All of these populations are relatively small and are concentrated in large forest tracts along the Myanmar-Thailand border. There is an additional area in Karen controlled territory for which presence of elephant can be considered confirmed.

CENTRAL MOUNTAINS: Wild elephants were reported for eight relatively small areas in the Bago Yoma (Fig. 1; Table 2). Most of these populations are small and have to be considered remnant populations. However, several of these areas are connected by forest corridors that may allow individuals to move between subpopulations.

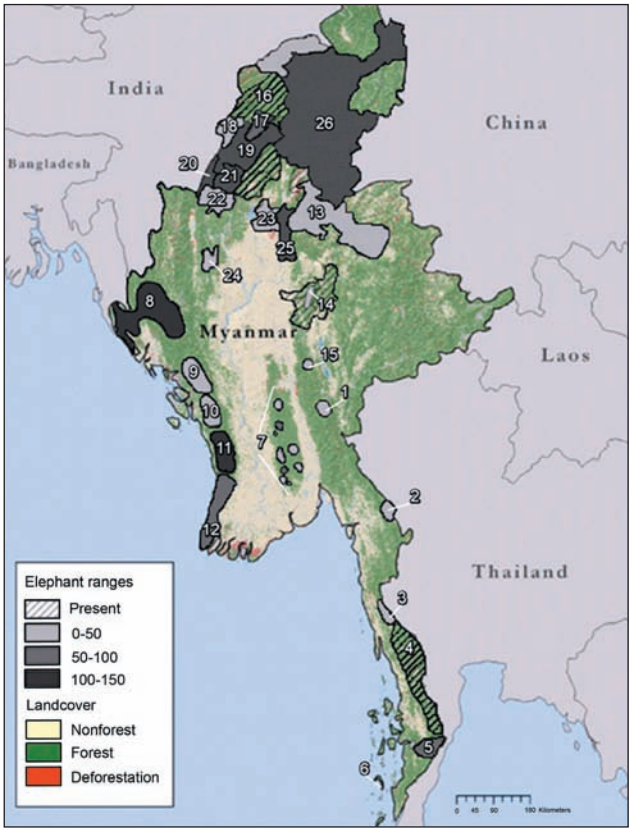

Figure 1. Status of wild elephant populations based on expert knowledge. Numbers correspond with those listed in Table 2.

Table 2. Estimates for wild elephant populations in Myanmar (Leimgruber & Wemmer 2004).

No.	Region	Area	# Elephants
1	SOUTHEAST	Kayah State	0-50
2		Karen (Kayin) State	0-20
		Mon State	0-50
3		Heinze-Kaleinaung Reserve Forest	<50
4		Myinmol Hkhat Mountain Area	unknown
5		Lenya-Mandaing-Manolon Area (Bo Kepyin & Tanintharyi)	100-150
6		Lampi Island	4
7	CENTRAL MOUNTAINS	Bago Yoma	200-240
8	SOUTHWEST (Rakhine State)	Mayyu	100
9		Ay	15
10		Taungup	30
11		Gwa Township	100-150
12		Thaboung, Pathein, Naguputaw Townships	100
13	EAST (Shan State)	Northern Shan	0-50
14		Myawaddy Area	unknown
15		Southern Shan —Southern Shan Pin Laung Area	12
16	NORTH - Sagaing Division	Kamti Township	Unknown
17		Htamanthi Wildlife Sanctuary	50-100
18		Lashe Township	0-50
19		Homalin Township	50-100
20		Tamu Township	<50
21		Phaungpyin Township	50-100
22		Mawleik Township	<50
23		Kanbalu Township	<15
24		Alaungda Kathapa National Park	<50
25	NORTH - Mandalay Division	Thabeikkyin & Simtku Townships	50-100
26	NORTH - Kachin State	Northern Forest Complex & adjacent areas	270

SOUTHWEST: The Rakhine Yoma region may be one of the strongholds for wild elephants in Myanmar (Fig. 1; Table 2). Elephants still appear to be abundant in inaccessible mountains and forests of the Rakhine stretching to the Mehu area and the border region to Bangladesh. The total number of remaining elephants may range between 350-400. In the Delta Region, wild elephants populations have completely disappeared, perhaps with the exception of remnant individuals in mangrove forest in Moulmyinkyun Township.

EAST: Shan State and the Shan Plateau make up most of these relatively densely populated and developed areas (Table 2; Fig. 1). Remaining elephant populations are very small and isolated. Conservation of these populations in the long run seems doubtful.

NORTH: The southern parts of this region border the edge of the central dry zone and are densely populated by people. Consequently, people-elephant conflicts are common. This is especially true for Mandalay Division where wild elephants remain in only two townships (Fig. 1; Table 2). In Thabeikkyin township for example, there may at times have been up to 40 wild elephants engaged in crop raiding. Other areas, although frequently degraded by mining and agricultural encroachment, may have had as many as 60 elephants. These are concentrated mostly in Chaunggyi Reserve Forest. People-elephant conflicts from these elephants occur most frequently in proximity of Zayakwin village. To reduce people-elephant conflict, MTE captured 41 elephants in 2003/2004 in this township (36 by Keddah and 5 via immobilization).

In contrast, northern Sagaing Division is less populated and developed and at least five townships have remaining wild elephant populations (Fig. 1; Table 2).

The Northern Forest Complex has to be regarded as one of the strongholds for wild elephants in

Myanmar (Fig. 1; Table 2). Based on information from the Forest Department in Kachin, the National Tiger Survey Team, and MTE data, there are only about five townships in the area that have no wild elephants. These include Naungmon, Putao, Khaungklanphu (formerly Kkaqpude), Chinare, and Injanyan. The group estimates the total number of wild elephant to be 270.

Threats to wild elephants

During the 2004 workshop, 35 experts also identified and delineated major threats to Asian elephants throughout Myanmar (Fig. 2). Habitat loss from agricultural conversion, hydro-electric developments, and mineral mining seems to be the greatest threat and often results in HEC. This type of habitat loss is on the rise and can be high locally (Leimgruber *et al*. 2003). There are three hotspots for habitat loss and HEC, including 1) the centrally located Bago Yoma, 2) the northern edge of Myanmar's Central Dry Zone, and 3) an area in northern Myanmar centered on Myitkyina and stretching from the headwaters of the Chindwin River across the forests to the Ayeyarwaddy. The number of human casualties from HEC in Myanmar, however, is low compared to South Asian range countries. Up to 12 people/year were killed in the late 1990s and early 2000s in Myanmar (Fig. 3A). HEC shows a strong positive correlation with annual deforestation rate at the state or divisional level in Myanmar (Spearman rank, $r=0.917$, $n=14$, $p<0.001$***; Fig. 3B).

The survival of Myanmar's wild elephants is tightly linked with the management and survival of the country's captive elephant population (Leimgruber *et al*. 2008). Recent population modeling demonstrated that Myanmar's captive elephant populations are not self-sustaining because mortality is too high and birth rate too low (Leimgruber *et al*. 2008). About 100 elephants need to be taken from the wild to supplement and sustain the captive herd. Such levels of removal can only be supported by wild populations that exceed 4000 animals.

Although little official information is available on live capture rates in Myanmar, incidental reports confirm that it has long been a practice to remove between 50-100 elephants from the wild each year. Often crop-raiding elephants are captured and transferred to captivity. To conserve wild elephants such practices need to be stopped and breeding in the captive population needs to be increased. Outside observers have tried to bring attention to this issue for decades (Caughley 1980), but so far this has been largely ignored by the elephant management and conservation community.

SOUTHEAST: Habitat loss from agricultural encroachment, oil palm plantation, and illegal logging are common in this region. However, the military and political situation in the border areas also has had negative impacts on wildlife and elephant populations through illegal poaching, trade, and disturbance from military operations.

CENTRAL MOUNTAINS: The Bago Yoma is surrounded by the densely populated lowlands, which are the home to roughly 80% of the country's human population. Consequently, pressures on wildlife and wildlife habitat in the area are high. Major threats to wild elephant

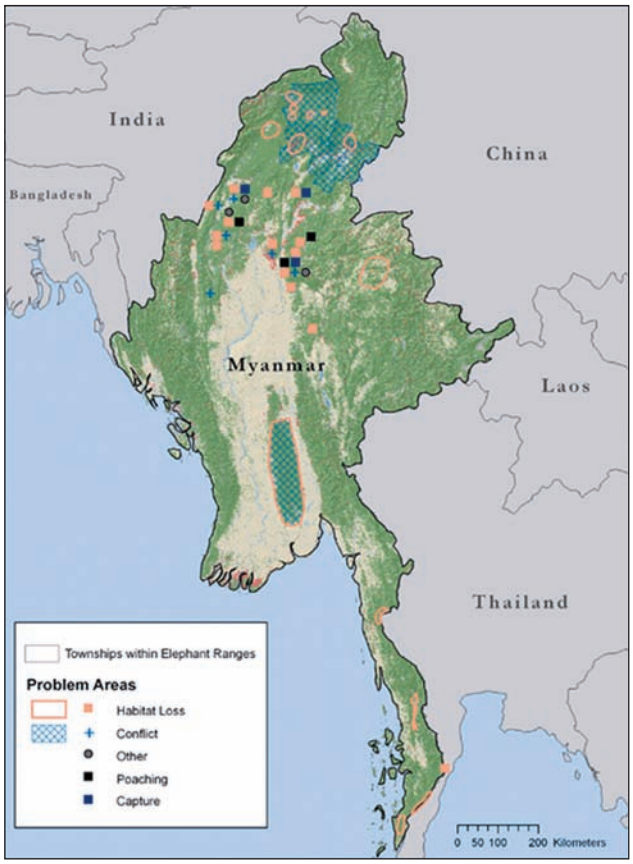

Figure 2. Threats to remaining wild Asian elephant populations in Burma.

populations include hydro-electric development (23 dams by 2004), agricultural land conversion and commercial logging. The Bago Yoma may also be one of Myanmar's regions with the highest HEC levels. The government has tried to reduce conflict by capturing "problem" elephants for their working camps.

SOUTHWEST: Major threats to wild elephant populations in the Rakhine Yoma region include habitat loss, HEC, poaching, and live-capture. Habitat loss and elephant population declines have been most severe in the region's coastal mangrove forests, resulting in the complete disappearance of wild elephants from the Ayeyarwaddy Delta during the last two decades.

NORTH: Throughout most of Sagaing and Mandalay Divisions, habitat loss from logging, charcoal production, and agricultural conversion represent the most serious threats to elephants, sometimes resulting in high levels of HEC, as

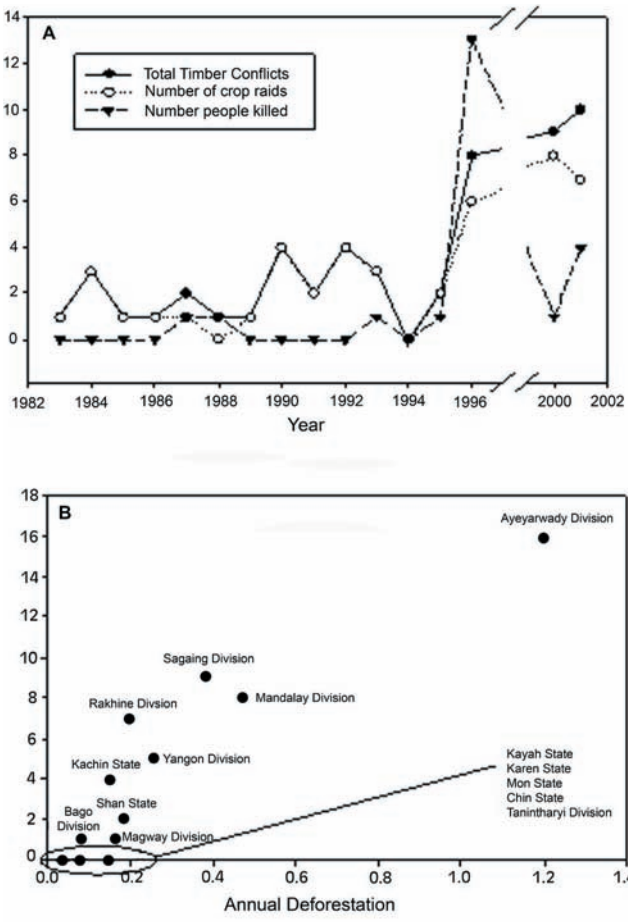

Figure 3. HEC in Myanmar. A) Increase in HEC over time; B) Annual deforestation rate and HEC (Data: Courtesy U Khin Maung Zaw).

was the case in Thabeikkyin township in the early 2000s. Increasing mining for gold may also locally contribute to elephant declines. In more remote areas poaching may also represent a threat. Unique to the area is increased live-capture of elephants by local Kachin people who have a long tradition in elephant capture and use.

Although much of the land in the Northern Forest Complex is still in pristine condition, several threats to elephant populations and other wildlife exist or are currently developing. The expert group for this region identified six major threats including habitat loss, poaching, live-capture using the traditional Melashikar lasso technique, wildlife trade to China, increased human activity and trespassing on wildlife habitats, and changes in the sex composition of the wild herds resulting from traditional capture techniques.

Elephant management and HEC mitigation

Although Myanmar has several protected areas that are designated protected elephant ranges, the country currently does not have an organized national approach to wild Asian elephant management and conservation. From 2001-2007, the Smithsonian Institution collaborated with Myanmar's Forest Department and its Nature and Wildlife Conservation Division to survey elephant populations in selected protected areas and to develop plans for a nationwide population survey. The original idea was to use the national survey to inform a national action plan for elephant conservation. While the joint project produced much useful information including population assessments for Alaungdaw Kathapa National Park and Htamanthi Wildlife Sanctuary, a satellite tracking study on elephant movement ecology, and an expert workshop to determine the elephant conservation status in 2004, the national survey and action plan were not executed because of political difficulties.

Wild elephants are protected by law in Myanmar and killing or capturing an elephant is prohibited. Officially, live-capture of elephants using Keddah techniques has also been abandoned and MTE does not conduct such operations directly. However, every year 50-100 elephants

are removed from the wild to supplement captive populations. Most wild elephants probably live outside protected areas, and HEC seems to be higher in disturbed or logged areas than adjacent to protected areas. HEC management usually is restricted to crop guarding by villagers, who also attempt to drive away elephants with noise makers and rocks. If HEC escalates the government sends MTE elephant teams to drive elephants away from crop areas and to, at least in some cases, capture "problem" elephants and transfer them into captivity. The responsible government agency is the Forestry Department and its Nature and Wildlife Conservation Division. Elephant captures as well as drives usually are executed by elephant teams under MTE or by private companies. MTE veterinary and elephant management staff probably are among the most experienced elephant experts in Myanmar.

Myanmar has a serious lack in technical capacity and resources to develop and apply other widely recommended HEC management tools, such as electric fencing, capture/translocation, or insurance and compensation schemes. A systematic nationwide assessment of remaining elephant populations, current threats to elephants, and extent and nature of HEC is urgently needed. This information should inform the previously planned National Elephant Conservation Action Plan.

Captive elephants

Myanmar is the country with the world's largest captive elephant population (Leimgruber *et al*. 2008; Lair 1997) and, perhaps, with the best developed and organized captive management system, which originated from the British colonial period. Most of Myanmar's captive elephants are being used in logging operations (Leimgruber *et al*. 2008; Lair 1997), although a few ecotourism camps were established during the past decade. About 20 elephants are currently in Myanmar's zoos, including Yangon Zoo (n=6), Hlaw Gar Garden (n=4), Mandalay Zoo (n=2), and Nay Pyi Taw Zoo (n=8). The revered Royal White Elephants that have been discovered in Myanmar during the last decade are housed at temples in Yangon (n=3) and Nay Pyi Taw (n=2).

Myanmar currently has about 4755 captive elephants (Table 3, Figs. 4-6), of these 2855 are owned by the government. Most of the government elephants are managed by the Myanmar Timber Enterprise (MTE). Approximately 1900 additional elephants are in private hands. Many of the privately owned elephants are rented by MTE during the year for logging operations. Elephant management is organized around resting and logging camps by region and each of the camps has MTE veterinarians, elephant managers, head mahouts and mahouts, called oozies in the national language. All elephants are examined at least once a month by MTE veterinary staff. Although there is a severe shortage in supplies, veterinary tools, and medicines, elephants in the logging camps usually are kept in good condition. Elephants work during the rainy and cool seasons, but are in rest camps during the hottest time of the year.

Rented private elephants are managed by their owner or the owner's oozies, but are integrated with the MTE elephants and receive the same overall management and veterinary care. MTE keeps records on every elephant via a studbook. This book is also used to record the medical and

Figure 4. Captive elephant in Myanmar (Photo: C. Wemmer).

reproductive history of each individual elephant. All privately owned elephants are registered with the Forest Department and owners are issued a license for each individual elephant.

Myanmar's captive elephant population probably was largest before World War II, when some experts estimated that there may have been ~6,000 to 10,000 work elephants held by the government and private owners (Williams 1950; Toke Gale 1974; Table 3). Disruption of logging operations and partial release of work elephants during the war reduced captive populations to about 2500 in the 1940s. Estimates of the overall captive population size vary considerably but seem to have increased throughout the 1960s and 1970s, reaching about 5500 elephants in 1980 and remaining relatively constant thereafter. It seems that most of the variation is caused by estimates of the privately held population. The government-owned population varies less and has stayed between 2500 to a little over 2900 for most of the last three decades.

Table 3. Past and present size of the captive elephant population (Leimgruber *et al*. 2008).

Year	Govt.	Private	All	Source
1910	–	2000-3000*	–	A
1935	–	1507*	–	B
1930s	–	–	6000	C
1930s	–	–	10,000	D
1945	–	–	2500#	D
1962-63	1526	–	–	E
1970	–	–	6396	F
1973	–	–	3400x	F
1973	–	–	6672	G
1974	–	–	3200 x	D
1978	–	–	3500 x	F
1980-81	2539	–	–	E
1981-82	2652	–	–	E
1982	–	–	5398	G
1982-83	2755	–	–	E
1983-84	2798	–	–	E
1984-85	2832	–	–	E
1985-86	2872	–	–	E
1986-87	2920	–	–	E
1987-88	2947	–	–	E
1988-89	2955	–	–	E
1988-89	2959	–	–	E
1989	–	–	5400	H
1989-90	2942	–	–	E
1990-91	2925	–	–	E
1991-92	2895	–	–	E
1992-93	2898	–	–	E
1993-94	2873	2718	5591+	I
1994-95	2858	–	–	I
1997	2800	–	–	I
1999-00	2715	–	–	E
1999-00	1672+	–	–	E
2002	–	–	6000	J
2011	2855	1900	4755	K

*Records for a single firm only (1910 = Bombay Burmah Trading Corporation); #Includes only adult elephants; xAlthough not stated in the text, it appears these estimates relate only to the government-owned elephants; +Registered elephants only.

A = Evans (1910); B = Hundley (1935); C = Williams (1950); D = Toke Gale (1974); E = Tun Aung & Thoung Nyut (2002); F = Olivier (1978); G = Ministry of Agriculture and Forestry (1982) as cited in Lair (1997); H = Sukumar (1989); I = Lair (1997); J = Khyne U Mar (2002); K = Zaw Oo, pers. comm.

A large proportion of Myanmar's captive elephant population is wild-caught (Leimgruber *et al*. 2008) with 335 elephants captured since 2004 (Table 4). Additionally, birth rates appear to be very low based on available published data, with only 7.1% of female elephants in MTE herds breeding. Using population viability analysis and published data on MTE elephant demography, Leimgruber *et al*. (2008) determined currently captive elephant populations in Myanmar are not self-sustaining and that these populations will decline if not supplemented from the wild. Declines will be relatively slow because of the current size of the population but to maintain current herd size, supplementation of 50-100 individuals from the wild each year would be required. Leimgruber *et al*. (2008) also used published capture rates throughout the last century to demonstrate that declines from 8000 to only about 2000 wild elephants could be solely explained by live-capture to supplement captive herds. Leimgruber *et al*. (2008) showed that continued live-capture may pose a serious risk for the survival of Myanmar's wild and captive elephants and that the best strategy would include improving current breeding rates, stopping all live-capture, and reducing the captive herd. The latter also may make sense considering that other range countries have long ended wide use of elephants in logging, as the logging industries have been modernized. In some cases, this has lead to significant animal

welfare problems, as former logging elephants have become unemployed and veterinary care, formerly provided by forest departments, is too expensive for private owners.

Conclusion

Myanmar is unique because of its large amount of remaining elephant habitat and its large captive elephant population. Additionally, there is a large number of elephant experts remaining in the country, especially in MTE and the Forest Department, but also in society represented by private elephant owners. The cumulative technical and traditional knowledge about elephant biology and management is significant but remains relatively untapped. Despite this significant expertise, capacity building tailored to the needs of these experts is urgently needed. This would include training in elephant care and husbandry, veterinary care, and elephant behaviour, ecology and biology.

Although much knowledge and even data exists in Myanmar, this data is largely inaccessible and thus, of limited value. Additionally, new

Table 4. Yearly live-capture rates (LCR) for wild elephants in Myanmar.

Year	LCR	Deaths	Releases	Source
1910-27	412			A
1910-72	228		450	B,C
1911-82	239			C
1935-41	214			B,D
1942-44	0			A
1945-62	140		281	B,C
1945-46	63		6	A,E
1946-47	144		18	A,E
1947-48	191		26	A,E
1948-49	131		24	A,E
1949-50	185		34	A,E
1950-51	156		21	A,E
1951-52	36		11	A,E
1952-53	107		27	A,E
1953-54	85		11	A,E
1954-55	60		9	A,E
1955-56	100		23	A,E
1956-57	170		28	A,E
1959-60	299		7	A,E
1960-61	283		11	A,E
1961-62	369		25	A,E
1964-65	15		1	A,E
1965-66	54		10	A,E
1966-67	129		25	A
1945-67	142		317	A
1962-72	153		50	B,C
1962-73	165			D
1969	272			D
1970	227			D
1970-71	228	64	7	F
1971-72	283	56	6	F
1972-73	201	32	17	F
1973-74	143	28	10	F
1974-75	111	21	3	F
1975-76	69	14	5	F
1976-77	82	15	1	F
1977-78	92	13	1	F
1978-79	93	13	0	F
1979-80	133	25	2	F
1980-81	122	30	10	F
1981-82	124	38	4	F
1982-83	56	8	1	F
1983-84	40	0	5	F
1984-85	41	7	6	F
1985-86	39	8	3	F
1986-87	49	3	1	F
1987-88	42	3	0	F
1988-89	26	5	1	F
1989-90	32	3	0	F
1990-91	22	0	0	F
1991-92	77	7	0	F
1992-93	17	2	0	F
1970-93	92	17	4	G
1972-82	117			H
1980-81	75			G
1981-82	76			C
1982-83	44			C
1983-84	35			C
1984-85	28			C
1985-86	28			C
1986-87	33			C
1987-88	39			C
1988-89	20			C
1989-90	29			C
1990-91	22			C
1991-92	23			C
1992-93	15			C
1993-94	13			C
1994-95	2			C
1995-04	?			
2004-05	166			I
2005-06	2			I
2006-07	3			I
2007-08	53			I
2008-09	26			I
2009-10	96			I
2010-11	9			I

A = Toke Gale (1974); B = Ministry of Agriculture and Forestry (1982) as cited in Lair (1997); C = Lair (1997); D = Olivier (1978); E = official figure as quoted by Hundley; F = Uga (2000); G = Myint Aung (1997); H = Santiapillai & Jackson (1990); I = Zaw Oo, MTE.

information needs to be collected, specifically on the wild elephant population status, using modern surveying tools. Such information is essential for future planning and management.

Most importantly, Myanmar urgently needs to develop a national plan for the management and conservation of its elephants, captive and wild. To develop this plan the Forest Department and MTE need to collect new data on the distribution, demography, and status of wild and captive elephants (government and privately owned) through new countrywide surveys. Once the data is collected the FD and MTE need to jointly convene an expert group to develop management recommendations for the government. None of these efforts, however, will come to fruition unless there is the recognition for such a plan and the political will to institute and enforce new regulations for elephant management and conservation at the highest government levels.

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Figure 5. Captive elephants in Myanmar (Photo: C. Wemmer).

References

Caughley G (1980) Comments on elephants in Burma. *Gajah* **14:** 1-9.

Evans GH (1910) *Elephants and Their Diseases*. Government Printing, Rangoon.

Fernando P & Leimgruber P (2011) Asian elephants and dry forests. In: *The Ecology and Conservation of Seasonally Dry Forests in Asia*. McShea WJ, Davies SJ, Phumpakphan N & Pattanavibool A (eds) Smithsonian Institution Scholarly Press. pp 151-163.

Hedges S, Fisher K & Rose R (2009) *Range-wide Mapping Workshop for Asian Elephant (Elephas maximus), Cambodia*. Report to USFWS. <http://www.fws.gov/international/DIC/species/ase/pdf/aserange-widemappingworkshopreportcambodia08.pdf> accessed Nov. 2011.

Hundley G (1935) Statistical record of growth in the Indian elephant (*E. maximus*). *Journal of the Bombay Natural History Society* **28:** 537-538.

Khyne U Mar (2002) The studbook of timber elephants of Myanmar with special reference to survivorship analysis. In: *Giants on our Hands: Proceedings of the International Workshop on the Domesticated Asian Elephant*. Baker I & Kashio M (eds) UN FAO Regional Office for Asia and the Pacific, Bangkok. pp 195–211. <www.fao.org/docrep/005/ad031e/ad031e0m.htm#bm22>

Lair RC (1997) Myanmar. In: *Gone Astray: The Care and Management of the Asian Elephant in Domesticity*. UN FAO Regional Office for Asia and the Pacific, Bangkok. pp 99–131 <www.fao.org/DOCREP/005/AC774E/AC774E00.HTM>

Leimgruber P & Wemmer C (2004) *National Elephant Symposium and Workshop*. Report to the USFWS and the Myanmar Forest Department.

Leimgruber P, Gagnon JB, Wemmer C, Kelly DS, Songer MA & Selig ER (2003) Fragmentation of Asia's remaining wildlands: implications for Asian elephant conservation. *Animal Conservation* **6:** 347-359.

Leimgruber P, Senior B, Uga, Myint Aung, Songer MA, Mueller T, Wemmer C & Ballou J (2008) Modeling population viability of captive elephants in Myanmar (Burma)—implications for wild populations. *Animal Conservation* **11:** 198-205.

Lynam T (2003) *A National Tiger Action Plan for the Union of Myanmar*. Forest Department and the Wildlife Conservation Society International Program, Yangon, Myanmar.

Myint Aung (1997) On the distribution, status and conservation of wild elephants in Myanmar. *Gajah* **18:** 47–55.

Olivier RCD (1978) *On the Ecology of the Asian Elephant Elephas maximus Linn.: With Particular Reference to Malaya and Sri Lanka*. Ph.D. thesis, University of Cambridge, UK.

Salter RE (1983) *Summary of Currently Available Information on International Threatened Wildlife Species of Burma*. Working People Settlement Board, FAO, Rangoon, Burma.

Santiapillai C & Jackson P (1990) *The Asian Elephant: An Action Plan for its Conservation*. IUCN/SSC Asian Elephant Specialist Group, Gland, Switzerland.

Sukumar R (1989) *The Asian Elephant: Ecology and Management*. Cambridge University Press, Cambridge.

Sukumar R (2003) *The Living Elephants: Evolutionary Ecology, Behavior, and Conservation*. Oxford University Press, Oxford.

Toke Gale (1974) *Burmese Timber Elephant*. Trade Corporation, Rangoon.

Tun Aung & Thoung Nyunt. (2002) The care and management of the domesticated Asian elephant in Myanmar. In: *Giants on Our Hands: Proceedings of the International Workshop on the Domesticated Asian Elephant*. Baker I & Kashio M (eds) UN FAO Regional Office for Asia and the Pacific, Bangkok. pp 89–102 <www.fao.org/docrep/005/ad031e/ad031e0d.htm>

Uga (2000) *Conservation and Use of Wild Asian Elephants (Elephas maximus)*. Forestry Department, Ministry of Forestry, Government of the Union of Myanmar. pp 1-15.

Williams JH (1950) *Elephant Bill*. Hart-Davis, London.

Figure 6. Captive elephant in Myanmar.