surveys).

2) Plot-based techniques. This involves any technique in which plots are designated on the ground, and dung piles are counted within them. Advantages: in areas of very high abundance sampling is easier, more effective in areas of poor visibility such as tall grass, easier in rough terrain.

SIGHTING TECHNIQUES

Advantages: can also provide information on population structure and animal condition, usually no problem identifying species. Disadvantages: requires good visibility.

1) Line transects: Advantages include the fact that this method can provide good quality data with confidence limits, and that it is a widely-used and hence well-known technique. Difficult to do in areas of rough terrain or poor visibility; can't be used effectively along roads, rivers, or cut transects [for statistical reasons], therefore, walking a known line and recording distances is difficult; for herding animals, results are expressed in density of groups (possibly reducing the utility of the data); can be very time consuming, especially in areas of low density.

2) Drive counts: This technique involves having many people walking systematically through a known area and counting animals that are flushed. Requires many people, a good organizer, good visibility and large animals. Even in the best conducted drive counts, some animals will be missed leading to under estimation of density.

3) Count/recount known animals: This technique is based on the same idea as capture/mark/recapture. Requires individual identification of a sufficient number of animals in the population, and good visibility such that resightings are frequent.

4) Concentration counts: Any simultaneous count made at points where animals may congregate, such as water holes, mineral licks, etc. This method can only be used for crude monitoring within an area.

5) Automatic camera "traps": Any set up involving the use of cameras with automatic trigger systems (e.g. trip wires), such that an animal may be photographed as it moves through the area. This method may be justified for very rare species in which sufficient funding is available. Most useful for determining presence/absence. Possibly allows for the identification of individuals.

6) Aerial surveys: Very expensive, appropriate in areas that are large and at least seasonally open.

7) Block searches: Predefined blocks are systematically searched ideally using teams of people. All animals sighted are recorded. Advantages: Produces detailed information on

habitat, behavior and ecology in addition to numbers. Disadvantages: Requires much organization, preparation, large numbers of people, time, and money.

TRACK COUNTS

For large, herding animals, the technique is only of any use for determining presence/absence of a species in an area, provided there are no other similar species or domestic forms in the area.

DISCUSSION

The issue of which technique/s to use for various purposes is complex, and depends on factors such as available resources (financial, time, and manpower), environmental conditions, size of the area to be surveyed, number of similar species in the area, and behavior of the animal in question. In general we recommend the following techniques for the different purposes of surveying, censusing, and monitoring.

Recommended Methods:

Census	Surveying	Monitoring
Faecal Techniques*	Faecal techniques	Faecal techniques
Sighting transects	Sighting transects	Sighting transects
	Drive counts	Drive counts
Count/recount known animals		
		(Concentration counts)
Aerial surveys	Aerial surveys	Aerial surveys
Block searches	Block searches	

*Faecal techniques only used if no other options are available because of problems inherent in determining decay and defecation rates.

If the goal of the project is simply to determine the presence or absence of a species in an area then concentration counts, automatic camera "traps" and track counts may be used. Of these track counts would be the cheapest but a common problem with the wild cattle and buffaloes is that we often have more than one species (or wild, feral and domestic members of the same species) with similar footprints within the same area.

We recommend that prior to the start of any census or survey advice is sought from people with experience of counting large terrestrial herbivores in similar environments, and from statisticians with knowledge of biological surveying.

Development of a modelling approach.

Quantitative models for estimating relative population size and potential trends for large mammals can be developed. Such models can be useful but previous attempts have focused on available remaining habitat and have not considered other factors limiting animal numbers, in particular hunting which has been identified as a major threat to wild bovids throughout most of Asia.

We recommend that a model be developed which incorporates information about extent and quality of available habitat, presence or absence of indicator species which may positively or negatively affect large bovid abundance; and the intensity and nature of hunting pressures. These variables are then combined with the results of brief surveys in the area to produce an estimate of likely abundance and expected future trends. The intention is that such a model would produce categories of relative abundance (very low, low, medium, high) and predicted trends (e.g. stable, increasing, decreasing).

Clearly such a model would require validation. By validation we mean that several areas are selected and for each area data on habitat parameters are collected, hunting pressure is assessed and high quality censuses are conducted. The model which best predicts actual abundance from the available habitat and hunting data can then be assessed for utility, applicability and repeatability. If it is judged to be adequate it can then be used to produce rapid estimates of abundance in other areas.

A valuable start has been made for Asian wild cattle. Dr Sompoad Srikosamatara and his colleagues have begun to develop and use a model to estimate gaur and banteng abundance in protected areas in Thailand. The results suggest that estimating hunting pressure is both difficult and crucial. Further research on this topic is urgently needed to validate and refine the model. Such an approach is both timely and relevant considering how many areas have wild cattle and buffalo populations, the multiple threats to these populations, and the need to identify significant populations of all species of Asian wild bovids before they disappear.

Contributors: Simon Hedges, Joel Heinen, Martin Tyson, Sompoad Srikosamatara

Status and Protection of Asian Wild Cattle and Buffalo

Introduction

The Species Survival Commission (SSC) of The World Conservation Union (IUCN) restructured the Asian Wild Cattle Specialist Group (AWCSG) in 1995. A joint meeting of AWCSG was held in July of that year with the Conservation Breeding Specialist Group (CBSG) to conduct a Conservation Assessment and Management Planning Workshop (CAMP) for the taxa covered by the AWCSG. The meeting took place at the Khao Kheow Open Zoo in Chonburi, Thailand. The purpose of this paper is to inform readers about the conservation status of Asian wild cattle and buffalo, major threats to these taxa, and recommendations made to enhance their management during the 1995 AWCSG meetings.

The AWCSG concerns itself primarily with eight species of wild bovids, four species in the genus *Bos* and four species in the genus *Bubalis* within the Asian range states. The species classified as *Bos* are the gaur (*Bos gaurus*), the banteng (*Bos javanicus*), the kouprey (*B. sauveli*), and the wild yak (*B. mutus*). *Bubalis* are the wild water buffalo (*Bubalus bubalis*), the tamaraw (*B. mindorensis*), the lowland anoa (*B. depressicornis*), and the mountain anoa (*B. quarlesi*). A ninth species, the recently discovered and presumably rare spindle-horned ox from Vietnam and Laos (*Pseudoryx nghetinhensis*), was also considered by the AWCSG in the preparatory document and the draft action plan. Brief taxon reports were filed in the preparatory document for two subspecies of the African buffalo (the African and forest buffalo, *Syncerus c. caffer* and *S. c. nanus*), two subspecies of the North American bison (the plains and the wood bison, *Bison b. bison* and *B. b. athabascae*), and the European bison or wisent (*B. bonasus*).

The range states for the taxa covered by AWCSG are Bangladesh, Bhutan, Cambodia, China, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, the Philippines, Sri Lanka, Thailand, and Vietnam. Because of their importance in domestication in Asia, several of the taxa covered by AWCSG pose difficult problems in conservation: the ranges of wild forms overlap with those of domestic forms, and some interbreeding is known or suspected to take place. Different range states contain domestic forms of the yak, gaur, and banteng; domestic water buffalo are found throughout most of the region. Representatives were present at the 1995 meetings from all Asian range states except for Bhutan and Bangladesh.

The 1995 Meetings

Prior to the meetings all participants were given for discussion and revision a preparatory document for the conservation assessments (Read et al. 1995) and a working draft of the status report and conservation action plan for all taxa (Hedges 1995). The former document instructed participants of the IUCN categories of threat based on the criteria of Mace and Lande (1991), which take into account extinction probabilities based on population and range reductions as well as fragmentation. The IUCN criteria also allow for assessments based on the quality of data available. The categories used by Mace and Lande are critical, endangered, and vulnerable. The IUCN also allows for the categories of extinct, extinct in the wild, susceptible, conservation dependent, low risk, and data deficient. The draft action plan (Hedges 1995) represents an extensive literature review of the biology and status of each taxon within each range state and includes a good deal of information on national conservation legislation for range states as well as information on the status and security of many of the prime reserves known to have populations of one or more taxa.

Participants of the meeting formed working groups to discuss and categorize the status of each species in each state based on individual experience for the purposes of revising CAMP taxon reports. Single-taxon reports were produced for the yak, kouprey, tamaraw, and the two species of anoas. Multiple-taxon reports were produced for the other three Asian species—the gaur, banteng, and water buffalo—because the threats to and status of different populations in the various states are different, as is the quality of information available upon which to make conservation assessments. Three taxon reports were produced for the banteng, four for the gaur, and nine for the wild buffalo (Table 1).

The CAMP taxon reports include information for each taxon about conservation and taxonomic status, current and former distributions, population trends, world and regional population numbers, threats, recommendations for conservation, and the sources for compilation of the information. Additional working groups were formed to prepare special topical reports on taxonomy and nomenclature; census, survey and monitoring techniques; disease communication; assisted reproductive technologies; and captive wild-cattle

Conservation Biology, Pages 931–935
Volume 10, No. 4, August 1996

Table 1. Summary data for Asian wild cattle taxa assessed at the 1995 AWCSG and CAMP meetings.[a]

Taxon	Range	Number locations	Data quality[b]	Category of threat[c]	Type of threat[d]	Research and management recommendation[e]
1. *Bubalus bubalis*	Thailand	1	3	CR	D, H, Hyb, L	M, S, T
2. *B. bubalis*	Nepal	1	2	CR	D, Hyb, I, L	M, S, T
3. *B. bubalis*	Central India	3	2	CR	D, Hf, Hyb, I, L	M, S, T
4. *B. bubalis*	Assam/Bhutan	>6	2	EN	D, H, Hyb, I, L	M, S, T
5. *B. bubalis*	Cambodia	4	4	DD/CR?	D, H, Hyb, I, L, Lf	M, O, S, T
6. *B. bubalis*	Vietnam	2?	4	DD/CR?	D, H, Hyb, I, L, Lf	M, S, T
7. *B. bubalis*	Borneo	?	4	DD	D, H, Hyb, I, L, Lf	M, S, T
8. *B. bubalis*	Sri Lanka	6	3	EN	D, Hyb, I, L	M, S, T
9. *B. bubalis*	Laos	?	4	DD/CR?EX?	D, H, Hyb, I, L, Lf, W	M, S, T
10. *B. depressicornis*	Sulawesi	>10	4	EN	Hf, Ht, I, L, Lf	Hm, Lh, Lr, M, S, T
11. *B. quarlesi*	Sulawesi	>5	4	VU/EN	Hf, Ht, I, L, T	Hm, Lh, Lr, M, S, T
12. *B. mindorensis*	Mindoro	4	1	EN	D, Hf, Ht, I, L, Lf	Hm, Lh, Lr, M,
13. *Bos g. gaurus*	South Asia	>10	2, 3	LR	D, Hf, L, Lf	M, T
14. *B. g. laosiensis*	Southeast Asia	43	1	CR/EN	Hf, Ht, Hm, I, L, Lf	Hm, M, S, T
15. *B. g. hubbacki*	Malay Penin.	3	1	CR	Hf, Ht, I, L	Hm, M, S, T
16. *B. g. frontalis*	Myanmar, China	4	3	VU	Hf, Lf	Hm, M, S, T
17. *B. j. javanicus*	Java	12	1, 2, 3	EN	D, H, Hyb, L, Tp	Hm, M, O, S, T
18. *B. j. birmanicus*	Southeast Asia	>23	1, 2, 3	CR	D, Ht, I, L, Lf, N, T, Tp	H, Hm, M, O, S
19. *B. j. lowi*	Borneo	>8	3	EN	Ht, Hyb, I, L, Lf	Hm, S, T
20. *B. mutus*	China, India	6	1	VU	Hf, I, Lf, S	H, Hm, S, M, T
21. *B. sauveli*	Southeast Asia	>2	2, 3, 4	CR	G, Ht, Lf, Tp, W	O, S

[a] *Adapted from Byers et al. 1995.*
[b] *(1) recent (conducted less than 8 years previously) censuses or population monitoring, (2) recent general field studies, (3) recent anecdotal field studies, and (4) indirect information such as numbers found in trade or habitat availability.*
[c] *EX, extinct; CR, critical; EN, endangered; VU, vulnerable; LR, low risk (as described by Mace & Lande 1991); DD, data deficient.*
[d] *D, disease; G, genetic problems; H, hunting; Hf, hunting for food; Hm, hunting for medicine; Ht, hunting for trophies; Hyb, hybridization; I, human interference or disturbance; L, loss of habitat; Lf, loss of habitat due to fragmentation; N, nutritional disorders; S, catastrophic events; T, trade for live animals; Tp, trade for parts; W, war or insurrection.*
[e] *H, husbandry research; Hm, habitat management; Lh, life-history research; Lr, limiting-factor research; M, monitoring; O, other; S, general surveys; T, taxonomic, morphological, or genetic studies.*

immobilization protocols. All CAMP and special topic reports were compiled and later provided to all participants (Byers et al. 1995).

Conservation Status of Species

Of 21 Asian taxa for which the criteria were applied, at least some populations of seven (33%) were considered critical, five (24%) endangered, three (14%) vulnerable, and one (5%) low-risk (Table 1). Those considered critical were the kouprey, two subspecies of gaur (the populations from Myanmar to southern China, and from southern Thailand to peninsular Malaysia), one subspecies of banteng that occurs from Myanmar to Vietnam, and the populations of wild buffalo in Nepal, Thailand, and central India. In addition, the preparatory document listed the spindle-horned ox as critical (Read et al. 1995). The taxa considered endangered were the Assamese population of buffalo, the tamaraw, the lowland anoa, and the Javan and Bornean subspecies of banteng. Those considered vulnerable were the mountain anoa, the yak, and the Burmese population of gayal or mithan, a recognized subspecies of gaur.

Only one Asian taxon, the Indian-Nepalese population of gaur, was considered at low risk. Data ~~was~~ were judged deficient for five populations of wild buffalo. In these cases—the populations in Sri Lanka, Borneo, Vietnam, Laos, and Cambodia—the free-ranging animals known to occur may be partly, largely, or solely of feral domestic origin. Other free-living populations (e.g., Java and Australia) were not considered by the group because they are known to be feral.

Of taxa that occur outside Asia, the preparatory document listed the European bison as vulnerable and the North American plains bison and the two subspecies of African buffalo as secure. Of the non-Asian species considered therein, only the wood bison was considered endangered. Thus, of wild cattle and buffalo worldwide, the Asian species, subspecies, and populations as a group are under the most severe threats.

The data quality used to make assessments is a major cause of concern for this group of animals. The IUCN uses four general categories: (1) recent (conducted less than 8 years previously) censuses or population monitoring, (2) recent general field studies, (3) recent anecdotal field studies, and (4) indirect information such as numbers found in trade or habitat availability. Assessments for only two of the seven Asian taxa considered critical were based on the highest-quality data; recent census information was available. In fact, recent censuses through-

out the range were available for only four of the 21 taxa assessed. For an additional three taxa, high-quality data were available only for select areas within their ranges. For 12 taxa, the data quality was fair to poor (lower than data quality number 2) for some or all populations. In many cases, even population presence and absence is difficult to detect because tracks and fecal remains can look superficially similar for several of these species.

Threats to Asian Wild Cattle and Buffalo

In the Asian range states, habitat loss and fragmentation was identified as a problem for all populations considered, and direct interference by humans was recognized as a threat for most (Table 1). Although the degree of inbreeding (and any deleterious effects therefrom) are only speculative, the general consensus was that a great need exists to increase the population size of many of these taxa by better-securing reserves throughout the region. This is especially true of the two anoas and the tamaraw because all three species are island endemics and habitat in all cases is increasingly limited.

Additional threats are many and varied. Domestic livestock pose potential threats to many taxa because they spread disease. In the case of species for which there are domestic, feral, and wild forms living sympatrically, there is great concern that hybridization with domestic forms will negatively influence wild gene pools. The species under most threat by this venue is the Asian water buffalo, but hybridization was considered a threat to all nine populations considered. Domestic buffalo occur throughout the range and are frequently herded in areas used by the few remaining wild populations. Feral, free-ranging buffalo also occur in many parts of the region, and it is likely that many of the censuses reported do not differentiate them from truly wild forms (Heinen 1993). Hybridization with domestic forms is recognized as a problem for several subspecies of banteng, and it is a potential concern for wild yak in some parts of the range.

Hunting of some form was recognized as a threat to 19 of 21 taxa (Table 1), and the hunting and selling of trophies was considered particularly problematic for several species in southeast Asia, including gaur, banteng, and kouprey in Thailand, Vietnam, Laos, and Cambodia. The spindle-horned ox, discovered in 1992 (Schaller & Rabinowitz 1995), may also be under threat from trophy hunting. The kouprey has not been observed in the wild since 1988. The species is thought to persist based on the occasional findings of skulls for sale in local markets in Cambodia and along the border between Thailand and neighboring countries (Srikosamatara & Sutteehorn 1995). There is also some track evidence found on occasion in parts of western Vietnam and border areas in Laos, Cambodia, and Thailand. The selling of skulls is also considered a threat to the few remaining wild buffalo that may occur in southeast Asia, and some indirect evidence discussed at the meeting suggests that the Assamese (Indian) buffalo, the largest subspecies of Asian buffalo, may fall victim to the trophy markets in southeast Asia via the frontier between India and Myanmar.

Research and Management Recommendations

For most species, subspecies, and populations of Asian wild cattle and buffalo, there is a critical need for high-quality field censuses in all range states. This is especially true for the kouprey and the spindle-horned ox, for which there are virtually no data of any kind about even the most basic aspects of the species' distribution or ecology. The high-quality censuses conducted in the Philippines for the tamaraw must continue, to provide regular monitoring of the species and the remaining habitat. Several of the status assessments made for the Asian populations classed as critical or endangered were based on the lowest-quality data (data quality number 4, based on indirect evidence or general habitat availability). This was not true for the African, North American, or European taxa considered in the preparatory document (Read et al. 1995). In all those cases (five taxa of three species), the recorded data qualities were either 1 or 2.

The water buffalo populations considered critical and endangered (that is, all populations) pose the additional problem of feral buffalo throughout the range; therefore, the potential for poor census data is high if they cannot be differentiated from wild stock. There is a critical need to derive more-specific recommendations useful to rangers and other wildlife officials within all buffalo range states so that more standardized and repeatable censuses can be done. There is also a need for genetic studies on most populations of the species in an effort to determine what (if anything) represents truly wild stock. We are currently working on some guidelines to help accomplish these goals.

Because of the poor quality of information available, participants agreed that survey and monitoring studies are needed on most Asian taxa (Table 1). Basic information on habitat use and availability—and even population presence—are frequently lacking, and more-detailed information on fecundity, life span, recruitment, and disease transmission are needed for many of the Asian taxa. This again is not the case with the North American, European, or African taxa considered in the preparatory document. Participants also agreed that taxonomic, morphological, and genetic research is needed for most taxa, especially because of the domestic and feral populations of several species that live throughout the region. Habitat management to enhance populations was also recommended for 10 of the taxa consid-

cred. Workshops on population and habitat viability were suggested for six taxa, and recommendations for workshops for an additional four taxa are pending the availability of more information.

Conclusions

The CAMP and AWCSG meetings in Thailand proved ~~vulnerable~~ valuable from several perspectives. Participants were encouraged that their efforts for and concerns about Asian wild cattle and buffalo conservation were gaining attention and that the specialist group's work is proceeding. A new group codirector was chosen (S. Srikosamatara), and the action plan compiled in 1995 is scheduled for publication by IUCN. The conservation concerns for these taxa, however, cannot be separated from those for many other species throughout south and southeast Asia. The region contains some of the world's most dense human populations, and natural areas and species are succumbing at accelerated rates.

Recent economic improvements throughout large parts of south and southeast Asia have also hastened the decline of species. The markets for bovid trophies and for numerous other wildlife products are expanding as purchasing power increases. There is a great need in all range states to enforce existing national and international laws for the protection of natural areas and for the reduction and eventual elimination of trade threats such as the selling of trophies. Proposals for workshops and training on monitoring, surveying, and law enforcement were prepared at the meeting for the southeast Asian range states; as a result, large-mammal management training for Cambodian officials are currently underway in Thailand.

In addition to these developments, there is a great need for expanded conservation education programs for the public in all range states. These issues were discussed at the 1995 meetings; for its part, the AWCSG will continue to update information and make recommendations for the conservation of and education about this important group of animals, which will be available to members and to others in the conservation community throughout the region.

Acknowledgments

We thank all participants of the 1995 AWCSG and CAMP meetings. Special thanks go to the director and staff of Khao Kheow Open Zoo in Chonburi, Thailand, for making the meetings a success, and to O. Byers of the Captive Breeding Specialist Group for compiling and distributing the information in a timely manner.

Joel T. Heinen

Department of Environmental Studies, Florida International University, Miami, FL 33199, U.S.A.

Sompoad Srikosamatara

Department of Biology, Faculty of Sciences, Mahidol University, Bangkok 10400 Thailand

Literature Cited

Byers, O., S. Hedges, and U. S. Seal. 1995. Asian wild cattle conservation assessment and management plan workshop. Working document. World Conservation Union and Species Survival Commission, Gland, Switzerland

Hedges, S. 1995. Asian wild cattle and buffalo: draft status report and conservation action plan (parts I and II). World Conservation Union and Species Survival Commission, Gland, Switzerland.

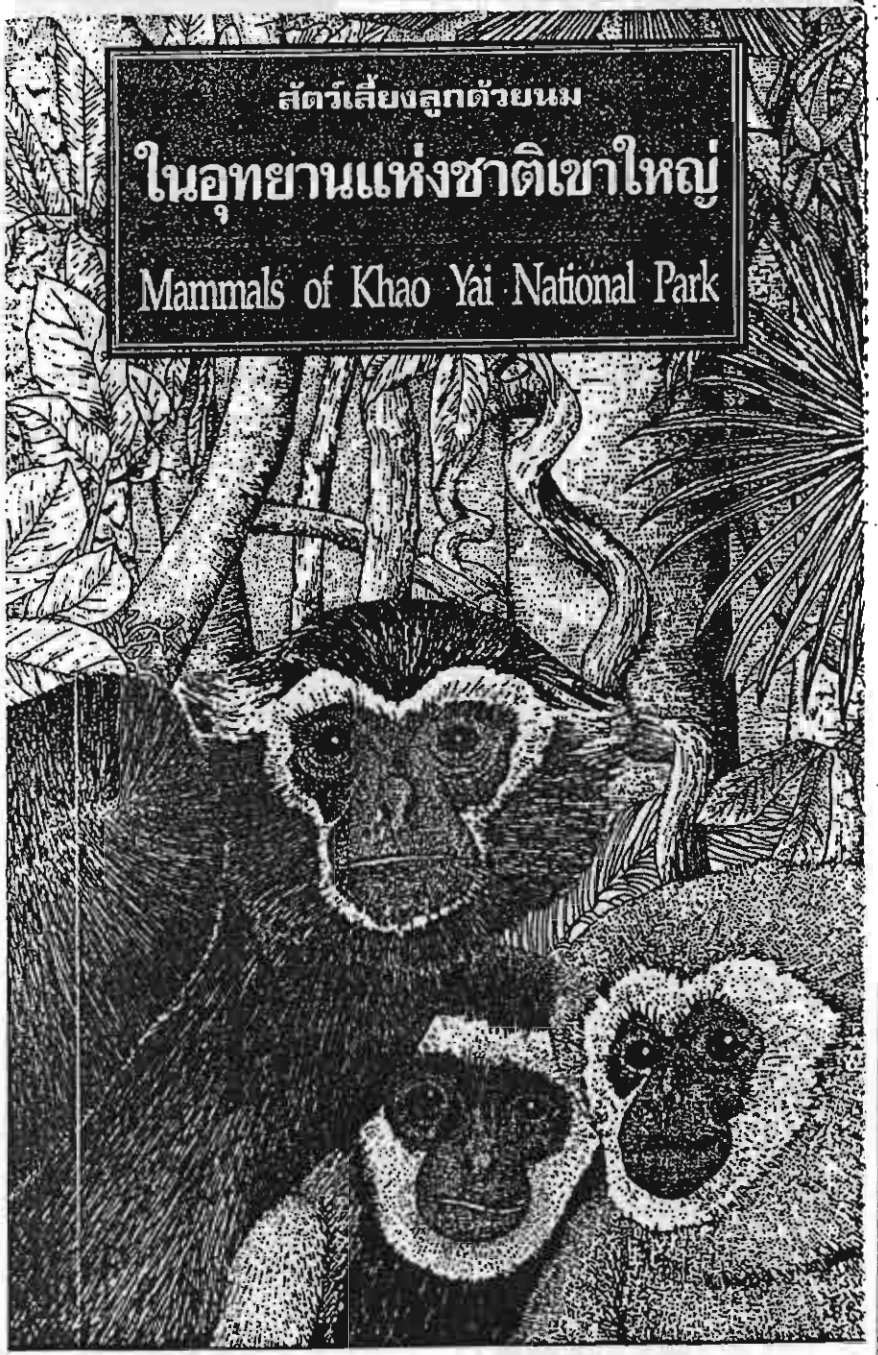
Heinen, J. T. 1993. Population viability and management recommendations for wild water buffalo (*Bubalus bubalis*) in Kosi Tappu Wildlife Reserve, Nepal. Biological Conservation 65:29–34.

Mace, G. M., and R. Lande. 1991. Assessing extinction threats: Toward a reevaluation of IUCN threatened species categories. Conservation Biology 5:148–157.

Read, B., D. Morris, N. Loskutoff, O. Byers, and S. Ellis. 1995. Preparatory document for the bovid conservation assessment and management plan. Working document. World Conservation Union and Species Survival Commission, Gland, Switzerland.

Schaller, G. B., and A. Rabinowitz. 1995. The saola or spindle-horned bovid (*Pseudoryx nghetinhensis*) in Laos. Oryx 29:107–114.

Srikosamatara, S., and V. Suteethorn. 1995. Populations of gaur and banteng and their management in Thailand. Natural History Bulletin of the Siam Society 43:55–83.



โดย สมโภชน์ ศรีโกสามาตร (Sompoad Srikosamatara)
ทรอย แฮนเซล (Troy Hansel)

อุทยานแห่งชาติเขาใหญ่เป็นอุทยานที่มีความเก่าแก่และเป็นที่รู้จักกันดีของประเทศไทย รวมทั้งเป็นสถานที่ท่องเที่ยวติดอันดับยอดนิยม หนังสือเล่มนี้ ถือได้ว่าเป็นคู่มือศึกษาสัตว์เลี้ยงลูกด้วยนมในอุทยานแห่งชาติเขาใหญ่เล่มแรก เขียนขึ้นจากความรู้และประสบการณ์ของ ดร. สมโภชน์ ศรีโกสามาตร และคุณทรอย แฮนเซล มีเนื้อหาสั้นกะทัดรัดเพื่อเป็นข้อมูลพื้นฐานและง่ายต่อการใช้ในการสังเกตพฤติกรรมและชีววิทยาของสัตว์เลี้ยงลูกด้วยนม นอกจากนี้แล้ว ยังประกอบด้วย ภาพวาดสัตว์ป่าและรอยเท้าสัตว์ 30 ชนิด ตารางข้อมูลของสัตว์เลี้ยงลูกด้วยนม 71 ชนิด และแผนที่เส้นทางเดินป่าในอุทยานแห่งชาติเขาใหญ่

Khao Yai National Park is Thailand's oldest and most-visited National Park. This is the first guide to the mammal fauna of the park. Written by acknowledged expert Dr. Sompoad Srikosamatara and keen naturalist Troy Hansel, this pocket guide will prove invaluable to all those wishing to know more about the fascinating wildlife inhabiting this national park. Includes:

- 30 species illustrated
- Comprehensive checklist of 71 species
- 3 maps incl. detailed trail map
- Guide to popular trails

1996
Size 115 x 200 mm
Pages 110
ISBN 974-8941-40-8

WWF

มูลนิธิโลกสีเขียว

กระทิง หรือ เมย

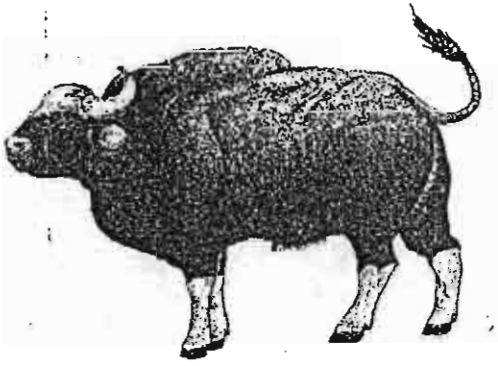
ขนาด: ความยาวลำตัวและหัว 2500-3000 มม. ความยาวหาง 700-1050มม.
น้ำหนัก : 650-900 กก.
ลักษณะทั่วไป : เป็นสัตว์ขนาดใหญ่มีสีดำตามลำตัวยกเว้นบริเวณส่วนปลายของขาจะมีขนสีขาวหรือสีเหลือง ส่วนหลังของคอจะมีเนื้อที่นูนขึ้นมามีลักษณะเป็นหนอก จะมีขนสีน้ำตาลอ่อนปกคลุมบริเวณหน้าผาก และบริเวณรอบๆ ปากจะมีสีขาวล้อมรอบ ตามลำตัวของตัวผู้จะมีเหงื่อออกเหนียวๆ คล้ายน้ำมันมาปกคลุมหนังและขนทำให้มีสีหนังและขนเป็นสีเหลืองทอง เขากระทิงจะโค้งงอนิดหน่อยมีสีออกเหลืองลูกมะกอก และมีสีดำบริเวณปลายเขา เขาจะทื่อและสั้นเมื่อกระทิงมีอายุมากขึ้น
อุปนิสัย : มักหากินในเวลากลางคืน แต่สามารถพบเห็นได้ในเวลากลางวันเช่นเดียวกัน ค่อนข้างกลัวคนทำให้เห็นได้ยาก กินทั้งหญ้าและใบไม้ อาหารอย่างอื่นประกอบด้วยใบไม้อ่อน ผลไม้ เปลือกไม้ และหน่อไม้ พวกมันจะออกหากินแร่ธาตุต่างๆ และเกลือโดยกินดินจากโป่งต่างๆ มีผู้พบเห็นรอยเท้าในบริเวณทุ่งหญ้าและในป่าใกล้คลองอีเต่าและบริเวณเขาแหลม แต่ก่อนฝูงกระทิงเคยออกหากินดินโป่งที่หอดูสัตว์ที่หนองผักชี แต่เนื่องจากถูกรบกวนมากจึงเห็นได้ยากในปัจจุบัน มีผู้ถ่ายรูปฝูงกระทิงครั้งสุดท้ายจำนวน 6 ตัวที่หนองผักชีเมื่อวันที่ 19 กันยายน 2524 คาดว่ามีกระทิงในอุทยานาเขาใหญ่ประมาณ 100 ตัว

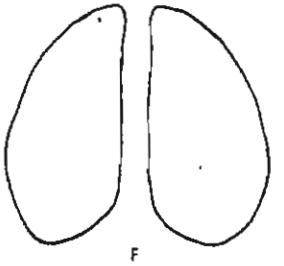
Gaur
(Bos gaurus)

Size : Head and body: 2500-3000 mm, Tail: 700-1050 mm,
Weight : 650-900 kg.

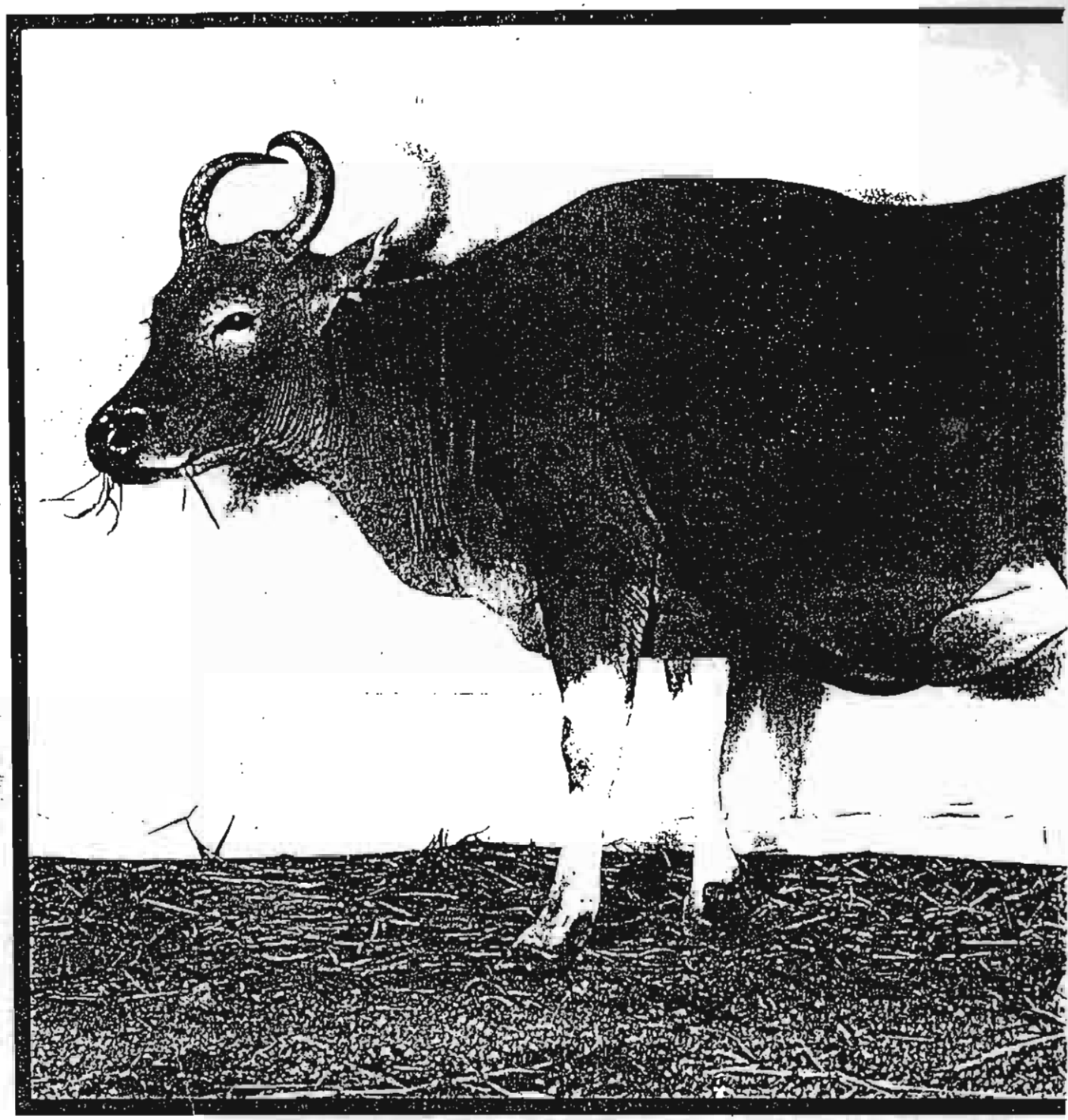
Description : A large, dark bovine with white or yellow stockings on all four legs and a high ridged back. The forehead is light brown to just above the eyes and the mouth has a white line around it. Bulls produce an oily sweat that stains their skin and hair a golden-yellow, as can be seen on the lighter areas of the body. The slightly curved horns of gaur are olive-yellow, darkening at the tip. Older animals have blunter and shorter horns.

Ecology and Behavior : Gaurs tend to be nocturnal in habit; however, the animals are occasionally seen during daylight hours. The gaur is very shy and difficult to see. They are combination grazers and browsers, foraging on a wide variety of plant life: grasses, young leaves, fruits, woody fiber, and bamboo shoots. Gaurs visit mineral salt licks to supplement their diet with essential salts and minerals. Tracks of gaur may be seen in the fields and nearby forest at Klong E Tao and Khao Laem area, not far from headquarters.





F = Forefoot (รอยเท้าหน้า)



วัวแดง

ชื่อวิทยาศาสตร์	*Bos javanicus* d'Alton 1823
ชื่อภาษาอังกฤษ	Banteng
ขนาดใหญ่สุด (วัดจากความสูงระดับไหล่ของตัวผู้)	๑.๙ เมตร
น้ำหนักมากที่สุด (ตัวผู้)	๙๐๐ กิโลกรัม
ถิ่นอาศัย	ป่าเต็งรัง ป่าเบญจพรรณในที่ราบต่ำ สูงจากระดับน้ำทะเลไม่เกิน ๖๐๐ เมตร แต่อาจพบได้ในป่าดงดิบทางภาคใต้ของประเทศไทย ในหมู่เกาะต่าง ๆ ของประเทศอินโดนีเซีย และเกาะบอร์เนียว
สถานภาพ	เป็นสัตว์ป่าคุ้มครองในบัญชีหมายเลขที่ ๒ ตาม พ.ร.บ. สงวนและคุ้มครองสัตว์ป่า พ.ศ. ๒๕๓๕ และเนื่องจากประชากรวัวแดงลดลงในอัตราที่สูงมาก จึงถูกเสนอให้เป็นสัตว์ป่าที่อยู่ในขั้นวิกฤต (Critically endangered) ตามระบบ IUCN และกำลังถูกนำเสนอให้อยู่ในบัญชีหมายเลข ๑ ของอนุสัญญาไซเตส เนื่องจากมีการค้าเขาระหว่างประเทศเป็นปริมาณมาก

สารคดี 143(12): 4-5 (มกราคม 2540)

ประเทศไทย สัตว์ใกล้สูญพันธุ์

เรื่อง : สมโภชน์ ศรีโกสามาตร • ภาพ : ฝ่ายภาพ "สารคดี"

วัวแดงเป็นวัวป่าในกลุ่มเดียวกับกูปรี กระทิง จามรี ไบซันอเมริกา ไบซันยุโรป และ Ure-ox หรือ Aurochs ซึ่งเป็นบรรพบุรุษของวัวเลี้ยงในปัจจุบัน และมีถิ่นกำเนิดจากวัวในเอเชียตะวันตก ทั้งหมดจัดอยู่ในวงศ์ Bovidae วงศ์ย่อย Bovinae และกลุ่ม Bovina ลักษณะที่สำคัญของวัวแดงที่ต่างจากวัวบ้านโดยทั่วไป คือ บริเวณขาจากตีนถึงเข่าทั้ง ๔ ข้าง มีสีขาวคล้ายสวมถุงเท้า และที่ก้นมีวงสีขาวคล้ายใบโพ นอกจากนี้เขาของวัวแดงยังมีขนาดใหญ่กว่าวัวบ้านด้วย

วัวแดงตัวผู้มีเขาใหญ่และวงเขากว้างกว่าตัวเมีย และมีหนังแข็งอยู่ตรงส่วนหัวบริเวณเหนือหน้าผากขึ้นไป ภาพตัดขวางของเขาวัวแดงตัวผู้จะเป็นวงกลมมากกว่าเขากระทิงตัวผู้ เมื่อโตเต็มวัย วัวแดงตัวผู้จะมีขนาดใหญ่กว่าตัวเมีย ความสูงระดับไหล่โดยเฉลี่ยของตัวผู้และตัวเมียเท่ากับ ๑.๖ และ ๑.๔ เมตรตามลำดับ และน้ำหนักโดยเฉลี่ยของตัวผู้และตัวเมียเท่ากับ ๖๓๕ และ ๔๐๐ กิโลกรัมตามลำดับ ลูกวัวแดงและวัวแดงตัวเมียมีสีออกส้มคล้ายสีอิฐ เมื่อโตขึ้นสีขนของลูกวัวแดงตัวผู้จะค่อย ๆ เปลี่ยนจนกระทั่งเป็นสีคล้ำคล้ายสีเม็ดมะขาม ทั้งนี้วัวแดงตัวผู้ที่อาศัยอยู่ในหมู่เกาะต่าง ๆ ของประเทศอินโดนีเซียจะมีสีคล้ำออกดำมากกว่าวัวแดงที่อาศัยอยู่บนแผ่นดินใหญ่ของทวีปเอเชีย

วัวแดงอาศัยอยู่ตามป่าทางเอเชียตะวันออกเฉียงใต้ ทั้งในประเทศพม่า ไทย ลาว กัมพูชา เวียดนาม เกาะบอร์เนียว เกาะชวา เกาะบาหลี ในอดีตจะพบเห็นวัวแดงได้ทั่วไปในบริเวณป่าต่ำ ซึ่งสูงจากระดับน้ำทะเลไม่เกิน ๖๐๐ เมตรในทุกประเทศที่กล่าวมานี้

ปรกติวัวแดงจะอยู่เป็นฝูง ในแต่ละฝูงจะมีตัวเมียที่โตเต็มวัยจำนวนมากกว่าตัวผู้ที่โตเต็มวัย ตัวเมียที่มีอายุมากและมีลูกมากที่สุดมักจะเดินนำฝูง ส่วนตัวผู้ตัวเด่นในฝูงมักจะเดินตามหลังกลุ่มตัวเมีย โดยอยู่ค่อนมาทางด้านหน้าของฝูง ส่วนตัวผู้ที่มีอายุน้อยกว่ามักจะถูกกีดกันจากฝูง ต้องเดินตามหลังหรืออยู่รอบนอก และในที่สุดก็จะแยกตัวออกจากฝูงไป วัวแดงฝูงใหญ่ที่สุดที่นับได้ที่เขตรักษาพันธุ์สัตว์ป่าห้วยขาแข้งมีจำนวน ๒๓ ตัว

วัวแดงเป็นสัตว์ที่ทนร้อนได้ดีกว่ากระทิง มันมักจะเดินทาง ๗-๑๕ กิโลเมตรต่อวันในพื้นที่หากินประมาณ ๕๐ ตารางกิโลเมตร เพื่อหากินพืชและเปลือกไม้บางชนิด ในเขตรักษาพันธุ์สัตว์ป่าห้วยขาแข้งมักจะพบวัวแดงในป่าเต็งรังและป่าเบญจพรรณ ซึ่งมีอากาศร้อนมากในเวลากลางวัน ในขณะที่กระทิงจะหากินในป่าดิบแล้งและป่าดิบเขาซึ่งมีอากาศเย็นกว่า เรามักจะพบกระทิงและวัวแดงตามโป่งในเขตรักษาพันธุ์สัตว์ป่าห้วยขาแข้ง

ในป่าที่เป็นถิ่นที่อยู่อาศัยตามธรรมชาติของวัวแดงทั่วโลกมีวัวแดงอยู่ประมาณ ๕,๐๐๐-๘,๐๐๐ ตัว แต่ก็ไม่มีบริเวณใดเลยที่มีวัวแดงมากกว่า ๕๐๐ ตัว และบริเวณที่มีจำนวนวัวแดงมากกว่า ๕๐ ตัวขึ้นไปก็มีเพียง ๗ แห่งเท่านั้น โดย ๕ แห่งอยู่ในเกาะชวา ๑ แห่งในไทย และอีก ๑ แห่งในเวียดนาม

ประเทศไทยมีวัวแดงเหลืออยู่ประมาณ ๔๕๐ ตัว ในขณะที่มีวัวบ้านทั้งหมดมากกว่า ๕ ล้านตัว เขตรักษาพันธุ์สัตว์ป่าห้วยขาแข้งมีวัวแดงมากที่สุด คือประมาณ ๓๐๐ ตัว และเนื่องจากการจัดการเขตรักษาพันธุ์สัตว์ป่าที่ดีในช่วง ๕ ปีที่ผ่านมา ทำให้จำนวนวัวแดงเพิ่มขึ้นเรื่อย ๆ โดยเฉพาะอย่างยิ่งบริเวณที่ราบใกล้ที่ทำการใหญ่ของเขตฯ ซึ่งแต่ก่อนมีหมู่บ้านและผู้คนอยู่ แต่เมื่อมีการย้ายหมู่บ้านและผู้คนออกไป รวมทั้งตรวจตราไม่ให้มีการล่าสัตว์ ทำให้วัวแดงมีพื้นที่หากินเพิ่มขึ้น และขยายการใช้พื้นที่และเพิ่มประชากรมากขึ้นในบริเวณดังกล่าว อย่างไรก็ตามในช่วง ๒๐ ปีที่ผ่านมา จำนวนวัวแดงในประเทศไทยโดยเฉลี่ยก็ลดลงถึงร้อยละ ๘๐

สาเหตุสำคัญที่ทำให้จำนวนวัวแดงลดลงอย่างรวดเร็ว คือ การบุกรุกถิ่นที่อยู่อาศัยของวัวแดงที่เป็นป่าในที่ราบต่ำ ซึ่งส่วนใหญ่มักจะเป็นบริเวณแรก ๆ ที่การคมนาคมเข้าถึง และเป็นบริเวณป่าที่มักจะถูกถากถางพื้นที่เพื่อทำเกษตรกรรม สาเหตุใหญ่อีกประการ คือ การล่าเพื่อเอาเขา ในปี พ.ศ. ๒๕๓๗ พบว่ามีเขาวัวแดงสะสมตามบ้านคนในกรุงเทพฯ ประมาณ ๑,๘๐๐ คู่ และในจังหวัดอุทัยธานีไม่ต่ำกว่า ๑๗๐ คู่ นอกจากนี้การเลี้ยงวัวบ้านในบริเวณติดกับถิ่นที่อยู่อาศัยของวัวแดงในเขตรักษาพันธุ์สัตว์ป่าห้วยขาแข้ง ก็อาจจะทำให้มีการติดโรคจากวัวบ้านไปสู่วัวแดง และเป็นเหตุให้วัวแดงตายเป็นจำนวนมาก ดังมีหลักฐานบ้างแล้วว่าวัวแดงบางตัวในเขตรักษาพันธุ์สัตว์ป่าห้วยขาแข้งตายลงเนื่องจากเป็นโรค

วารสารคณะวิทยาศาสตร์ มหาวิทยาลัยมหิดล 10(3): 13-14. พ.ค.-มิ.ย. 2540.

การอนุรักษ์กระทิงและวัวแดงในประเทศไทย*

สมโภชน์ ศิริโกสามาตร ภาควิชาชีววิทยา คณะวิทยาศาสตร์ มหาวิทยาลัยมหิดล

การอนุรักษ์กระทิงและวัวแดงเป็นกรณีศึกษาการอนุรักษ์ความหลากหลายทางชีวภาพ โดยสามารถประยุกต์ให้เข้ากับกรณีของสัตว์ที่มีขนาดใหญ่ ทำให้มีอัตราการเจริญพันธุ์ต่ำ เป็นสัตว์ที่มีการล่าสูงเพื่อเอาผลผลิตของมันคือเขาไว้เป็นเครื่องประดับมากกว่าล่าเพื่อเอาเนื้อ เป็นสัตว์ที่ไม่มีประวัติศาสตร์เกี่ยวข้องกับวัฒนธรรมไทยเมื่อเปรียบเทียบกับช้าง เป็นสัตว์ที่ไม่มีการนำมาใช้ประโยชน์ในประเทศไทย ถึงแม้ว่าในประเทศอื่น ๆ ข้างเคียงมีการนำมาเลี้ยงเช่นประเทศพม่า และอินโดนีเซีย และเป็นสัตว์ที่มีอัตราการลดลงของประชากรสูง

กระทิงและวัวแดงอยู่ในกลุ่มเดียวกับบรรพบุรุษของวัวบ้านแต่เป็นคนละสปีชีส์ กระทิงมีขนาดใหญ่กว่าวัวแดง โดยกระทิงเต็มวัยจะมีน้ำหนักประมาณ 650-900 กิโลกรัม และวัวแดงประมาณ 400-636 กิโลกรัม ลำตัวกระทิงมีสีดำและเป็นสัตว์ที่ทนความร้อนไม่ค่อยดีจึงมักอาศัยอยู่ในป่าดิบ ในขณะที่วัวแดงมีลำตัวสีแดงอิฐหรือค่อนข้างคล้ำทนอากาศร้อนได้ดีจึงสามารถอาศัยอยู่ในป่าโปร่งเช่นป่าเต็งรังและเบญจพรรณได้ดี ลักษณะของกระทิงแตกต่างจากวัวบ้านอย่างเห็นได้ชัด ในขณะที่ลักษณะเด่นของวัวแดงที่ต่างจากวัวบ้านโดยทั่วไปคือที่ก้นมีวงสีขาวคล้ายใบโพ บรรพบุรุษของวัวบ้านมีชื่อเรียกว่า Ure-ox หรือ Aurochs และมีชื่อวิทยาศาสตร์ว่า Bos primigenius เมื่อโตเต็มวัยจะมีน้ำหนักประมาณ 800-1,000 กิโลกรัม Ure-ox เป็นตัวอย่างความล้มเหลวของการอนุรักษ์ที่ประยุกต์ได้กับสิ่งมีชีวิตที่ถึงแม้ว่าจะเป็นประโยชน์แก่มนุษย์อย่างมหาศาล Ure-ox ตัวสุดท้ายตายไปเมื่อปี ค.ศ. 1627 ใกล้เมืองวอร์ซอประเทศโปแลนด์

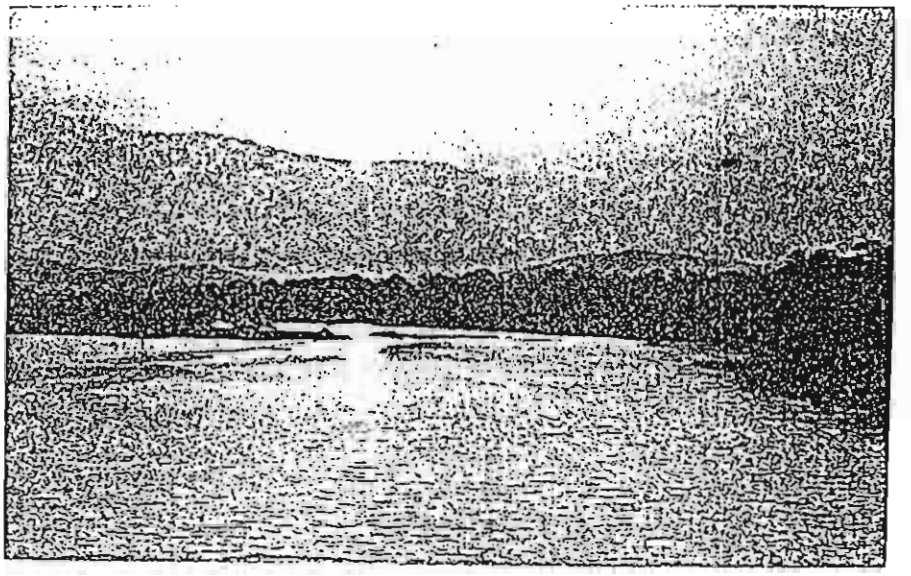
ในปัจจุบันมีประชากรของกระทิงในประเทศไทยประมาณ 1,000 ตัว และวัวแดง 450 ตัว โดยมีอัตราการลดลงของประชากรของกระทิงประมาณ 60 % และวัวแดง 80% ในช่วง 20 ปีที่ผ่านมา ในปี พ.ศ. 2539 วัวแดงจัดอยู่ในสัตว์ใกล้สูญพันธุ์ (endangered) และกระทิงเป็นสัตว์ที่เสี่ยงต่อการสูญพันธุ์ (vulnerable) โดยสหภาพนานาชาติเพื่อการอนุรักษ์ธรรมชาติและทรัพยากรธรรมชาติ (International Union for Conservation of Nature and Natural Resources หรือ IUCN) การลดลงของประชากรของกระทิงและวัวแดงเนื่องมาจากการทำลายถิ่นที่อยู่อาศัยและการล่าเพื่อเอาเขามาประดับตามบ้านและห้องรับแขก ในปี พ.ศ. 2537 มีเขากระทิงและวัวแดงที่ลงทะเบียนที่กรมป่าไม้จำนวน 967 และ 1840 คู่ตามลำดับ โดยส่วนใหญ่จะเป็นเขาตามบ้านคนในกรุงเทพฯ และเมื่อรวมกับจำนวนเขาตามต่างจังหวัดซึ่งไม่มีสถิติทำให้คาดว่าจะมีมากกว่านี้

ประชากรของกระทิงหรือวัวแดงที่เหลืออยู่จะมีอยู่แต่ในเฉพาะเขตอนุรักษ์คืออุทยาน

---

*โครงการฝึกอบรมทางวิชาการให้แก่ราชการสถาบันราชภัฏ เรื่อง ความหลากหลายทางชีวภาพและการอนุรักษ์ ภาควิชาชีววิทยา คณะวิทยาศาสตร์ มหาวิทยาลัยมหิดล พฤษภาคม 2540

แห่งชาติและเขตรักษาพันธุ์สัตว์ป่าเท่านั้น โดยมีกระทิงมากที่สุดในเขตรักษาพันธุ์สัตว์ป่าห้วยขาแข้งและทุ่งใหญ่นเรศวร และวัวแดงมากที่สุดในเขตรักษาพันธุ์สัตว์ป่าห้วยขาแข้ง การจัดการเขตรักษาพันธุ์สัตว์ป่าห้วยขาแข้งเข้มงวดทำให้ประชากรของวัวแดงเพิ่มขึ้นและสามารถอพยพเข้าไปใช้พื้นที่ราบต่ำที่แต่ก่อนเคยถูกรบกวนจากมนุษย์แต่เนื่องจากบริเวณดังกล่าวมีการเลี้ยงวัวบ้านเป็นจำนวนมากซึ่งอาจจะเป็นสาเหตุที่ทำให้เกิดจากติดเชื้อโรคจากวัวบ้านมาสู่วัวป่าได้และอาจจะเป็นสาเหตุหลักทำให้ประชากรของวัวป่าในเขตรักษาพันธุ์สัตว์ป่าห้วยขาแข้งลดลง จึงได้มีการเสนอให้มีการควบคุมการเลี้ยงวัวบ้านในเขตดังกล่าว นอกจากนี้ยังได้มีการดำเนินการให้วัวแดงอยู่ในบัญชีหมายเลข 1 ของอนุสัญญาไซเตส หรืออนุสัญญาว่าด้วยการค้าระหว่างประเทศซึ่งชนิดของสัตว์ป่าและพืชป่าที่กำลังจะสูญพันธุ์ หรือ Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) เนื่องจากพบว่ามีการค้าขายเขาสัตว์ดังกล่าวระหว่างประเทศเป็นจำนวนมากโดยเฉพาะตามแนวชายแดนไทย-พม่า ไทย-ลาว และไทย-เขมร เป็นต้น



FACTORS REVERSING POPULATION DECLINE OF GAUR AND BANTENG IN THAILAND

Sompoad Srikosamatara [1] and Varavudh Suteethorn [2]

[1] Department of Biology, Faculty of Science, Mahidol University, Rama 6 Road, Bangkok 10400

[2] Geological Survey Division, Department of Mineral Resources, Ministry of Industry, Rama 6 Road, Bangkok 10400, Thailand.

ABSTRACT

Additional information still confirm the last population estimate (SRIKOSAMATARA & SUTEETHORN, 1995) of 900s wild gaur and 400s wild banteng in Thailand. More information reveal that there is no viable population of either gaur and banteng in protected areas in Northern Thailand even in Om Koi WS-Mae Tuen WS-Mae Ping NP Forest Complex. A healthy population of gaur is found in Phu Khieo WS of northeast Thailand, a few protected areas along Thai-Malaysia border and some gaur were left in Khlong Saeng WS but it has been heavily disturbed by human. The population of gaur and banteng are still declining countrywide except a few areas like Khao Yai Forest Complex and Huai Kha Khaeng WS. This is because they are areas where forest encroachment happened recently in 1960s and 1970s and the result of community involvement in protected area management in Khao Yai National Park and strong law enforcement in Huai Kha Khaeng Wildlife Sanctuary. In Khao Yai Forest Complex, gaur started to colonize the abandon and degraded areas near Khao Yai NP since 1995 and also in an area disturbed by the dirt road which encourages secondary growth in Pang Sida NP since 1993. Banteng were reported only in Dong Yai WS and Ta Phraya NP of this Khao Yai Forest Complex. Strong law enforcement makes populations of gaur and banteng increase in Huai Kha Khaeng WS but their populations are also regulated by their natural predators, e.g. tiger.

INTRODUCTION

Banteng has been classified as internationally endangered while gaur as internationally vulnerable (IUCN, 1996). From the world population of 15,000 wild gaur and 5,000-8,000 wild banteng, there are about 900s gaur and 400s banteng in Thailand (SRIKOSAMATARA & SUTEETHORN, 1995; HEINEN & SRIKOSAMATARA, 1996; HEDGES, 1998). Trophy collection in Thai houses following western tradition

encouraged hunting both gaur and banteng possibly since late 19th Century when European and Chinese counterparts worked in logging companies and brought high-quality rifles into Thailand (DE A'TH, 1992; CAMPBELL, 1935). Improving the means of transportation by railways and roads since 1900s and 1940s (DONNER, 1978) in combination with the available of powerful guns after the 2nd World War (LEKAGUL & MCNEELY, 1977), most areas have been easily accessible and a large number of gaur and banteng were hunted for trophy collection and local trophy trade. Even after 1960s when Thailand set up a network of protected areas, gaur and banteng have also been hunted in protected areas to supply trophy trade for rich people in large cities like Bangkok. In 1994, a total of 967 pairs of gaur horns and 1840 pairs of banteng horns were registered in Bangkok only (SRIKOSAMATARA & SUTEETHORN, 1995). It is expected that there are more trophies in other provinces but the data are not available.

Due to the long history of over-hunting, in which some areas can be traced back since the 2nd World War and some even since the late 19th Century, a few gaur and banteng were left in a lot of protected areas of 100s or 1000s km^2 in size. To do a proper census, survey and monitoring by well established methods (e.g. HEDGES ET AL., 1995; WILSON ET AL., 1996; SPELLERBERG, 1991; CROZE, 1984; VARMAN & SUKUMAR, 1995) especially in many protected areas are always costly, impractical and time consuming. Mixture of methods, including information exchange from informal conservation network, gathering information from unpublished report, interviewing local people, quick survey and proper line transect, were used to maximize the amount of information obtained.

This study reports more information about populations of gaur and banteng in a few more protected areas where information are limited as reported by SRIKOSAMATARA & SUTEETHORN, (1995). A few areas, where the populations of gaur and banteng are expected to increase due to various conservation efforts, were systematically monitored so that the conservation success can be assessed.

STUDY SITES AND METHODS

Special efforts were made to obtain information about populations of gaur and banteng in protected areas where little information were obtained in the report by SRIKOSAMATARA & SUTEETHORN (1995). As the authors have involved in wildlife conservation activities, including serving in a few conservation committees and involving

in training various conservation personal for some times, information has been exchanged among concerned individuals including some scientists, protected area managers, expatriate volunteers and conservation NGOs. This informal network was set up in a process which is hard to describe but it is based on trust, which is mixture o' honesty, benevolence and reciprocity (MOORE, 1996), and the network was formed as a "serendipity" process or "the process that the faculty of finding valuable or agreeable things not sought for". During the network forming, the authors just realized that it is a process which is a subject under active research by itself (SAUNDERS et al., 1996). In fact, information obtaining is the secondary objective in network forming, the main objective is to increase effectiveness of conservation effort.

Preliminary information were usually seek from secondary sources especially in protected area management document administered by the Royal Forest Department since 1987. Quick survey were always made using 4-wheeled drive vehicle and by walking. The route of traveling were plotted in maps of 1:50,000 scale with the help of Global Positioning System (GPS) device. During the survey, information can be obtained by indirect signs such as tracks and dung or interviewing with local people.

In San Pan Dan WS and Lum Nam Pai WS of Northern Thailand (Fig. 1), local villagers in 26 and 36 villages were interviewed for the presence or absence of gaur or banteng during May to August, 1998 with the help of Mr. Suwit Naosawat and Mr. Somsak Laoyipa. Field work was also done during January and June 1998.

In Khong Saeng WS of Southern Thailand (Fig.1), with the collaboration of Ms. Busabong Kanchanasaka, the survey were made in seven areas during the dry season in 1997-1998. In each area, the survey was made in 10 routes of 1 km each so that total routes used for survey are 70 km long. Tracks of wild cattle, other important mammal species and human signs were recorded every 100 m.

In Pang Sida NP, gaur's dung were monitored along the road annually during 1994 to 1997. The park has just been recently encroached in 1980s and it is about 27 km from the new province called Sra Kaew (UHLIG, 1984). A dirt road (security road No. 3462) cut through the park from Sra Kaew to the Headquarters of Pang Sida NP and to km33 since 1980 (RFD, 1993) and then the road were constructed to Khlong Nam Mun Guard Station of Tap Lan NP. The dirt road in Pang Sida is about 49 km while the road extends to km78 to Khlong Nam Mun Guard Station. The road cut through the park were used seasonally as the road was interrupted during the rainy

season. Limited car passed through the park during the study period. Dung were surveyed along the road of 78, 49, 33.7, and 28.5 km long after the rainy season. The survey were done on 12 November 1994, 1 January, 1996, 12 December 1996 and 14 December1997. In 1994, the road of 78 km long could be driven through from the headquarters of Pang Sida NP to Khlong Nam Mun Guard Station in Tap Lan NP. At the end of 1995, only 49 km were surveyed while in 1996 and 1997, the road was damaged so that the survey could be made until km 33.7 and km 28.5, respectively. The survey were done by driving slowly using two more people to survey both sides of the dirt road at the rate of about 13-14 km/hr. Spot-lighting were also done during the night time to census the gaur. Spot-lighting were done on 31 December 1995 during 1800-1945, 1 January 1996 during 1800-1900 and 2145-2415, 12 December, 1996 during 1800-1900, 2100-2200, 13 December, 1996 during 1800-1830 and 14 December, 1997 during 2000-2200. Ground survey in Huai Samong was also done during December 29, 1997 to January 4, 1998. Number of trees of *Grewia* sp were surveyed in 15 December1997. Nine samples of fresh dung were collected in 13 December 1996 and preserved in FAA (formalin, acetic acid and alcohol) solution. Their diet can be studied by looking at epidermis of plant references (STEWART, 1967) which was studied by Ms. Kanyarat Sornsuparb.

Gaur and banteng in Khao Yai NP and Huai Kha Khaeng WS were selected for intensive study as there has been special conservation measures in the areas. In Khao Yai National Park which was the first national park in Thailand set up in 1960s. Forest encroachment started when the railroad was built to Pak Chong in 1901. Eventually, Friendship highway was built in 1958 and the road linked Pak Thong Chai to Kabin Buri was built in 1962 (THUNG, 1972; DONNER, 1978; UHLIG, 1984). Environmental awareness and Development program were done in 11 villages surrounding the park by The Population and Community Development Association (PDA) and Wildlife Fund Thailand (WFT) since 1987 and the reforestation program in the event of Commemoration of the Royal Golden Jubilee of his majesty the King of Thailand's accession to the throne was started in 1995 (WELLS, BRANDON & HANNAH, 1992; PORALOKANON, 1997). In an area adjacent to the eastern side of Khao Yai NP, Khao Phaeng Ma, a herd of 20 gaur were studied for 5 days each month for a year during June 1997 to May 1998. This study was made by Ms. Thattaya Bidayabha.

In Thung Yai and Huai Kha Khaeng WS, population estimates of gaur and banteng were made mainly by using the estimated density of gaur and banteng in the intensive study site (SRIKOSAMATARA, 1993), and the distribution of the mineral licks surveyed during 1989-1994. Other information about mineral licks e.g. NAKSATIT (1994), was also integrated in this study. Direct sightings during mid-1980 and early 1990 by various observers were also used.

An intensive study were done in a selected area of Huai Kha Khaeng WS to demonstrate how conservation measures affect gaur and banteng populations. This area is situated in NE side of the sanctuary between Khao Nang Rum Wildlife Research Station, the headquaters and a village, Ban Bung Charoen. This area has been recently encroached since 1970s (HIRSCH, 1990) but wildlife in the area were poached heavily in the mid-80. In 1986-88, 21 gaur, 10 banteng, one wild water buffalo, one serow, seven sambar deer and six muntjaks were known to be poached (NAKHASATHIEN & STWEWART-COX, 1990). A strong anti-poaching activities have been implemented since 1991 in Huai Kha Khaeng WS (ANON., 1990; Mr. Chatchawan Pitdamkam, pers.comm.) and buffer zone management in 1996 (SATUTHAM, 1997). The study were done in this selected area before (1988) and after (1992, 1996 and 1998) this active conservation measures. Dung of wild cattle were surveyed along the line transect during the dry season in March and April of 1988, 1992, 1996 and 1998. The total parallel lines walked were 8, 8, 15 and 17 with the total length of 30.95, 30.58, 45.025 and 47.5 km, in 1988, 1992, 1996 and 1998, respectively (Table 1). The study site can be separated into 2 areas (Fig. 2). Area 1 is where Khao Nang Rum Wildlife Research Station is situated and where protection has reasonably been good during the study. Area 2 is a little further north but it is in a lowland. There used to be heavily disturbed by people including poaching activities. Since 1991, the protection has been better and there has been less and less poaching in this area. The number of line transects walked in each sub-area in different year can be seen in Table 1. There were also concurrent studies on gaur, banteng and other large cats in this study site during 1987-1988 and 1994-1998 (RABINOWITZ, 1989; RABINOWITZ AND WALKER, 1991; PRAYURASIDDHI, 1997; BHUMPAKPHAN, 1997; Simcharoen, in progress). ← Table 1 ← Fig. 2

RESULTS

Populations of Gaur and Banteng in a Few More Protected Areas in Thailand

There is very few gaur and banteng left in protected areas in northern Thailand even in Om Koi WS-Mae Tuen WS-Mae Ping NP Forest Complex and it is expected that their populations will be eventually extirpated. Healthy population of gaur may exist in Phu Khieo WS which is situated in Phetchabun range. Very few gaur were left in Peninsula South except protected areas bordered with Malaysia. Additional information make the population estimates for gaur and banteng in Thailand are not so much different comparing with SRIKOSAMATARA & SUTEETHORN (1995). It is estimated that there are about 900s wild gaur and 400s wild banteng in Thailand.

Northern Area

Additional information were obtained about gaur and banteng in Doi Khuntan NP, Lum Nam Pai WS, Mae Ping NP, Mae Tuen WS, Mae Yuam Right Side WS, Ob Luang NP, Om Koi WS, Phu Pha Chit NP, San Pan Daen WS and Sri Satchanalai NP.

Survey in November 1996 revealed that SRIKOSAMATARA & SUTEETHORN (1995) overestimated population of gaur and banteng in Om Koi WS, Mae Tuen WS and Mae Ping NP Forest Complex. Very small populations of gaur and banteng of less than 50 were left in these protected areas. Three herds of 7, 5 and 2 banteng were reported while only a herd of 3 gaur were reported in 1996 in Om Koi WS (Mr. Pat Tipfun, pers. comm). In 1997, PATTANAVIBOOL (in progress) reported a herd of 8 banteng near Nam Ping River. Two banteng were poached for trophy in 1998. In Mae Tuen WS, neither gaur nor banteng was reported recently. Herds of domestic cattle were commonly seen within this forest complex.

There was no report of either gaur or banteng from interviewing local people in 26 and 36 villages (Fig. 3) within and nearby San Pan Dan WS and Lum Nam Pai WS. CHIANG MAI UNIVERSITY (1998) and NAOSAWAT (1996) also reported neither gaur nor banteng in Lum Nam Pai and San Pan Daen WS. Ground survey in 1998 revealed no report of gaur and banteng.

← Fig. 3

There was also no report of either gaur or banteng in Mae Yuam Right Side WS (Mr. Thanaphon Saranart, per. comm., Sept. 1997), Ob Luang NP (survey in 1996) and Doi Khuntan NP (TISTR, 1996). A small population may exist in Phu Pha Chit NP as three gaur were poached on June 1996 (Chakara Kinisri, pers. comm).

It is confirmed that there are still banteng left in Sri Satchanalai NP. Mr. Martin van de Bult, a Dutch volunteer from the Voluntary Service Overseas (VSO) based in

U.K., did a survey by hiking 16 km in January 1996 and estimated about six banteng in the park. Tracks and feeding sign on grass and young branches were found at the elevation 600-900 m. between Mae Wang Chang Guard Station and the headquaters.

Petchabun Range

Additional information on gaur and banteng were obtained from Nam Nao NP, Phu Khieo WS, Phu Luang WS, Phu Sam Phak Nam WS, Ta Baw-Huai Yai WS and Tat Mok NP. Tat Mok NP, Ta Baw-Huai Yai WS and Phu Sam Phak Nam WS were declared in additional to Nam Nao NP and Phu Khieo WS making a combined area of 3,840 km^2. Since 1997, European Community (EU) has supported a management project in Phu Khieo WS-Phu Kradueng NP-Phu Luang WS Complex.

Brief survey to encourage systematic survey in Phu Khieo WS were made in Jul.,1996, Feb., Aug, 1997 and Nov., 1997. It was found that mammals and birds were already surveyed for 31 months during May 1993-November 1995 by HORATA & KREETIYUTANUMN, (1996) and these information were put into geographical information system (GIS) by MONGKOLSAWAT & THIRANGOON, (1995). These information were not recorded in the way we were looking for. Gaur were commonly reported all over the area in Phu Khieo. Banteng were possibly extirpated from Phu Khieo. Tracks of banteng were reported only once at a mineral lick named Huai Mai Sot Yai near Sala Prom Guard Station.

In Phu Luang WS, a herd of 10 gaur was encountered in the eastern side of the sanctuary by CHANARD ET AL. (1998) in 1995. There is no realiable information about gaur or banteng in Nam Nao NP (TISTR, 1991).

Peninsular South

In Khlong Saeng WS, both gaur and banteng were reported by SUKMASUANG & BOONCHAI (1996) The relative abundance of gaur tracks and human signs in seven survey areas (Fig. 4) can be seen in Table 2. Human has a negative effect on gaur abundance but only a certain measure can be made. The most abundant tracks of gaur found in Area B or Khlong Saeng near Khlong Khuan area where BHUMPAKPHAN (1997) estimated gaur density of 2.05 and 2.98 km^{-2} in 1994 and 1995, respectively. The next most abundance area is Area G or Khlong Mui which is situated next to Khlong Yan WS and near Huai Tam Chan where BHUMPAKPHAN (1997)

estimated the density of gaur as 3.30 km^{-2} in 1994. BHUMPAKPHAN (1997) estimated density of gaur by walking along line transect with the total distance of 16.84 and 4.45 km in Khlong Khuan area and Huai Thum Chan Valley in 1994 and in 8 transects of 6.4 km in total in Khlong Khuan area in 1995. Gaur were still reported to be poached in 1997 (Ms. Busabong Kanchanasaka, pers. comm.).

In Ha La Ba La WS, gaur were recorded along Klong Ha La, south of Bang Lang Reservior near Thai-Malay Border on April 1997 (Tony Lyman, pers. comm.). While in Khao Sok NP, banteng were photographed by a camera-trap (Tony Lyman, pers. comm.).

← Fig. 4
← Table

Populations of Gaur and Banteng in Some Protected Areas Where Their Populations Are Increasing

Khao Yai Forest Complex

This forest complex is in Dong Paya Yen and Sun Kampaeng range and there are 5 protected areas in this complex including Khao Yai NP, Tap Lan NP, Pang Sida NP, Ta Phraya NP and Dong Yai WS with the area of 6283 km^2 (Fig. 5). This forest complex is dominated as a World Heritage Site in 1998 (DEARDEN ET AL., 1998). Gaur were found in most area while banteng can be found in Ta Phraya NP and Dong Yai WS. The populations of gaur and banteng are increasing. This is possibly due to the recent history of human disturbance in the area (UHLIG, 1984; PHONGPAICHIT & BAKER, 1998; DEARDEN ET AL., 1998) and the past public awarenes programme at few villages surrounding Khao Yai NP. Good gaur population live in Khao Yai and Pang Sida NPs. Gaur were reported to adapt to grassland and secondary growth in many area including Paeng Ma Mountain bordering Khao Yai National Park, along the dirt road in Pang Sida NP, grassland and secondary growth in Tap Lan NP and Dong Yai WS. Banteng were reported in the secondary vegetation in the lowland of Ta Phraya NP.

← Fig. 5

In Khao Yai NP, gaur used area around Samopun valley more in 1996 (TRISURAT ET. AL., 1997; TRISURAT, 1997) than in 1990 (CLIMO, 1990; SRIKOSAMATARA & SUTEETHORN, 1995) (Fig. 5). Other concentration areas are in the Khlong E-thao, in the northeast of the park, in Khao Rom compound, Khao Samo Pun plateau and in Khao Khat area (TRISURAT ET AL., 1997). Trend of gaur population in

Khao Yai NP is expected to increase slightly during the past 5 years. A herd of 20 gaur had been regularly seen at a reforestation station of Wildlife Fund Thailand (WFT) at Khao Phaeng Ma in the eastern side of the park since December 1995 (Mr. Nikhom Putta, pers.). This gaur herd used an area of about 5.85 km^2 within a year during June 1997 to May 1998. They are active both during the night and the daytime. They feed on Phak pheet or Krua E-thao which is secondary growth vines or weeds: *Pueraria thomsonii* Bth (Leguminosae, Papilionoideae), banana fruit and other grass and adapted very well with this degraded and secondary vegetation. During June 1997 to August 1998, seven newly born gaur were found in the observed group indicating that the population is increasing. This population is free from the natural predator as there has been no report of tracks or sightings of tiger or other large cats in this area. No gaur was poached during the study.

In Pang Sida NP, distribution of dung indicates that gaur prefer to use two areas along the road. One of them is between km7-19 which is a part of Huai Nam Yen valley (Fig. 6). Even the distance along the road is 12 km but the displacement distance is only 6 km. The other area that they prefer to use is between km22-33 especially km26-29 which is a part of Huai Samong valley (Fig. 6). Gaur of 3, 9, 10 and 10-12 were seen at km8, km16, km7 and km 15 at the time of 2130, 1745, 2030, 2120 of 1 July 1995, 11 November 1995 and 12 and 14 October, 1997, respectively. Combining direct sighting and indirect sign, it can be concluded that there were at least two herd of gaur using the area along the road. At least one herd of 10-12 animals use the area between km 7-19 and another herd at km 26-29 may be smaller. Ground survey in Huai Samong valley in December 1997 discovered many gaur tracks but few dung. Logging and poaching happened heavily in this area during 1985-1993. The forest in this area is very dry and there is very few free water during the dry season. Gaur may use this area more during the rainy season but move to a more evergreen forest in the high elevation during the dry season. Tracks of a tiger were also found at km18 on 3 January 1998. Tiger definitely regulate the population of gaur in this area.

←Fig. 6

Comparing the number of dung along the dirt road during 1994-1997 (Table 3), the number of dung found along the road in 1996 are the largest, this may be a combination that the gaur number may increase slightly and also as a result of the well regulation on the use of road. In 1996, the general public cannot use the road after 6 o'clock while 1994-1995 the use of dirt road was not well regulated. In 1997, the

dung number were a lot less, this is because there was a gang of 100s off-road vehicles disturbed the area at the end of October, 1997 or about one and a half month before the survey.

Grewia sp. is a secondary growth tree belonging to the Family Tiliaceae of dicotyledon and they are common along both sides of the dirt road where gaur dung were found. Table 3 shows the number of *Grewia* tree along the road. The survey in 1997 can be done only to km 26 because the road was damaged and it was impossible to drive through. *Grewia* tree can be found in most area. Analyzing the food left in the feces collected in December, 1996, gaur fed on 22 species of plants consisting of 15 species of dicotyledons and 7 species of monocotyledons. *Grewia* sp is the most preferred species occupied about 28.6 (13.1-58.6) per cent of amount of food feed. The 2nd, 3rd and 4th preferred species occupied about 12.6 (4.3-29.4), 11.1 (0.8-34.9) and 6.9 (0.4-14.2) per cent, respectively. Diversity of food fed by the gaur measuring by Shannon-Wiener Index is between 0.51-1.22.

In Tap Lan NP, over half of the villages settled there after the Park had been declared in 1981 (P. Ketanond cited by DEARDEN ET AL., 1998) but tracks and old dung of solitary gaur were found in August 1997 (Fig. 6). There is no gaur dung along the road of 29 km long between km49 of Pang Sida NP to Khlong Nam Mun Guard Station (Fig. 5). In Dong Yai WS, a visit was made on 25 July 1997. Guar and banteng were reported near old Cambodian Camp near Raraeng Roi Ru Guard Station (Fig.5). Fresh tracks and fresh dung of gaur were also found. In Ta Phraya WS, a visit was made on 25 July 1997. Tracks of banteng were also found (Fig.5)

← Table 3

Western Forest Complex (WEFCOM)

There are 17 protected areas with the total areas of 17,000 km^2 in this forest complex. Good information demonstrating population increasing obtained from Huai Kha Khaeng WS. Some information were also obtained in the Eastern Wing of Thung Yai Wildlife Sanctuary that solitary gaur started to use evacuated areas where minorities like Hmong used to occupy the area but they were moved out in 1987-1991 and 1992-1995 (MANEERAT, 1997).

← Fig. 7

Population estimate of gaur and banteng in Huai Kha Khaeng and Thung Yai WS were made using the data in the intensive study site in 1988 (SRIKOSAMATARA, 1993). These data including the estimated density and the distribution of dung from the mineral licks. The estimated density of gaur and banteng is 1.8 (1.3-2.3) km^{-2} while about

99 per cent of dung was seen within 2.5 km of a mineral lick (Fig. 7). The distribution of dung piles in 100-m lengths of line transect was highly clumped (chi-square test for Poisson distribution, $p < 0.01$). The index of dispersion (variance/mean ratio) of dung is 2.6. Since most dung were distributed within a 2.5 km radius from surveyed mineral licks, these circular areas were used to calculate population of gaur and banteng at different sites. To calculate population of gaur and banteng in an isolated mineral lick, a density of 1.8 (1.3-2.3) km^{-2} was multiplied by an area of a circle with a radius of 2.5 km. In the case of two mineral licks situated less than 2.5 km apart, sum of the two individual areas surrounding both mineral licks of 2.5 km radius is subtracted by the area of overlap. This can be applied as well in the case of more than two mineral licks situated near one another of less than 2.5 km. The overlap area can be calculated using the following formula:

$$\frac{\pi r^2 \theta}{90} - 2ar \sin\theta$$

when r = radius of a circle surrounding a mineral lick = 2.5 km

$a = \frac{1}{2}$ (distance between mineral licks)

$\theta = \frac{1}{2}$ (central angle of a sector where two mineral licks overlap)

$= \cos^{-1}\frac{a}{r}$

Table 4 and 5 and Fig. 8 show the population estimate of gaur and banteng and their distribution in each area in Huai Kha Khaeng WS. There are about 580 gaur and banteng combined in Huai Kha Khaeng WS and 170 gaur in Thung Yai WS. It is assumed that the ratio of gaur and banteng is 1:1 in Huai Kha Khaeng so that there are about 290 gaur and 290 banteng. This estimate is similar to what PRAYURASIDDHI (1997) estimated by compiling all sightings of gaur and banteng made by himself and other observers both on foot, by helicopter and radio tracking location data and estimated 17 herds of 300-335 gaur and 20 herds of 240-270 banteng in 1983-1996.

← Fig. 8
← Table 4
← Table 5

Table 6 showed the dung densities of gaur and banteng combined in two sub-areas and overall area in the main study site in Huai Kha Khaeng WS during 1988-1998. Dung densities of wild cattle in the study site varied from 1541, 1154, 1336, 1137 km^{-2} in 1988,1992, 1996 and 1998, respectively. But when looking at different area at a time, the dung densities are decreasing in Area 1 (1842, 871, 861 and 96 km^{-2} in 1988, 1992, 1996 and 1998, respectively) but increasing in Area 2 (555, 2079, 2520, 1683 km^{-2} in 1988, 1992, 1996 and 1998, respectively). By look at the dung distribution across the year, wild cattle started move from Area 1 to other areas. Area 2 was occupied more by wild cattle after the poaching pressure has been released (Table 7; Fig. 9). At the same time, tiger number in the study site has been increasing from one in 1988-1989 (RABINOWITZ, 1989) to 6-8 in 1994-1996 (Simcharoen, pers. comm.; BHUMPAKPHAN, 1997). In 1995-1996, two gaur and 12 banteng were predated by tiger (Simcharoen, pers. comm.; BHUMPAKPHAN, 1997; PRAYURASIDDHI, 1997).

← Table 6
← Table 7
← Fig. 9

In Thung Yai WS, most gaur distributing in the Western Side of the Sanctuary (Fig. 8). Very limited evidence demonstrates that their populations are increasing. There are still reports about poaching and the centers of their distribution are very near to the mining road from the headquaters to Ja Kae (Fig. 8). There is some evidence demonstrating that solitary gaur started to use abandoned area in In Thung Yai East Side WS. MANEERAT (1997) monitored the change in the presence and absence of gaur in six abandon areas for 2 years during January 1995 to December 1997 (Fig. 8). In each area a plot of 2 km long and 5 m wide were set up to record the presence and absence of gaur sign including dung and tracks. Solitary gaur started to use the area near Nam Khieo, Ka Nae Sod and Ua Ta Khi Guard Station. Most of these gaur are possibly from nearby area in Huai Kha Khaeng WS or from Ka Nae Sod Area. During our survey in 1989 before MANEERAT (1997)'s study period, there was no track of either gaur and banteng in major mineral licks in this area (Fig. 8, Table 5).

Other information on gaur and banteng were also obtained from Sai Yok NP and Sri Nakharin NP. In Sai Yok NP, short visit was made on Feb. 1997. A skull with a bullet was seen decorated in a house in the southern area of the national park. Almost all area can be access by road or river and hunting pressure have been always very high. In Sri Nakharin NP, a herd of 15 banteng was reported in 1995 near Khao Tung Sawang about 15 km. south of Huai Kha Khaeng WS (Ms. Mattana Srikrajang, pers.

comm.). VISETSATHORN (1997) reported that gaur used a mineral lick at a reforestation plot (FTP 2/5) near Khlong Lan NP, Kamphaengphet Province.

DISCUSSION

This additional study do not make a lot of differences comparing with the last population estimate of gaur and banteng by SRIKOSAMATARA & SUTEETHORN (1995). The populations of gaur and banteng in Thailand are still about 900s wild gaur and 400s wild banteng in Thailand in 1998. However, the survey in northern Thailand confirmed what DEARDEN (1995) made about the rarity of wildlife in northern Thailand in general and made the last estimate of gaur and banteng populations in Om Koi WS-Mae Tuen WS-Mae Ping NP Forest Complex as an overestimate.

Due to the small populations of gaur and banteng in most protected areas, population estimates using line transect seem impractical. In addition, there are a large numbers of protected areas in Thailand. In 1998, there are 65 terrestrial national parks and 44 wildlife sanctuaries with the total areas of about 15-16% of the countries (DEARDEN, 1996; Surachet Chettamart, pers. comm.). To get accurate figures on populations of gaur and banteng is to combine accurate estimates in each protected area which require a lot manpower, resources and coordination efforts which it is not the time that Thailand is affording. As gaur and banteng are not international high profile species comparing with endangered species like African and Asian Elephant, and tiger or economic game species like deer that international conservation circles, e.g. the Global Environmental Monitoring System (GEMS) in UNEP's Nairobi headquaters or World Conservation Monitoring Centre based at Cambridge, may help to estimate and monitor (CROZE, 1984; GILL, 1990; SAID ET AL., 1995; SPELLERBERG, 1991).

This study, however, gives an insight about the factors that help to reverse the population declines in some protected areas. In all cases, the conservation efforts are not well planned and some people may see it as piecemeal implementation. At the same time, there are very few cases of conservation success came out from the well plan process. Planning also has its intrinsic problem. From the experience of making many plans for protected area, MCKINNON (1994) concluded that there are too many plan. All successful stories were usually done by the process called learning by doing (WALTERS, 1986; WALTERS & HOLLING, 1990; MCKINNON, 1994) and the good outcome came out as "serendipity". The results in these few case studies help to

confirm that so far there is no good theory to explain factors reversing the population decline paradigm in conservation biology comparing with the small population paradigm (CAUGHLEY, 1994; CAUGHLEY & GUNN, 1996; HEDRICK ET AL., 1996; HAPPOLD, 1995).

Information on the status of gaur and banteng in Thailand and worldwide demonstrating that they are much more threatened than many other wild species in Asia, for example, Asian elephant. There are 15,000 wild gaur, 5,000-8,000 banteng and 37,000-48,000 wild Asian elephant worldwide, while there are 900s wild gaur, 400s wild banteng, 1,200-1,500 wild Asian elephant in Thailand (SRIKOSAMATARA & SUTEETHORN, 1995; HEINEN & SRIKOSAMATARA, 1996; HEDGES, 1998; SANTIAPILLAI, 1996 cited by LAIR, 1997). However, there is so little attention given to conserve wild cattle in Asia. This may be because, international conservation effort are always western-center and Asian wild Cattle in western eyes may not be so much different from the domestic cattle. In fact the European domestic cattle (*Bos taurus*) derived from Ure-ox or aurochs (*Bos primigenius* Bojanus 1827) which gone extinct in 1627 in the Jaktorowska Primeval Forest, south-west of Warsaw in Poland (SZAFER, 1968). The origin of domestic cattle in Thailand (*Bos indicus*) is still under discussion whether they are from the extinct species like *Bos primigenius* in West Asia or India Subcontinent (PAYNE, 1990; BAILEY ET AL., 1996) or *Bos namadicus* or other species in Asia (GROVES, 1978).

Even conservation effort can be made locally at national level but general public so far know very little about gaur and banteng comparing with Asian elephant which are domesticated and culturally ties with Thai Culture (RINGIS, 1996). In addition, trophy collectors which are Bangkok-based and rich urban people still keep searching trophies by paying local people to hunt and buy the trophies. These collectors still have their images about trophy collection tradition of 1930s (LEKAGUL 1952, 1954; ASKINS, 1959; GATES, 1971). Even they have realized how endanger they are, the rarity creates the increasing in demand instead of decreasing. The increasing in demand ultimately causes not only the decline on populations of gaur and banteng in Thailand but also in other countries in Indochina like Lao PDR, Cambodia, Vietnam and Myanmar. Recent attempt to include both gaur and banteng in CITES Appendix I may help to reverse the decline of gaur and banteng in Thailand's neighboring countries even their populations are so small (OLIVIER & WOODFORD, 1994; DESAI & VUTHY, 1996;

CANH ET AL., 1997; DILLON & WIKRAMANAYAKE, 1997). .

ACKNOWLEDGMENTS

The Thailand Research Fund (TRF) supported general activities and research on monitoring of gaur and banteng population. Wildlife Conservation Society (WCS) partly supported the survey in 1989-1994. Philip Round shares "serendipity" concepts. Ms. Busabong Kanchanasaka, Ms. Thattaya Bidayabha, Mr. Suwit Naosawat, Mr. Anak Pattanavibool, Mr. Somsak Laoyipa and Mr. Martin van de Bult shared information. Professor Jean-Jacques Jaeger and George McKay made trips to France and to Conservation Biology meeting in Australia possible and a lot of ideas developed from these trips.

ANON., 1990. Obituary: Seub Nakhasathien. *The Ecologist* 20(6): 234-235.

ASKINS, C. 1959. *Asian Jungle-African Bush*. The Stackpole Company, Harrisburg, Pennsylvania, U.S.A. 258 pp.

BAILEY, J.F., M.B. RICHARDS, V.A. MACAULAY, I.B. COLSON, I.T. JAMES, D.G. BRADLEY, R.E.M. HEDGES AND B.C. SYKES. 1996. Ancient DNA suggests a recent exapnsion of European cattle from a diverse wild progenitor species. *Proc. R. Soc. Lond. B.* 263:1467-1473.

BHUMPAKPHAN, N. 1997. *Ecological Characteristics and Habitat Utilization of Gaur (Bos gaurus H. Smith, 1827) in Different Climatic Sites.* Ph.D. dissertation, Kasetsart University. 125 pp.

CAMPBELL, R. 1935. *Teak-Wallah: The Adventures of a Young Englishman in Thailand in the 1920s.* Hodder & Stoughton, London. 279 pp.

CANH, L.X., P.T. ANH, J.W. DUCKWORTH, V.N. THANH, AND L. VUTHY. 1997. *A Survey of Large Mammals in Dak Lak Province, Vietnam.* WWF and IUCN, Hanoi. 104 pp.

CAUGHLEY, G. 1994. Directions in conservation biology. *Journal of Animal Ecology* 63: 215-244.

CAUGHLEY, G. AND A. GUNN. 1996. *Conservation Biology in Theory and Practice.* Blackwell Science, USA. 459 pp.

CHANARD, T., T. POSANG, AND W. WONGKALASIN. 1998. Distribution of wild Elephant (*Elephas maximus*) in Phu Luang Wildlife Sanctuary, Thailand. *Nat. Hist. Bull. Siam Soc.* 46(1): 17-26.

CHIANG MAI UNIVERSITY. 1998. *Application of Remote Sensing Data and GIS for Monitoring Forest Landuse Change in Lum Nam Pai Wildlife Sanctuary.* Unpublished Report to Royal Forest Department by Centre for Remote Sensing and GIS for Northern Thailand, Department of Geography, Faculty of Social Sciences. 154 pp.

CLIMO, L. 1990. *Wildlife survey in the Samopun Valley, Khao Yai National Park, Thailand.* A report prepared for the National Park Division, Royal Forest Department and Wildlife Fund Thailand. 25 pp.

CROZE, H. 1984. Monitoring within and outside protected areas. Pages 628-633 in

J.A. McNeely and K.R. Miller (eds). *National Parks, Conservation, and Development: The Role of Protected Areas in Sustaining Society.* Smithsonian Institution Press, Washington, D.C. 825 pp.

DE ' ATH, C. 1992. A history of timber exports from Thailand with emphasis on the 1870-1937 period. *Nat. Hist. Bull. Siam Soc.* 40:49-66.

DEARDEN, P. 1995. Development, the environment and social differentiation in Northern Thailand. Pages 111-120 in J. Rigg (ed.) *Counting the Costs: Environmental Growth and Economic Change.* Institute of Southeast Asian Studies, Singapore.

_____1996. Protected areas in Thailand: Thoughts on future directions. Pages 8-22 in *Proceedings of the FORTROP'96: Tropical Forestry in the 21st Century.* Kasetsart University, Bangkok.

DEARDEN, P., S. CHETTAMART, D. EMPHANDU. 1998. Protected areas and property rights in Thailand. *Environmental Conservation* 25(3):

DESAI, A., AND L. VUTHY. 1996. *Status and Distribution of Large Mammals in Eastern Cambodia.* IUCN, Hanoi, FFI & WWF Large Mammal Conservation Project, Phnom Penh, Cambodia. 54 pp.

DILLON, T.C. AND E.D. WIKRAMANAYAKE. 1997. *A Forum for Transboundary Conservation in Cambodia, Laos, and Vietnam.* UNDP and WWF. Hanoi. 27 pp.

DONNER, W. 1978. *The Five Faces of Thailand: an Economic Geography.* Hamburg Institute of Asian Affairs. 930 pp.

FOREST RESEARCH INSTITUTE (FRI). 1994. *Sri Satchanalai National Park Mangement Plan.* Kasetsart University, Bangkok (in Thai.)

GATES, E.T. 1971. *Trophy Hunter in Asia.* Winchester Press, New York. 272 pp.

GILL, R. 1990. *Monitoring the Status of European and North American Cervids.* GEMS Information Series No. 8. Global Environmental Monitoring System, UNEP, Nairobi. 277 pp.

GROVES, C.P. 1978. On the agriotypes of domestic cattle and pigs in the Indo-Pacific Regions. Pages 429-438 in V.N. Misra and P. Bellwood (eds.) *Recent Advances in Indo-Pacific Prehistory.* Oxford & IBH Publishing Co., New Delhi.

HAPPOLD, D.C.D. 1995. The interactions between humans and mammals in Africa in relation to conservation: a review. *Biodiversity and Conservation* 4(4): 395-414.

HEDGES, S. 1998. *Asian Wild Cattle and Buffalo: Status Report and Conservation Action Plan (Parts I and II).* World Conservation Union and Species Survival Commission, Gland, Switzerland.

HEDGES, S., J. HEINEN, M. TYSON AND S. SRIKOSAMATARA. 1995. Census, survey and monitoring techniques. Pages 23-26 in O. Byers, S. Hedges, and U.S. Seal (eds.) *Asian Wild Cattle Conservation Assessment and Management Plan Workshop.* IUCN/SSC Conservation Breeding Specialist Group.

HEDRICK, P.W., R.C. LACY, F.W. ALLENDORF AND M.E. SOULE. 1996. Directions in conservation biology: comments on Caughley. *Conservation Biology* 10(5): 1312-1320.

HEINEN, J.T. AND S. SRIKOSAMATARA. 1996. Status and protection of Asian Wild Cattle and Buffalo. *Conservation Biology* 10: 931-934.

HIRSCH, P. 1990. *Development Dilemmas in Rural Thailand.* Oxford University Press, Oxford. 244 pp.

HORATA, T. AND K. KREETIYUTANUN. 1996. *Species Diversity and Status of Mammals and Birds in Phu Khieo Wildlife Sanctuary.* Royal Thai Forest Department, Bangkok. 57 pp. (in Thai.)

IUCN 1996. *1996 IUCN Red List of Threatened Animals.* IUCN, Gland Switzerland.

LAIR, R. 1997. *Gone Astray: The Care and Management of the Asian Elephant in Domesticity.* FAO Regional Office For Asia and the Pacific, Bangkok. 300 pp.

LEKAGUL, B. 1952. *Hunting of Guar: Life History, Behavior, and Hunting Etiquette.* The Science Society of Thailand, Bangkok. 160 pp. (in Thai).

_____1954. *Banteng Hunting.* Association for the Conservation of Wildlife, Bangkok. (in Thai).

LEKAGUL, B. AND J.A. MCNEELY. 1988. *Mammals of Thailand.* Second edition. The Association for the Conservation of Wildlife, Bangkok. 758 pp.

MACKINNON, J. 1994. *Too Many Plans: Personal Views on the Planning Process.* IUCN Biodiversity Programme, Gland, Switzerland.

MANEERAT, S. 1997. The use of evacuated area by gaur in Thung Yai Wildlife Sanctuary. Unpublished report. Royal Thai Forest Department. 10 pp. with appendices. In Thai

MONGKOLSAWAT, C. AND P. THIRANGOON (eds.) 1995. *Integrated Information System for the management of Phu Khieo Wildlife Sanctuary.* Khon Kaen University and Phu Khieo Wildlife Sanctuary. 57 pp.

MOORE, S.A. 1996. The role of trust in social networks: formation, function and fragility. Pages 148-154 in D.A.Saunders, J.L. Craig, and E.M. Mattiske (eds.), *Nature Conservation 4: The Role of Networks.* Surrey Beatty & Sons Pty Limited, Australia. 684 pp.

NAKHASATHIEN, S. AND B. STEWART-COX. 1990. *Nomination of the Thung Yai-Huai Kha Khaeng Wildlife Sanctuary to be a UNESCO World Heritage Site.* Wildlife Conservation Division, Royal Forest Department.

NAKSATIT, N. 1994. *A Study on the Distribution and Physical Environment of Salt Licks in Huai Kha Khaeng Wildlife Sanctuary, Uthai Thani Province.* MS thesis. Mahidol University, Bangkok. 82 pp. (in Thai with English abstract).

NAOSAWAT, S. 1996. *Preliminary Survey of San Pan Daen Wildlife Sanctuary.* Unpublished Report, Royal Forest Department. 38 pp.

OLIVER, R. AND M. WOODFORD. 1994. *Aerial Survey for Kouprey in Cambodia.* IUCN Species Survival Commission, IUCN, Gland, Switzerland and Cambridge, U.K. 59 pp.

PARALOGANON, C. 1997. Buffer zone project: Case Study II: Khao Yai National Park. Pages 18-30 in C. McQuistan (ed.) *Proceedings of Buffer Zone: a Strategy Towards Sustainable Forest Management.* Thailand Environmental Institute, Bangkok. 116 pp.

PATTANAVIBOOL, A. in progress. *Wildlife Diversity, Abundance, and Distribution in Hill Evergreen Forest Fragments Created by Hilltribes in Northern Thailand.* Ph.D. Dissertation. University of Victoria, Canada.

PAYNE, W.J.A., 1990. *An Introduction to Animal Husbandry in the Tropics.* Fourth Edition. ELBS with Longman Scientific & Technical, England. 881 pp.

PHONGPAICHIT, P. AND C. BAKER. 1998. *Thailand's Boom and Bust.* Silkworm Books, Chiang Mai. 367 pp.

PRAYURASIDDHI, T. 1997. *The Ecological Separation of Gaur* (Bos gaurus) *and*

Banteng (Bos javanicus) *in Huai Kha Khaeng Wildlife Sanctuary, Thailand.* Ph.D. Dissertation, The University of Minnesota. 266 pp.

RABINOWITZ, A. 1989. The density and behavior of large cats in a dry tropical forest mosaic in Huai Kha Khaeng Wildlife Sanctuary, Thailand. *Natural History Bulletin of the Siam Society* 37: 235-251.

RABINOWITZ, A.R. & WALKER, S.R. 1991. The carnivore community in a dry tropical forest mosaic in Huai Kha Khaeng Wildlife Sanctuary, Thailand. *Journal of Tropical Ecology* 7:37-47.

RINGIS, R. 1996. *Elephants of Thailand: Myth, Art and Reality.* Oxford University Press. 189 pp.

ROYAL FOREST DEPARTMENT (RFD). 1993. Pang Sida National Park Management Plan. RFD, Bangkok. (in Thai).

SAID, M.Y., R.N. CHUNGE, G.C. CRAIG, C.R. THOULESS, R.F.W. BARNES, AND H.T. DUBLIN. 1995. *African Elephant Database 1995.* IUCN, Gland, Switzerland. 225 pp.

SATUTHAM, P. 1997. Buffer zone project: Case Study VII: Huai Kha Khaeng Wildlife Sanctuary. Pages 57- 70 in C. McQuistan (ed.) *Proceedings of Buffer Zone: a Strategy Towards Sustainable Forest Management.* Thailand Environmental Institute, Bangkok. 116 pp.

SAUNDERS, D.A., J.L. CRAIG, AND E.M. MATTISKE. 1996. *Nature Conservation 4: The Role of Networks.* Surrey Beatty & Sons Pty Limited, Australia. 684 pp.

SPELLERBERG, I.F. 1991. *Monitoring Ecological Change.* Cambridge University Press. 334 pp.

SRIKOSAMATARA, S. 1993. Density and biomass of large herbivores and other mammals in a dry tropical forest, western Thailand. *Journal of Tropical Ecology* 9: 33-43.

SRIKOSAMATARA, S. AND V. SUTEETHORN. 1995. Populations of gaur and banteng and their management in Thailand. *Nat. Hist. Bull. Siam Soc.* 43:45-83.

STEWART, D.R.M. 1967. Analysis of plant epidermis in faeces: a technique for studying the food preference of grazing herbivores. *Journal of Applied Ecology* 4: 83-111.

SUKMASUANG, R. AND K. BOONCHAI. Diversity of fauna in Khlong Saeng Wildlife

Sanctuary. Unpublished report. Royal Thai Forest Department.

SZAFER, W. 1968. The Ure-ox, extinct in Europe since the Seventeenth Century: an early attempt at conservation that failed. *Biological Conservation* 1:45-47.

THUNG, H.L. 1972. *An Evaluation of the Impact of a Highway on a Rural Environment in Thailand by Aerial Photographic Methods.* Ph.D. dissertation, Cornell University Press. 130 pp.

TISTR. 1991. *Nam Nao National Park Management Plan.* Thailand Institute of Scientific and Technological Research, Bangkok. (in Thai.)

_____1996. *Doi Khuntan National Park Management Plan.* Thailand Institute of Scientific and Technological Research, Bangkok. (in Thai.)

TRISURAT, Y. 1997. *Spatial-ecological Impact Assessment of the Proposed Dam Construction in Khao Yai National Park, Thailand.* Ph.D. Dissertation, School of Environment, Resources and Development, Asian Institute of Technology, Bangkok. 164 pp.

TRISURAT, Y., A. EIUMNOH, S. MURAT AND M.Z. HUSSAIN. 1997. Biodiversity hot spots in Khao Yai National Park, Thailand. AMBIO

UHLIG, H. (ed., 1984). *Spontaneous and Planned Settlement in Southeast Asia.* Institute of Asian Affairs, Hamburg. Giessener Geographische Schriften. Volume 58. 330 pp.

VARMAN, K.S. AND R. SUKUMAR. 1995. The line transect method for estimating densities of large mammals in a tropical deciduous forest: an evaluation of methods and field experiments. *J. Biosci.* 20(2): 273-287.

VISETSATHORN, U. 1997. The Petroleum Authority of Thailand (PTT)'s role in tree plantation for sustainable forest management. Pages 108-116 in C. McQuistan (ed.) *Proceedings of Buffer Zone: a Strategy Towards Sustainable Forest Management.* Thailand Environmental Institute, Bangkok. 116 pp.

WALTERS, C.J. 1986. *Adaptive Management of Renewable Resources.* McGraw-Hill, New York, USA.

WALTERS, C.J. AND C.S. HOLLING. 1990. Large-scale management experiments and learning by doing. *Ecology* 71(6):2060-2068.

WELLS, M., K. BRANDON, AND L. HANNAH. 1992. *People and Parks. Linking Protected Area Management and Local Communities.* The World Bank. 99 pp.

WILSON, D.E., F.R. COLE, J.D. NICHOLS, R. RUDRAN, AND M.S. FOSTER. (eds.) 1996. *Measuring and Monitoring Biological Diversity. Standard Methods for Mammals.* Smithsonian Institution Press, Washington and London. 409 pp.

Table 1. The name, number and total distance of line transect walked in Huai Kha Khaeng WS. Line code can be seen in Figure 2, n represents the number of pararell line of 1 km apart.

Year	Area 1			Area 2			Total		
	Line	n	Distance (km)	Line	n	Distance (km)	Line	n	Distance (km)
1988	B-4	6	24.2	5-7	3	6.75	B-7	9	30.95
1992	A-4	5	23.85	5-7	3	6.73	A-7	8	30.58
1996	B-4	6	26.20	5-13	9	18.83	B-13	15	45.03
1998	B-4	6	16.78	5-15	11	30.72	B-15	17	47.50

Table 2. Relative abundance of human sign and gaur tracks in seven survey areas in Khlong Saeng WS. Survey routes were 1 km each for 10 routes in each areas. Human signs and wild cattle tracks were recorded every 100 m. Relative abundance is the per cent of 100m-segment where gaur tracks or human signs were found to the total of 100 segments in each area.

Area	Relative Abundance	
	Human signs	Gaur Tracks
A (Reservoir surrounding Area)	8.3	2.5
B (Khlong Saeng)	10.8	55.8
C (Khlong E)	23.3	19.2
D (Khlong Mon)	28.3	20.0
E (Khlong Yi)	50.0	1.7
F (Khlong Ya)	11.7	15.0
G (Khlong Mui)	27.5	30.80
Total	25.4	21.00

Table 3. Number of dung piles and *Grewia* tree found along the road in Pang Sida NP in 1994-1997.

Distance	Number of Dung along the Road					Number of
	1994	1995	1996	1997	Total 1994-97	*Grewia sp*
0-1						
1-2						
2-3						102
3-4						41
4-5						46
5-6						66
6-7			3		3	7
7-8	10	2	33	20	65	13
8-9	9		19	4	32	12
9-10	5	1	26	5	37	7
10-11	5	1	27	9	42	7
11-12	4	1	32	16	53	13
12-13	3	3	21	10	37	50
13-14	7	2	16	8	33	7
14-15	1	9	27	10	47	69
15-16	10	1	28	15	54	54
16-17	3	1	15	5	24	65
17-18	7		10	4	21	53
18-19	1	6	7	15	29	47
19-20		1	2	2	5	136
20-21			3	2	5	61
21-22		1	1		2	78
22-23	1	4	3	2	10	36
23-24	2		10	2	14	6
24-25		3	6	6	15	13
25-26				1	1	9
26-27		1	17	3	21	
27-28	6		24	6	36	
28-29	7	7	9	Stop	23	
29-30			2		2	
30-31		1	3		4	
31-32	1		5		6	
32-33	1	1	4		6	
33-34			1		1	
34-35			Stop			
Total	83	46	354	145	628	998

Table 4. Population estimates of gaur and banteng in different areas in Huai Kha Khaeng WS. GS=guard station.

Area	Main Mineral Licks	Area of population estimates (km^2)	Population estimates	Ranges
Khao Nang Rum	Phai, Thalu	38.30	70	50-90
Khao Nang Rum	Huai Luang	19.64	35	25-45
Sap Fa Pha	Sap Fa Pha, Sap Kao, Sap Ta Lae	71.07	130	90-160
Ka Puk Ka Piang GS	Phu Nam Ron	48.96	90	60-110
Huai Nam Tuen GS	-	-	-	-
Yang Daeng GS	6 small mineral licks	-	-	-
Nai Sor	Nai Sor, Ta Nea, Noi, Plung, Jaew	73	130	95-170
Ta Gea	Ta Gea [1]	19.64	35	25-45
Khao Bandai GS	Ya [2]	31	55	40-70
Klua-Ta Tao	Klua, Ta Tao [3]	-	-	-
Krung Krai GS	3 small mineral licks	-	-	-
Ong Thang GS [4]	-	-	-	-
Wang Pai-I Sa-Sai Ber-Ban Dong GSs [5]	-	-	-	-
Huai Mae Di-Ban Klauey GSs	Chan To	19.64	35	25-45
Total			580	410-735

[1] 30 gaur were seen on November 1994

[2] 30 gaur and 12 banteng were seen on 26 March 1985 and 28 banteng and 4 gaur were seen on April 1993.

[3] A lot of gaur and banteng tracks were found in 1985 while very few were found in 1990. A lot of fresh tracks and dung piles were found again in March 1994.

[4] 12 and 6 gaur were reported in July 1993 and March 1994. They possibly moved from nearby area.

[5] Few mineral licks were expected.

Table 5. Population estimates of gaur in different areas in Thung Yai WS. GS=guard station, sn=small number.

Area	Main Mineral Licks	Area of population estimates (km^2)	Population estimates	Range
Song Tai	n=11	38	70	50-90
Ta Lae Sae [1]	Ta Lae Sae, Pu Bong	28.44	50	40-65
Mong Po Pae	Mong Po Pae, Mong Kae, Mong Va Pouey	19.64	35	25-45
Mong Ta Nae [2]	n=7	-	-	-
Kreang Paeng	Kreang Paeng	-	sn	sn
U Ta Khi-Thung Na Noi-Yu Yee-Nam Khieo GSs	-	-	-	-
Ka Nae Sod GS [3]	-	-	15	10-20
Northern Part of Proposed Nam Choan Dam	Ti Ya Sup, Am Poe	-	-	-
Huai Kuur GS	Hom	-	sn	sn
Mae Chan Ta [4]	-	-	-	-
Mountain area, west of Thung Yai WS [5]	-	-	-	-
Total			170	120-220

[1] 53 gaur were photographed from a helicopter in Thung Yai Grassland in April 1985 near Hmong settlement which was moved out in 1989

[2] Ten Hmong villages were located and moved out in 1986, 1989 and 1995. Tracks and dung piles of gaur were seen in April 1995 near Nam Khieo Guard Station.

[3] Grassland of about 0.15 km^2 surrounded by evergreen forest is located in this area. A herd of 10-12 gaur was seen in April 1989.

[4] Five Karen villages are located in this area

[5] Few mineral licks were expected. Six Karen villages, Ja Kae, Thi Rai Pa, Ko Satoeng, Lai Wo, Sa Nae Phong and Kong Mong Ta, are located in this area.

Table 6. Density of wild cattle dung in Area 1 and Area 2 (Figure 2) in 1998, 1992, 1996 and 1998 in Huai Kha Khaeng WS.

Year	Area 1	Area 2	Total Area
1988	1842(0-3804)	555 (0-2087)	1541(330-2752)
1992	871(0-2062)	2079(0-5313)	1154 (227-2081)
1996	861(34-1688)	2502(292-4748)	1336(3-2668)
1998	96(0-195)	1683(485-2882)	1137(321-1953)