

ELEPHANT POPULATIONS IN THAILAND

A Preliminary Survey of Wild Elephant Populations and their Prospects for Conservation in Thailand

*Philip J. Storer**

ABSTRACT

From 1 April 1979 through September 1979 a survey was conducted to determine the distribution and status of elephant herds in Thailand. Elephants were found in twelve national parks and fifteen wildlife sanctuaries in a total of 21,868 km². Agricultural expansion is the most serious long term threat, poaching is the most serious immediate threat. Recommendations concerning managed elephant ranges were also made. Khao Yai National Park was chosen as the best place to conduct an elephant research and technical training project.

INTRODUCTION

For centuries, the elephant has played an essential role in the Thai culture and economy (LEKAGUL & MCNEELY, 1977), often appearing in Thai literature and religion. Sacred white elephants are still occasionally presented to His Majesty the King with due ceremony. The last one was presented 13 August 1979. In the past elephants have been used as beasts of burden and war animals. In modern times elephants have been trained for work in forestry and in shows for tourists.

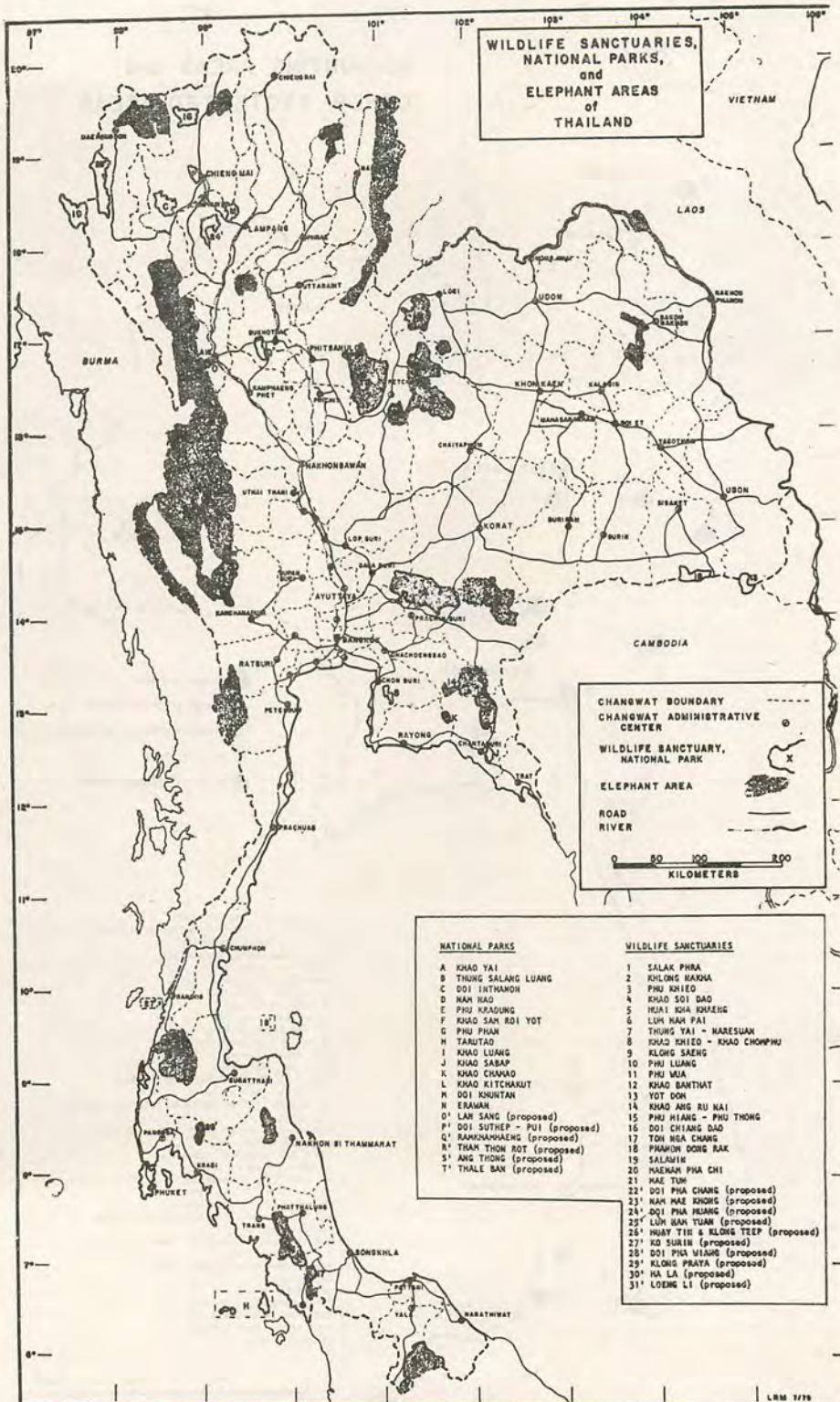
Prior to World War II when Thailand was 80% forests, wild elephants were found throughout the country. After the war vehicles and firearms became more available, causing heavy pressure on elephant herds and habitat. It is now feared that few existing or proposed national parks or wildlife sanctuaries containing elephants are of sufficient size to maintain viable elephant populations. Even within protected areas, direct poaching and continual human encroachment on elephant habitat constitute serious threats.

* President Address : 24 Magean street Brunswick, Maine 04011, U.S.A.

OLIVIER (1978) developed the concept of "managed elephant ranges" in Malaya. These ranges include the entire annual range of a healthy elephant population. The concept does not exclude human use and allows selective logging, traditional hunting, mining, and slash-and-burn agriculture. However, the entire area is managed for the benefit of elephants. LEKAGUL & MCNEELY (1977) then took Olivier's basic idea and applied it to Thailand. They recommended the establishment of two elephant ranges. One is the Phetchabun Mountain Range in the northeast. The other is in the Tenasserim Mountain Range of western Thailand. Both would contain existing national parks, wildlife sanctuaries, and reserve forests. The national parks and wildlife sanctuaries would retain their current administrative structure, but the areas outside the parks and sanctuaries would be zoned for multiple use in coordination with elephant management.

From April 1979 through September 1979 a survey was conducted to do the following:

1. Map the existing distribution and range of wild elephants in Thailand in conjunction with the existing and proposed protected areas (Maps 1 & 2).
2. Evaluate the nature and extent of human threats to elephants in and around protected areas.
3. Assess the feasibility of effective implementation of LEKAGUL & MCNEELY's (1977) recommendations regarding elephant ranges.
4. Assess if the measures called for in paragraphs 1.2 through 1.6 in the ASIAN ELEPHANT SECRETARIAT's (1978) "Action Plan" for Thailand are sufficient to ensure the viability of local populations and how these measures may be best implemented in the managed areas.
5. Recommend which elephant areas in Thailand would most benefit from a large scale research and technical training project.
6. Determine what unsurveyed areas are important for elephants.
7. Investigate the availability of worked and unworked ivory and sources of the latter.



Map 1. Wildlife sanctuaries, national parks, and elephant areas of Thailand. No order for the wildlife sanctuaries or national parks.



Map 2. Non-hunting areas and other protected areas.

METHODS

A total of 33 questionnaires were distributed to all national parks and wildlife sanctuaries (15 and 18 respectively) in areas where elephants were thought to occur. A total of 28 questionnaires were returned (10 and 18 respectively). The questionnaire asked for information concerning threats to elephants and elephant habitat; use and ownership of bordering areas; and population range, status, and movements. It also inquired about problems caused by elephants.

Four field trips were taken. The Tenasserim Mountain Range including Ratburi Province, Erawan National Park, and Salak Phra Wildlife Sanctuary was visited twice. The Phetchabun Mountain Range and Khao Yai National Park were also visited. Interviews with local officials and villagers were made. Information concerning ivory came from interviewing shopkeepers. All population estimates are tentative and are a combination of information from the questionnaire and estimates from other people best qualified to comment. All information concerning forest types (except where indicated) and sizes of elephant areas follow the format in the "National Conservation Plan for Thailand" (IUCN/UNEP/FAO. 1979).

RESULTS AND DISCUSSION

Elephant Ranges

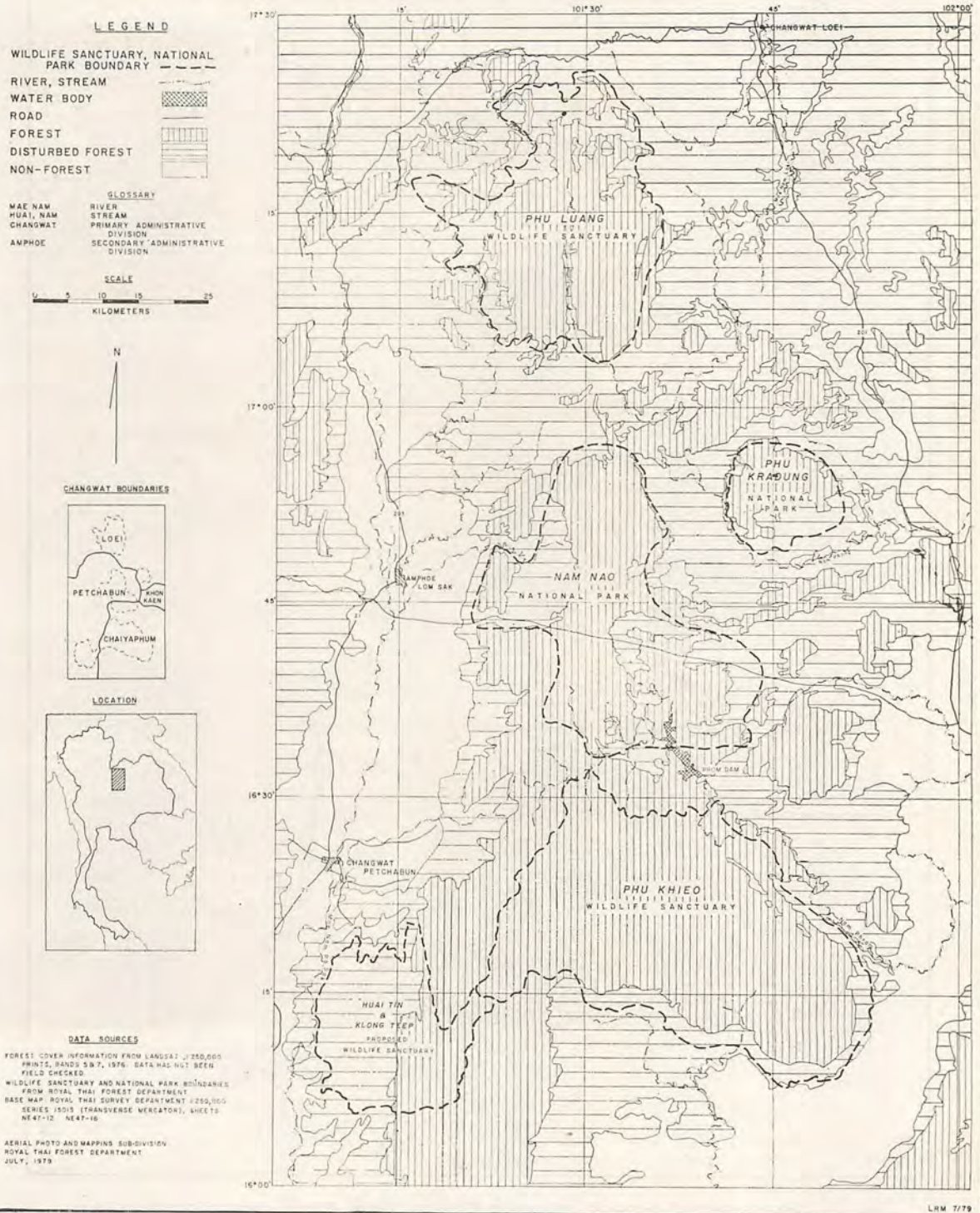
The elephant range concept (OLIVIER, 1978; LEKAGUL & MCNEELY, 1977) would serve as a way to combine wildlife sanctuaries, national parks, and reserve forest into larger, more effective management units which would be able to include ecologically sound human activities. The main premise for the successful implementation of the elephant range concept is that human activities are performed at traditional population densities and at a sustained yield level for the system. Despite the efforts of Royal Forest Department (RFD), human encroachment is rampant in most existing national parks, wildlife sanctuaries, and reserved forests. Squatters have moved into reserve forests, permanently clearing the forest, cutting off elephant migration. These people have always been extremely difficult to relocate, especially when they have already planted their crops. To further complicate the relocating

of villagers. One of the previous Governments had already granted amnesty to people in reserve forests, and later designated additional land for them to use for agriculture. If Thai officials cannot control existing protected areas where all extractive human activities are proscribed, it is doubtful that they could enforce the complicated laws needed to manage multiple use areas.

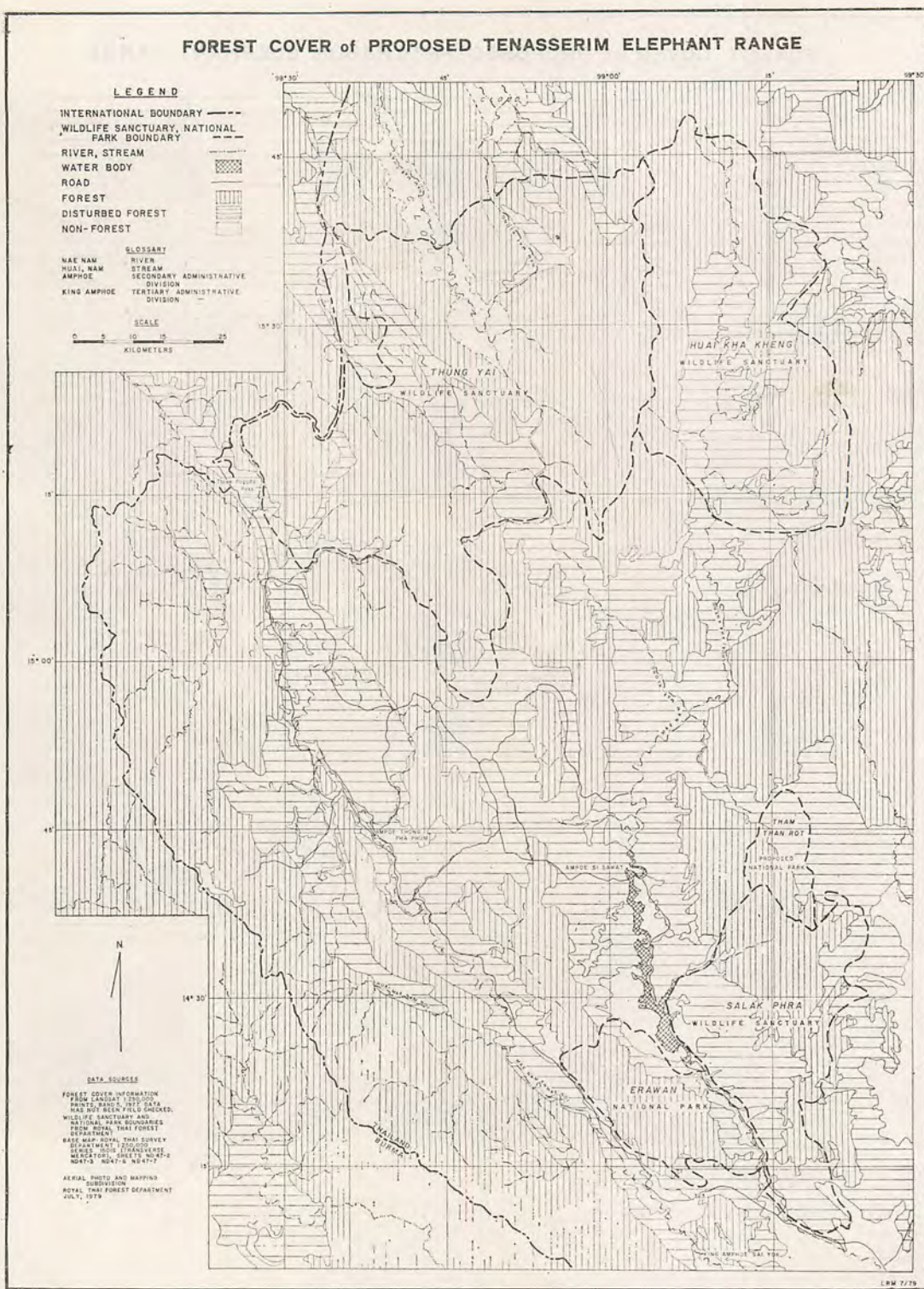
In LEKAGUL & MCNEELY's (1977) plan an Elephant Range Supervisory Committee would be formed. It would be made up of the heads of the Divisions of Wildlife Conservation, National Parks, Watershed Protection, and Forest Industry Organization and high level representatives from the National Environmental Board, the Ministry of Defense, the Tourist Organization of Thailand, and the Electricity Generating Authority of Thailand (EGAT). The chairman of the committee would be the Director General of the RFD. Due to the vast bureaucracy, interdepartmental rivalries, and conflicts of interest among the different organizations, it is felt this structure would have little beneficial effect on elephant conservation efforts in Thailand.

At this time it would be difficult to implement the elephant range concept in Thailand. Areas between protected areas are privately owned, and the government does not have the money to buy them back. Looking at the situation realistically, knowledgeable people realize elephant population are going to become isolated eventually (Maps 3 & 4). The RFD must be prepared for that time by having sufficient elephant habitat under its jurisdiction. The acquisition of new elephant habitat, as well as the enforcement of existing forestry laws, is the best direction for elephant conservation efforts. Elephant corridors should be established where applicable; this would ensure viable populations for the future. In cases of a national park connecting with a wildlife sanctuary, the corridor should fall under the jurisdiction of the Wildlife Conservation Division, since its main responsibility is protection rather than tourism. The corridor should be established in locations where the least number of villagers would have to be relocated. The main land use in most areas of remaining unprotected elephant habitat is logging. Since elephants require five times the range in primary forest as in disturbed forest (OLIVIER, 1978); and because of the economic importance

FOREST COVER of PROPOSED PETCHABUN ELEPHANT RANGE



Map 3. Forest cover of proposed Phetchabun Elephant Range. Forest cover information from LANDSAT 1:250,000 prints, bands 5 & 7, 1976. Data has not been field checked. Wildlife sanctuary and national park boundaries from Royal Thai Forest Department. Base maps, Royal Survey Department, scale 1:250,000, series 1501S (Transverse Mercator), Sheets NE47-16.



Map 4. Forest cover of proposed Tenasserim Elephant Range. Forest cover information from LANDSAT, 1 : 250,000 prints, band 5, 1977. Data has not been field checked. Wildlife sanctuary and national park boundaries from Royal Thai Forest Department. Base map : Royal Thai Survey Department, scale 1 : 250,000, Series 150IS (Transverse Mercator), Sheets ND47-6 and ND47-7.

Table 1. Tabulated results of questionnaire and other information for national parks—under threat, listed in order of importance.

Elephant Area	Estimated # of Elephants	# of Elephants reported poached (5 yrs.)	Size of area (ha)	Future prospect for Elephants	Border land	Threat	Direction area could be extended
Khao Yai	150 - 200	4	216,800	Good	Agriculture	Poaching Agriculture	
Phu Kradung	5 - 20	5	34,800	Fair (better if corridor established)	Agriculture Reserve forest	Poaching	Corridor from north connecting with Nam Nao
Thung Salang Luang	5 - 20	0	126,200	Fair	Agriculture	Agriculture Poaching	
Nam Nao	Not given	0	96,600	Good	Not given	Not given	Southwest
Phu Phan	A few	10	69,900	Poor	Not given	Poaching	West
Khao Luang	Not known	0	56,700	Poor	Not given	Insurgents	
Erawan	10 - 15	0	55 000	Fair	Agriculture Reserve forest	Poaching Agriculture	North
Khao Chamao	5 - 15	0	8,300	Fair	Agriculture Reserve forest	Agriculture	Corridor from northwest
Khao Kitchakut	A few	0	5,800	Fair (dependent on Khao Soi Dao)	Agriculture Khao Soi Dao	Agriculture	
Lan Sang (prop)	Not given	0	17,000	Not known	Not given	Insurgency Agriculture	North
Tham Thon Rot (prop)	Small population	3	6,700	Fair	Reserve forest Salak Phra	Poaching	East, west, north
Srisatchanalai	Small population	8	2.133	Poor	Agriculture Loeng Li	Poaching	West
Total	175 - 270 +	30	693,802.133				

of forestry to Thailand, selective logging could be allowed. After logging, they should be gazetted as national parks or wildlife sanctuaries, with all extraction of forest products prohibited.

The following elephant areas are discussed in chronological order of their being gazetted as national parks or wildlife sanctuaries. Many of these areas could not be visited because of the danger from insurgents.

National Parks

The Division of National Parks, RFD, was established in 1962 to preserve Thailand's natural heritage. National parks are managed to encourage tourism and to cater to the visitors. There are twelve national parks containing elephants (Table 1).

Khao Yai National Park: Khao Yai was Thailand's first national park and is situated around the junction of Nakhon Ratchasima, Prachin Buri, Nakhon Nayok, and Saraburi Provinces. Its 216, 800 ha of mixed deciduous, dry evergreen, and hill evergreen forests are completely surrounded by agricultural land. There is a medium degree of threat from log poaching on the eastern border. Game poaching is common, and clashes between wardens and poachers are normal occurrences. On 18 July, 1979 wardens killed four poachers and seriously wounded another. Four elephants have been reported poached in the last 5 years. Clearing of the forest for agriculture is heavy all around the park, especially during the hot season. Although the park is considered militarily secure, there have been problems concerning insurgency in Prachin Buri and Nakhon Nayok Provinces. On 23 January, 1979 a ranger station in Prachin Buri was attacked. Terrorists burned the station and stole weapons. It is feared that insurgents are fleeing to the park from nearby areas as a result of harassment by government troops.

The elephant population is estimated to be from 150 to 200 animals. Mr. *Vichit Yarnpirat*, Chief of Khao Yai for 11 years (personal communication), believes it to be increasing. Although there are no reports of elephants raiding crops, they do destroy road signs and markers belonging to the Highway Department.

Khao Yai would be ideal to conduct a large scale elephant research and technical training project because of:

1. The large and stable elephant population.
2. The security from insurgents compared to other elephant areas.
3. The proximity to the cities of Bangkok and Korat, both of which have airports.
4. Optimal public awareness would be guaranteed through the National Parks Division, Tourist Organization of Thailand, and Friends of Khao Yai National Park Association.

Phu Kradung National Park: Phu Kradung, Loei Province, contains 34,800 ha of deciduous dipterocarp, mixed deciduous, hill evergreen, pine forests, and open grassland plateau. Poaching is the main threat to animals at Phu Kradung, especially in the Chong Hin Taek area. Poaching for smaller species, such as barking deer and sambar, is common and 5 elephants have been poached in the last 5 years. There are between 5 and 20 elephants remaining in Phu Kradung. Elephants stay mostly in the tall forested areas and the north slope and are rarely found crossing the grassy plateau due to the number of tourists there. Elephants are reported either to trample or eat rice plants around the northwest border area. Historically elephants moved from Nam Nao National Park and the Dong Lan Reserve Forest during the rainy season. This movement is currently endangered due to agricultural expansion in the valley separating Nam Nao and Phu Kradung. A corridor from the north connecting with Nam Nao could be established, but many villagers would have to be relocated.

Thung Salaeng Luang National Park: This park, surrounded by agricultural land, is situated in Phitsanulok and Phetchabun Provinces and contains 126,200 ha of deciduous dipterocarp, mixed deciduous, pine, and hill evergreen forests. Little is known about the elephants in the area because of the danger from Meo insurgents, but there are an estimated 5 to 20 elephants remaining there. It is considered a restricted area, and no one is permitted to enter the park. Meo tribesmen are abundant, and D. Damman (personal communication) found during his visit in 1978 that they have cleared vast areas of the forest. There is a low degree of threat from log poachers and charcoal producers, mainly from November through February. Game poaching is heavy throughout the year, but no elephants have been reported killed.

Phu Phan National Park : Phu Phan is in Sakon Nakhon and Kalasin Provinces. It contains 69,900 ha of deciduous dipterocarp, evergreen, and mixed deciduous forests. Mr. Sanga Nethin, Chief of Phu Phan for 16 years, reports that the elephant population is small and is definitely decreasing due to poaching pressure. At least 6 small elephants and 4 adults have been reported killed or captured during the last 5 years. Elephants are reported to raid crops during the rainy season. Insurgents are also known to harbour there. Mr. Nethin reports that Phu Phan could be extended westward.

Khao Luang National Park : Khao Luang, Nakhon Si Thammarat Province, contains 56,700 ha of evergreen rain forest and swamp forest. Nothing is known about the park's elephants due to the danger from insurgents. The park has been ordered closed by the military and is considered a restricted area.

Erawan National Park : Erawan, Kanchanaburi Province, contains 55,000 ha of mixed deciduous, deciduous dipterocarp, and evergreen forests. North of the park is reserved forest which could be added to the park. To the west is the Khwae Noi River. Land south of Erawan is privately owned and planted with sugarcane. To the east is Salak Phra Wildlife Sanctuary. Erawan has between 10 and 15 elephants. Movement is believed to be cut off, but there may possibly be limited movement from the north in the rainy season. The elephants are reported to stay at higher elevations, especially on Phu Lang Lan Mountain. This is due to the large number of tourists coming to see the park's waterfalls at lower elevations. Although no elephants have been reported poached, poaching of smaller wildlife species by Thai villagers is believed to be heavy. There is also poaching pressure from the north and northeast by Mon Hilltribesmen.

Khao Chamao National Park : Khao Chamao in Rayong and Chanthaburi Provinces contains 8,300 ha of evergreen rain forest and mixed deciduous forests. BROCKELMAN (1978) describes the forest in the southern region, above an elevation of 520 m, as tall. In the northern interior he found the forest undisturbed from an elevation of 150 m. Until recently, Khao Chamao was connected to the large forest area to the north. Many large

wildlife species still occur there including from 5 to 15 elephants. Elephant migration is cut off, and animals are believed to stay at higher elevations although BROCKELMAN (1978) found them utilizing the Khlong Phlu Valley and the far north slope of the mountain. There is some threat from villagers cutting occasional trees and poaching smaller species of wildlife during the rainy season (May to September). Most of the trees cut are sato bean trees (Leguminosae: *Parkia sumatrana*) and "mai hom" (sweet smelling wood from the core of *Aquilaria crassna*). People have also tapped *Garcinia hanburyi* (Guttiferae) for its yellow sap from which a dye is made. While in the forest these people eat wild game; but no elephants have been reported killed. Protection through forest patrolling has recently improved and, it is hoped that it will continue. The "Elephant Action Plan for Asia" (ASIAN ELEPHANT SECRETARIAT, 1978) has given a high priority to the enlargement of Khao Chamao. At present the park is surrounded by agricultural land to the east, west, and south; and there has been heavy disturbance from the northeast. An elephant corridor could be set up from the northwest through Khao Chamao and Khao Chamun (which contain elephants), ideally connecting with the large forested area to the north. To implement this, some families would have to be relocated.

Khao Khitchakut National Park: Khao Khitchakut, Chanthaburi Province, contains 5,800 ha of evergreen rain forest. To the south, west, and east is cultivated land planted mostly with durian and rambutan fruit trees. To the north is Khao Soi Dao Wildlife Sanctuary. Khao Khitchakut still has a few elephants that probably move between the park and the sanctuary. Logging and wood collecting are common all around the park during all seasons. Poaching is heavy for smaller species of wildlife, especially on Khao Phrabat and Khao Krasu, but there are no reports of elephants being shot. From February through April there is a medium degree of threat on the eastern border from villagers clearing land for agriculture.

Lan Sang National Park: This proposed national park in Tak Province contains 17,000 ha of mixed deciduous, deciduous dipterocarp, and evergreen forests. Illegal lumbering is common on the roads up the mountain throughout the year. Little is known concerning the park's elephants due to the danger of insurgency. No elephants have been reported poached

but poaching of other species is common. Most of the park is burned from December through April by villagers who plant crops then and harvest them in September. Lan Sang could be extended northward.

Tham Than Lot National Park : The proposed Tham Than Lot National Park, Kanchanaburi Province, contains 6,700 ha of mixed deciduous (mostly bamboo) and evergreen rain forest. Its small elephant population probably moves back and forth between the park and Salak Phra Wildlife Sanctuary (to the south). To the east, west, and north is reserved forest which could be included in the park. Game poaching is believed to be heavy because of Tham Than Lot's proximity to Salak Phra. Three elephants have been shot and killed there within the last 5 years.

Si Satchanalai Forest Park : This forest park, Sukhothai Province, is surrounded by agriculture except to the west which is the proposed Loeng Li Wildlife Sanctuary, and has an area of 2,133 ha. The park's small elephant population is decreasing due to poaching. At least 8 elephants have been shot in or around the park in the last 5 years.

Wildlife Sanctuaries

In 1960, Thailand passed the Wild Animals Reservation and Protection Act B.E. 2503 which came into effect on 1 January, 1961. This act established the section of Wildlife Management in the Silviculture Division of the RFD. In 1975, the status of the Section was raised to a Division. The main purpose of this Division is to protect and preserve wildlife but not to encourage tourism. Hence sanctuaries function differently from national parks. There are fifteen existing wildlife sanctuaries containing elephants (Table 2).

Salak Phra Wildlife Sanctuary : Salak Phra, Kanchanaburi Province, was Thailand's first wildlife sanctuary, being gazetted in 1965. It contains 83,540 ha of mixed deciduous, dry evergreen, deciduous dipterocarp, and mixed dipterocarp forests. Land bordering the southwest, south, and east of the sanctuary is scrub bamboo and cultivated land, planted mostly with sugarcane. The Chao Nen Dam and associated village resettlement areas

Table 2. Tabulated results of questionnaire and other information for wildlife sanctuaries—proposed sanctuaries not included due to the uncertainty of them being gazetted.

Elephant Area	Estimated # of Elephants	# of Elephants reported poached (5 yrs.)	Size of area (ha)	Future prospect for Elephants	Border land	Threat	Direction area could be extended
Salak Phra	20 - 35	10	83,540	Fair	Agriculture Tham Thon Rot Reserve forest	Poaching	
Khlong Nakha	Not known	0	48,000	Fair-Good	Agriculture Khlong Saeng	Not given	
Phu Khieo	100 +	10 - 20	141,300	Good	Agriculture Reserve forest	Poaching	North, west, northwest
Khao Sci Dao	50 - 75	1 inside sanctuary 2 - 4 out- side sanc.	102,500	Fair-Good (Better if extended)	Agriculture Reserve forest	Agriculture	Northwest
Huai Kha Khaeng	150 - 200	3	163,100	Good	Reserve forest	Poaching Insurgency	South
Thung Yai	Large population	0	320,000	Good	Reserve forest Huai Kha Khaeng Burma	Not known	
Khlong Saeng	25 - 75	7	123,600	Fair-Good	Agriculture Reserve forest	Agriculture Mining Poaching	
Phu Luang	100 +	0	84,000	Good	Agriculture	Insurgency	
Phu Wua	10 - 15	10	18,650	Poor	Reserve forest Agriculture	Poaching	North, east, west
Khao Banthat	10 - 25	0	12,800	Poor	Agriculture	Agriculture Insurgents	
Maetuen	Not known	0	250,000	Not known	Not known	Not known	
Ton Nga Chang	5 - 15	4	26,458	Poor	Agriculture Reserve forest	Agriculture Poaching	South
Phu Miang-Phu Thong	Not known	0	54,500	Not known	Not known	Not known	

(Continued)

Table 2. (Continued).

Elephant Area	Estimated # of Elephants	# of Elephants reported poached (5 yrs.)	Size of area (ha)	Future prospect for Elephants	Border land	Threat	Direction area could be extended
Khao Ang Ru Nai	5 - 15	0	10,810	Poor-Fair	Not given	Agriculture	
Maenam Pha Chi	Not given	2	53,750	Fair	Reserve forest Burma	Mining Poaching	South, east
Total	475 - 655 +	49 - 61	1,493,008				

border the sanctuary to the northwest. To the north is a combination of reserve forest and military land. The northeast borders the proposed Tham Than Lot National Park area. To the west of Salak Phra is the Mae Klong (or Kwaie Yai) River and then Erawan National Park. Elephant movement between Salak Phra and Erawan has been cut off by the building of the Chao Nen Dam. There probably is still movement from Tham Than Lot and the reserve forest to the north, but pressure from poachers and the military may soon cut this area off.

The main threat to elephants and all other wildlife in the area is poaching. During a 6-day trip in the area I found shooting platforms at all salt licks. At one there was a fresh gaur's skin. In the Thung Nam Mon area I came across a poachers' camp of approximately ten hunters. During 4 days of hunting they had shot 4 barking deer, 1 sambar, 1 gaur and 1 bear. There were several tortoise shells and gibbon skulls scattered around the camp. These hunters were armed with guns ranging from muzzle loaders to M16 automatic rifles. I later received word that these same hunters were still regularly hunting in the area. At other places in the sanctuary I found empty cartridges of high velocity sporting loads such as 30.06 cal. This suggests that Salak Phra is being used by more wealthy sport hunters as well as poorer villagers. At least 10 elephants have been poached in the last 5 years. Poaching pressure is heaviest during the dry season when animals congregate near water. A lack of rain between 1976 and 1979 intensified the problem.

Much of Thung Salak Phra is burned during the dry season. Present estimates of the remaining elephant population range from 15 to 30. Villagers are digging test pits for wolfram and fluorite at Thung Nam Mon and Khao Khanueng Mountain, but this causes little threat at current levels. There is also a serious problem concerning bamboo extraction which WILES (1980) reports makes up a high percentage of the elephants' diet at Salak Phra. Elephants will trample crops planted by sanctuary workers at Salak Phra Ranger Station, and villagers report a lone bull elephant that is very aggressive.

Mr. *Vachara Unjak* (personal communication), Chief of the sanctuary, feels there is no way of enlarging the sanctuary. In fact, he feels that the

southeastern-most part should be removed from the sanctuary, since it is already under cultivation and relocating villagers would prove very difficult.

Phu Khieo Wildlife Sanctuary: Phu Khieo, Chaiyaphum Province, contains 141, 300 ha of grassland savanna, pine grassland, bamboo, dry dipterocarp, dry evergreen, and hill evergreen forests. Dry evergreen forest comprises the greatest area within the sanctuary, followed by bamboo (ERICKSON, 1976). The sanctuary consists of a ridge that separates the lower agricultural valley from the upper plateau which runs along the southern, eastern, and part of the northern borders. The western part is characterized by undulating mountains and stream valleys. The southern and eastern borders are densely populated, and the cultivated land is planted mostly with rice. Villagers are also clearing the hillsides to plant corn. To the west and northwest is Huay Hin-Khlong Tip Reserve Forest where the main land use is logging, but there is a serious problem with squatters. To the southwest is the proposed Huay Hin-Khlong Tip Wildlife Sanctuary. EGAT has constructed the Chulaphorn Dam on the Nam Phrom River to the northeast of Phu Khieo. They control the land along the river above and below the dam.

There has been a problem with villagers settling in the sanctuary in areas of grassland savana where the land is flat enough to plant rice, mainly at Ban Thung Kamang. The RFD has so far been able to resettle these people, but it has proved dangerous and difficult once the villagers are established (ERICKSON, 1976). A sanctuary truck was ambushed on August 31, 1976 killing three persons and seriously wounding nine. Poaching is serious, and from 10 to 20 elephants have been shot or captured in the last 5 years.

The elephant population is possibly 100 plus animals (ERICKSON, 1977). Erickson found elephants are dispersed throughout the sanctuary during the rainy season. Elephant trails usually follow the ridges and do not usually traverse hillsides. As the forest becomes drier, elephants become concentrated in the western section of the sanctuary. He found that elephants leave the sanctuary in the area west of the Chulaphorn Dam during the dry season and very likely move between Phu Khieo and Nam Nao National Park. Due to heavy pressure from loggers and squatters, and the serious problems with insurgency, this movement is presently questionable. Both the

"National Conservation Plan for Thailand" (IUCN/UNEP/FAO, 1979) and the "Elephant Action Plan for Asia" (ASIAN ELEPHANT SECRETARIAT, 1978) recommend the enlargement of Phu Khieo into this area between Phu Khieo and Nam Nao. This would also protect Sumatran rhino habitat. Several rhinos are believed to remain there still.

Khao Soi Dao Wildlife Sanctuary: Khao Soi Dao is in Chanthaburi Province and contains 102,500 ha. BROCKELMAN (1977a) describes Khao Soi Dao as comprising two somewhat different regions, separated by the Khlong Ta Ruang and Khlong Pratong streams. The region in the south is the more mountainous, covered with wet evergreen forest. Streams have water all year round. The northern region is finely dissected with steep but fairly low ridges and valleys and elevations are generally lower, mostly 200–600 m. The forest is dry to wet evergreen, and much seems rather scrubby.

In the southern part of the sanctuary the forests are highly disturbed and logged in the lower stream valleys and basins through which there is easy access from the outside, but higher elevations retain intact forests. Some of these valleys, especially the Khlong Ta Riu and Khlong Wang Kaphae still provide good foraging for elephants. On the east of the mountains, however, most valleys appear to lack recent elephant signs (BROCKELMAN, 1977b). The elephants may have been hunted out or moved to other locations because of disturbance by villagers. The northern part of Khao Soi Dao is still continuous with the large forest area which still covers the central parts of southeastern Thailand. This forest is being destroyed on all sides, but probably still contains good elephant populations. The northern parts have never been adequately surveyed biologically, but short hikes penetrating the region from the south have revealed elephant dung and trails in abundance (W.Y. BROCKELMAN and D. DAMMAN, personal communication). The area is not visited by sanctuary personnel, and is said to contain insurgents.

Groups of five to 15 villagers during the past several years have roamed throughout the sanctuary cutting "mai hom". Even the most remote sections show signs of the wood collectors (BROCKELMAN, 1977b). Approximately 80 villagers were planting cardamon (*Amomum krevanh*) in the Khlong Phra Phut and Khlong Thung Krang Valleys. The total area devoted to cardamon farming at that time was several ha. To prepare for planting,

the understorey and middle storey of the forest are cleared away. The areas planted are at altitudes of 400 to 600 m on moderate slopes. The "mai hom" collectors and cardamon farmers poach small game. Poaching pressure is heaviest after planting and during heavy rains, since villagers from the lowlands are idle. Some Thai military personnel also shoot wildlife. There is no evidence that they poach elephants, although 1 elephant was reported shot in the sanctuary and from 2 to 4 more were reported shot outside the sanctuary (near the Kampuchean border) in the last 5 years.

There is also a strong threat from agriculture on the northern and eastern borders. Habitation of the northeast section of the sanctuary is dangerous because of insurgents and poachers. The Hin Dat Dam is a possible threat to elephant movements, as it will flood part of Khao Soi Dao. The proposed dam on the Khlong Ta Ruang would cause flooding of much valuable foraging area and an important north-south migration route.

The boundary area south and west of the sanctuary is privately owned and is planted mostly with tapioca. To the east and south are scattered stands of rubber trees. Until recently, to the east of the sanctuary was reserve forest, but villagers were relocated there at the establishment of Khao Soi Dao Wildlife Sanctuary. It was then changed into an agricultural development area under the responsibility of the Ministry of Agriculture and Cooperatives. The area northwest is covered with good lowland forest. The forests have been given away as logging concessions. Both the "Elephant Action Plan for Asia" (ASIAN ELEPHANT SECRETARIAT, 1978) and the "National Conservation Plan for Thailand" (IUCN/UNEP/FAO, 1979) recommend the enlargement of Khao Soi Dao in this area. It extends eastward to Chon Buri Province, connecting with Khao Ang Rue Nai Wildlife Sanctuary. This is probably the last relatively undisturbed lowland forest in Thailand and contains other endangered species, such as pileated gibbons.

Huay Kha Khaeng Wildlife Sanctuary: Huay Kha Khaeng, Uthai Thani Province, contains 163,100 ha of dry evergreen, mixed deciduous, and deciduous dipterocarp forest with extensive grassland. The sanctuary is completely surrounded by reserved forest and the Thung Yai Wildlife Sanctuary (another important elephant area). Logging concessions have been given

(to the Thai Plywood Company) to the south and southwest of the sanctuary. VINCENT (1976) reported that a lumber road had been cut through to Ban Mai Village and would eventually cut through to Tambon Kammakrut. He later reports (personal communication) that a new road has been cut close along the southeast border. This road is being used by Karen tribesmen to open up areas for planting, but not many Thai villagers are permanently settling the area due to the danger from Karen insurgents. This danger has also stopped most logging and all forestry personnel have been transferred from the southern to the northern areas of the sanctuary. The Karen are heavy poachers of other species and shoot elephants, but not regularly. Karen elephant poaching could increase due to the availability of modern weapons. There are fewer Karen living in the sanctuary now than 15 years ago (MCNEELY & SEIDENSTICKER, 1974). Most have moved to villages with better communications, such as Ban Nai. In the past, Huay Kha Khaeng may also have been used by Mon Hilltribe shifting agriculturalists. Meo Hilltribes are mostly inside the sanctuary along the western border. They also are found to the north outside the sanctuary. They have carried out considerable deforestation inside the southwestern border area. Meo are trophy hunters and are thought to poach heavily for ivory. VINCENT (1978) has examined two elephant skeletons shot by Meo hunters. MCNEELY & SEIDENSTICKER (1974) examined a skeleton which died from undetermined causes. Thai villagers poach elephants between Khao Nam Yen and Khao Yai Mountains, along the southeastern border. They also mine nickel and cut wood for charcoal.

VINCENT (1978) states that the elephant population is of good size and stable, containing from 150 to 200 animals. Herds are made up of 5 to 30 individuals but are usually found in groups of 12 to 15. Tracks indicate that there is a good age stratification with several young in each herd. There appear to be three main core areas joined by trails on which the elephants move back and forth. The areas are located in the following places:

1. South of Huay Ai Yoh to Tambon Kammakrut and west of Pong San Ton.
2. Between the waterfalls on the Huay Ai Yoh, Khao Nang Ram Wildlife Research Station, and the eastern border.
3. The area north of Khao Nang Ram.

Movement is mainly north-south following the Huay Kha Khaeng and Huay Ai Yoh and the line of mountains to the east. East/west movement is limited to the area north of Pong Nai So and Sop Fa Pha and from Huay Ai Yoh. VINCENT (1978) further claims that elephants avoid the western section of the sanctuary due to pressure from Meo ivory poachers and, that this pressure is probably enough to have cut off most traditional migration routes to Burma through Thung Yai Wildlife Sanctuary. The only remaining routes are believed to go through Tambon Kammakrut (south of the sanctuary) and then through Thung Yai into Burma. Elephants enter during the rainy season and leave during the dry season. The probability of existing migration routes in the north is low due to disturbance from agriculture and from people in Mae Ka Si (Nakhon Sawan Province) and in Umphang (Tak Province). (This area is also dangerous because of insurgents and poachers. In May 1979, poachers ambushed a sanctuary truck, killing a ranger and seriously wounding five others.) Elephants are not reported to raid crops on the eastern border but do raid banana plantations at Karen villages along the Huay Kha Khaeng River. Huay Kha Khaeng should be extended southwards. This would ensure the remaining elephant migration routes to Burma and help protect the remaining herds of wild water buffaloes in Thailand. At present, administration and patrolling could prove impossible because of insurgency.

Considering the relative proximity to Bangkok, the large elephant population, and the relative safety in large sections of the sanctuary, I would recommend Huay Kha Khaeng as the first alternative location for a research and technical training project [as proposed by LEVRAT (1977) for Khao Yai National Park]. The Khao Nang Ram Wildlife Research Station could be used as project headquarters.

Khlong Saeng Wildlife Sanctuary : Khlong Saeng, Surat Thani Province, contains 123,600 ha of evergreen rain forest. Khlong Nakha Wildlife Sanctuary, another elephant area, borders Khlong Saeng to the north. To the east and west is reserved forest and private property. The main land use is logging, to the south is mainly private property planted mostly with fruit trees. There is a small problem with illegal logging on the eastern border during the dry season. Tin mining is a serious problem in the

northern and western regions all year round. Thai villagers are slowly expanding agriculture up along the Khlong Saeng Stream. A dam which is also being considered for Khlong Saeng Stream would flood part of the sanctuary. The "National Conservation Plan for Thailand" (IUCN/UNEP/FAO, 1979) has recommended the sanctuary be extended southward. This could prove difficult, since many villagers would have to be relocated.

The elephant population of from 25 to 75 animals enter and leave Khlong Saeng along the northern border with Khlong Nakha and the eastern border with reserved forest, which could be included in the sanctuary.

Phu Luang Wildlife Sanctuary: Phu Luang, in Loei and Phetchabun Provinces, contains 84,000 ha of mixed deciduous, deciduous dipterocarp, dry evergreen, and pine forests and open areas with rhododendron/pine grassland. The sanctuary is surrounded by agricultural land planted mostly with corn, rice, and peanuts. A large elephant population of approximately 100 plus is believed to be confined within the sanctuary.

At present the main danger is from insurgency. On 30, May 1979, the commander of the Third Army Division ordered the closure of the sanctuary. The "Nation Review" quoted the Minister of Defense as saying that the area was closed for fear that its forested areas might provide communist insurgents with good refuge. During 5-10 June, 1979, a military operation with air and artillery support was launched against the insurgents. After 5 days of fighting, the Government forces took a communist camp which contained tunnels, lodgings, a dining hall and a sports field.

Both the "National Conservation Plan for Thailand" (IUCN/UNEP/FAO, 1979) and the "Elephant Action Plan for Asia" (ASIAN ELEPHANT SECRETARIAT, 1978) recommends the enlarging of Phu Luang, ideally connecting it with Nam Nao and Phu Kradung National Parks. This might be impossible, since too many villagers would have to be relocated. Conservation efforts must wait for the military to clear the region of insurgents and reopen the park.

Phu Wua Wildlife Sanctuary: Phu Wua, Nong Khai Province, contains 18,650 ha. The highland is mixed deciduous forest and savanna. Deciduous

dipterocarp, mixed deciduous, and dry evergreen forests make up the lower slope. The sanctuary is surrounded by reserved forest, except to the south, which is agricultural land. This forest still contains elephants and could be included in the sanctuary. Illegal logging, agriculture and terrorism are common in Phu Wua, but poaching is the most serious threat to elephants. Within the last 5 years, 10 elephants have been reported killed. Present estimates of the elephant population are from 10 to 15 animals. Elephants are reported to migrate into Phu Wua from Laos, crossing the Mekong River into Thailand.

Khao Banthat Wildlife Sanctuary: Khao Banthat is in Phatthalung, Trang, and Satun Provinces. Its 128,800 ha of evergreen rain forest is completely surrounded by agriculture. There is a strong threat posed to the sanctuary from logging and poaching during the dry season, although no elephants have been reported killed or captured. There are believed to be from 10 to 25 elephants remaining there. Insurgency is a problem all year long. Invasion of agriculture by elephants is common, especially during the rainy season.

Phanom Dongrek and Yot Dom Wildlife Sanctuaries: The Dongrek Mountain Range extends in Thailand along the Kampuchean border from Udon Thani Province to Prachin Buri. It includes Phanom Dongrek and Yot Dom Wildlife Sanctuaries (76,100 ha and 20,300 ha respectively) and crosses Si Saket and Udon Thani Provinces. This mountain range contains the last remaining forested areas in Si Saket, Surin and Buriram Provinces. Until recently, the Dongrek Range was considered an important elephant area, containing from 100 to 200 elephants (LEKAGUL & MCNEELY, 1977). ENDERLEIN & MAXWELL (1976a, 1976b) failed to find any sign of big game in the area, although an elephant was sighted below the escarpment on the Kampuchean side. They found the forested lowland areas at the base of the range on the Thai side being cut for a sawmill in Kantharak town, in which the loggers had been given a 30-year concession by the RFD to exploit the forest. The loggers were in turn followed by squatters, with their shifting agriculture and charcoal ovens, leaving only patches of what was once an extensive dry dipterocarp forest. At the foot of the escarpment they found

only a strip of dry evergreen forest perhaps 5 to 8 km wide remaining in Si Saket Province (Phanom Dongrek Wildlife Sanctuary); this was also being rapidly cut by loggers. Because of the removal of canopy species, the remaining forest is changing its evergreen character towards a deciduous facies. ENDERLEIN & MAXWELL (1976b) felt that another factor influencing the presence or absence of big game in the area could be the fall of Phnom Penh to the Khmer Rouge. After their victory, the Khmer Rouge had time to consolidate control of Kampuchea and divert troops no longer needed for the siege of the capital to patrolling border areas. Due to the economic and political situation, these troops may have relied heavily on hunting for food. ENDERLEIN & MAXWELL (1976b) found large bands of hunters who complained that they could now find only small game. The hunters reported that large game animals were still found in Kampuchea but were not crossing into Thailand any more due to excessive human interference.

Since then, Phanom Dongrek and Yot Dom have been declared wildlife sanctuaries with all logging, hunting, or human encroachment outlawed. The political situation in Kampuchea has worsened with the outbreak of war, and insurgency has worsened on the Thai side. In June 1979, 40,000 Kampuchean refugees were pushed back into Kampuchea through the Dongrek Range. Although elephants may occasionally be found in these areas, the Dongrek Mountain Range can no longer be thought of as a major elephant area.

Ton Nga Chang Wildlife Sanctuary: Ton Nga Chang, Songkhla, and Satun Provinces, contains 26,458 ha of evergreen rain forest. It is surrounded by agricultural land except to the south, which is reserved forest. Agricultural expansion and poaching are the largest threats to the area. Several years ago, 4 elephants were reported killed in Amphur Rattaphum when they raided crops and attacked villagers trying to ward them off. The small elephant population of 5 to 15 moves between the sanctuary and the reserved forest. This reserved forest should be included in Ton Nga Chang.

Khao Ang Rue Nai Wildlife Sanctuary: Khao Ang Rue Nai, Chachoengsao Province, contains 10,810 ha of dry evergreen, evergreen rain forest, and mixed deciduous forests. It is estimated that from 5 to 15 elephants still

live there. There are minor threats from logging, agriculture, and insurgents throughout the year. Parts of the sanctuary are burned from March to April.

Maenam Phachi Sanctuary: Maenam Phachi, Ratburi Province, contains 53,750 ha of dry evergreen, evergreen rain, and mixed deciduous forests. The sanctuary is bordered by reserved forest (which could feasibly be included in the sanctuary), Khao Khieo Mountain to the north, and Burma to the west. Game poaching of smaller species in the Phu Nam Ron and Huay Thong Kin Chao areas is heavy all year round. Two elephants have reportedly been poached. Tin mining is common in the Huay Thong Kin Chao and Huay Nam Nak areas during the rainy season. Some areas around Huay Thong Kin Chao and Phu Nam Ron are burned every year during the dry season. There is a weak threat from insurgency in the Phu Nam Ron and Huay Thong Kin Chao areas.

Threats to Elephants

Logging and agriculture: Elephant herds in Thailand are becoming isolated due to human disturbance. First, the area is logged, which is not necessarily harmful to elephants, but loggers do live off other game while in the forest. Villagers follow the loggers, permanently clearing the forest for agriculture thus eventually forms isolated ecological islands, cutting off elephant migration. Agricultural expansion then continues to encroach further into elephant areas, destroying valuable habitat. In the long term, this is the most serious threat to Thailand's elephant population. Historically, elephants immigrated from Burma, Kampuchea, and Laos during the rainy season. Due to political changes and human disturbance along the borders, migration is being cut off.

Insurgency: Insurgency is common in most elephant areas, since both insurgents and elephants require large forested regions for refuge. These forests are usually thick, and travel is often restricted to elephant trails. There is not only danger to elephants from land mines and boobytraps, but there is little doubt that well-armed insurgents do not pass up elephant

meat or ivory. Insurgents sell protection to illegal loggers and make patrolling by game wardens or biologists impossible in many sanctuaries and parks.

Poaching: Elephants have been protected since the early days of the Chakri Dynasty, when all wild elephants belonged to the King. Special permission was needed to capture them. The Wild Elephant Act of 1921 declared all wild elephants the property of the Government. Anyone who endangered wild elephants in any way, except when under direct attack, was subject to a fine and imprisonment. The Wild Elephant Act was updated in 1961. No capture permits have been issued in the last few years.

There are two types of elephant poaching in Thailand. The first type is killing the elephant for meat and ivory. The meat is made into "nuea khem" (dried salted meat) and commonly sold as "dried water buffalo meat". Most of the ivory sold in Thailand is sometimes reported to be African ivory imported from China through Hong Kong, but all shops visited claimed to be stocked with Thai ivory. The main ivory outlets are the tourist centres of Bangkok, Chiang Mai, Phatthaya, and Hat Yai. Most Thai ivory is reported to come from western and northern Thailand. There is a large ivory factory in Nakhon Sawan Province which is believed to be the main source of locally worked ivory. Thai ivory carving is usually not intricate and is in the form of small pendants or knick-knacks. Some unworked Thai ivory is also smuggled to Hong Kong for carving, the more intricate carvings coming from Hong Kong. A 5-kg carving will range in price from U.S. \$425 to \$1250 depending on the intricacy of the carving and the quality of the ivory.

The second type of poaching is live capture. In the past, large elephant roundups were undertaken with their own ritual preparations and language. These animals were either trained as beasts of burden or exported. From 1950 to 1969, 1138 elephants were legally exported. More recent figures are not available. Two female elephants (2 and 2½ years old) were exported by the Dusit Zoo, Bangkok, to the Irish capital's Royal Zoological Society, in trade for 2 giraffes on 3 July, 1979. Work elephants can be bought locally for U.S. \$1250. The capturing of wild elephants seems to be decreasing. Villagers claim that the stronger enforcement of the wildlife

laws by forestry officials, the relative scarcity of elephants, and the danger from insurgents in elephant areas are prohibiting them from capturing elephants. The Forest Industry Organization is also now breeding and training their own elephants to be used for forestry work.

Crop Raiding by Elephants

It has been felt that elephants have not caused much of a problem raiding agricultural crops in Thailand, since they prefer to avoid settlements. As agriculture creeps further into elephant habitat, the likelihood of confrontation with man increases. This is shown by the crop raiding reports in this survey. It is possible that many more incidents occur but are not reported since villagers are illegally in the area. It is not known what types of crops are destroyed or whether the crops are eaten or trampled.

SUMMARY AND CONCLUSION

The managed elephant range concept is not applicable to Thailand at this time for the following reasons:

1. Elephant populations are already isolated.
2. The RFD will be unable to enforce the laws necessary for its successful implementation.

In a more practical plan, remaining unprotected elephant habitat would be added to existing protected areas or be gazetted as national parks or wildlife sanctuaries. These areas could be logged before being gazetted. Elephant corridors should be set up where indicated. The main management activities, at this time, should be directed toward protection of the elephant populations and elephant habitat within these restricted areas.

In the long term, agricultural expansion is the most serious threat to Thailand's elephants, since it cuts off migration, thus isolating populations. Poaching is the most serious immediate threat. The capturing of wild elephants seems to be decreasing because of the stronger enforcement of wildlife laws, the relative scarcity of elephants, and the danger from insurgents in many elephant areas. Poaching for meat and ivory appears to be increasing as a result of the accessibility of modern weapons and the rising price of ivory. The RFD should keep a record of all elephant poachings.

Khao Yai National Park would be the best location to conduct a large scale elephant research and technical training project. Huay Kha Khaeng Wildlife Sanctuary should be considered as the first alternative location. Phu Khieo, Thung Yai, and Phu Luang Wildlife Sanctuaries could also be considered, but at this time the danger from insurgents is too great for a research team to operate.

There is a possibility that the occurrence of elephants raiding crops is increasing. The RFD should follow up all reports of crop depredations to find out whether the crops are being eaten or trampled, what crops are preferred, and what measures can be taken to stop these depredations.

ACKNOWLEDGEMENTS

Acknowledgement is made to the support by the *Wildlife Conservation Division* and the *National Parks Division* of Thailand's Royal Forest Department. Pong Leng-Ee and Sawat Nitcharat deserve special thanks. Larry Moore and Manit Nayanetra, Aerial Photo and Mapping Subdivision, Royal Forest Department, drew all the maps included in this paper. Kopkun Sukpran, Sri Nakariniwiroth University, Bang Saen, translated the questionnaire. David Knupp, Unity College, reviewed the manuscript. Thanks must also go to Dr. Boonsong Lekagul, D.L. Damman, Dr. W.Y. Brockelman, and Dr. J.J. Raemaekers for their constant aid and encouragement. Funding by the *World Wildlife Fund* (project #1699) is also gratefully acknowledged.

REFERENCES

- ASIAN ELEPHANT SECRETARIAT, 1978. *Elephant action plan for Asia*. IUCN/WWF. Morges. Mimeo.
- BROCKELMAN, W.Y. 1977a. *A survey of pileated gibbons in Khao Soi Dao Wildlife Sanctuary, Chanthaburi, Thailand*. A special report to the Wildlife Conservation Division, Royal Thai Forest Department. Mimeo.
- BROCKELMAN, W.Y. 1977b. *Second Survey of pileated gibbons in Khao Soi Dao Wildlife Sanctuary, Chanthaburi, Thailand*. Special report to the Wildlife Conservation Division, Royal Thai Forest Department. Mimeo.

- BROCKELMAN, W.Y. and S. SRIKOSARMATARA, 1978. *Surveys for pileated gibbons in Khao Chamao and Khao Srabap National Parks, Thailand*. Special report to the National Parks Division, Royal Thai Forest Department. Mimeo.
- ENDERLEIN, P. and J.F. MAXWELL, 1976a. *A preliminary report from an attempt to find evidence of the presence of kouprey (Bos sauveli) in eastern Thailand and a recommendation to the government of Thailand to set aside the Dongrak Mountain Range for conservation purposes*. FAO. Bangkok. Mimeo.
- ENDERLEIN, P. and J.F. MAXWELL, 1976b. *A report from the second expedition to the Dongrak Mountain Range in eastern Thailand in search of kouprey (Bos sauveli)*. FAO. Bangkok. Mimeo.
- ERICKSON, J.R. 1976. *Management plan for a road system and central station within Phu Khieo Wildlife Sanctuary*. U.S. Peace Corps/Wildlife Conservation Division, Royal Thai Forest Department. Bangkok. Mimeo.
- ERICKSON, J.R. 1977. *A preliminary survey of Phu Khieo Wildlife Sanctuary*. U.S. Peace Corps/Wildlife Conservation Division, Royal Thai Forest Department. Bangkok. Mimeo.
- IUCN/UNEP/FAO, 1979. *National conservation plan for Thailand*. Morges. Mimeo.
- LEKAGUL, B. and J.A. MCNEELY, 1977. Elephants in Thailand: importance, status and conservation. *Tigerpaper* 4 (3) : 22-25.
- LEYRAT, J.C. 1977. *Status of the asian elephant in Thailand. Pilot project for Khao Yai National Park*. Project proposal to WWF. Morges. Mimeo.
- MCNEELY, J.A. and J. SEIDENSTICKER, 1974. *Huay Kha Khaeng : a preliminary ecological survey*. Association for the Conservation of Wildlife, Bangkok. Mimeo.
- OLIVIER, R.C.D. 1978. *On the ecology of the Asian elephant (Elaphas maximus) with particular reference to Malaya and Sri Lanka*. Ph.D thesis, University of Cambridge.
- VINCENT, D. 1976. *A survey of the wild water buffalo at Huay Kha Khaeng Game Sanctuary, Uthai Thani Province*. U.S. Peace Corps/Wildlife Conservation Division, Royal Thai Forest Department. Bangkok. Mimeo.
- VINCENT, D. 1978. *Elephant movements in relation to habitat*. U.S. Peace Corps/Wildlife Conservation Division, Royal Thai Forest Department, Bangkok. Mimeo.
- WILES, G. 1980. Faeces deterioration rates of four ungulates in Thailand. *Nat. Hist. Bull. Siam Soc.* 28 : 121-134.