# รายงานฉบับสมบูรณ์
# เมธีวิจัยรุ่นที่ 2 : RSA/5/2538
## สนับสนุนโดย
## สำนักงานกองทุนสนับสนุนการวิจัย (สกว)

(1 กันยายน 2538 - 30 สิงหาคม 2541)

# การติดตามการเปลี่ยนแปลงขนาดและการกระจาย ของประชากรของกระทิงและวัวแดงในประเทศไทย

สมโภชน์ ศรีโกสามาตร

ภาควิชาชีววิทยา คณะวิทยาศาสตร์ มหาวิทยาลัยมหิดล

## กิตติกรรมประกาศ

สำนักงานกองทุนสนับสนุนการวิจัย (สกว) มีส่วนสนับสนุนเป็นอย่างมากทำให้งานวิจัยต่อไปนี้เป็นไปด้วยความสำเร็จ นอกจากนี้ยังมีหน่วยงานอื่น ๆ และบุคคลหลายคนที่ทำให้งานดำเนินได้เป็นอย่างดี ดังมีรายละเอียดสอดแทรกในกิตติกรรมประกาศของแต่ละบทความ


## บทคัดย่อ


มีกระทิงประมาณ 900 ตัวและวัวแดง 400 ตัวในเขตอนุรักษ์ในประเทศไทย ประชากรของกระทิงที่เขตรักษาพันธุ์สัตว์ป่าห้วยขาแข้ง อุทยานแห่งชาติเขาใหญ่ และอุทยานแห่งชาติปางสีดามีประชากรเพิ่มขึ้นเนื่องจากมีการจัดการที่ดีคือมีการปราบปรามการล่าสัตว์อย่างเคร่งครัดที่ห้วยขาแข้ง และมีการทำให้ประชาชนมีส่วนร่วมที่อุทยานแห่งชาติเขาใหญ่ การสะสมเขาสัตว์เป็นปัจจัยที่สำคัญทำให้ประชากรของกระทิงและวัวแดงลดลงและเป็นวัฒนธรรมต่อเนื่องของการใช้ทรัพยากรสัตว์ป่าที่มีมาตั้งแต่สมัยอยุธยาจากการค้าขายหนังกวางในคริสศตวรรษที่ 17 จนมีการติดต่อกับประเทศจีนและคนจีนอพยพรวมทั้งการติดต่อค้าขายและเปิดประเทศกับประเทศตะวันตกตั้งแต่กลางคริสศตวรรษที่ 19 จนในที่สุดการล่าสัตว์และสะสมเขาสัตว์มีมากยิ่งขึ้นตั้งแต่มีการแพร่หลายของอาวุธปืนเพิ่มขึ้นหลังสงครามโลกครั้งที่ 2

It is confirmed that there are about 900 gaur and 400 banteng in protected areas in Thailand. Due to strong law enforcement and local people involvement in conservation in Huai Kha Khaeng Wildlife Sanctuary and Khao Yai National Park, some populations of gaur and banteng are increasing. Trophy collection in Thai houses is still a major factor causing population decline of gaur and banteng in Thailand. Trophy collection is a tradition following the long tradition on the use of wildlife resources for commercial trade since 17$^{th}$ century. It started from deer skin trade and then the other use of wildlife resources followed and continued on.

## รายละเอียดของผลงาน

ผลงานที่ตีพิมพ์ในช่วงของการรับทุนทั้งในวารสารวิชาการและในบทความทั่วไปมีดังต่อไปนี้คือ

SRIKOSAMATARA, S. AND V. SUTEETHORN (1995). Populations of gaur and banteng and their management in Thailand. *Natural History Bulletin of the Siam Society* 43(1): 55-83.

HEINEN, J.T. AND S. SRIKOSAMATARA (1996). Status and protection of Asian wild cattle and buffalo. *Conservation Biology* 10: 931-934

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สมโภชน์ ศรีโกสามาตร 2540. การอนุรักษ์กระทิงและวัวแดงในประเทศไทย. วารสารคณะวิทยาศาสตร์มหาวิทยาลัยมหิดล 10(3): 13-14.

ส่วนบทความที่อยู่ในรูปของ manuscript คือ

SOMPOAD SRIKOSAMATARA, & Varavudh Sutheethorn. Factors reversing population decline of gaur and banteng in Thailand

SOMPOAD SRIKOSAMATARA. Relative density and distribution of large herbivores in a formerly "compression area" of a dry tropical forest, western Thailand

SRIKOSAMATARA, S. AND G. SCHROERING. Commercial use of wildlife: an important factor for the extinction of deer in Thailand.

เอกสารทั้งหมดได้แนบมาในรายงานครั้งสุดท้าย

**สัญญาเลขที่ RSA/5/2538**

**รายงานการเงินในรอบ 36 เดือน**

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**ชื่อโครงการ** การติดตามการเปลี่ยนแปลงขนาดและการกระจายของประชากรของกระทิงและวัวแดงในประเทศไทย โดยเฉพาะในเขตรักษาพันธุ์สัตว์ป่าห้วยขาแข้ง

**ชื่อหัวหน้าโครงการ** รศ. ดร. สมโภชน์ ศรีโกสามาตร

**รายงานในช่วงวันที่** 1 มีนาคม 2541 ถึงวันที่ 30 สิงหาคม 2541

รายจ่ายประจำงวดปัจจุบัน

| หมวด (ตามเอกสารโครงการ) | รายจ่ายจากรายงานครั้งก่อน | รายจ่ายคราวนี้ | รวมสะสม |
|---|---|---|---|
| 1. ค่าจ้าง | 13,500 | 34,000 | 47,500 |
| 2. ค่าตอบแทนเมธีวิจัย | 90,000 | 90,000 | 180,000 |
| 3. ค่าใช้สอย | 10,000 | 10,150 | 20,150 |
| 4. ค่าวัสดุ * | 23,470 | 1,965 | 25,435 |
| 5. ค่าครุภัณฑ์ | 20,350 | 0 | 20,350 |
| 6. ค่า Reprints | 0 | 0 | 0 |
| 7. ค่าหนังสือและวารสาร | 10,000 | 10,000 | 20,000 |
| 8. ค่าลงทะเบียนสัมมนา | 0 | 0 | 0 |
| 9. ค่าเดินทาง ค่าเบี้ยเลี้ยงและที่พัก | 22,000 | 50,000 | 72,000 |
| รวม | 189,320 | 196,115 | 38,5435 |

**จำนวนเงินที่ได้รับและเงินคงเหลือ**

| | | | |
|---|---|---|---|
| งวดที่ 1 | ได้รับจาก สกว. | 360,000 | บาท |
| | ได้รับจากมหาวิทยาลัย * | 120,000 | บาท |
| | อื่น ๆ (เช่นดอกเบี้ย) | 4,387 | บาท |
| | รวม | 484,387 | บาท |
| | รายจ่าย | 164,425 | บาท |
| | เหลือ | 319,962 | บาท |
| งวดที่ 2 | ได้รับจาก สกว. | 0 | บาท |
| | ได้รับจากมหาวิทยาลัย * | 113,475 | บาท |
| | อื่น ๆ (เช่ นยกมาจากงวดก่อนหรือดอกเบี้ย) | 209,450 | บาท |
| | รวม | 322,925 | บาท |
| | รายจ่าย | 226,755 | บาท |
| | เหลือ * | 96,170 | บาท |
| งวดที่ 3 | ได้รับจาก สกว. | 360,000 | บาท |
| | ได้รับจากมหาวิทยาลัย (จากงวดที่แล้ว) * | 96,170 | บาท |
| | ได้รับจากมหาวิทยาลัย (เพิ่มเติม) * | 120,000 | บาท |
| | อื่น ๆ (เช่นยกมาจากงวดก่อนหรือดอกเบี้ย) | 1,984 | บาท |
| | รวม | 578,154 | บาท |
| | รายจ่าย | 147,330 | บาท |
| | เหลือ * | 430,824 | บาท |
| งวดที่ 4 | ได้รับจาก สกว. | 0 | บาท |
| | ได้รับจากมหาวิทยาลัย * | 216,170 | บาท |
| | อื่น ๆ (เช่นยกมาจากงวดก่อนหรือดอกเบี้ย) | 219,160 | บาท |
| | รวม | 435,330 | บาท |
| | รายจ่าย | 231,000 | บาท |
| | เหลือ * | 204,330 | บาท |
| งวดที่ 5 | ได้รับจาก สกว. | 270,000 | บาท |
| | ได้รับจากมหาวิทยาลัย * | 204,330 | บาท |

| | | | |
|---|---|---|---|
| | อื่น ๆ (เช่นยกมาจากงวดก่อนหรือดอกเบี้ย) | 3,453 | บาท |
| | รวม | 477,783 | บาท |
| | รายจ่าย | 189,320 | บาท |
| | เหลือ * | 288,463 | บาท |
| งวดที่ 6 | ได้รับจาก สกว. | 194,150 | บาท** |
| | ได้รับจากมหาวิทยาลัย * | 204,330 | บาท |
| | อื่น ๆ (เช่นยกมาจากงวดก่อนหรือดอกเบี้ย) | 1.965 | บาท |
| | รวม | 400,445 | บาท |
| | รายจ่าย | 196,115 | บาท |
| | เหลือ * | 204,330 | บาท |

เงินคณะ (เบิกได้แค่ค่าวัสดุ ค่าเบี้ยเลี้ยง ค่าที่พัก และค่าเดินทางบางส่วน และมีกฎระเบียบที่ยุ่งยากซับซ้อน) และใช้ได้น้อยมาก ส่วนที่ เหลือในที่สุดแล้วคณะจะเรียกคืน

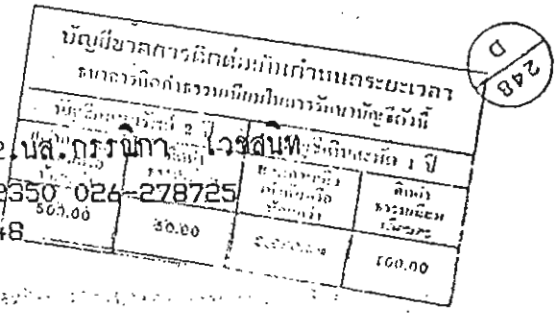
** รวมเงิน 90,000 บาทที่คาดว่าจะได้รับจาก สกว

เงื่อนไขการสั่งจ่าย2ใน3ท่าน

1.นายสมโภชน์ ศรีโกสามาตร 2.น.ส.กรรณิการ์ ไวชสินท

08/02/95 09:11 0851M*2350 026-278725

3.นางคารัญญ์ ศรีกสามาตร 0000723804B




78725-2

ชื่อบัญชี 78725-2 เมธีวิจัย สกว.-สมโภชน์ ศรีโกสามาตร
NAME

ธนาคารไทยพาณิชย์ จำกัด (มหาชน)
THE SIAM COMMERCIAL BANK PUBLIC COMPANY LIMITED

สาขารามาธิบดี -

บัญชีเงินฝากประเภทออมทรัพย์ SAVINGS ACCOUNT

เลขที่บัญชี ACCOUNT NO 026-2 78725-2

ลายมือชื่อผู้มีอำนาจ
Authorized Signature

| | | | |
|---|---|---|---|
| 8/09/95CDD | | ********100.00********100.00 | 0851I |
| 26/09/95QDN | | ****360,000.00****360,100.00 | 0324K |
| 3/10/95CWD | *****15,000.00 | ****345,100.00 | 0255C |
| 1/11/95XWD | *****15,100.00 | ****330,000.00 | 0254D |
| 4/12/95XWD | *****15,000.00 | ****315,000.00 | 0253C |
| 15/12/95CWD | ******2,070.00 | ****312,930.00 | 0249C |
| 25/12/95CWD | ******4,370.00 | ****308,560.00 | 0258C |
| 25/12/95CWD | *****15,000.00 | ****293,560.00 | 0258C |
| 28/12/95CWD | *****10,000.00 | ****283,560.00 | 0254C |
| 31/12/95T/I | **********0.00******4,387.59 | ****287,947.59 | 0000A |
| 25/01/96CWD | ******5,000.00 | ****282,947.59 | 0256C |
| 30/01/96XWD | *****15,000.00 | ****267,947.59 | 0252C |

| | | | |
|---|---|---|---|
| 30/01/96CWD | *****53,500.00 | ****214,447.59 | 0252C |
| 13/02/96CWD | *****40,000.00 | ****174,447.59 | 0257C |
| 15/02/96CWD | *****40,000.00 | ****134,447.59 | 0248C |
| 28/03/96CWD | *****45,000.00 | *****89,447.59 | 0253C |
| 16/04/96CWD | *****20,000.00 | *****69,447.59 | 0252C |
| 25/04/96CWD | *****30,000.00 | *****39,447.59 | 0248C |
| 24/05/96CWD | *****15,000.00 | *****24,447.59 | 0254C |
| 24/06/96CWD | *****12,000.00 | *****12,447.59 | 0251C |
| 30/06/96T/I | **********0.00******2,963.87 | *****15,411.46 | 0000A |
| 22/08/96CWD | *****12,000.00 | ******3,411.46 | 0255C |

| | | | |
|---|---|---|---|
| 22/08/96CWD | ******3,300.00 | ********111.46 | 0251C |
| 18/11/96QDN | ****360,000.00 | ****360,111.46 | 0259C |
| 19/11/96CWD | *****40,000.00 | ****320,111.46 | 0251L |
| 17/12/96CWD | *****30,000.00 | ****290,111.46 | 0253C |
| 31/12/96T/I | **********0.00 | ******1,984.36 | ****292,095.82 00004 |
| 16/01/97CWD | *****45,000.00 | ****247,095.82 | 0250C |
| 20/02/97CWD | *****25,000.00 | ****222,095.82 | 0248C |
| 24/02/97CWD | ******9,425.00 | ****212,670.82 | 0256C |
| 17/03/97CWD | *****11,000.00 | ****201,670.82 | 0255C |
| 28/03/97CWD | *****40,000.00 | ****161,670.82 | 0251C |
| 28/03/97CWD | *****15,000.00 | ****146,670.82 | 0258C |
| 22/05/97CWD | *****30,000.00 | ****116,670.82 | 0254C |

| | | | | |
|---|---|---|---|---|
| 20/06/97 | CWD | *****40,000.00 | *****76,670.82 | 0248C |
| | INT | ******4,506.31 | | |
| 30/06/97 | TAX | **********0.00 | *****81,177.13 | 0000A |
| 29/07/97 | CWD | *****25,000.00 | *****56,177.13 | 0258C |
| 08/08/97 | CWD | *****25,000.00 | *****31,177.13 | 0254C |
| 01/09/97 | CWD | *****30,000.00 | ******1,177.13 | 0252C |
| 29/09/97 | QDP | ****270,000.00 | ****271,177.13 | 0249C |
| 03/10/97 | CWD | *****15,000.00 | ****256,177.13 | 0254C |
| 10/10/97 | CWD | *****17,500.00 | ****238,677.13 | 0251C |
| 02/12/97 | CWD | *****15,000.00 | ****223,677.13 | 0255C |

| | | | | |
|---|---|---|---|---|
| 09/12/97 | CWD | *****15,000.00 | ****208,677.13 | 0252C |
| 22/12/97 | CWD | *****30,000.00 | ****178,677.13 | 0251C |
| | INT | ******3,453.24 | | |
| 31/12/97 | TAX | **********0.00 | ****182,130.37 | 0000A |
| 07/01/98 | CWD | *****15,000.00 | ****167,130.37 | 0257D |
| 22/01/98 | CWD | *****50,000.00 | ****117,130.37 | 0251C |
| 23/01/98 | CWD | *****50,000.00 | *****67,130.37 | 0259C |
| 29/06/98 | CWD | *****20,000.00 | *****47,130.37 | 0255C |
| | INT | ******1,965.80 | | |
| 30/06/98 | TAX | **********0.00 | *****49,096.17 | 0000A |
| 08/10/98 | CWD | *****15,000.00 | *****34,096.17 | 0254C |

NAT. HIST. BULL. SIAM SOC. 43: 55–83, 1995

# POPULATIONS OF GAUR AND BANTENG AND THEIR MANAGEMENT IN THAILAND

*Sompoad Srikosamatara* and Varavudh Suteethorn***

ABSTRACT

The populations of gaur and banteng in Thailand are estimated using data from the authors' research in Thung Yai and Huai Kha Khaeng Wildlife Sanctuaries, from research in Khao Yai National Park, and from brief surveys and available publications during the last 4–5 years. It is estimated that there are about 915 gaur and 470 banteng in the protected areas of Thailand. There are no gaur and banteng outside protected areas. The most important area for gaur and banteng conservation is Huai Kha Khaeng Wildlife Sanctuary with total populations of about 290 gaur and 290 banteng. There has been at least a 60% reduction in the population of gaur and 80% reduction in the population of banteng in Thailand during the last 20 years. Banteng in Thailand are more prone to extirpation than gaur and both are more threatened than elephant. The practice of keeping gaur and banteng trophies encourages poaching within protected areas. The trophies in Bangkok registered at the Royal Thai Forest Department in 1994 were equivalent to 967 gaur and 1840 banteng. A public campaign against the tradition of keeping gaur and banteng horns for trophies should be initiated by the government and conservation NGOs, combined with a good system for registering already acquired horns. More active management should involve regular patrolling in protected areas, strong law enforcement, and a strong program for regulating the number of guns owned by local people.

## INTRODUCTION

Both gaur and banteng are classified as internationally threatened by GROOMBRIDGE (1993). They are shy forest animals and difficult to count. A method for surveying gaur and banteng using line transect and dung has been developed by SRIKOSAMATARA (1993). To apply this method to a larger area requires systematic survey, which we did in Thung Yai and Huai Kha Khaeng Wildlife Sanctuaries and the detailed results will be reported elsewhere (SRIKOSAMATARA & SUTEETHORN, in manuscript).

This study is an attempt to estimate the populations of gaur and banteng in different protected areas in Thailand based on the authors' research in Thung Yai and Huai Kha Khaeng Wildlife Sanctuaries (SRIKOSAMATARA & SUTEETHORN, in manuscript), studies in Khao Yai National Park by DOBIAS (1985, 1986) and CLIMO (1990), short visits to many protected areas and information obtained from both published and unpublished reports. The data can contribute to regional action plans for management of these species (HEDGES, in prep.).

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## STUDY SITES AND METHODS

In addition to the authors' research in Thung Yai and Huai Kha Khaeng Wildlife Sanctuaries (WS), short surveys were made in many protected areas and information about populations of gaur and banteng was collected from various secondary sources, particularly management plans. Data on gaur in Khao Yai National Park (NP) was obtained from DOBIAS (1985, 1986, pers. comm.) and CLIMO (1990). The survey route in each protected area was based on information from maps, existing reports and interviews with protected area personel. More effort was put into surveying areas where densities of gaur and banteng were expected to be the greatest. From maps of various types and scales we obtained information on access, general topography, existing forest area, forest types, geology and the distribution of tribal villages. Whenever possible, mineral licks were investigated for tracks or other signs of gaur and banteng. Estimates of numbers were based on comparing the relative abundance of gaur and banteng tracks and dung with data from Thung Yai and Huai Kha Khaeng Wildlife Sanctuaries.

## RESULTS

### Populations of Gaur and Banteng in Protected Areas in Thailand

It is estimated that there are about seven subpopulations of 50 or more gaur with the total population of 915, and two subpopulations of 50 or more banteng with a total population of 470 in protected areas in Thailand. The most important area for gaur and banteng conservation is Huai Kha Khaeng WS with the total population of 290 gaur and 290 banteng. Other important areas for gaur and banteng conservation are summarized in Table 1 and Fig. 1. Detailed information for different protected areas is given in the following section and Appendix I.

*Northern Area*

All information about gaur and banteng in the North was obtained from secondary sources. Om Koi WS and Mae Tuen WS, with the combined area of 2397 $km^2$, are located in this area. Mae Ping NP is separated from both sanctuaries by a reservoir. These areas have experienced high poaching pressure (BHUMPAKPHAN & KUTINTARA, 1993). It is estimated that there are 50 gaur and 50 banteng in this area and most of them are in Om Koi WS. There are about 15 gaur and 5 banteng in Sri Satchanalai NP.

In Mae Tuen WS, both gaur and banteng have been reported (FRI, 1993a). Mixed Deciduous and Dry Dipterocarp Forest cover about 50% and 37% of the sanctuary, respectively. Since the main underlying rock is granite, numerous mineral licks are expected to be located in this area. About 30 villages (Karen, Thai and Hmong) are reported in the sanctuary and most villages are located near streams where mineral licks are likely to be found. Much of the area is easily accessable by boat. Due to the likelihood of high poaching pressure, the populations of gaur and banteng are expected to be very low.

In Om Koi WS, both gaur and banteng have been reported (FRI, 1993c). Mixed Deciduous and Dry Dipterocarp Forest dominate the area. Several villages (Karen, Lahu

and Lisu) of 720 households and 2,702 people are situated in the sanctuary. The high poaching pressure and long history of human occupation in the area since 1967 possibly caused rapid declines in the populations of gaur and banteng.

In Mae Ping NP, KU (1989b) reported the presence of banteng. The area is dominated by Dry Dipterocarp (42%) and Mixed Deciduous (35%) Forest (KU, 1989b). There are 28 villages of 3477 households with 16,449 people (mainly Thai but some Karen) within or on the boundary of the national park. Most villages have been set up for at least 30 years and some are about 100 years old.

***Petchabun Range***

Nam Nao NP and Phu Khieo WS, with a combined area of 2388 $km^2$, are located in this area. These areas have experienced heavy poaching pressure since 1960 (RFD, 1961; RUHLE, 1964; SUKAVANICH, 1988; PALIPHOD, 1989). It is roughly estimated that there are 30 gaur and 20 banteng in Nam Nao NP and Phu Khieo WS. Thirty gaur each are roughly estimated for Phu Luang WS and Thung Salaeng Luang NP.

In Nam Nao NP, gaur and banteng have been reported (DOBIAS, 1982). A visit by the authors in 1992 indicated that both gaur and banteng can often be found near Phrom Song Guard station which connects with Phu Khieo WS. In Feb. 1992, 6–7 gaur were reported from this area.

Both gaur and banteng have also been reported in Phu Khieo WS (KU, 1989a). Gaur were reported in the central part of the sanctuary around Thung Kamang (an area of several shallow lakes of about 8 $km^2$), Bung Paen (a rich swampy grassland of about 64 ha) and Phu Khing (SUKAVANICH, 1988). Three gaur were sighted in 1987 (SUKAVANICH, 1988). Tracks of gaur and banteng were found at two of the 13 mineral licks surveyed near Thung Kamang by SUPMEE (1986) during 1984–1985 but no local officials reported the presence of banteng in the sanctuary recently (Kitti Kreetiyutanont, pers. comm.). At least 13 gaur were known to be shot by villagers in the past (PALIPHOD, 1989) and a gaur was reported to be poached during our visit. About 60% of villagers near this area have guns (PALIPHOD, 1989).

In Phu Luang WS, both gaur and banteng were reported by RFD (1993d). During our visit in 1993, a forest guard at the Tat Loei station at the southern boundary of the sanctuary reported gaur tracks in the upper watershed area of the Loei river.

In Thung Salaeng Luang NP, RFD (1961) reported the presence of gaur, but hunting pressure for gaur was high during 1960 (RUHLE, 1964). Subsequent reports of sighting of gaur have appeared in newspapers which should be considered cautiously; for example, 50–60 gaur were reported near Poi Rab, Tambon Wang Nok Aen, Wang Thong District, Phitsanulok Province by Assistant Chief of the park Mr. Dhira Temwongra (*Matichon Daily Newspaper*, 14 Feb. 1994). Mr. Nat Ratana estimated 30 gaur left in the park and poaching is still being reported (*Matichon Daily Newspaper*, 22 Mar. 1994).

***Dong Paya Yen and Sun Kampaeng Range***

Khao Yai NP, with an area of 2168 $km^2$ and Tap Lan NP and Pang Sida NP, with a combined area of 2201 $km^2$, are located in this area. Lowland forests still remain in Pang Sida NP. It is roughly estimated that there are 100 gaur in Khao Yai NP and 50 gaur and 10 banteng in Tap Lan and Pang Sida NPs.

Table 1. Important protected areas for gaur and banteng conservation in Thailand. The numbers with G and B in brackets are the estimated numbers of gaur (G) and banteng (B) in different areas. SN = small number.

| | |
|---|---|
| 1. | NORTHERN AREA (65G, 55B) |
| 1.1 | Om Koi WS and Mae Tuen WS, 2397 $km^2$ (50G, 50B) |
| 1.2 | Sri Satchanalai NP, 213 $km^2$ (15G, 5B) |
| 2. | PETCHABUN RANGE (90G, 20B) |
| 2.1 | Nam Nao NP and Phu Khieo WS, 2388 $km^2$ (30G, 20B) |
| 2.2 | Phu Luang WS, 848 $km^2$ (30G, OB) |
| 2.3 | Thung Salaeng Luang NP, 1262 $km^2$ (30G, 0B) |
| 3. | DONG PAYA YEN AND SUN KAMPAENG RANGE (150G, 10B) |
| 3.1 | Khao Yai NP, 2169 $km^2$ (100G, 0B) |
| 3.2 | Tap Lan NP and Pang Sida NP, 2201 $km^2$ (50G, 10B) |
| 4. | PHU PHAN RANGE (0G, 0B) |
| 5. | PHANOM DONGRAK RANGE (20G, 20B) |
| 6. | SOUTH-EASTERN AREA (30G, 20B) |
| 6.1 | Khao Soi Dao WS, Khao Kitchakut NP and Khao Ang Ru Nai WS, 1834 $km^2$ (30G, 20B) |
| 6.2 | Khao Chamao–Khao Wong NP, 84 $km^2$ (SN) |
| 7. | TENASSERIM (510G, 315B) |
| 7.1 | Huai Kha Khaeng WS, 2575 $km^2$ (290G, 290B), Thung Yai WS, 3200 $km^2$ (170G, 0B), Umphang WS (SN), Mae Wong NP (SN), Khlong Lan NP (SN), Khao Laem and Sri Nakharin NP (SN), 12429 $km^2$ (460G, 290B) |
| 7.2 | Kaeng Krachan NP and Mae Nam Phachi WS, 3438 $km^2$ (50G, 25B) |
| 8. | PENINSULAR SOUTH (50G, 30B) |
| 8.1 | Khlong Nakha WS, Khlong Saeng WS, Khlong Yan WS, Khao Sok NP, Sri Phangnga NP and Kaeng Krung NP, 3515 $km^2$ (50G, 30B) |
| Total (915G, 470B) | |

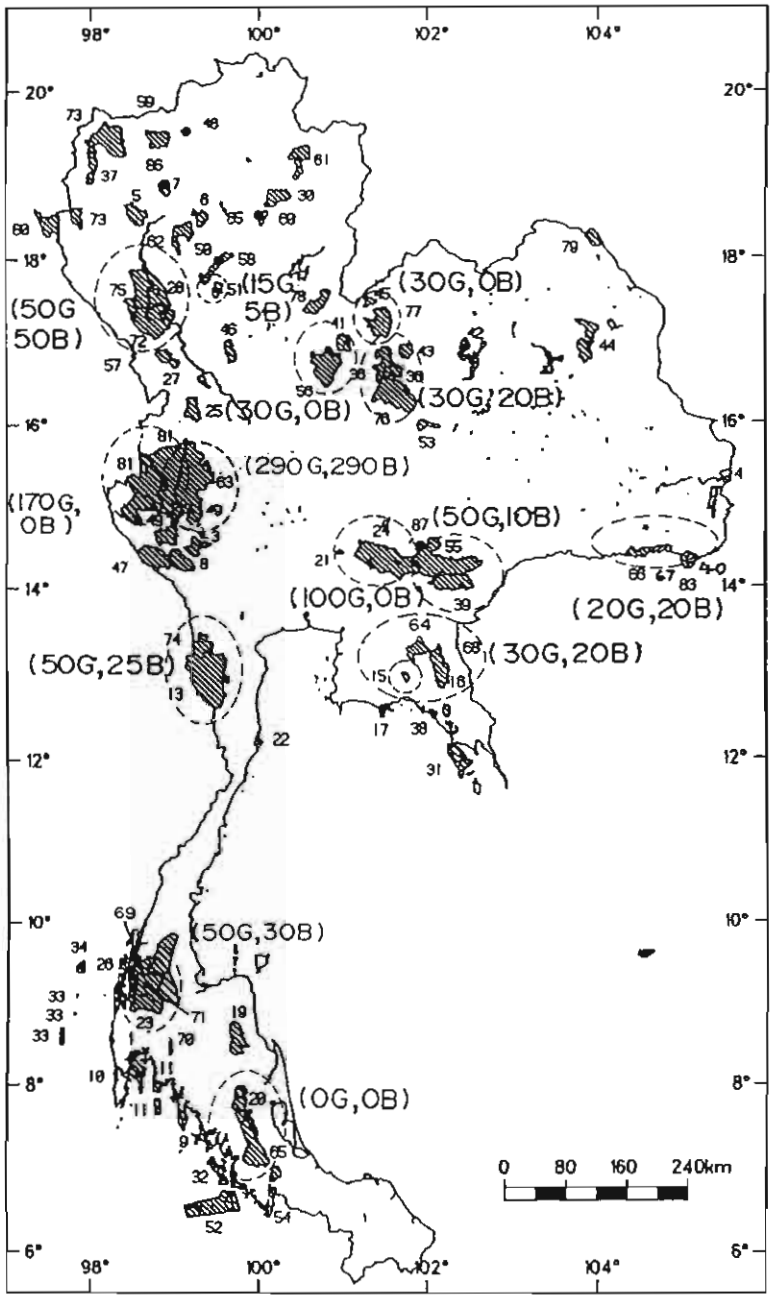


Figure 1. Distribution of important areas for gaur and banteng conservation in Thailand. The map and numbers representing different protected areas are modified from IUCN (1992). The total number of protected areas in this map is about 91 but the number increased to more than 108 in 1992. The numbers in front of G and B in brackets represent estimated numbers of gaur and banteng in different areas.

In Khao Yai NP only gaur have been reported (SAYER, 1981; KUTINTARA & PONGUMPHAI, 1982; DOBIAS, 1985, 1986; NPD, 1987). In 1932 sympatric gaur and banteng were described at a lowland of Thung Kha, north of Pak Chong district and westward between Klong Yai Railway Station to Heo Ta Bua (LEKAGUL, 1952).

There are two subpopulations of gaur in Khao Yai. One in the west near Khao Fa Pha-Khao Inthani area, and another in the east around perhaps east of Khao Laem and Khao Rom. DOBIAS (1986) estimated the density of gaur around Khao Fa Pha-Khao Inthani (82 $km^2$) as 0.5 with the range of 0.3–0.6 $km^{-2}$. When we drew up lines to all locations where signs of gaur were found in this area, we obtained a minimum polygon of about 100 $km^2$, so that a population estimated in this area is about 50 with a range between 30 to 60.

For the population in the eastern side of the park, DOBIAS (1986, pers. comm.) did not report any gaur dung in line transects around the headquarters area (82 $km^2$) but reported 3 gaur dung along 24.6 km transect in the Sai Yai area (82 $km^2$) which yields a density of gaur dung of 17 (0–71) $km^{-2}$. During Jan. to Mar. 1990, CLIMO (1990) walked 20 km of line transect in 40 $km^2$ of Samopun Valley and observed gaur tracks only once but they encountered gaur tracks six times and one dung pile as they were cutting the transects. This indicates a low population density of gaur in this area. It has also been reported that gaur are also numerous on Khao Rom. Brockelman (pers. comm.) has reported numerous tracks on the sides of Khao Laem. On Apr. 1995, high density of gaur dung were reported between Khao Khieo and Khao Rom Noi at an elevation of 1200m asl (W.Y. Brockelman, pers. comm.). In 1985, two gaur sightings were reported near Khao Kamphaeng in the northeast area of the park (DOBIAS, 1985). A herd of 30 gaur was reported from Wang Sai Village, Tambon Wang Mi, Pak Thong Chai District on Nov. 1991 (*Matichon Daily Newspaper*, 9 Nov. 1991) but this information should be considered cautiously. It is roughly estimated that there are at least 50 gaur in the eastern side of the park.

Gaur may have been affected by tourist activities or poaching near the headquarters area. This is supported by comparing numbers of gaur sighted in 1985 and 1973–1974. During 1985 two gaur sightings were reported between this area and headquarters (DOBIAS, 1985). One gaur sighting was made at a mineral lick, 5 km from the headquarters while the other was made in an area 6 km from the headquarters. This can be compared with a report form 1973–1974 (SUCHART ET AL., 1976), during which, at least 8 sightings of gaur in herds of up to 17 individuals were reported from the wildlife tower at Nong Phak Chi, 5 km northwest of headquarters. The last sighting of gaur at Nong Phak Chi was documented by a photograph of 6 gaur taken by Mr. Surachit Jamonman on Sept. 1981 (Fig. 2).

DOBIAS (1985) reported that poaching was widespread and intense within the park, and it became a more serious problem in the headquarters area in 1985, when market hunting for gaur meat and trophies occured. The Khao Fa Pha and Sai Yai areas might be under the heaviest poaching pressure (DOBIAS, 1985, 1986). Gaur poaching was also reported 6 km from headquarters on 7 Jun. 1986 and in the northeast of the park on Nov. 1991. Five gaur were reported to be poached in early 1992 (*Bangkok Post Daily Newspaper*, 21 Sept. 1992) and poachers from Ban Mu Sri, Amphoe Pak Chong were reported to poach two gaur in May 1993 (*Matichon Daily Newspaper*, 21 May 1993).

In 1992, restaurants in Nakhon Nayok (near the south edge) and Pak Chong (north of

the park) were still reported to offer recipes with wildlife meat (*Bangkok Post Daily Newspaper*, 21 Sept. 1992). Poachers still sold gaur meat to restaurants at resorts surrounding Khao Yai NP in May 1993 (*Matichon Daily Newspaper*, 21 May 1993).

The road extending from Nakhon Nayok into the south part of the park in 1982-1983 and connecting with the existing road built from Pak Chong in 1960, cut the park into two big pieces. The heavy traffic reported by GRANDSTATFF (1988) possibly acts as a barrier for gaur dispersal. CONRY (1989) reported gaur trails following or crossing logging roads, but gaur evidently do not cross asphalt roads with heavy traffic like that in Khao Yai.

In Pang Sida NP, RFD (1993a) reported both gaur and banteng. On Nov. 1994, 83 dung piles of wild cattle (most of them possibly belonging to gaur) were seen along the dirt road of 77 km from the park headquaters to Klong Nam Mun Guard Station of Tap Lan NP (Fig. 3). These dung piles were possibly accumulated during the last rainy season. The distribution of the dung piles was clumped near the headwaters of Huai Nam Yen and Huai Samong at an elevation of about 300–500m asl. The density of wild cattle (mostly gaur) found along the road is possibly about the same as SRIKOSAMATARA (1993) found in Khao Nang Rum, about 1.8 $km^{-2}$. Banteng were reported by national park workers but their population must be very small. In Jan. 1995, a mineral lick was visited in the middle of the grassland named "Bu Ta Poad" (Fig. 3). Old tracks of gaur from the last rainy season were found in the lick and nearby area. Gaur were also reported in the eastern part of the park near Laloeng Phai. It is estimated that there are about 50 gaur and about 10 banteng in this national park.

As there is still very little traffic within Pang Sida NP, the road still has little effect on the area's use by gaur and banteng. Gaur were also found feeding on shrubs along the road. It is expected that when the road is improved and there is more traffic within the park, gaur and banteng will avoid using the road. The high density of wild cattle found in this national park is probably due to the prime lowland forest habitat which still remains. Also, poachers do not hunt gaur much as their meat sells for less and spoils faster than that of sambar deer and barking deer. For trophy hunting, poachers aim more to elephant hunting than wild catlle.

In Tap Lan NP, gaur and banteng have both been reported (RFD, 1993f). No dung was seen on the road connecting Pang Sida NP and Klong Nam Mun Guard Station in Tap Lan on Nov. 1994. This area is quite degraded (RFD, 1993f) and if the gaur and banteng exist, their population must be very small.

***Phu Phan Range***

All gaur and banteng are extirpated from this area (Appendix I).

***Phanom Dongrak Range***

This is an important site for a possible trans-boundary park between Thailand and Cambodia. It is roughly estimated that there are 20 gaur and 20 banteng in this area.

***South-eastern Area***

The deforestation rate in south-east Thailand has been high (CHUNKAO, 1987). Khao Soi Dao WS, Khao Kitchakut NP and Khao Ang Ru Nai WS, with a total area of 1834 $km^2$, contain nearly all the forest that remains. There are perhaps 30 gaur and 20 banteng

in these three protected areas and a small population of gaur and banteng in Khao Chamao-Khao Wong NP.

In Khao Soi Dao WS, RFD (1993e) reported only gaur. MIDAS (1993) mentioned that gaur and banteng occur mainly the northwest part of the sanctuary, in and area proposed for an extension. During the survey of pileated gibbons by W.Y. Brockelman and S. Srikosamatara in 1977, some banteng-like tracks were seen but not confirmed, while one set of gaur tracks was seen on the pass NW of Khao Soi Dao Tai, at an elevation of about 920m asl. Evidence of wildlife poaching in Khao Soi Dao has been widespread (BROCKELMAN ET AL., 1977). During a study on ecology and behavior of the pileated gibbons, S. Srikosamatara reported 59 gunshots during 234 days of his stay in 1978–1979.

In the contiguous Khao Kitchakut NP, banteng and gaur were reported by DOBIAS (1982). In Khao Ang Ru Nai WS, both gaur and banteng have been reported (RFD, 1991) while KU (1986) reported only gaur. Seven gaur were seen near Bo Thong Guard Station on Jan. 1992.

In Khao Chamao–Khao Wong NP, a single herd of 20–30 banteng was reported by DOBIAS, (1982). Poaching camps were encountered during the 1978 survey by W.Y. Brockelman and S. Srikosamatara. A population of gaur and banteng still survived in the park during our visit on Nov. 1994.

***Tenasserim***

Gaur and banteng were once common in this region (LEKAGUL, 1952). Huai Kha Khaeng WS, Thung Yai WS, Umphang WS, Mae Wong NP, Khlong Lan NP, Khao Laem NP, and Sri Nakharin NP, with a total area of 12,429 $km^2$, and Kaeng Krachan NP and Mae Nam Phachi WS to the south, with a total area of 3438 $km^2$, are situated in this area. Within the first large conservation area, there are reasonable numbers of gaur and banteng only in Huai Kha Khaeng WS and Thung Yai WS.

In Huai Kha Khaeng WS, both gaur and banteng were reported and mixed group were found at mineral licks (Fig. 4). The population density of gaur and banteng combined appears to be only about 20–50% of what the area could support based on comparison with similar habitat in India (SRIKOSAMATARA, 1993). The population of gaur and banteng combined is estimated to be about 580 with a range of 410–735 and there are possibly more banteng than gaur (SRIKOSAMATARA & SUTEETHORN, in manuscript). In this paper 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.

In Thung Yai WS gaur are more commonly reported than banteng. A large herd of 53 gaur was found in Thung Yai grassland in April 1985 (Fig. 5). Banteng were reported 10–15 km north of Thi Nuai Guard Station in May 1993, which is near Hom Mineral Lick, south of the sanctuary and next to Huai Kha Khaeng WS. The population of gaur is estimated to be about 170 with the range of 125–220 (SRIKOSAMATARA & SUTEETHORN, in manuscript).

In Kaeng Krachan NP, gaur were reported in 1912 in the Huai Ma Reo area (GAIRDNER, 1915) but this area is in the lowland and now situated outside the eastern boundary of the park, where forest encroachment has been very high. Both gaur and banteng have also been reported within the park recently (TISTR, 1992b). DOBIAS (1982) mentioned that both gaur and banteng were common around the summit of Phanoen Thung Mountain.

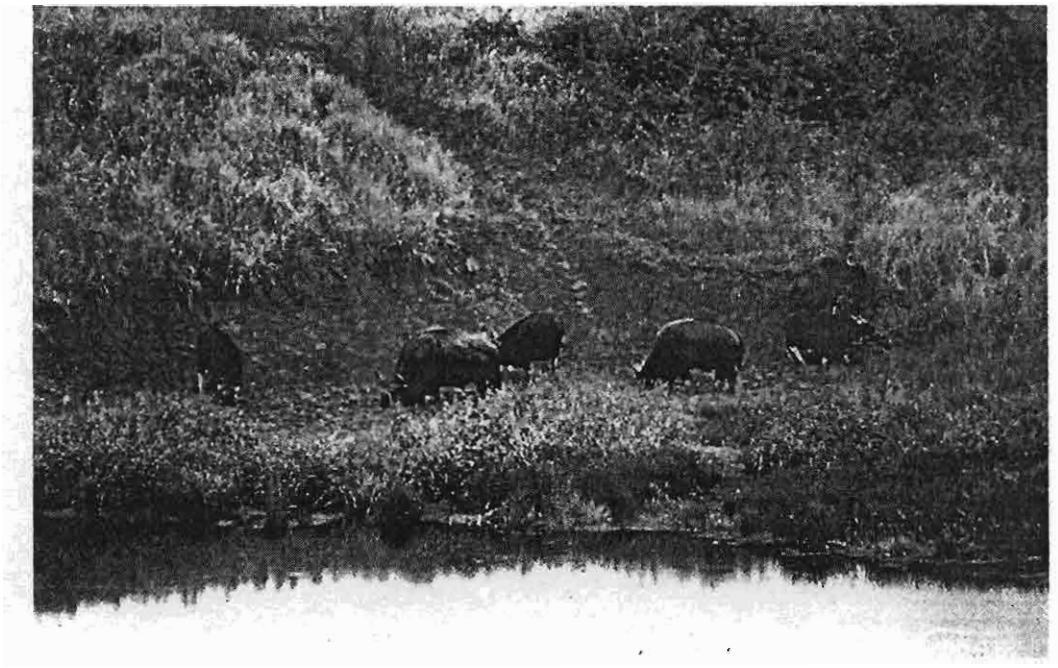

Figure 2. A herd of six gaur at a mineral lick in Khao Yai NP (Photo by Mr. Surachit Jamonman)

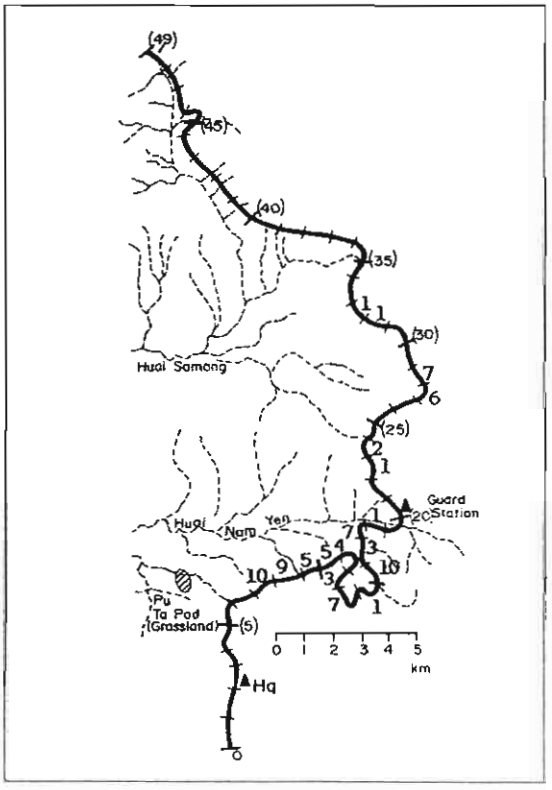


Figure 3. Dung of gaur and/or banteng found along the dirt road in Pang Sida NP on 12 Nov. 1994. The numbers in brackets are reference points in km. The numbers between the km reference line are number of dung found.

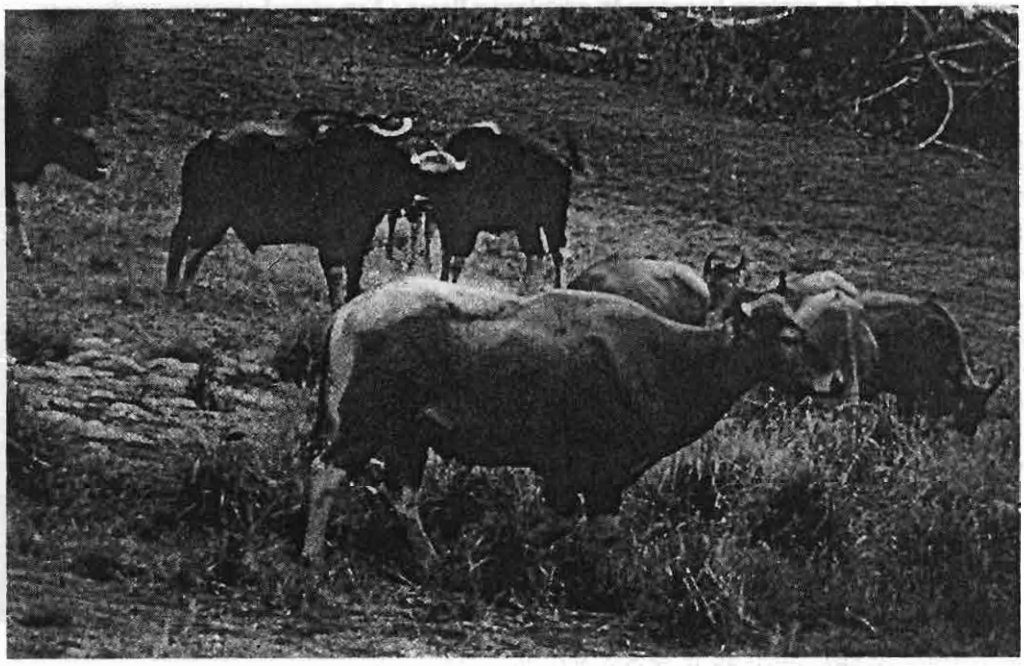

Figure 4. A mixed herd of gaur and banteng at Ya Mineral Lick in Huai Kha Khaeng WS (Photo by Ms. Busabong Kanchanasaka).

Figure 5. A herd of 53 gaur in Thung Yai WS (Photo by Mr. Jira Jintanugool)

TISTR (1992b) reported a sighting of 4 banteng near Komkris Stream in 1978. Gaur tracks were common around Pan Stream while only one sighting of gaur was reported near Tortip Waterfall. We visited the area on Aug. 1993, and Apr. and May 1994. Four mineral licks were checked where there were signs of elephant but no sign of either gaur or banteng. Two other mineral licks located near Tortip Waterfall and Phanoen Thung Mountain were also reported having neither gaur nor banteng tracks. Very old tracks of a gaur were seen along the road along Mae Nam Pan River near Khao Prakarang. As almost all the area in the park is tropical rain forest, and grassland areas in the middle of tropical rainforest have been shown to attract herds of gaur in Malaysia. A major population of gaur is expected to be distributed around a grassland of about 30 ha on Phanoen Thung Mountain.

In Mae Nam Pachi WS, both gaur and banteng were reported by MIDAS (1993). We visited the southeast and northwest side of the sanctuary during May 1994. Tropical deciduous forest dominates the sanctuary. Granite rock covers most of the area in the sanctuary. From the pattern of mineral lick formation in Huai Kha Khaeng WS where granite rock also underlies the area, mineral licks should be found along lowland streams, but most of the area in the lowlands has been settled by people. However, quite a few villages still maintain the names of former mineral licks e.g. Ban Pong Krathing, Ban Pong Phrom, Ban Pong Chang Thaeng and Ban Pong Yo (Pong in Thai means mineral lick). Old tracks of gaur were seen near Pu Nam Ron Guard Station. Two gaur were reported to be poached near this area, one in 1991 and the other in 1993; a small population of gaur still exists.

***Peninsular South***

Banteng have been reported as far south as northern Perlis of West Malaysia (6° 30'N) (WILD LIFE COMMISSION OF MALAYA, 1932) although LEKAGUL (1959) and LEKAGUL & MCNEELY (1977) cited no report of banteng south of 8° N. The only block of forest that still harbors gaur and banteng in the South consists of Khlong Nakha WS, Khlong Saeng WS, Khlong Yan WS, Khao Sok NP, Sri Phangnga NP and Kaeng Krung NP, with a total area of 3515 $km^2$. The prime lowland habitat for gaur and banteng in these protected areas has been flooded by the Chiew Larn or Ratchaprapra Dam since 1980 (NAKHASATHIEN, 1989). The dam has also made the area more accessable by boat. Wildlife poaching was reported in the protected areas during 1987–1988 (BOONRATANA, 1988). It is estimated that there are 50 gaur and 30 banteng in the above areas.

In Khlong Nakha WS, only gaur were reported in the sanctuary during a visit on May 1994.

In Khlong Saeng WS, gaur and banteng have been reported (EGAT, 1980; NAKHASATHIEN, 1989). The prime low elevation habitat for gaur and banteng has been flooded by the Chiew Larn Dam. Mr. Ronglarp Sukmasuang, a researcher at Khlong Saeng Wildlife Research Station, walked 6 transects with a total lenglth of 8 km and found a few dung of gaur. His survey area was near Khlong Khuan, a tributary of Khlong Saeng. Two herds of three and five gaur were seen during 1994 near this area. Another area where gaur were reported was near Khlong Mon near Khao Na Nok Huk. There is no recent report of banteng.

In Khlong Yan WS, a short visit was made on May 1994. No information about gaur

and banteng could be obtained.

In Khao Sok NP, both gaur and banteng were reported (EGAT 1989; NAKHASATHIEN, 1989). In 1982, gaur and banteng were common around Kai Han Field in the northeast part of the park. Tracks of gaur and banteng were reported in Jan. 1988 (BOONRATANA, 1988) and a small herd of gaur was reported near upper Khlong Yi in 1988. A short visit was made on May 1994. It was found that Kai Han Field is in fact a sinkhole where water floods the area and some grassland grows. The proximity of this area to a large village means that the gaur and banteng in this area may have already been hunted out.

Sri Phangnga NP is a long and narrow national park where tropical rain forest dominates. A visit was made on May 1994 indicate that gaur and banteng could occur around the border with Khao Sok NP and Khlong Saeng WS.

In Kaeng Krung NP, tracks of gaur were reported in Jan. 1987 (P.D. Round, pers. comm.) and in 1990. During a visit in May 1994, a park worker reported banteng near the park headquarters which is near the proposed Kaeng Krung Dam site. TCE (1983) reported that wildlife populations in this area are more abundant than in Chiew Larn area.

### Threats to Gaur and Banteng in Thailand

Gaur and banteng have been extirpated from many protected areas in Thailand e.g. Salak Pra WS. The densities of gaur and banteng in the best protected areas such as Huai Kha Khaeng WS, are very low, less than 50% of the carrying capacity of the area. This is largely due to the demand for trophies which encourages poaching in protected areas. The total number of trophies in Bangkok registered at the Royal Thai Forest Department in 1994 were equivalent to about 967 gaur and 1840 banteng. Data on numbers of trophies outside Bangkok are not available. Trophies are still sent to shops in areas such as Nakhon Ratchasima Province, and Cha-Am, Ban Lat and Muang Districts of Phetchaburi Province, where faked animal heads can be added to the trophies for decoration (Fig. 8).

## DISCUSSION

### Status of Gaur and Banteng in Thailand

When we combine the population estimates of gaur in this paper (approx. 1,000) with the number of gaur trophies in Bangkok registered at the Royal Forest Department in 1994 (N=967), it is likely that there were at least 2,000–2,500 gaur in Thailand in 1970. This is similar to the estimate of LENG-EE (1978) of 2,500–3,000, though much greater than the 500 gaur estimated by LEKAGUL & MCNEELY (1977). This would indicate at least a 50-60% reduction within the last 20 years.

We can also add the population of banteng estimated in this study (approx. 500) to the number of trophies in Bangkok registered at the Royal Forest Department in 1994 (N= 1840). It is highly probable that there were at least 2,300–2,500 banteng in Thailand in 1970. The population of banteng estimated by LEKAGUL & MCNEELY (1977) as 500 and by LENG-EE (1978) as 500–1000 are probably underestimates. This would indicate a population reduction of at least 80% within the last 20 years.

Figure 6. A herd of 23 banteng at Phai Lom Stream near Noi Mineral Lick within Huai Kha Khaeng Wildlife Sanctuary taken on 25 May 1992 (Photo by Mr. Theerapat Prayurasiddhi). The herd was led by a mature cow. One mature bull was black.

Figure 7. A gaur was shot dead near Kor Stream in Huai Kha Khaeng Wildlife Sanctuary on April 1988 (Photo by Sompoad Srikosamatara).

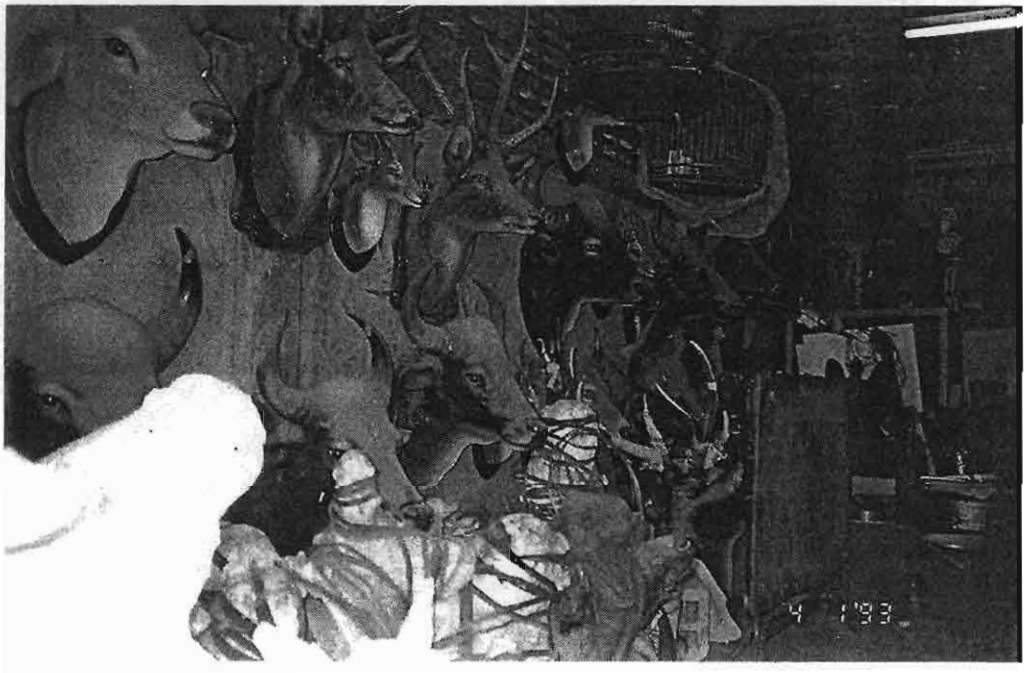

Figure 8. Trophies at a shop at Nakhon Ratchasima Province where faked animal heads were added (Photo by S. Srikosamatara). Trophy collection encourages poaching in protected areas.

The population size of banteng in Thailand has been declining faster than that of gaur. This is probably due to the fact that the dry lowland habitat which is preferred by banteng, has been destroyed and encroached upon more rapidly than upland habital types. Almost all of the best hunting grounds for gaur and banteng before World War II were lowlands which have been colonized by people or flooded by dams. These include, for example, Heo Ta Bua near Khao Yai NP, Thung Kang Yang near Sai Yok and Erawan NPs, Thung Phlai Ngam and the area near Cha-Am District which is south of Kaeng Krachan NP and Mae Wong area near Mae Wong NP. Banteng are also easier to hunt than gaur, as they are less aggressive and tend to stay closer to human habituations than gaur.

The factors contributing to population declines of gaur and banteng at present are different from those observed in the past. LEKAGUL (1959) mentioned that wildlife became over-hunted in Thailand as more vehicles became available and areas became accessable after World War II. Even after protected areas were set up in Thailand, LEKAGUL & MCNEELY (1977) and LENG-EE (1978) stated that overhunting and destruction of wildlife habitats were still the primary problems of wildlife conservation during 1970–1980. During 1980–1990, as the rate of deforestation increased in Thailand (CHUNKAO, 1987) more attention was shifted to habitat destruction as the major factor in the depletion of wildlife populations (NOOTONG, 1980; SAIVICHIEN, 1985; JINTANUGOL, 1985; WONGPAKDEE, 1991). Trophy collection may have grown in the earlier days when hunting was non-selective. It was the custom of rural people in Thailand to give trophies to high ranking officials as souvenirs. Trophy collections still exist today, and are even admired by many people.

## Status of Subspecies of Gaur

Gaur in Thailand (except Peninsular South which belong to *B. gaurus hubbacki*) and Indochina belong to the subspecies *B. gaurus readei* Lydekker 1903, which is the most threatened. According to YIN (1993), gaur in Myanmar are heavily poached and their populations are probably becoming reduced. YIN (1993) reported gaur in Piduang WS (727 $km^2$), Shwe-u-daung WS (327 $km^2$), Shwe-settaw WS (555 $km^2$), Kahilu WS (161 $km^2$), Tamanthi WS (2158 $km^2$), proposed Kyaukpandaung WS (133 $km^2$), proposed Lemro WS (45 $km^2$), proposed Yegauk WS (193 $km^2$) and Alaungdaw Kathapa NP (1612 $km^2$). RABINOWITZ ET AL., (1995) roughly estimated 100–200 gaur in Tamanthi WS (2151 $km^2$). Viable populations of gaur may also be found in Alaungdaw Kathapa NP (1612 $km^2$) and Pegu Yoma NP (1461 $km^2$) (BLOWER, 1982). The high level of trophy trade along the Thai-Myanmar border at Mae Sai-Tachilek (SRIKOSAMATARA ET AL., 1992; SRIKOSAMATARA & SUTEETHORN, 1994) and Mae Sot (Ardith Eudey, pers. comm.) indicates a serious poaching problem in Myanmar.

In Lao PDR, gaur can still be found in the southern and central part of the country (SALTER, 1993; SALTER ET AL., 1990; DUCKWORTH ET AL., 1994). TAMMINS & EVANS (1994) estimated 200 gaur in Nam Theun National Biodiversity Conservation Area (3445 $km^2$). A protected area system in Lao PDR just now being established. There has been a high level of trophy trade along Thai–Lao border (SRIKOSAMATARA ET AL., 1992; SRIKOSAMATARA & SUTEETHORN, 1994) and high hunting pressure (CHAZEE, 1990; TAMMINS & EVANS, 1994; SCHALLER & RABINOWITZ, 1995) so that the populations of wild cattle in Lao PDR are expected to be declining. In 1991 and 1993, the total number

of wild cattle trophies for sale along Thai-Lao border were 100 and 36, respectively (SRIKOSAMATARA ET AL., 1992; SRIKOSAMATARA & SUTEETHORN, 1994). These trophies did not include ones that were not shown openly. Some trophies may come from Cambodia.

In Cambodia, THOULESS (1987) reported that perhaps large mammals are not as threatened as most people thought but the large scale of trophy trade along Thai-Cambodia border reported in Thai newspapers during 1989-1991, inside Phnom Penh (BAIRD, 1993) and in Lomphat of eastern Cambodia (OLIVIER & WOODFORD, 1994) suggest the opposite. OLIVIER & WOODFORD (1994) did aerial surveys from a single-engined aircraft (Cessna 206) in Mondolkiri area (4754 $km^2$) of eastern Cambodia and found only three gaur.

In Vietnam, the density of ungulates in one of the best protected areas for wild cattle, Yok Don Nature Reserve, was about half of that found in Huai Kha Khaeng WS and the current hunting pressure within the reserve was very high (MACKINNON ET AL., 1989). Gaur were less common than banteng in Yok Don NR (LAURIE ET AL., 1989). Gaur were also reported in Nam Cat Tien NP (HOE & QUY, 1991), Green Forest in Dac Lac Province and Nui Bi Doup (710 $km^2$) of Lam Dong Province in South Vietnam (CANH, 1995).

In China, XIANG & SANTIAPILLAI (1993) reported indiscriminate hunting which had led to the extirpation of gaur in Xishuangbanna. Gaur were extirpated from most areas of Gaoligongshan region of Yunnan Province and only remnant populations cross back and forth along the Chinese-Myanmar border (MA ET AL., 1994).

It is hard to tell whether populations of gaur (*B. gaurus hubbacki* Lydekker 1907) in Malaysia are increasing according to numbers estimated by KHAN (1973), KHAN ET AL., (1982) and ABIDIN ET AL., (1991): 400 in 1973, 472 in 1981, 600 in 1991. This is because it is not clear how population sizes were estimated.

It is possible that the population of gaur in Thailand is a lot lower than the populations in India and Nepal which belong to the subspecies *B. gaurus gaurus*. Table 2 shows population estimates of gaur in different protected areas in India. It can be seen that there is higher populations of gaur in smaller areas in India than in Thailand. This may be partly due to the Hindu culture in which cattle are considered sacred. Wild cattle trophies are rarely seen in Indian or Nepalese houses (Tirtha Maskey, David Smith, and Ullas Karanth, pers. comm.). SCHALLER (1967) stated that the villagers did not appear to poach gaur very often at Kanha, although a few young may have been taken in snares. According to local forest officers, poachers found it difficult to handle and dispose of an adult quickly and efficiently, and the Hindu population in the town adjured gaur for the most part because of the animal's resemblace to the sacred cow (SCHALLER, 1967).

In conclusion, the subspecies of gaur *B. g. readei* Lydekker in Thailand and Indochina is the most threatened subspecies and its population size is declining. The subspecies in India *(B. g. gaurus)* and Malaysia *(B. g. hubbacki)* appear to be increasing or remaining stable.

Table 2. Population estimates of gaur in some protected areas in India. NP and S stand for national park and sanctuary, respectively.

| Name of Protected area | Area ($km^2$) | Population estimates | Reference |
|---|---|---|---|
| Kanha NP | 318 | 200 | SCHALLER (1967) |
| | | 550–600 | COE (1980) |
| Mudumalai S | 321 | 300–400 | SCHALLER (1967) |
| Parambikulan S | 235 | 157 | EASA & BALAKRISHNAN (1990) |
| Dajipur S | 218 | 200–300 | SAMANT (1990) |
| Nagarahole NP & Bhadra S | 1064 | 1000+ | KARANTH (1986) |
| Bandipur NP | 690 | 464 | BASAPPANAVAR (1985) |
| Melghat S | 1597 | 1581 (1018–2144) | RODGERS (1991) |
| Manas S | 391 | 1200–1500 | DEBROY (1991) |

## Status of Subspecies of Banteng

Banteng in Thailand all belong to the subspecies, *B. javanicus birmanicus* Lydekker 1898, as do those in Indochina. This is the most threatened subspecies due to the large-scale trophy trade, the Vietnam war and the slow development and management of protected area systems in Indochina. According to YIN (1993), banteng in Myanmar are reported in Pidaung WS (727 $km^2$), Shwe-u-daung WS (327 $km^2$). Viable populations of banteng may be found in Alaungdaw Kathapa NP (1606 $km^2$) and Pegu Yoma NP (1461 $km^2$) (BLOWER, 1982).

Banteng can still be found in the southern and central part of Lao PDR (SALTER ET AL., 1990; DUCKWORTH ET AL., 1994). There was no recent report of banteng in 3445 $km^2$ of Nam Thuen National Biodiversity Conservation Area (TIMMINS & EVANS, 1994). There has been a high level of trophy trade along Thai-Lao border as mentioned above. In eastern Cambodia, OLIVIER & WOODFORD (1994) found 97 banteng in Mondolkiri area (4754 $km^2$) during their aerial survey. Large-scale trophy trade was also found in Lomphat of eastern Cambodia (OLIVIER & WOODFORD. 1994). In Vietnam, one of the best protected area for banteng is Yok Don Nature Reserve as mentioned above. Banteng were also reported in Nam Cat Tien NP, Green Forest in Dac Lac province and Nui Bi Doup (710 $km^2$) of Lam Dong province (CANH, 1995) in southern Vietnam.

The number of banteng in Thailand is less than in Java. Javan banteng belong to another subspecies *B. javanicus javanicus* d'Alton. In 1988, ASHBY & SANTIAPILLAI (1988) estimated that about 700-1000 banteng remained in Java of which half were estimated to be in Udjung Kulon (783 $km^2$) and Baluran reserves (250 $km^2$). The Udjung Kulon population of banteng has been stable over a period of 50 years and has been no clear evidence of a recent decline (ASHBY & SANTIAPILLAI, 1988). HOOGERWERF (1970) stated that during the entire period of his investigations in Udjung Kulon, poaching did not have

a great adverse effect on the banteng population. Poachers found the risk too great to hunt anything other than the valuable rhino in the period from 1937 to 1942 and again from 1950 to 1957, due to the ever improving management of Udjung Kulon.

Banteng in Borneo, belonging to *B. javanicus lowi* Lydekker, are possibly more threatened than the subspecies in Thailand and Java. There is no estimate of population size of banteng in Borneo but they have gone extinct from Brunei and Sarawak and their population is expected to be small due to the nature of the habitat (tropical rainforest), low density of mineral licks (PAYNE, 1992), high level of poaching by the natives of Borneo (AKEN & KAVANAGH, 1982; CALDECOTT, 1988) and the transmigration of farmers from Java. In Sarawak, banteng may persist in remote parts of the north and east of the country (AKEN & KAVANAGH, 1982). CALDECOTT (1988) reported 7 banteng trophies from 1,113 trophies and pets in longhouses and bazaars in Sarawak and this may reflect a low density of banteng in Sarawak. In Sabah, banteng occur in scattered concentrations throughout much of the eastern part (in Kulamba and Tabin Wildlife Reserve, and Kretam Virgin Jungle Reserve) but have been almost exterminated in the western half of the country (DAVIES & PAYNE, 1982; PAYNE, 1982; PAYNE & ANDAU, 1991). However, the areas surrounding mineral licks where a large population of banteng occurs in Kretam Virgin Jungle Reserve in Sabah are scheduled for conversion to permanent agriculture (AMBU, 1990). COCKBURN & SUMARDJA (1978) reported no banteng in Tanjung Puting National Park in Central Kalimantan along the coast of southwest Borneo while ASHBY & SANTIAPILLAI (1988) mentioned that banteng have disappeared from this park. YASUMA (1994) reported very few banteng in East Kalimantan. WIRAWAN (1985) and DOI (1988) reported sighting and tracks of banteng in Kutai National Park in East Kalimantan. Skulls of banteng were seen hung in longhouses at Longnawan village and Bahau River and tracks were seen at Iwan River in the interior of Kalimantan in March 1991 (Tim O' Brian, pers. comm.).

It can be concluded that the subspecies of banteng in Thailand and neighboring countries, *B.j. birmanicus*, is less threatened than the subspecies in Borneo, *B.j. lowi*, and that the populations of both subspecies are declining. The Javan subspecies, *B.j. javanicus*, is the least threatened and its populations are quite stable.

## Management of Gaur and Banteng in Thailand

The demand for gaur and banteng horns as trophies has been identified as a current threat to gaur and banteng, not only in protected areas in Thailand but also in her neighboring countries. Proper management of these species requires a multifaced approach.

A popular option which has been adopted for managing Thai protected areas, e.g. Khao Yai NP, is to attempt to improve the standard of living of people surrounding these areas (WELLS ET AL., 1992). But this measure will not be successful without regular patrolling in protected areas and strong law enforcement. An effective system to register gaur and banteng trophies should be instigated. A public campaign against a practice of trophy collection should be initiated by the government and conservation NGOs.

Given the current low population densities of gaur and banteng even in good protected areas, which are far below 50% of the carrying capacity, poaching should be eliminated from protected areas. At very low population density, any wildlife harvesting at all will

be below a level of sustainable yield (ROBINSON & REDFORD, 1994). The population should be allowed to grow back to at least at 50–60% of the carrying capacity.

This consideration should be at least applied to Thung Yai and Huai Kha Khaeng WS which maintain the largest population of gaur and banteng in Thailand. As we do not know yet how long it will take for the populations to grow to a satisfactory level. A monitoring programme to track changes in population density should be set up. In Huai Kha Khaeng WS, the population density should increase from the current 1.8 $km^{-2}$ to 2.3–5.0 $km^{-2}$. At the same time the current protective measures (PITDAMKAM, 1992) of very strong law enforcement should be supported. A strong programme for regulating the number of guns owned by local people around protected areas should be initiated. Emphasis on protection should also be given to the lowland forest near Sap Fa Pha Guard Station, as it currently contains a high density of gaur and banteng, and it is also rather close to human habituations. The same protective measures and gun control should also be applied to other protected areas where substantial populations of gaur and banteng still exist. Pang Sida NP should receive more attention as it is the only other protected area in addition to Huai Kha Khaeng WS where lowland forests are still left. The effect of a road through this park on wildlife could be considerable, and thus management action should control how the road can be used by the general public.

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Notes added in proof:

1. Morphometric data suggest that the Thailand and Indochinese (*Bos gaurus readei* Lydekker 1903) and Malaysian (*B. gaurus hubbacki* Lydekker 1907) gaur are the same and may be called *Bos gaurus laosiensis* Heude 1901 (Colin Groves, pers. comm.). The mainland (*Bos javanicus birmanicus* Lydekker 1898) and Javan (*B. j. javanicus* d'Alton 1823) banteng are also the same and both may be called *B. javanicus javanicus* (Groves, pers. comm.). Adopted scientific name is based on earliest available name. This may not be applied to gaur as the first scientific name was given to mithan (*Bos frontalis* Lambert 1804) which is domestic gaur. Domestic gaur are not species and subspecies in the same sense as wild gaur. More research (e.g. skull measurement and genetic data) is still required to confirm the above conclusion.

2. The densities of dung of gaur and banteng surveyed in 1988 and 1992 around Khao Nang Rum Wildlife Research Station in Huai Kha Khaeng WS were not different (SRIKOSAMATARA & SUTEETHORN, in manuscript). This is due to a successful law enforcement since 1991 and there have been few reports of wildlife poaching in this area. However, in 1995 poaching of banteng and gaur was reported in the southern part of the sanctuary (Theerapat Prayurasiddhi, pers. comm.). In 1995, a cattle disease, Foot Rot, was a cause of death of a wild banteng in this area (Prayurasiddhi, pers. comm.). This disease was possibly transmitted from domestic cattle. There have been about 326,00 domestic cattle in the buffer zone since 1992. A number of cattle diseases can be transmitted from domestic to wild cattle and there are also examples of these diseases causing a large-scale reduction of wild cattle population in India, Myanmar and Thailand. An appropriate action should be made to stop such disease transmission. This can be done by not allowing domestic cattle to be raised in the buffer zone. If this action cannot be made, limited number of domestic cattle should be allowed to be raised. This should be combined with an effective programme of vaccination of all domestic cattle in the buffer zone.

3. The total number of trophies of gaur and banteng in Thailand is a lot higher than is reported in this paper. This is because there are few data available outside Bangkok. In 1992 the total number of trophies in Uthai Thani Province, next to Huai Kha Khaeng WS, registered at the Provincial Forest Unit, in addition to those reported before in Bangkok as 967 gaur and 1840 banteng, were equivalent to 685–1370 gaur and 174–347 banteng.

4. Some trophies in Thailand possibly came from neighboring countries such as Lao PDR, Myanmar and Cambodia. A large scale trade of trophies between Thailand and Lao PDR possibly started after 1990. Significant trophy trade between Thailand and Myanmar took place at Mae Sot, Tak Province at least during 1982–85. There was no trophy trade

at Mae Sot during our visit in May 1990. Trophy trade between Thailand and Cambodia has been reported at Poi Pet opposite Aranyaprathet, Prachinburi Province since 1991 (*Bangkok Post Daily Newspaper,* 15 Apr. 1991.)

**Appendix I.** Detailed information on gaur and banteng in different protected areas in Thailand.

**Northern Area**

**Doi Chiang Dao WS,** 521 km$^2$ (gaz. 24 Aug. 1978; Fig. 1, No. 59): Gaur and banteng which once occured in the sanctuary have been hunted out (MIDAS, 1993).

**Doi Khuntan NP,** 255 km$^2$ (gaz. 5 Mar. 1975; Fig. 1, No. 6): A few banteng may occur in the park (DOBIAS, 1982).

**Doi Inthanon NP,** 482 km$^2$ (gaz. 2 Oct. 1972; Fig. 1, No. 5): Hill Evergreen Forest occupies about 42% of the park (KU, 1989c). There are 67 villages of 2,212 households of 12,650 people within and nearby the park. Villagers are Karen, Hmong and Thai. Gaur were possibly present in 1959 (RUHLE, 1964) but probably extirpated (DOBIAS, 1982; MIDAS, 1993). The last banteng was possibly shot in 1975 near Siriphum Waterfall (KU, 1989c).

**Doi Pha Muang WS,** 576 km$^2$ (gaz. 16 Jul. 1980; Fig. 1, No. 62): Neither gaur nor banteng are reported.

**Doi Phu Kha NP,** 1680 km$^2$ (gaz. 1993): Gaur were not reported in the area during our survey on Apr. 1993 (SRIKOSAMATARA & SUTEETHORN, 1994).

**Doi Suthep-Pui NP,** 262 km$^2$ (gaz. 14 Apr. 1981; Fig. 1, No 7): Intensive human use of the area has eliminated large mammals including gaur or/and banteng (DOBIAS, 1982; KU, 1989d). ELLIOTT & BEAVER (1992) stated that hunting had caused the disappearance of all large mammal species (except barking deer) 20 years ago.

**Khao Ja Son NP,** 592 km$^2$ (gaz. 28 Jul. 1988; Fig. 1, No. 2): Neither gaur nor banteng were reported. Hunting and poaching in the national park is very high and the large mammals which are still left are wild boar and barking deer (Lisa Evans, pers. comm.).

**Lansang NP,** 104 km$^2$ (gaz. 14 May 1979; Fig. 1, No. 27): No gaur and/or banteng are reoprted (DOBIAS, 1982).

**Lum Nam Pai WS,** 1194 km$^2$ (gaz. 13 Dec. 1972): No information.

**Mae Ping NP,** 1005 km$^2$ (gaz. 13 Jul. 1981; Fig. 1, No. 28): Details in the article.

**Mae Tuen WS,** 1173 km$^2$ (gaz. 10 Aug. 1978; Fig. 1 No. 72): Details in the article.

**Mae Yom NP,** 454 km$^2$ (gaz. 1 Mar. 1986; Fig. 1, No. 30): TCE (1982) reported the presence of gaur. During the survey in 1991, CCB (1992) reported no sign of wild cattle in the inundation area of the proposed Kaeng Sua Ten Dam or upland areas. Local hunters and tribal occupants state that there are no longer any wild cattle in the park (CCB, 1992).

**Mae Yuam WS,** 292 km$^2$ (gaz. 1 Mar. 1986): No information.

**Namtok Mae Surin NP,** 397 km$^2$ (gaz. 29 Oct. 1981; Fig. 1, No 37): Gaur and/or banteng have not been reported.

**Om Koi WS,** 1224 km$^2$ (gaz. 19 Aug. 1983; Fig. 1, No. 75): Details in the article.

**Phu Nang NP,** 512 km$^2$ (not gaz. in 1992) : No information.

**Ramkhamhaeng NP,** 341 km$^2$ (gaz. 27 Oct. 1980; Fig. 1 No. 46): Banteng and gaur were reported (DOBIAS, 1982).

**Salawin WS,** 875 km$^2$ (gaz. 24 Aug. 1978; Fig. 1, No. 84): Gaur and banteng were reported (SAYER, 1981; FRI, 1991b). BHUMPAKPHAN & KUTINTARA (1993) reported the presence of gaur but banteng may have been extirpated. Sightings of gaur were recorded in 1986 and 1988. FRI (1991b) reported high poaching pressure within the sanctuary by Karen and Thai Yai minorities, and by minority army along the Thai-Myanmar border. Poaching of gaur was reported in the nearby area from Mae La Luang near Mae Yuam WS (FRI, 1991b).

**Sri Satchanalai NP,** 213 km$^2$ (gaz. 8 May 1981; Fig. 1, No. 51). About 15 gaur and 5 banteng were estimated in the national park in 1994 (Martin van de Bult, pers. comm.).

**Taksin Maharat NP,** 149 km$^2$ (gaz. 23 Dec. 1981): No information.

### Petchabun Range

**Nam Nao NP,** 962 km$^2$ (gaz. 4 May 1972; Fig. 1, No. 36): Details in the article.

**Namtok Chatakan NP,** 543 km$^2$ (gaz. on 2 Nov. 1987; Fig. 1, No. 4): A visit was made on Dec. 1992. Both gaur and banteng were possibly extirpated from the area 20 years ago.

**Phu Hin Rong Kla NP,** 307 km$^2$ (gaz. 26 Jul. 1984; Fig. 1, No. 41): A visit was made on Dec. 1992. No recent report of gaur and banteng in the park and they were possibly extirpated from the area long time ago.

**Phu Kao-Phu Phan Kham NP,** 322 km$^2$ (gaz. 20 Sept. 1985; Fig. 1, No 42) : A visit was made on Jun. 1991. There has been no report of gaur and banteng in this area.

**Phu Khieo WS,** 1560 km$^2$ (gaz. 26 May 1972; Fig. 1, No. 76): Details in the article.

**Phu Luang WS,** 848 Km$^2$ (gaz. 18 Dec. 1974; Fig. 1, No. 77): Details in the article.

**Phu Kradeung NP,** 348 Km$^2$ (gaz. 23 Nov. 1962; Fig. 1 No. 43): No wild cattle were reported (RUHLE, 1964; DOBIAS, 1982). FRI (1991a) reported the extirpation of gaur from the area and there has been no sighting of gaur during at least the past 10 years.

**Phu Miang-Phu Thong WS,** 545 km$^2$ (gaz. 31 Dec. 1977; Fig. 1, No. 80): A brief visit was made on Dec. 1992. No gaur and banteng have been reported. Both gaur and banteng have possibly been extirpated.

**Phu Rua NP,** 120 km$^2$ (gaz. 26 Jul. 1979; Fig. 1, No. 45): There has been no report of any gaur or banteng in the area (TRISURAT, 1989).

**Phu Wiang NP,** 325 km$^2$ (gaz. 8 Dec. 1991): Visits were made on Sept. 1989 and Jun. 1991. There have been no report of gaur or banteng.

**Tat Ton NP,** 217 km$^2$ (gaz. 31 Dec. 1980; Fig. 1, No. 53): A visit was made on Jul. 1991. Gaur and banteng have been extirpated from the area.

**Thung Salaeng Luang NP,** 1262 km$^2$ (gaz. 13 Dec. 1972; Fig. 1, No. 56): Details in the article.

**Sap Lanka WS,** 155 km$^2$ (gaz. 31 Dec. 1986; Fig. 1, No. 85): Banteng were reported near Ban Pang Hu Sua near Heo Ta Bua, in the headwaters of Lam Phaya Klang River, Chai Badan District in 1923 (WANARAKS, 1941). Neither gaur nor banteng were reported recently in the area.

### Dong Paya Yen and Sun Kampaeng Range

**Khao Yai NP,** 2169 km$^2$ (gaz. 18 Sept. 1962; Fig. 1, No. 24): Details in the article.

**Pang Sida NP,** 844 km$^2$ (gaz. 27 May 1982; Fig. 1, No. 39): Details in the article.

**Sakaerat Environment Research Station,** 72 km$^2$ (gaz. 1976): Gaur are probably extirpated from the area (TONGYAI, 1980).

**Sam Lan NP,** 44 km$^2$ (gaz. 2 Jun. 1981; Fig. 1, No. 21): Neither gaur nor banteng have been reported (DOBIAS, 1982).

**Tap Lan NP,** 2236 km$^2$ (gaz. 23 Dec. 1981; Fig. 1, No. 55, Fig. 4): Details in the article.

### Phu Phan Range

**Huai Huat NP,** 828 km$^2$ (gaz. 24 Jul. 1988): On Mar. 1991, a one day hike was made through part of the best forest in the national park from Ban Kok Tum toward southwest direction to Ban Kham Phak Kut. One track of Indian muntjac and wild pig droppings were found. Our guide, Mr. Not Chaokonkhaeng, who classified himself as Phuthai and was 39 years old from Ban Kok Tum told us that last gaur was possibly shot in 1975.

**Kaeng Tana NP,** 80 km$^2$ (gaz. 13 Jul. 1981; Fig. 1, No. 4): MIDAS (1993) did not report the presence of gaur or banteng. A brief visit was made on Apr., 1991, 1993 and Jan. 1994. There was no report of gaur or banteng from any informant.

**Mukdahan NP,** 49 km$^2$ (gaz. 28 Dec. 1988): A visit was made on Mar. 1991. There is no report of gaur or banteng in this national park.

**Pha Taem NP,** 340 km$^2$ (gaz. 31 Dec. 1991): There was no report of gaur or banteng during our survey of Apr. 1993 (SRIKOSAMATARA & SUTEETHORN, 1994).

**Phu Langka NP,** 50 km$^2$ (not gaz. in 1992): A short visit was made on Apr. 1991. No report of gaur or banteng in this area.

**Phuphan NP,** 665 km$^2$ (gaz. 6 Jun. 1973; Fig. 1, No. 44): A visit was made on Mar. 1991. Gaur and banteng were extirpated from the area. SAYER (1981) reported banteng while SRIKOSAMATARA & DOUNGKHAE (1982) mentioned the possibility of gaur and banteng presence. TISTR (1992a) did not mention the presence of banteng and reported that a gaur was poached on Jun. 1979 in a forest near Ban Mai Pattana village. Only one gaur is expected to be left in the park near Ban Phupan Thong Village or at the back of Srikaoe Cave Temple, Kut Bak District (TISTR, 1992a). Hunting was also reported in 1959 (LEKAGUL, 1959). Poaching pressure inside the national park is expected to be very high judging from the news about elephant poaching in the national park in Jun. 1993 (*Matichon Daily Newspaper*, Jun. 1993).

**Phu Si Than WS,** 250 Km$^2$ (gaz. 3 Jun. 1990): Visits were made on Mar, and Jul. 1991. Both gaur and banteng were extirpated from the area.

**Phu Wua WS,** 187 km$^2$ (gaz. 2 May 1975; Fig. 1, No. 79): A visit was made on Apr. 1991. No gaur or banteng was reported in the area.

### Phanom Dongrak Range

**Huai Sala WS,** 380 km$^2$ (gaz. 28 Dec. 1990; Fig. 1, No. 66): A brief visit was made on Apr. 1992. Due to land mine problems, no field survey was made. There was a report of 3 banteng in Jul. 1981 but the follow-up survey on Aug. 1981 was aborted due to a mine explosion.

**Phanom Dongrak WS,** 316 km$^2$ (gaz. 15 Dec. 1978; Fig. 1, No. 67): A brief visit was made on Apr. 1992. Due to land mines, no survey can be made. A soldier told us that from his station at Khao Phra Wihan where he can see Cambodian lowland he saw five banteng grazing on young grass along the Thai-Cambodia border on Nov. 1990 and Apr. 1991. A report about an expedition during Apr. and Aug. 1976 (ANON., 1976a, b) documented a gaur shot in Jun. 1976. Tracks of banteng and gaur were found during April survey but they were not fresh and were believed to be from the previous monsoon season. No tracks of any wild cattle were found during the August survey. ANON. (1976a,b) considered this area to be hopeless for large herbivores in general.

**Phu Chong Nayoi NP,** 686 km$^2$ (gaz. 1 Jun. 1987; Fig. 1, No. 40): A brief visit was made on Apr. 1991. On Nov. 1990, there was a report of three banteng near Phu Man Kaeo in the northern part of the park.

**Yot Dom WS,** 203 km$^2$ (gaz. 11 Oct. 1977; Fig. 1, No. 83): A brief visit was made on Apr. 1991. Our informant, Mr. Mai Nantana (48 years old at the time of our survey), who was born and grew up in that area told us that there were still gaur in the area. On Apr. and Nov. 1991, there was a report of three herds of banteng with 4-7 individuals each and there were three kouprey mixed with the herds at the border area between Yot Dom WS and Phu Chong Nayoi NP (*Thai Rath Daily Newspaper*, Nov. 18, 1991; *Manager Daily Newspaper*, 20–26 Jan. 1992).

### Eastern Area

**Khao Ang Ru Nai WS,** 1030 km$^2$ (gaz. 10 Oct. 1977; Fig. 1, No. 64): Details in the article.

**Khao Chamao-Khao Wong NP,** 84 km$^2$ (gaz. 31 Dec. 1975; Fig. 1, No. 15): Details in the article.

**Khao Khieo-Khao Chomphu WS,** 145 km$^2$ (gaz. 2 Jul. 1974): Neither gaur nor banteng was reported (STORER, 1979; DOBIAS, 1982).

**Khao Kitchakut NP,** 59 km$^2$ (gaz. 4 May 1977; Fig. 1, No. 16): Details in the article.

**Khao Sabap NP,** 134 km$^2$ (gaz. 2 May 1975; Fig. 1, No. 38): No recent survey was made. Srikosamatara visited the area during Apr. 1978. During 20 km hiking, deer and wild pigs were the only signs of large mammals encountered.

**Khao Soi Dao WS,** 745 km$^2$ (gaz. 4 Sept. 1972; Fig. 1, No. 16): Details in the article.

### Tenasserim

**Chaloem Rattanakosin NP,** 59 km$^2$ (gaz. 12 Feb. 1980; Fig. 1, No. 3): Gaur and banteng were reported in the park (DOBIAS, 1982). Wildlife tended to concentrate in the west from where it could roam to the adjacent Srinagarin NP and Erawan NP. Poaching was believed to be heavy (STORER, 1981).

**Erawan NP,** 550 km$^2$ (Khao Salob, RUHLE 1964; gaz. 19 Jun. 1975; Fig. 1, No. 8): Gaur and banteng were reported (DOBIAS, 1982, FRI, 1993b).

**Huai Kha Khaeng WS,** 2575 km$^2$ (gaz. 1972; Fig. 1, No. 63): Details in the article.

**Kaeng Krachan NP,** 2915 km$^2$ (gaz. 12 Jun. 1981; Fig. 1, No. 13): Details in the article.

**Khao Laem NP,** 1497 km$^2$ (gaz. 8 Nov. 1990): A short visit was made on Dec. 1991 and Jan. 1992. All the lowland (388 km$^2$) which is the best habitat for gaur and banteng has been flooded due to Khao Laem Dam since 1984. Most areas are accessable either by road or by boat. If there are gaur in the national park (TISTR, 1994b), very few are expected.

**Khlong Lan NP,** 300 km$^2$ (gaz. 25 Dec. 1982; Fig. 1, No. 25): RFD (1993b) reported both gaur and banteng on the western side of the park.

**Khlong Wang Chao NP,** 748 km$^2$ (gaz. 29 Aug. 1990): No gaur and banteng was reported.

**Mae Nam Pachi WS,** 489 km$^2$ (gaz. 1 Aug. 1987; Fig. 1, No. 74): Details in the article.

**Mae Wong NP,** 894 km$^2$ (gaz. 14 Sept. 1987; Fig. 1, No. 29): A short visit was made on May 1990. There has been no recent report of gaur and banteng in this area. Banteng used to be common in this area (WANARAKS, 1941; LEKAGUL, 1954) and this area was once a popular area for big game hunting (LEKAGUL, 1954; LEKAGUL & MCNEELY, 1977). A picture of a large male banteng shot in 1907 can be seen in GAIRDNER (1917). The area has been easily accessible and heavily disturbed since 1959.

**Sai Yok NP,** 500 km$^2$ (gaz. 27 Oct. 1980; Fig. 1, No. 47): Gaur and banteng have been reported (DOBIAS, 1982; FRI, 1992b). FRI (1992b) reported both gaur and banteng along Maenam Lo Stream and Bong Ti Stream to the Thai-Myanmar border. Banteng probably occur in the southern part of the national park (FRI, 1992b). FRI (1992b) expected that both species would be prone to extirpation from the national park.

**Salak Phra WS,** 859 km$^2$ (gaz. 31 Dec. 1965): Banteng are relatively more abundant than gaur (WILES, 1980). STORER (1981) reported that during his 6-day trip in 1979, he found shooting platforms at all salt licks. At one platform there was a fresh gaur's skin. In the Thung Na Mon area, he came across a poachers' camp of approximately ten hunters who had poached wildlife including one gaur. These poachers were armed with guns ranging from muzzle loaders to M16 automatic rifles. At other places in the sanctuary he found empty cartridges of high velocity sporting loads such as 30.06 cal. The evidence indicated that Salak Phra was used by more wealthy sport hunters as well as poorer villages at least during 1979. Poaching is highest during the dry season when animals congregate near water. Gaur and banteng are extirpated from this area due to the road that cut across the sanctuary and the building of Sri Nakharin dam.

**Sri Nakharin NP,** 1532 km$^2$ (gaz. 23 Dec. 1981; Fig. 1, No. 49): Both gaur and banteng have been reported in the park (DOBIAS, 1982) while later FRI (1992a) reported only gaur. Short visits were made on Mar. 1989, Dec. 1991 and Jan. 1992. Most of the lowland has been flooded due to Sri Nakharin Dam since 1981. The area is easily accessable both by road or by boat. If gaur are left in the area, the population size must be very small.

**Thung Yai WS,** 3200 km$^2$ (gaz. 24 Apr. 1989; Fig. 1, No. 81): Details in the article.

**Umphang WS,** 2515 km$^2$ (gaz. 17 Apr. 1989): A short visit was made on May 1990. Both gaur and banteng have probably been extirpated.

### Peninsular south

**Chalerm Pha Kiet Somdej Prathep Rattana Rachasuda WS,** 200 km$^2$ (gaz. 12 Sept. 1990): No information.

**Kaeng Krung NP,** 541 km$^2$ (gaz. 8 Dec. 1991): Details in the article.

**Khao Banthad WS,** 1267 km$^2$ (gaz. 4 Sept. 1975; Fig. 1, No. 65): TISTR (1994a) mentioned nothing about either gaur or banteng. Gaur and banteng as large mammals were probably extirpated due to poaching (MIDAS, 1993).

**Khao Luang NP,** 570 km$^2$ (gaz. 18 Dec. 1974; Fig. 1, No. 19): Banteng is possibly present while gaur was reported by National Park workers (BOONRATANA, 1988). Neither gaur nor banteng was reported by MIDAS (1993) and RFD (1993C).

**Khao Phanom Bencha NP,** 50 km$^2$ (gaz. 9 Jul. 1981): BOONRATANA (1988) reported neither gaur nor banteng.

**Khao Pra Bang Khram WS,** 156 km$^2$ (gaz. 1993): Both gaur and banteng were reported in the area until early 1970 (Vichian Thongthao and P.D. Round, pers. comm.).

**Khao Pu Khao Ya NP,** 694 km$^2$ (gaz. 27 May 1982; Fig. 1, No. 20): No information.

**Khao Sam Roi Yot NP,** 98 km$^2$ (gaz. 28 Jun. 1966; Fig. 1, No. 22): Neither gaur nor banteng has been

reported in the park (DOBIAS, 1982).

**Khao Sok NP,** 645 km$^2$ (gaz. 22 Dec. 1980; Fig. 1, No. 23): Details in the article.

**Khlong Nakha WS,** 480 km$^2$ (gaz. 26 May 1972; Fig. 1, No. 69): Details in the article.

**Khlong Phraya WS,** 95 km$^2$ (gaz. 12 Nov. 1980; Fig. 1, No. 72): MIDAS (1993) reported both gaur and banteng. The area is too small to support any viable population of either species.

**Khlong Saeng WS,** 1156 km$^2$ (gaz. 18 Dec. 1974; Fig. 1, No. 71): Details in the article.

**Khlong Yan WS,** 491 km$^2$ (gaz. 1993): Details in the article.

**Sri Phangnga NP,** 246 km$^2$ (gaz. 16 Apr. 1988): Details in the article.

**Thaleban NP,** 102 km$^2$ (gaz. 27 Oct. 1980; Fig. 1, No. 54): Neither gaur nor banteng were reported (DOBIAS, 1982). The largest mammals found are Indian muntjac and wild pigs (Mr. Colin McQuistan, pers. comm.).

**Ton Nga Chang WS,** 182 km$^2$ (gaz. 14 Jul. 1978; Fig. 1, No. 87): Neither gaur nor banteng was reported (DOBIAS, 1982).

**Uttayan Sadet Nai Krom Luang Chumphon WS,** 454 km$^2$ (gaz. 23 Mar. 1988): A short visit was made on May 1994. Very little forest is left due to Typhoon "Gay" which moved through the area on Nov. 1989. Neither gaur nor banteng was expected.

# ASIAN WILD CATTLE CONSERVATION ASSESSMENT AND MANAGEMENT PLAN WORKSHOP

## Chonburi, Thailand
## 21 - 25 July 1995

## WORKING DOCUMENT


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O. Byers, S. Hedges and U.S. Seal, Editors

COMPILED BY
Workshop Participants


HOSTED BY
Khao Kheow Open Zoo

A COLLABORATIVE WORKSHOP OF
The Zoological Parks Organization of Thailand
The Royal Forest Department of Thailand
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## Census, Survey and Monitoring Techniques

The Asian Wild Cattle Specialist Group has to deal with eight species in many different areas throughout south and southeast Asia. At the present time we know very little about how many animals actually remain and many of the counts which have been conducted have been brief and rather crude. Counts using robust and reliable techniques which can be carried out relatively quickly in the field are urgently needed.

Before starting an animal count the goals of the project must be well defined (i.e. what is the information needed for?). A major consideration is whether absolute numbers are ever required. In almost all cases indices of relative abundance combined with information on population trend is adequate for wildlife managers and conservation planners. Careful thought must be given to the level of confidence required, and the time, resources and number of interested and dedicated people available.

For the purpose of this report we will use the following definitions:

SURVEY: Attempt to produce an index of relative abundance.

CENSUS: Attempt to estimate the absolute number of animals in an area.

MONITORING: Attempt to assess population trends over time through repeated surveys or censuses.

Below is a list of potential techniques which can be used for censusing, surveying and monitoring wild bovid populations.

### FAECAL TECHNIQUES

Advantages: relatively cheap (time and money required are low), good for estimating relative abundance. Better than sightings for low density populations. Major problems: confusion will arise if >1 species produce similar faeces, needs good quality data on decay rate, cannot be used for censuses unless information is available on defecation rate (very limited data are usually available), provides no information on population structure, and many animals defecate in a non-random fashion thus requiring a large sample size. Rainy season rapid decay rates in the tropics frequently make this technique unsuitable except in areas of high population density. There are two major ways of recording faecal abundance: line transects and plots.

1) Line transects. This includes any technique in which a known line is patrolled, and the distance from the line to the faecal piles are recorded. Advantages: can provide good quality data with confidence limits, a widely used technique; it is frequently more efficient than plot-based techniques, as more time is spent collecting data; allows for quantitative compensation for samples of unknown origin (i.e. dung from unknown species can be ignored during

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.

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# 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



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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.

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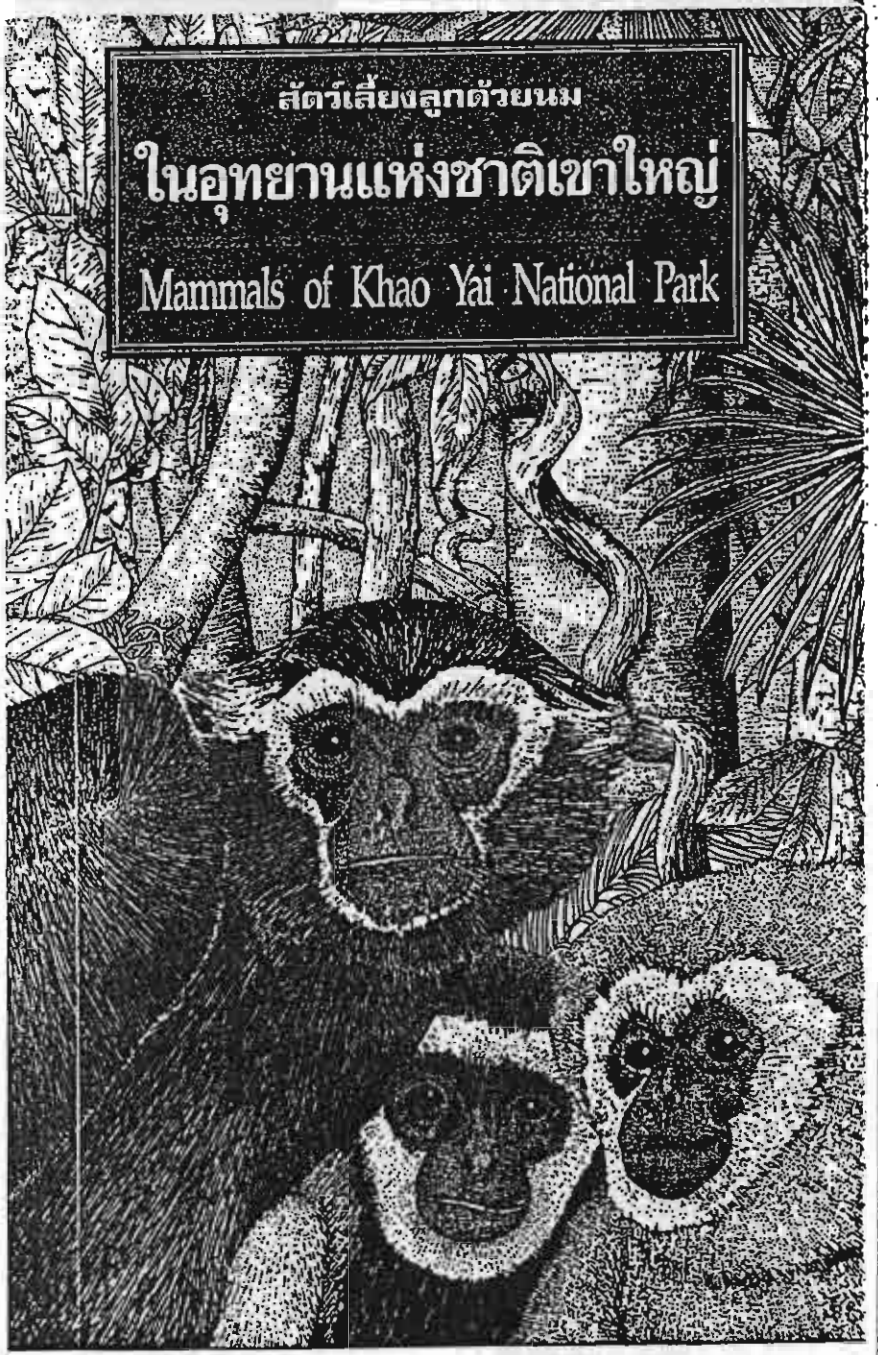


โดย สมโภชน์ ศรีโกสามาตร (Sompoad Srikosamatara)
ทรอย แฮนเซล (Troy Hansel)

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

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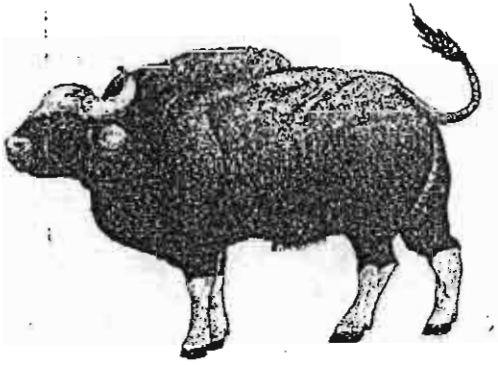
ขนาด: ความยาวลำตัวและหัว 2500-3000 มม. ความยาวหาง 700-1050มม.
น้ำหนัก : 650-900 กก.
ลักษณะทั่วไป : เป็นสัตว์ขนาดใหญ่มีสีดำตามลำตัวยกเว้นบริเวณส่วนปลายของขาจะมีขนสีขาวหรือสีเหลือง ส่วนหลังของคอจะมีเนื้อที่นูนขึ้นมามีลักษณะเป็นหนอก จะมีขนสีน้ำตาลอ่อนปกคลุมบริเวณหน้าผาก และบริเวณรอบๆ ปากจะมีสีขาวล้อมรอบ 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

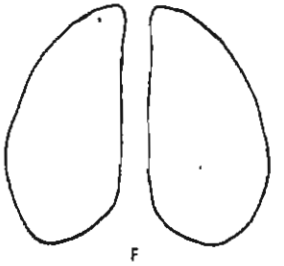
## Gaur
## *(Bos gaurus)*

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

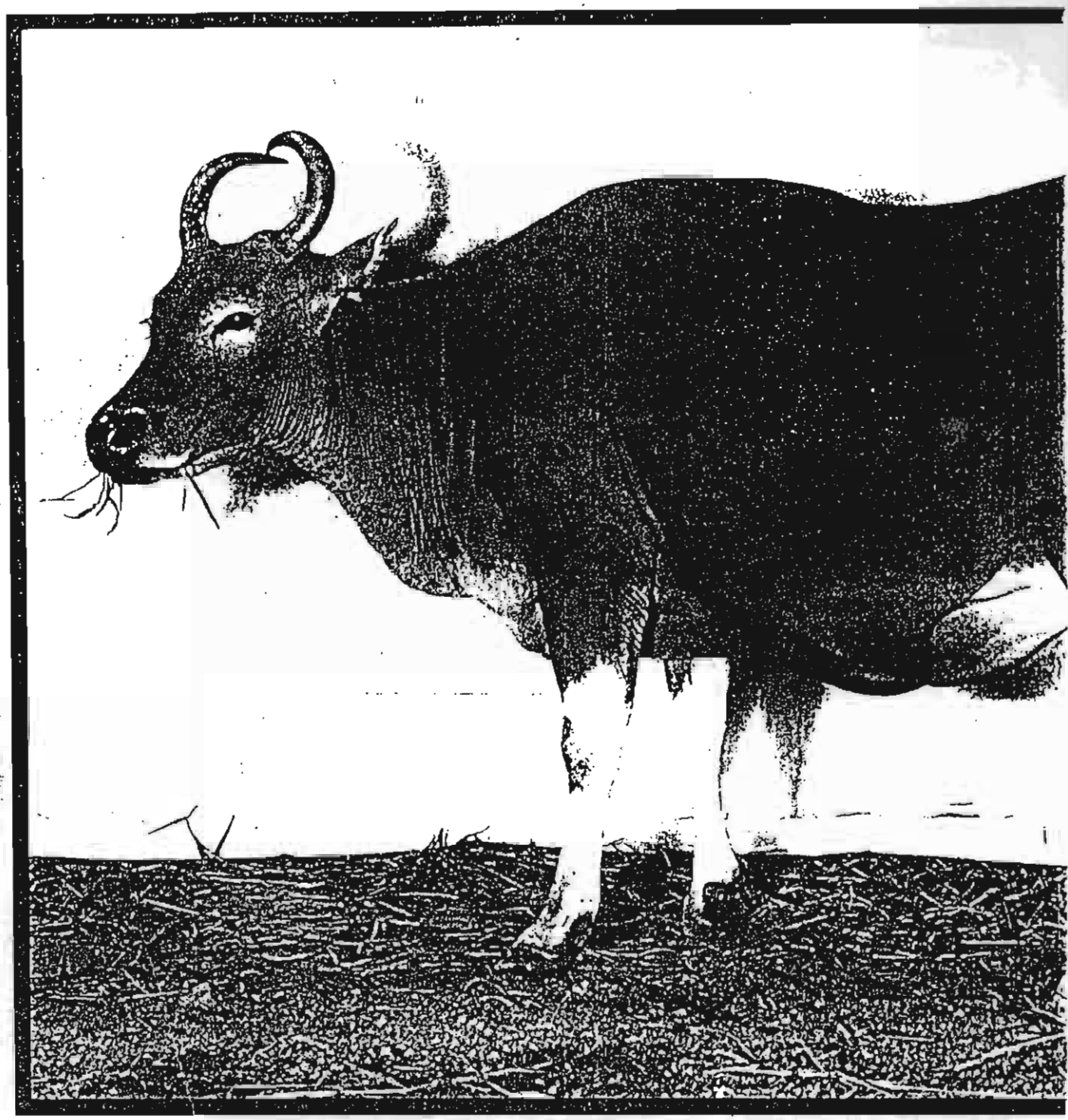
**Description :** A large, dark bovine with white or yellow stockings on all four legs and a high ridged back. The forehead is light brown to just above the eyes and the mouth has a white line around it. Bulls produce an oily sweat that stains their skin and hair a golden-yellow, as can be seen on the 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 จึงถูกเสนอให้เป็นสัตว์ป่าที่อยู่ในชั้นวิกฤต (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.



# การอนุรักษ์กระทิง และวัวแดงในประเทศไทย*

สมโภชน์ ศิริโกสามาตร ภาควิชาชีววิทยา คณะวิทยาศาสตร์ มหาวิทยาลัยมหิดล

*การอนุรักษ์กระทิงและวัวแดงเป็นกรณีศึกษาการอนุรักษ์ความหลากหลายทางชีวภาพโดยสามารถประยุกต์ให้เข้ากับกรณีของสัตว์ที่มีขนาดใหญ่ 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

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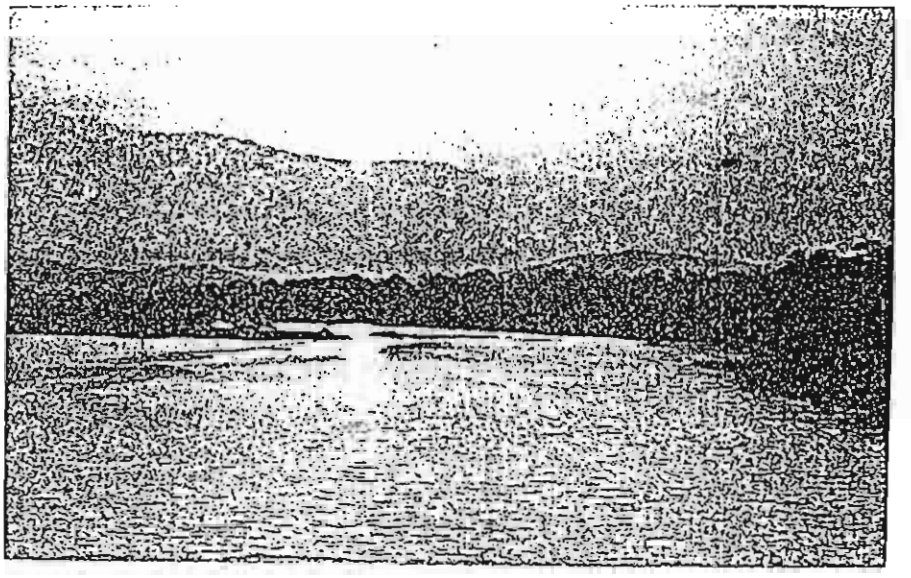
*โครงการฝึกอบรมทางวิชาการให้แก่ราชการสถาบันราชภัฏ เรื่อง ความหลากหลายทางชีวภาพและการอนุรักษ์ ภาควิชาชีววิทยา คณะวิทยาศาสตร์ มหาวิทยาลัยมหิดล พฤษภาคม 2540

แห่งชาติและเขตรักษาพันธุ์สัตว์ป่าเท่านั้น โดยมีกระทิงมากที่สุดในเขตรักษาพันธุ์สัตว์ป่าห้วยขาแข้ง และทุ่งใหญ่นเรศวร 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

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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 2$^{nd}$, 3$^{rd}$ and 4$^{th}$ 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). .

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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 1988, 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) |

Table 7. Number of dung of wild cattle found in different line transect and the total distance walked. Transect line number B to 4 are in Area 1 while the transect line number 5 to 15 are in Area 2.

| Line | 1988 | | 1992 | | 1996 | | 1998 | |
|---|---|---|---|---|---|---|---|---|
| | Distance (km) | Wild Cattle | Distance (km) | Wild Cattle | Distance (km) | Wild Cattle | Distance (km) | Wild Cattle |
| 15 | | | | | | | 1.125 | 43 |
| 14 | | | | | | | 1.700 | 10 |
| 13 | | | | | 1.300 | 19 | 1.025 | 29 |
| 12 | | | | | 1.325 | 9 | 6.475 | 106 |
| 11 | | | | | 2.000 | 98 | 3.650 | 27 |
| 10 | | | | | 2.400 | 70 | 4.120 | 31 |
| 9 | | | | | 2.000 | 43 | 3.180 | 19 |
| 8 | | | | | 1.400 | 28 | 4.400 | 10 |
| 7 | 3.000 | 5 | 3.000 | 22 | 4.400 | 7 | 4.400 | 0 |
| 6 | 2.000 | 4 | 1.730 | 3 | 2.000 | 1 | 0.200 | 0 |
| 5 | 1.750 | 0 | 2.000 | 9 | 2.000 | 0 | 0.450 | 0 |
| 4 | 6.000 | 13 | 5.900 | 8 | 5.000 | 3 | 3.000 | 3 |
| 3 | 5.650 | 18 | 5.600 | 9 | 5.000 | 3 | 3.000 | 0 |
| 2 | 5.150 | 10 | 5.000 | 57 | 5.000 | 6 | 2.775 | 6 |
| 1 | 3.000 | 36 | 3.000 | 19 | 3.000 | 3 | 2.200 | 1 |
| A | 4.400 | 27 | 4.350 | 9 | 5.000 | 18 | 3.000 | 1 |
| B | | | | | 3.200 | 7 | 2.800 | 4 |
| Total | 30.95 | 113 | 30.58 | 136 | 45.025 | 315 | 47.500 | 290 |

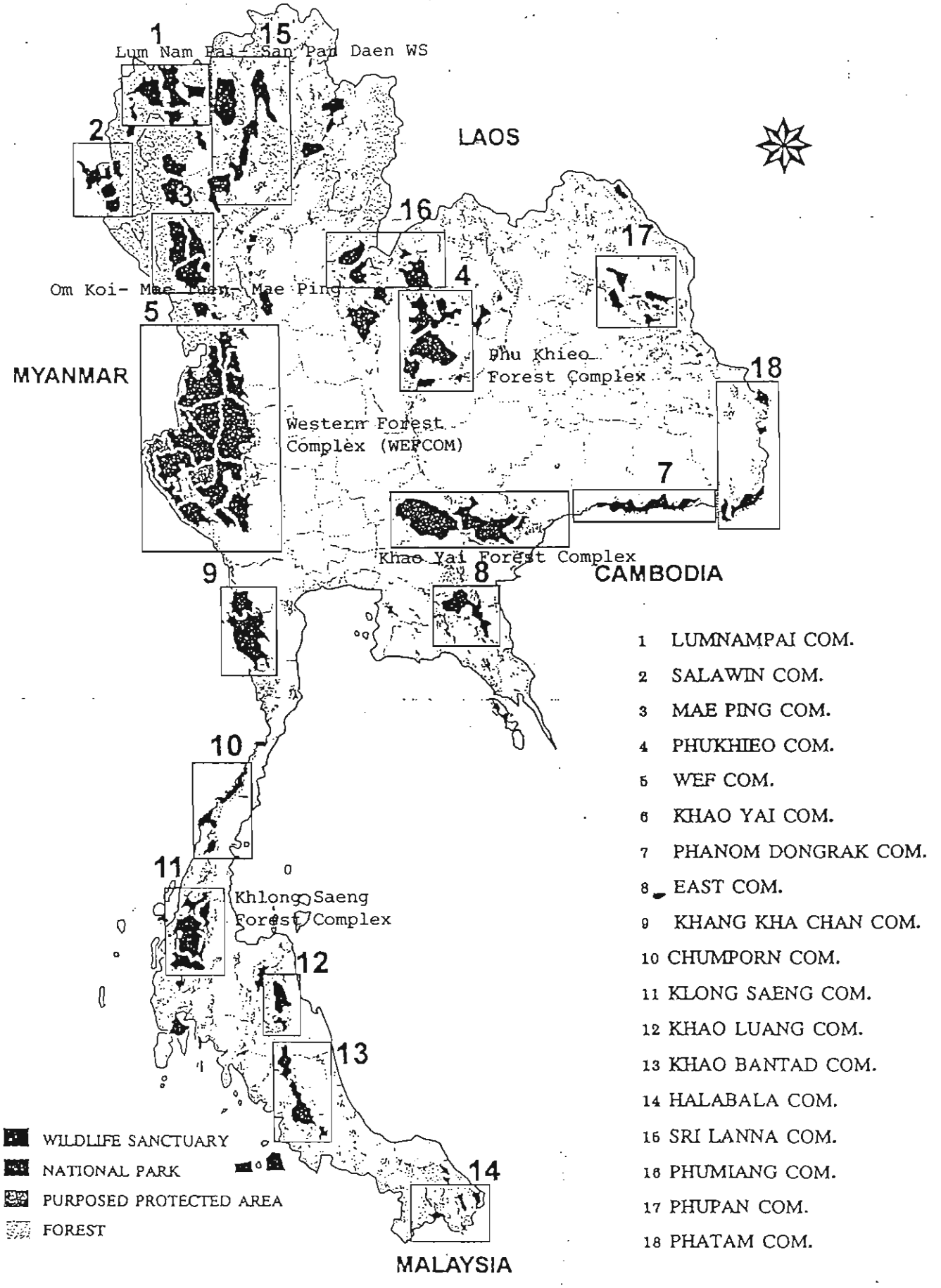


Figure 1. Map of protected areas where additional information on populations of gaur and banteng have been obtained.

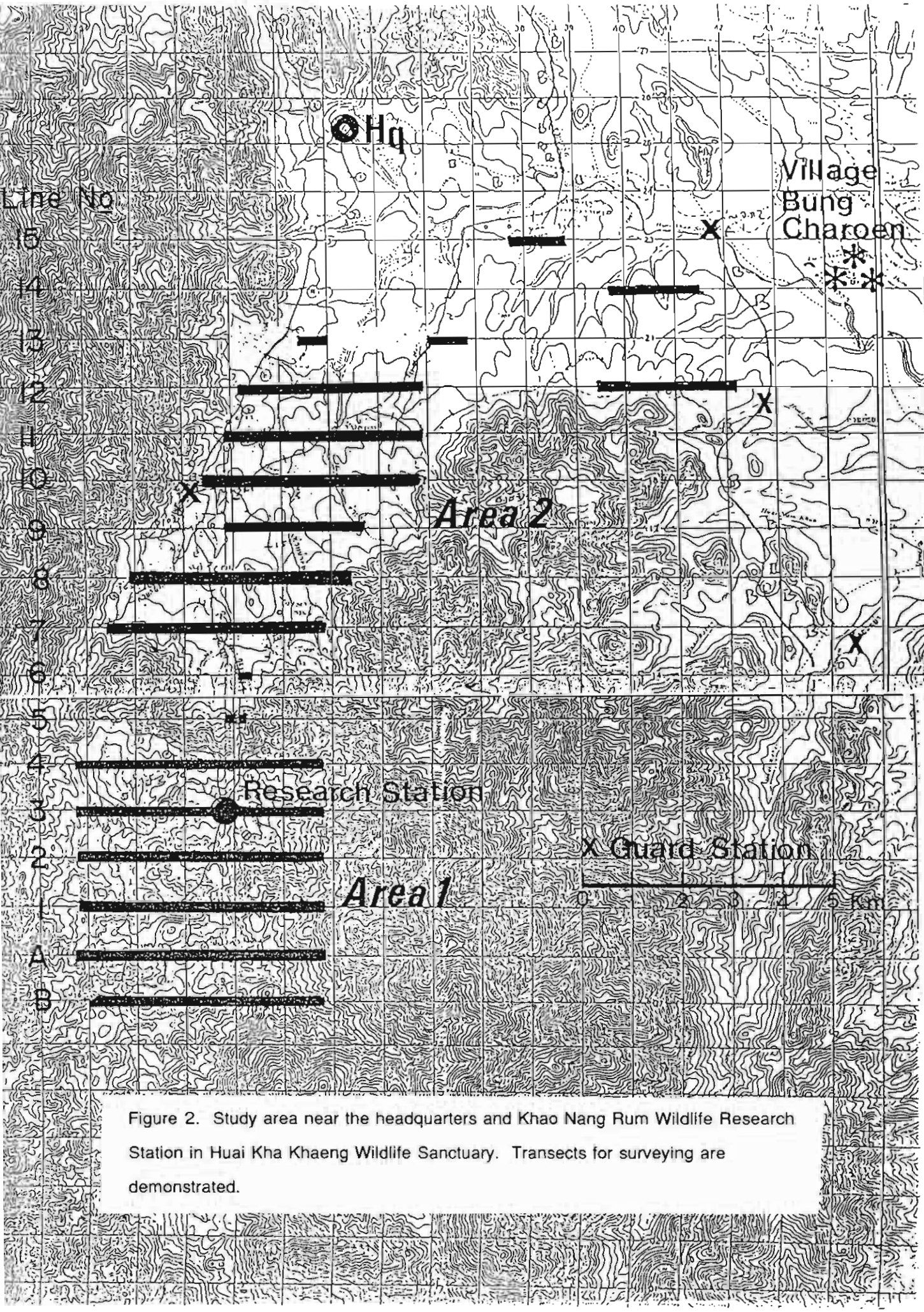


Figure 2. Study area near the headquarters and Khao Nang Rum Wildlife Research Station in Huai Kha Khaeng Wildlife Sanctuary. Transects for surveying are demonstrated.

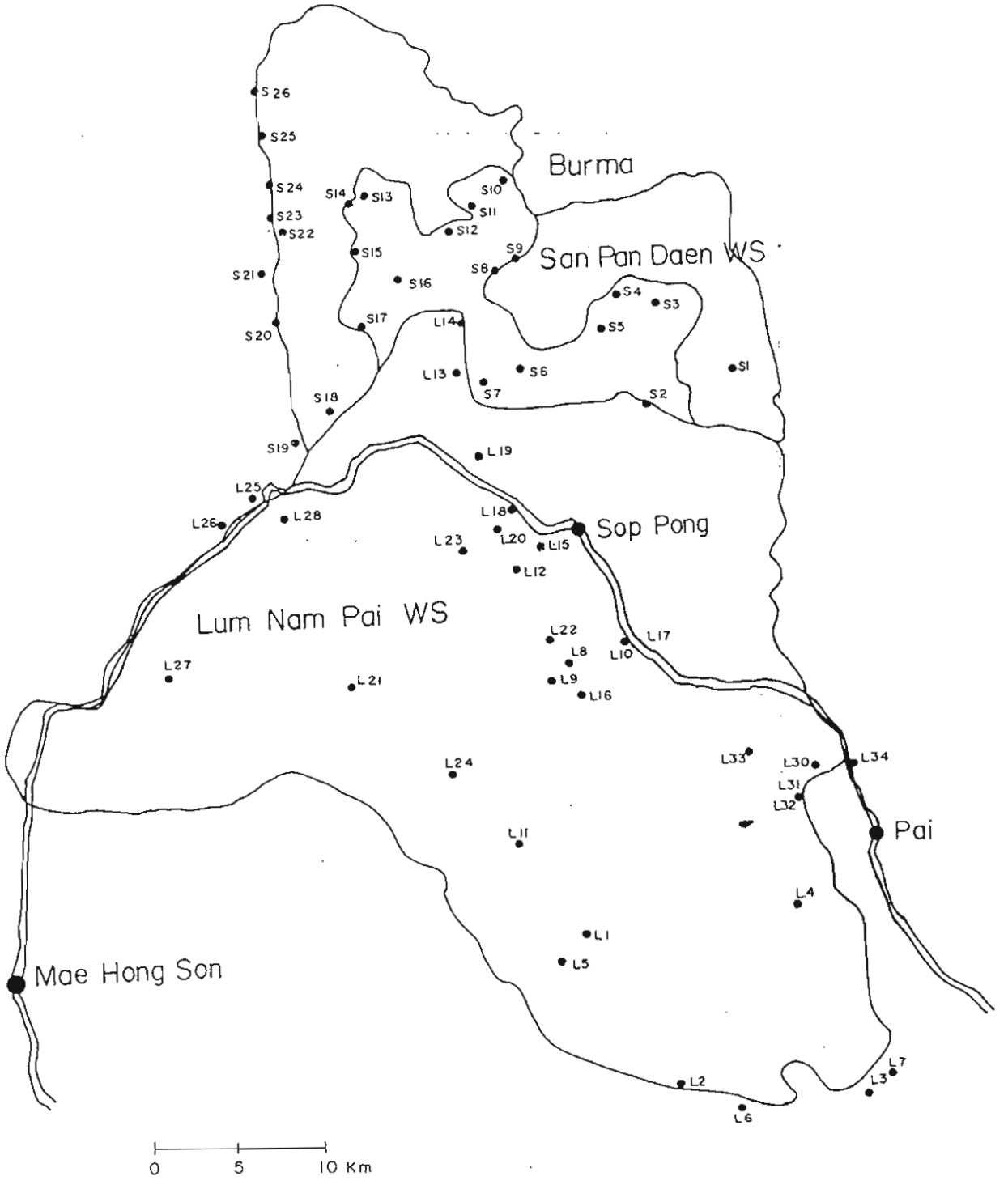


Figure 3. Villages in San Pan Daen WS and Lum Nam Pai WS where local people were interviewed. S1,S1,S3.....Sn and L1, L2, L3,...Ln are locations of villages in San Pan Daen WS and Lum Nam Pai WS, respectively.

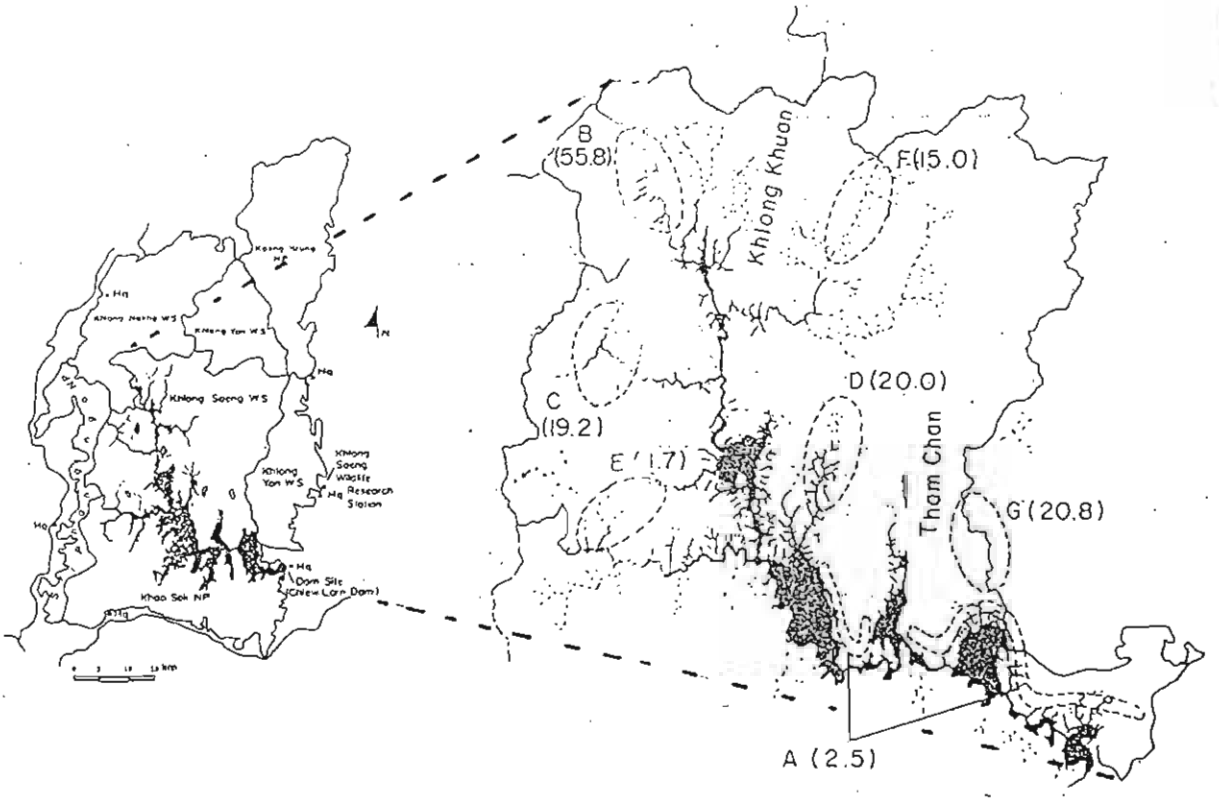


Figure 4. Seven areas in Khlong Saeng Wildlife Sanctuary that were surveyed to look at relative abundance of human signs and gaur tracks. A to G represent study sites. The numbers in brackets are per cent of 100 m-segment where gaur tracks were found. Khlong Khuan and Huai Tam Chan were areas where BHUMPAKPHAN (1997) did the study.

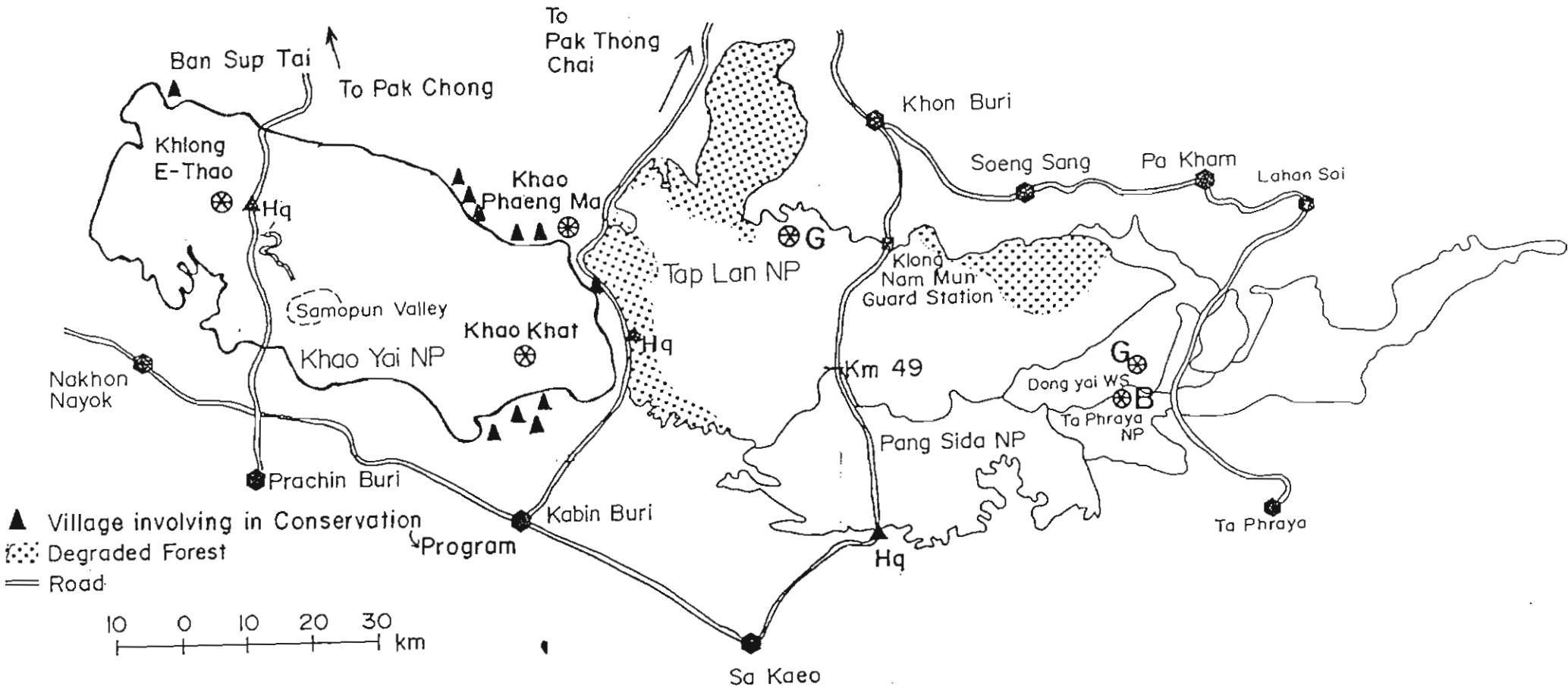


Figure 5. Protected areas in Khao Yai Forest Complex and some Important location mention in the text. Community involvement in Environmental Awareness and Development Program help the recovery of gaur population in Khao Yai NP. Viable populations were also found in Pang Sida NP and the area bordering among Pang Sida, Tap Lan NP, Dong Yai WS and Ta Phraya NP. There are few gaur left in Tap Lan NP. Banteng were found only in the area bordering between Dong Yai and Ta Phraya NP.

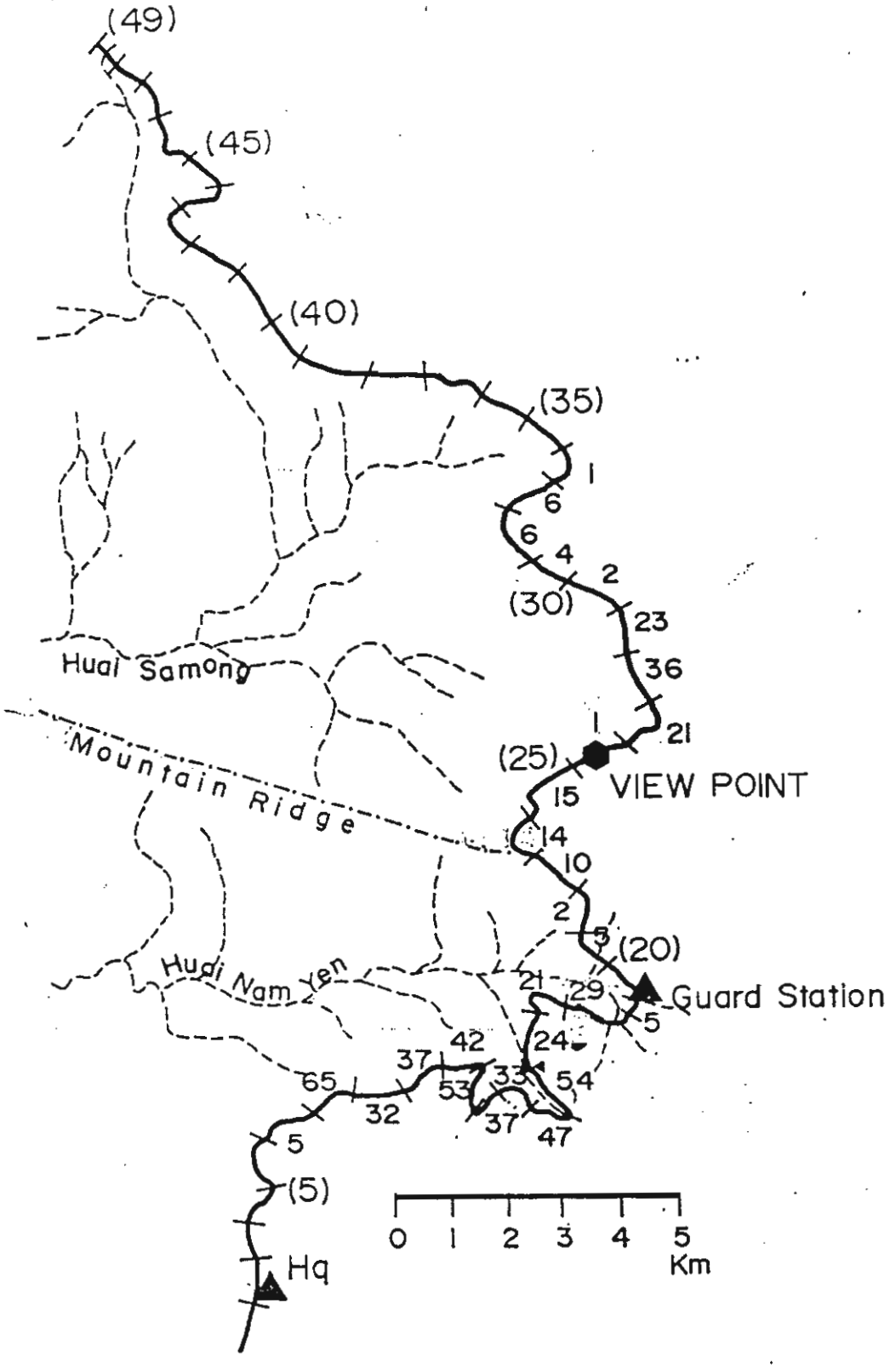


Figure 6. Distribution of dung of wild cattle in every kilometer along the road from the headquaters to km 49 in Pang Sida NP. The numbers in brackets are reference points in km. The numbers between km reference line are number of dung found.

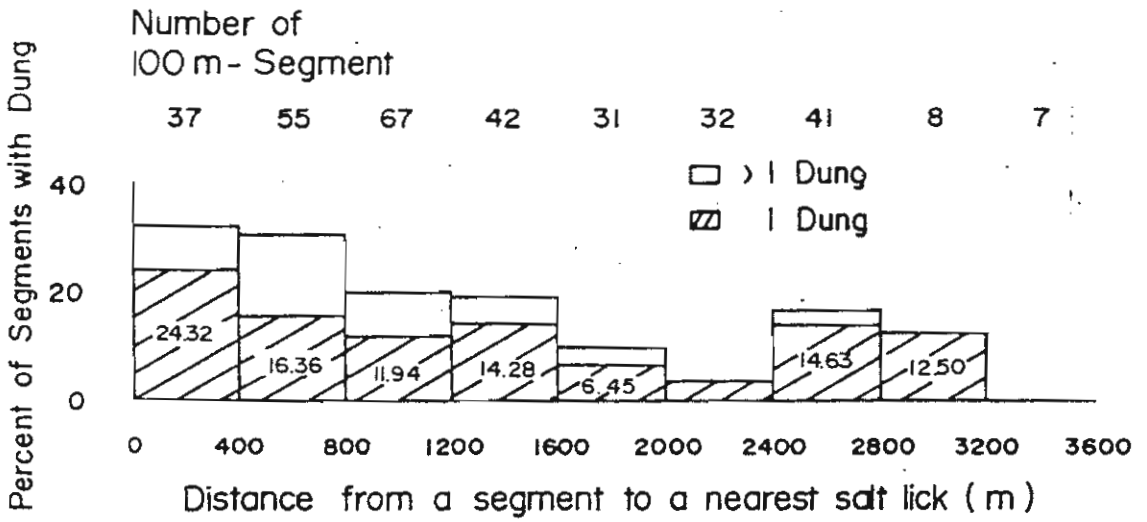


Figure 7. Per cent of transect segments with dung in relation to the distance from a segment to a nearest mineral lick.

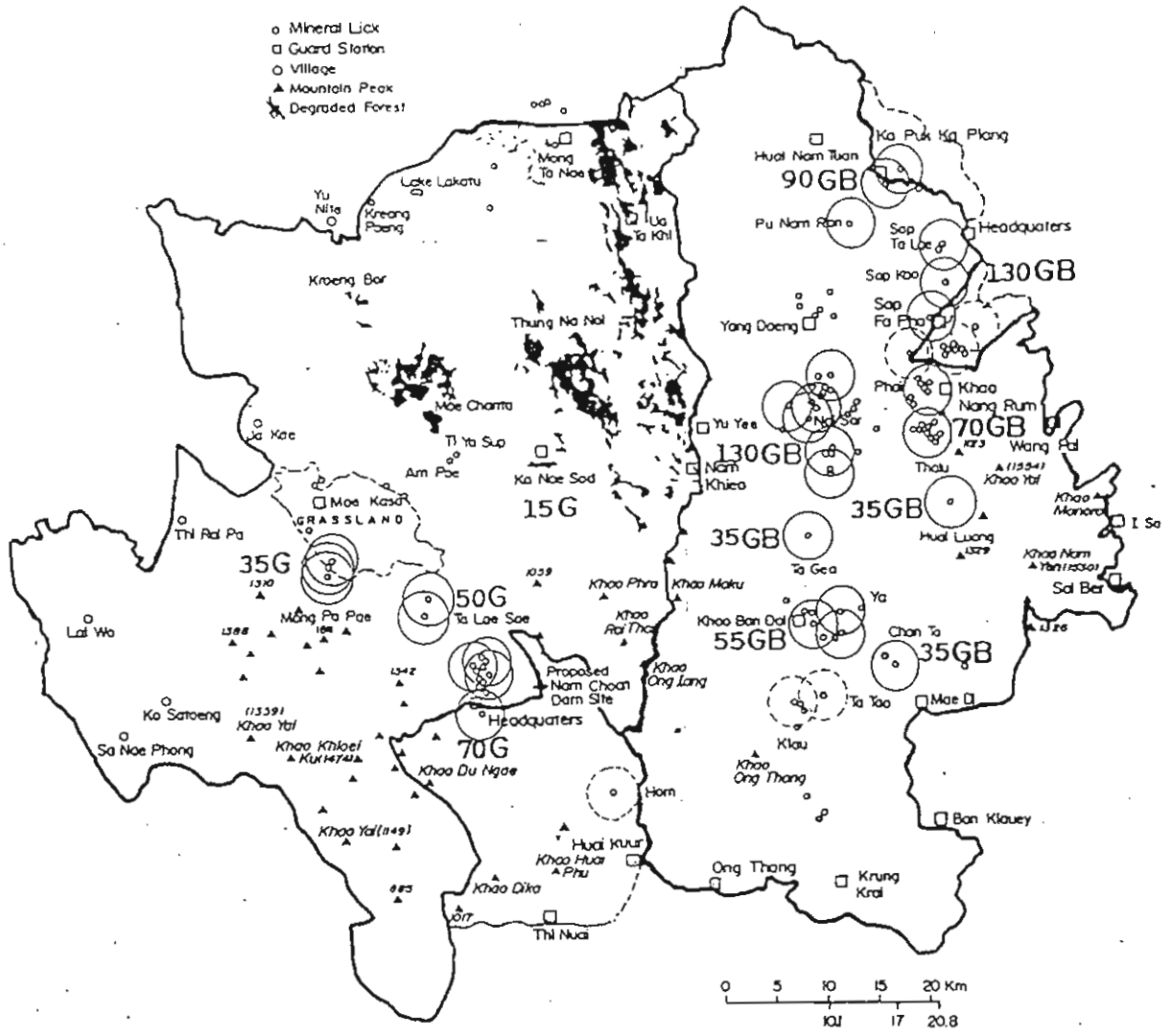


Figure 8. Distribution of populations of gaur and banteng in Thung Yai and Huai Kha Khaeng WS. The number in front of G and GB is the estimated number of gaur, and gaur and banteng combined. Area near Mong Ta Nae, Ua Ta Khi, Thung Na Noi, Ka Nae Sod and Nam Khieo in Thung Yai WS Eastern Wing were monitored by MANEERAT (1997) during Jan. 1995 and Dec. 1997.

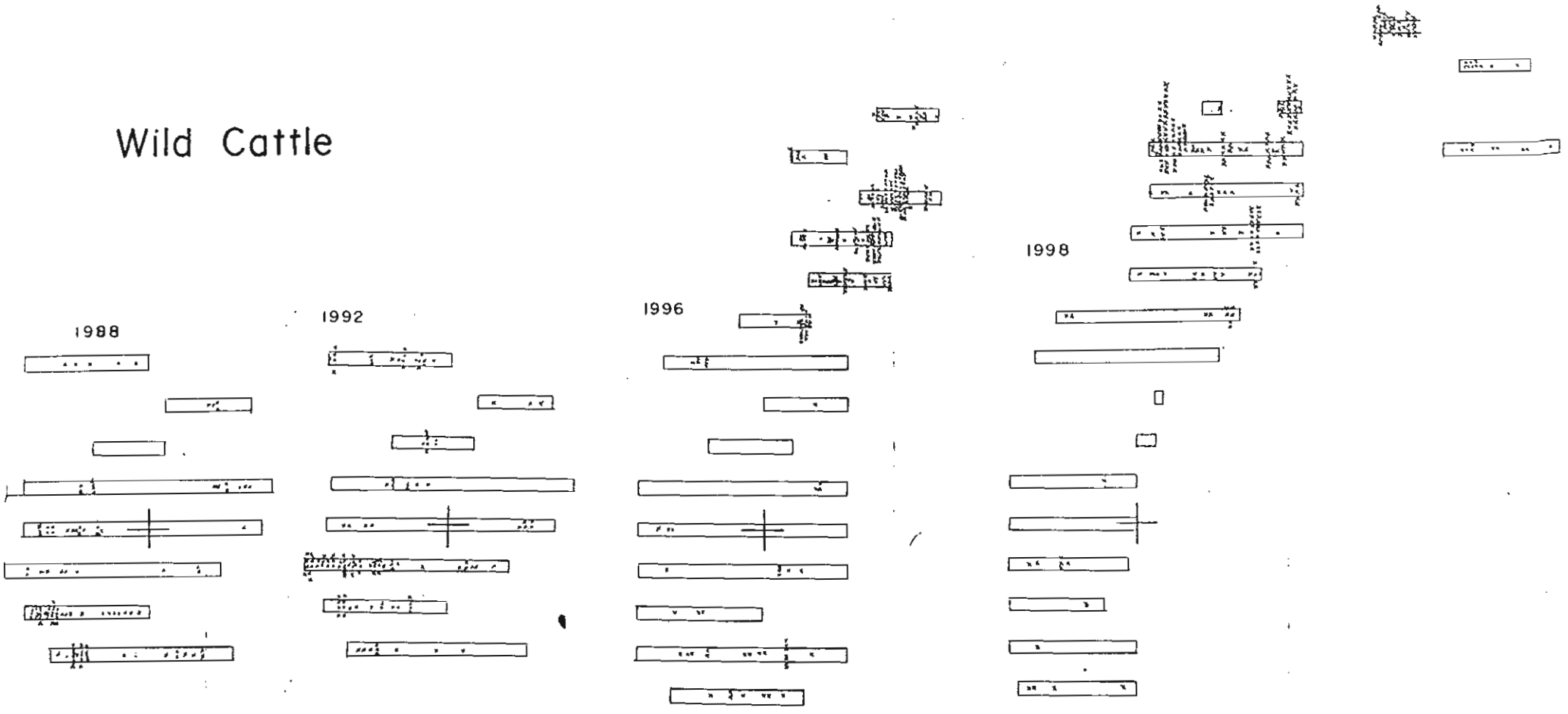


Figure 9. Distribution of wild cattle dung in a study area between Khao Nang Rum Wildlife Research Station in the northeastern side of Huai Kha Khaeng WS in 1988, 1992, 1996 and 1998. Dung are various in ages and they were possibly accumulated during the last four months before the survey. The estimate is based on the study by SRIKOSAMATARA (1993) and the study on dung deterioration rate by BHUMPAKPHAN (1997).

# Relative density and distribution of large herbivores in a formerly "compression area" of a dry tropical forest, western Thailand

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ABSTARCT. After poaching activities were relaxed, relative densities of large mammals in a "compression area" are decreasing and most large mammals move to nearby area. The population of small herbivores such as barking deer fluctuate from year to year more comparing with large herbivores such as gaur, banteng and sambar deer. This is because the small herbivores are small, solitary, less mobile so that they are predated more by their natural predators like tiger and leopard. Wild pig are good colonizing species in nearby area while elephant do not colonize this nearby area as the forest is dry and little water is available so that their requirements are not fulfilled.

KEY WORDS: Asian wildlife ecology, relative density, distribution, compression area, dry tropical forest, large herbivores, Huai Kha Khaeng Wildlife Sanctuary, Thailand

## INTRODUCTION

Wildlife ecology in Asia is special as it has been affected by high density of human population. In Asia, human activities affect so much on wildlife ecology even in an area that looks superficially natural. For example, destroying wildlife habitat push wildlife into a "compression area" so that their populations are high as shown in the case of elephant and other wildlife in India (Nair et al. 1977, Karanth and Sunquist 1992). Little is known about the effect of other human activities such as poaching on wildlife ecology. It is obvious that poaching will cause the wildlife population to decline and the human traffic itself will affect the distribution of animals (Griffith & van Schaik, 1993). In Asia, as conservation is getting better, there will be more and more areas where human activities such as poaching are removed. How wildlife respond to this situation is important for understanding wildlife ecology in Asia.

The purpose of this study is to examine the changes in the relative density and distribution of herbivores in an area where poaching activities used to be high. Due to a

stronger law enforcement so that there was little poaching activities, the relative densities and distributions of these herbivores were monitored to detect the pattern of changes.

## STUDY SITE AND METHODS

The study site was located near Khao Nang Rum Wildlife Research Station in Huai Kha Khaeng Wildlife Sanctuary where a study on the density and biomass of large herbivores were made in 1988 (Srikosamatara 1993). The study site can be divided into 2 areas (Figure 1). Area 1 is about 25 $km^2$ and can be called a "compression area" as it is near a research station where a certain level of anti-poaching activities happened in 1988 while the adjacent areas in the northeastern side (Area 2) were subjected to heavy poaching pressure in 1988. Strong law enforcement started in Area 2 in 1991 (Anon., 1990; Nakhasathien & Steward-Cox, 1990). Area 2 is about 40 $km^2$ and is lowland and very dry during the dry season. In both areas, four major forest types are found: dry deciduous dipterocarp forest, mixed deciduous forest, dry evergreen forest and hill evergreen forest (Srikosamatara, 1993). ← Figure 1

The study was done in 1988, 1992, 1996 and 1998. Line transect methods were used to estimate the dung density (Srikosamatara, 1993). The total length of the transects walked in each line and in each area can be seen in Table 1. Dung density were calculated by program ELEPHANT developed by Dawson & Dekker (1992). Density and biomass of each species of herbivores were calculated using the same data obtained in 1988 by Srikosamatara (1993) and were summerized in Table 2. ← Table 1 ← Table 2

Other concurrent studies in the same study site were done on ecology of gaur and banteng during 1994-1996 by Prayurasiddhi (1997) and Bhumpakphan (1997) and on carnivore ecology in 1987-1988 by Rabinowitz (1989) and Rabinowitz and Walker (1991) and in 1994-1998 by Simchareon (in progress).

## RESULTS

Using dung density as an indicator for population density, different species shows different pattern of density changes (Table 3). Densities of wild cattle change slightly while the densities of sambar deer increase slightly. Densities of barking deer vary a lot from year to year while the densities of wild pig and elephant are increasing.

When the study area are divided into two sub-areas. In Area 1, the densities of wild cattle are decreasing, the densities of sambar deer, barking deer vary from year to

year, and the densities of wild pig and elephant are increasing. In Area 2, the densities of all species, except barking deer, are increasing while the densities of barking deer vary a lot from year to year.

When converting the dung density to animal density and biomass for 3 species of herbivores (gaur and banteng, and sambar deer), the total biomass of these three species are more less constant (vary from 948, 938 and 835 kg $km^{-2}$ in 1988, 1996 and 1998 (Table 4 and 5). Their biomass were decreasing in Area 1 but increasing in Area 2..

← Table 4
← Table 5

When looking at the changes in distributions through time, wild cattle moved away from Area 1 and some of them used Area 2 more and more while the distribute of sambar deer in both areas more less equally (Table 6 and Fig. 2). Elephant still used the southwestern side of Area 1 while some started to use Area 2. Wild pig were found in the edge of Area 2 while very few barking deer were found in most area.

← Table 6
← Fig. 2a
2b
2c
2d
2e

## DISCUSSION

After poaching pressures were relaxed, most large herbivores move from the "compression area" to nearby areas. The changes in their densities varied from species to species. This depends on whether they are subjected to heavy predation by two large cats, tiger and leopard. Barking deer are major prey of both tiger and leopard (Rabinowitz 1989, Rabinowtz & Walker, 1991) so that their populations were heavily regulated. Other larger herbivores, e.g. wild cattle and sambar deer, are predated more when their densities are high which is similar to the situation in Royal Bardia National Park in Nepal (Stoen & Wegge, 1996). In 1995-1996, 2 gaur, one old elephant, 12 banteng and more than 20 sambar deer and many common barking deer were predated by tiger (Simcharoen, personal communication, Bhumpakphan 1997, Prayurasiddhi 1997).

As the densities of prey increase, the numbers of predator also increase but faster in this study. There was only one tiger in the study area in 1988-1989 (Rabinowitz 1989 ) but there were 6-8 in 1994-1996 (Simcharoen, personal communication, Bhumpakphan 1997). In 1988-1989, there were 4 leopard in the study site (Rabinowitz 1989) while there were at least 7 in 1994-1996 (Simcharoen, personal communication, Bhumpakphan 1997). The increasing in the number of leopard is not as high as the tiger as some leopard were also predated by tiger (Simcharoen, personal communication) which is also found in Royal Bardia National

Park in Nepal (Stoen & Wegge, 1996). The increasing in the number of predators may be transient as well (Karanth, 1997).

The constancy of the total biomass of three species of herbivores, gaur banteng and sambar deer, indicates the stability in multi-species assemblage of large herbivores which is similar to the study in East Africa (Prins & Douglas-Hamilton, 1990) These 3 species have great potential mobility and a capacity to form cohesive social group and contribute over 70% of the of the estimated herbivore biomass. The daily movement of gaur and banteng are about 1.0-5.7 km and 0.9-4.9 km and the gaur move about 0.6 km further than banteng on average (Prayurasiddhi, 1997). Gaur form a larger herd of up to 40 animals while the largest banteng herd is 30 (Prayurasiddhi, 1997). There is no good study of the group size of sambar deer in the study site but Varman and Sukumar (1993) reported the group size of 3.1-50 in India.

Even the density and biomass of herbivores in this area are a lot lower than in India like Nagarahole National Park (Karanth & Sunquist, 1992) but it may reflect natural density and biomass. This is because this study site is not under the strong human pressure as in Nagarahole. Other area in India like Mudumalai Sanctuary in Southern India (Varman & Sukumar, 1993) and Bandipur (Johnsingh, 1983) has lower density and biomass of large herbivores than Nagarahole but higher than this study site. The difference in the human pressure, micro-climate, natural vegetation, distribution of keystone resource like mineral lick, mammalian assemblage, and the predator-prey interaction influence the density and biomass of large mammals in an area (Fryxell & Sinclair, 1988; McNaughton, 1992) In Nagarahole, Mudumalai and Bandipur, mineral licks seem to influence very little on the distribution of large mammals, and a medium-sized deer weight about 45 kg and live in a large herd, axis deer (Axis axis Erxleben), contribute a major part of the ungulate biomass and they are the major prey of tiger (Karanth & Sunquist, 1992, 1995; Varman & Sukumar, 1993; Johnsingh, 1983, 1992). The other factor involving in prey selection is learning but the process is not well documented in tiger except in the case of man-eating tiger (Karanth, 1997). Gaur as the prey preference for tiger in Nagarahole may be exceptional as a result of learning process. In most area, prey abundance affects on the tiger food choice.

The rate of change in population density will depend on fecundity of different species but less sensitive than the adult survival rate (Gaillard, 1991). In ungulate, the multiplication rate is sensitive to adult survival rate and will increase with generation

time. Using the allomatric relationship between body size and generation time for population closed to the equilibrium level (Gaillard, 1991), the expected generation time of elephant (2700 kg), gaur (700 kg), banteng (500 kg), sambar deer (160 kg) and barking deer (20 kg) are 21.5, 14.5, 13.1, 9.4, 5.1 years. Due to predation, adult survival rate of barking deer is lower than other large mammals so that their multiplication rate is low in this study.

The movement of large herbivores from Area 1 may also due to the degradation of vegetation as the area were heavily overgrazed by the herbivores while the food in the nearby area are more plentiful. It may also due to the great traffics of human due to various research activities in Area 1 while there is less traffic in the nearby area where poaching activity used to be very high. The effect of human traffic on animal distribution have been demonstrated before by Griffith and van Schaik (1993).

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Table 1. The name, number and total distance of line transect walked in total area and each area in different year in the study site in Huai Kha Khaeng Wildlife Sanctuary. Line code can be seen in Figure 3, 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. Variable to convert dung density to animal density and biomass from Srikosamatara (1993).

| Species | Defecation Rate ( no. day$^{-1}$) | Age of Dung (day) | Body Weight per Unit of Animal Density (kg) |
|---|---|---|---|
| Wild Cattle | 9.5 | 100 | 450 |
| Sambar Deer | 12 | 68 | 134 |
| Elephant | 16 | 156 | 2088 |

Table 3. Dung density ($km^{-2}$) of different species of large herbivores in different areas.

| Year | Area 1 | | | | | Area 2 | | | | | Total | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wild Cattle | Sambar Deer | Barking Deer | Wild Pig | Elephant | Wild Cattle | Sambar Deer | Barking Deer | Wild Pig | Elephant | Wild Cattle | Sambar Deer | Barking Deer | Wild Pig | Elephant |
| 1988 | 1842 (0-3804) | 1469 (25-2912) | 712 (68-1356) | 0 | 220 (0-678) | 555 (0-2087) | 678 (0-3052) | 1385 (0-7315) | 273 (0-1207) | 132 (0-928) | 1541 (330-2752) | 1359 (328-2389) | 792 (0-1666) | 104 (0-302) | 199 (0-487) |
| 1992 | 871 (0-2062) | | | | | 2079 (0-5313) | | | | | 1154 (227-2081) | | | | |
| 1996 | 861 (34-1688) | 802 (195-1410) | 160 (0-596) | 0 | 129 (0-261) | 2520 (292-4748) | 3129 (809-5450) | 254 (31-478) | 190 (0-463) | 636 (121-1151) | 1336 (3-2668)) | 1869 (668-3070) | 165 (0-388) | 91 (0-230) | 368 (68-668) |
| 1998 | 96 (0-195) | 1248 (378-2119) | 770 (0-1992) | 119 (0-450) | 1847 (0-5883)) | 1683 (484-2882) | 2208 (705-3712) | 897 (0-2025) | 459 (0-1107) | 729 (27-1432) | 1137 (321-1953) | 1784 (758-2810) | 671 (0-1441) | 455 (0-1073) | 1007 (0-2256) |

Table 4. Density ($km^{-2}$) of different species of large herbivores in different areas.

| Year | Area 1 | | | Area 2 | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | Wild Cattle | Sambar Deer | Elephant | Wild Cattle | Sambar Deer | Elephant | Wild Cattle | Sambar Deer | Elephant |
| 1988 | 1.9 (0-4.0) | 1.8 (0-3.6) | 0.1 (0-0.3) | 0.6 (0-2.2) | 0.8 (0-3.7) | 0.1 (0-0.4) | 1.6 (0.3-2.9) | 1.7 (0.4-2.9) | 0.1 (0-0.2) |
| 1992 | 0.9 (0-2.2) | | | 2.2 (0-5.6) | | | 1.2 (0.2-2.2) | | |
| 1996 | 0.9 (0-1.8) | 1.0 (0.2-1.7) | 0.1 (0-0.1) | 2.7 (0.3-5.0) | 3.8 (1.0-6.7) | 0.3 (0-0.5) | 1.4 (0-2.8)) | 2.3 (0.8-3.8) | 0.1 (0-0.3) |
| 1998 | 0.1 (0-0.2) | 1.5 (0.5-2.6) | 0.7 (0-2.4)) | 1.8 (0.5-3.0) | 2.7 (0.9-4.5) | 0.3 (0-0.6) | 1.2 (0.3-2.1) | 2.2 (0.9-3.4) | 0.4 (0-0.9) |

Table 5. Biomass (kg $km^{-2}$) of wild cattle and sambar deerin different areas.

| Year | Area 1 | | | Area 2 | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | Wild Cattle | Sambar Deer | Total | Wild Cattle | Sambar Deer | Total | Wild Cattle | Sambar Deer | Total |
| 1988 | 855 (0-1800) | 241 (0-482) | 1096 (0-2282) | 270 (0-990) | 107 (0-496) | 377 (0-1486) | 720 (135-1305) | 228 (54-369) | 948 (189-1694) |
| 1992 | 405 (0-990) | | | 990 (0-2520) | | | 540 (90-990) | | |
| 1996 | 405 (0-810) | 134 (27-228) | 539 (27-1038) | 1215 (135-2250) | 509 (134-898) | 1724 (269-3148) | 630 (0-1260)) | 308 (107-509) | 938 (107-1769) |
| 1998 | 45 (0-90) | 201 (67-348) | 246 (67-438) | 810 (225-1350) | 362 (121-603) | 1172 (346-1953) | 540 (135-945) | 295 (121-456) | 835 (256-1401) |

Table 6. Number of dung found in each transect in 1988, 1992, 1996 and 1998. Transect line number B to 4 are in Area 1 while the transect line number 5 to 15 are in Area 2.

| Line | 1988 | | | | | | 1992 | | 1996 | | | | | | 1998 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Distance | Wild cattle | Sambar Deer | Barking Deer | Wild Pig | Elephant | Distance | Wild cattle | Distance | Wild cattle | Sambar Deer | Barking Deer | Wild Pig | Elephant | Distance | Wild cattle | Sambar Deer | Barking Deer | Wild Pig | Elephant |
| 15 | | | | | | | | | | | | | | | 1.125 | 43 | 3 | 7 | 4 | 0 |
| 14 | | | | | | | | | | | | | | | 1.700 | 10 | 0 | 9 | 3 | 0 |
| 13 | | | | | | | | | 1.300 | 19 | 0 | 1 | 0 | 0 | 1.025 | 29 | 3 | 1 | 20 | 0 |
| 12 | | | | | | | | | 1.325 | 9 | 0 | 0 | 0 | 0 | 6.475 | 106 | 15 | 2 | 21 | 0 |
| 11 | | | | | | | | | 2.000 | 98 | 1 | 1 | 0 | 5 | 3.650 | 27 | 46 | 3 | 5 | 7 |
| 10 | | | | | | | | | 2.400 | 70 | 1 | 2 | 5 | 5 | 4.120 | 31 | 3 | 1 | 1 | 3 |
| 9 | | | | | | | | | 2.000 | 43 | 6 | 1 | 1 | 14 | 3.160 | 19 | 33 | 5 | 0 | 20 |
| 8 | | | | | | | | | 1.400 | 26 | 14 | 3 | 5 | 2 | 4.400 | 10 | 43 | 1 | 1 | 5 |
| 7 | 3.000 | 5 | 9 | 2 | 2 | 2 | 3.000 | 22 | 4.400 | 7 | 20 | 1 | 1 | 19 | 4.400 | 0 | 5 | 0 | 0 | 9 |
| 6 | 2.000 | 4 | 0 | 0 | 4 | 1 | 1.730 | 3 | 2.000 | 1 | 14 | 1 | 0 | 23 | 0.200 | 0 | 0 | 0 | 0 | 0 |
| 5 | 1.750 | 0 | 0 | 11 | 0 | 0 | 2.000 | 9 | 2.000 | 0 | 9 | 1 | 0 | 2 | 0.450 | 0 | 0 | 0 | 0 | 0 |
| 4 | 6.000 | 13 | 7 | 4 | 0 | 1 | 5.900 | 8 | 5.000 | 3 | 10 | 0 | 0 | 7 | 3.000 | 3 | 3 | 0 | 2 | 1 |
| 3 | 5.650 | 18 | 15 | 6 | 2 | 0 | 5.600 | 9 | 5.000 | 3 | 3 | 0 | 0 | 3 | 3.000 | 0 | 12 | 0 | 0 | 4 |
| 2 | 5.150 | 10 | 9 | 3 | 0 | 28 | 5.000 | 57 | 5.000 | 6 | 8 | 0 | 1 | 5 | 2.775 | 6 | 6 | 1 | 0 | 2 |
| 1 | 3.000 | 36 | 1 | 6 | 0 | 0 | 3.000 | 19 | 3.000 | 3 | 4 | 1 | 0 | 1 | 2.200 | 1 | 3 | 0 | 0 | 0 |
| A | 4.400 | 27 | 1 | 3 | 0 | 6 | 4.350 | 9 | 5.000 | 16 | 1 | 6 | 0 | 0 | 3.000 | 1 | 4 | 1 | 0 | 5 |
| B | | | | | | | | | 3.200 | 7 | 6 | 0 | 0 | 7 | 2.800 | 4 | 3 | 0 | 0 | 81 |
| Total | 30.95 | 113 | 42 | 35 | 8 | 38 | 30.58 | 136 | 45.025 | 315 | 99 | 18 | 13 | 93 | 47.500 | 290 | 184 | 31 | 57 | 137 |

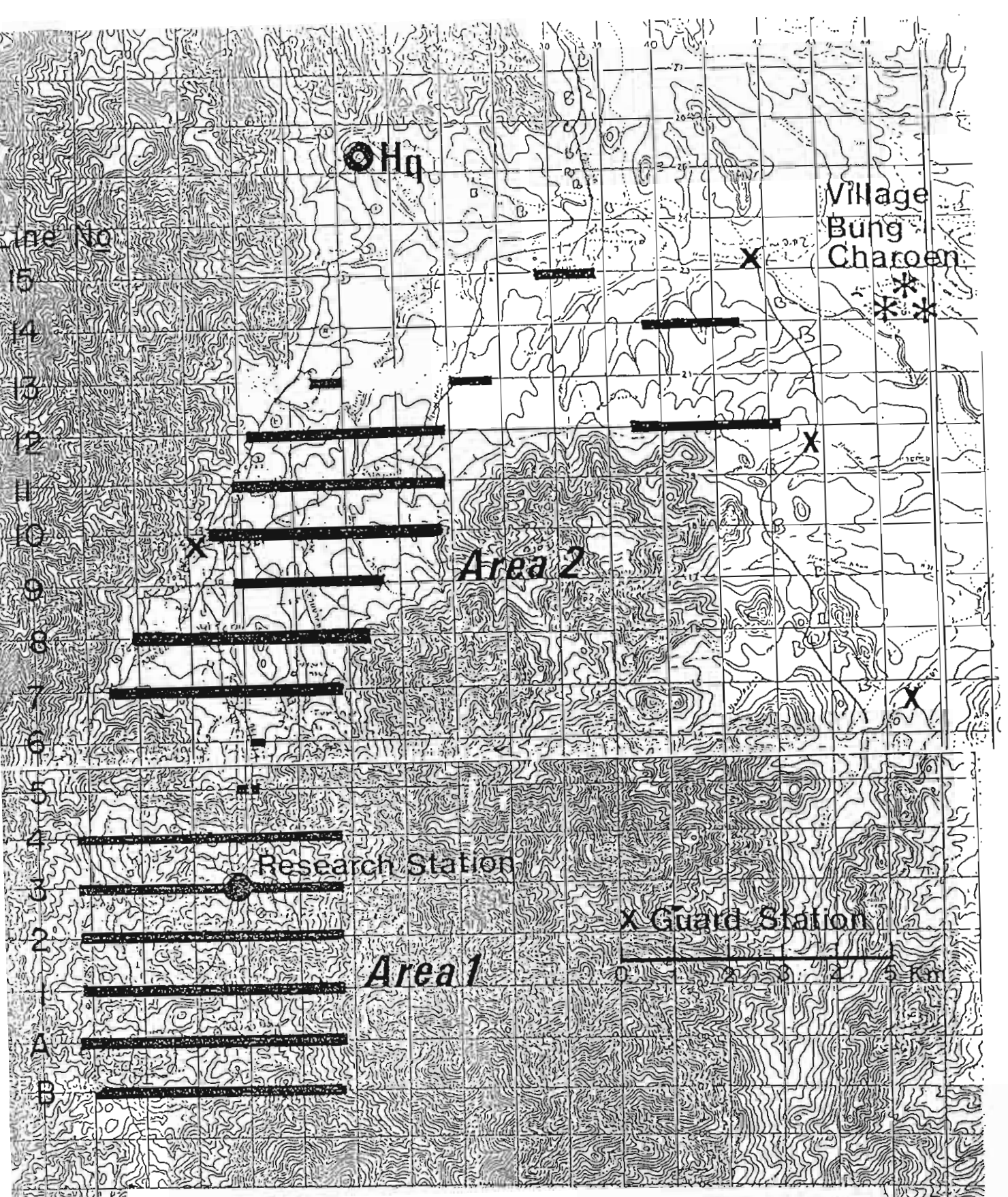


Figure 1. Study area near the headquaters and Khao Nang Rum Wildlife Research Station in Huai Kha Khaeng Widllife Sanctuary. Transects for surveying are demonstrated.

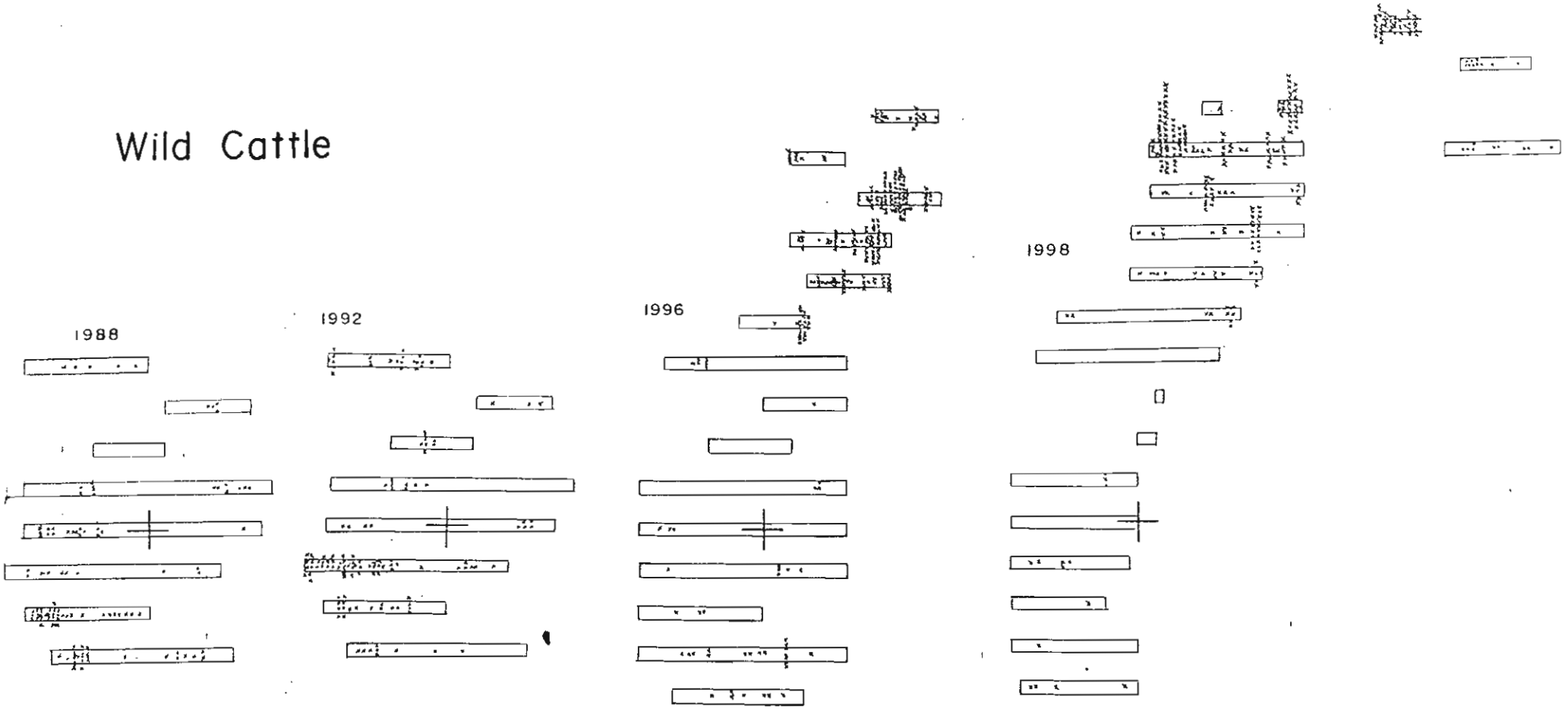


Figure 2a. Changes in the distribution of wild cattle (gaur and banteng combined) through time. Each crossing (X) represent a dung found in each location along the transect. Dung were possibly accumulated during the last four months before the survey. The big "+" sign indicate the location of Khao Nang Rum Wildlife Research Station.

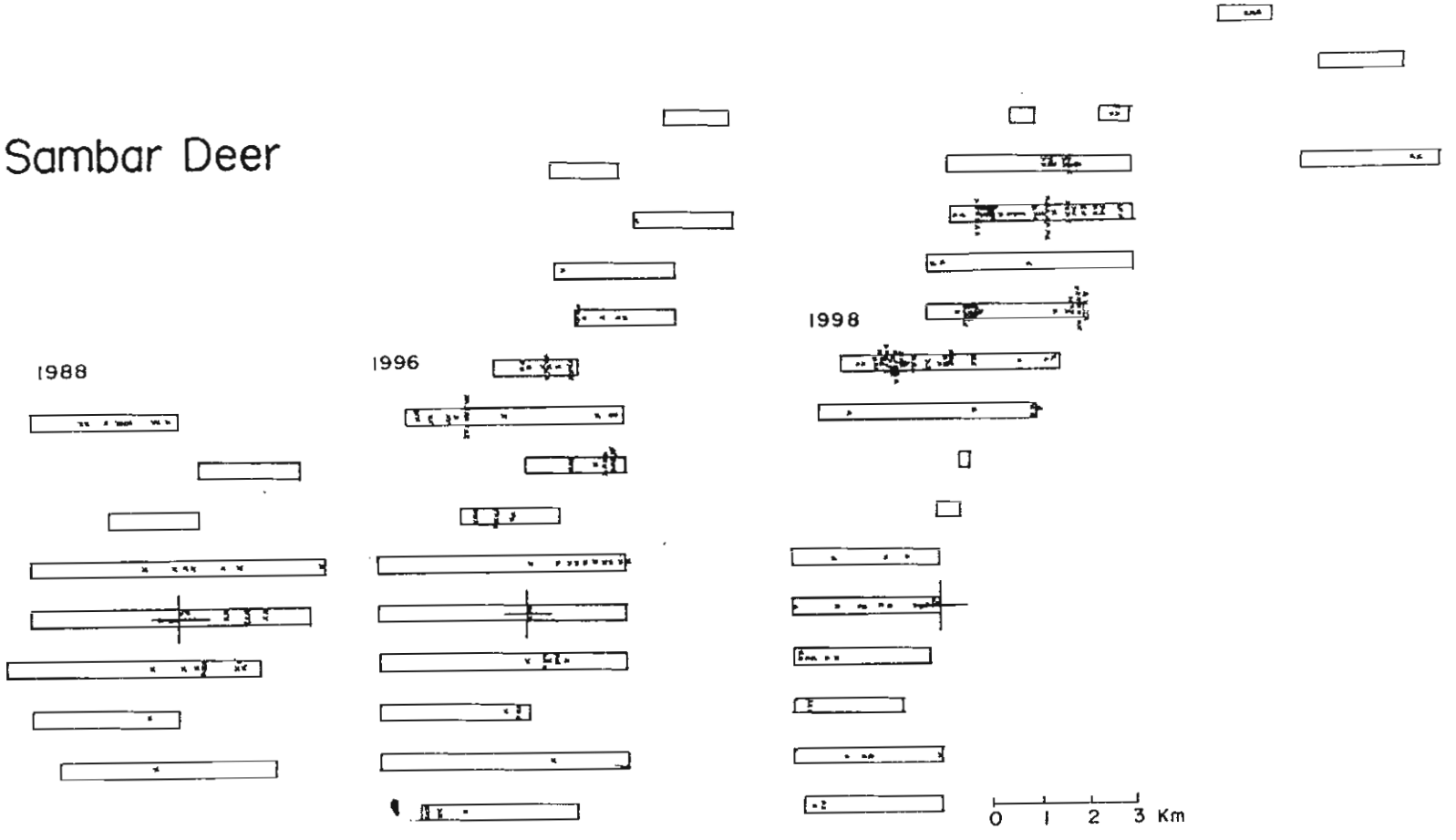


Figure 2b. Changes in the distribution of sambar deer through time. Each crossing (X) represent a dung found in each location along the transect. Dung were possibly accumulated during the last four months before the survey. The big "+" sign indicate the location of Khao Nang Rum Wildlife Research Station.

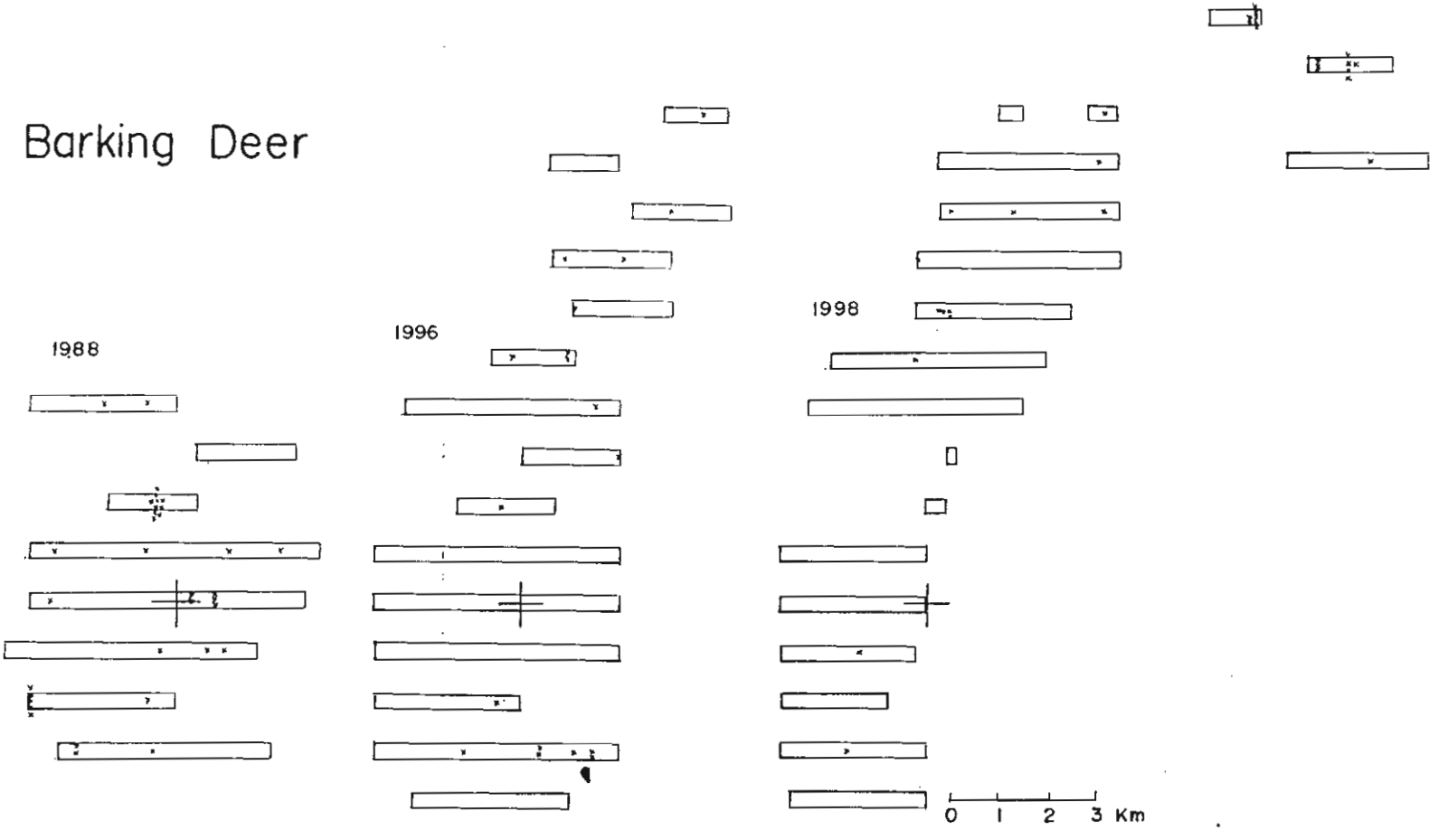


Figure 2c. Changes in the distribution of barking deer through time. Each crossing (X) represent a dung found in each location along the transect. Dung were possibly accumulated during the last four months before the survey. The big "+" sign indicate the location of Khao Nang Rum Wildlife Research Station.

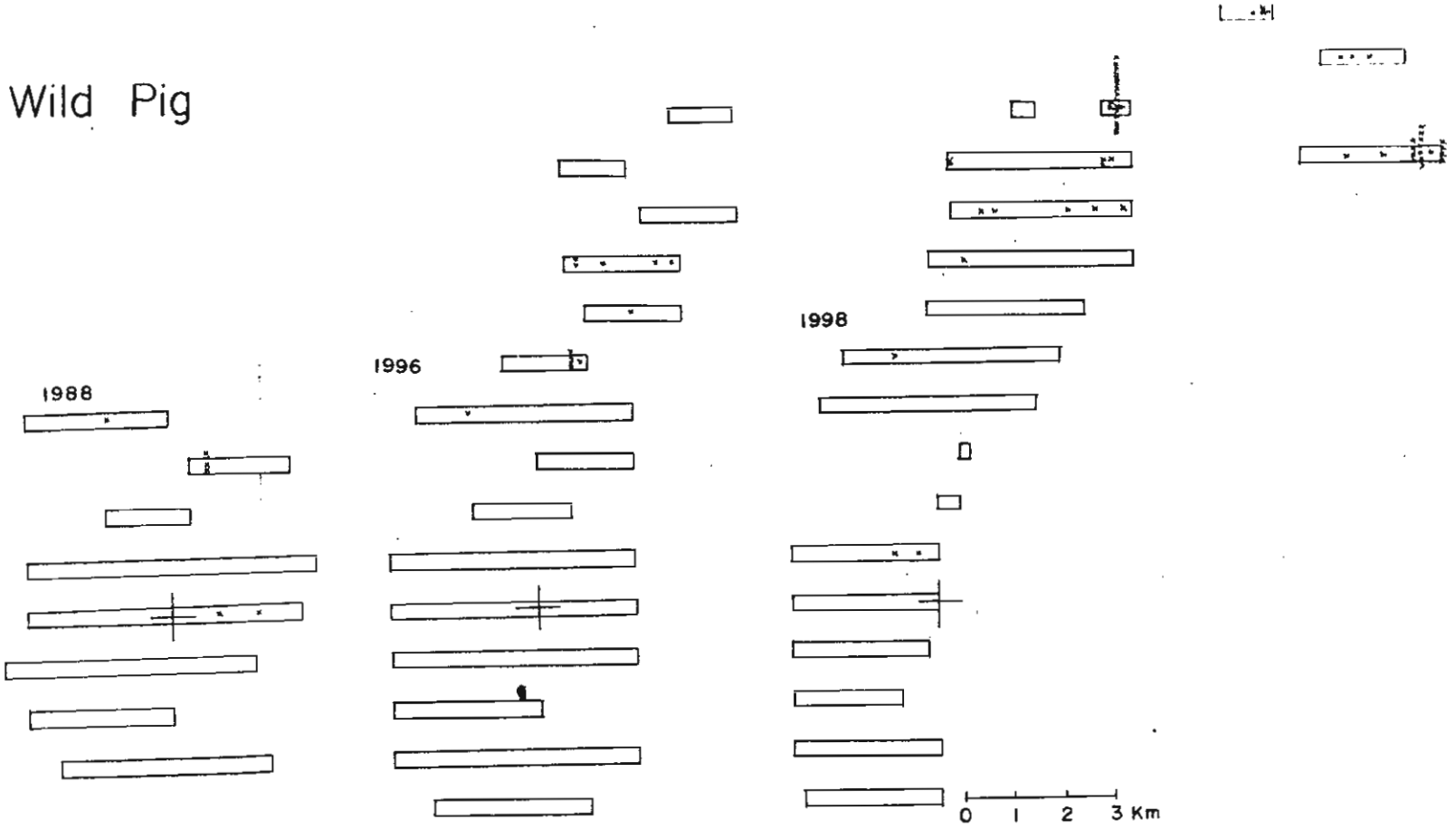


Figure 2d. Changes in the distribution of wild pig through time. Each crossing (X) represent a dung found in each location along the transect. Dung were possibly accumulated during the last four months before the survey. The big "+" sign indicate the location of Khao Nang Rum Wildlife Research Station.

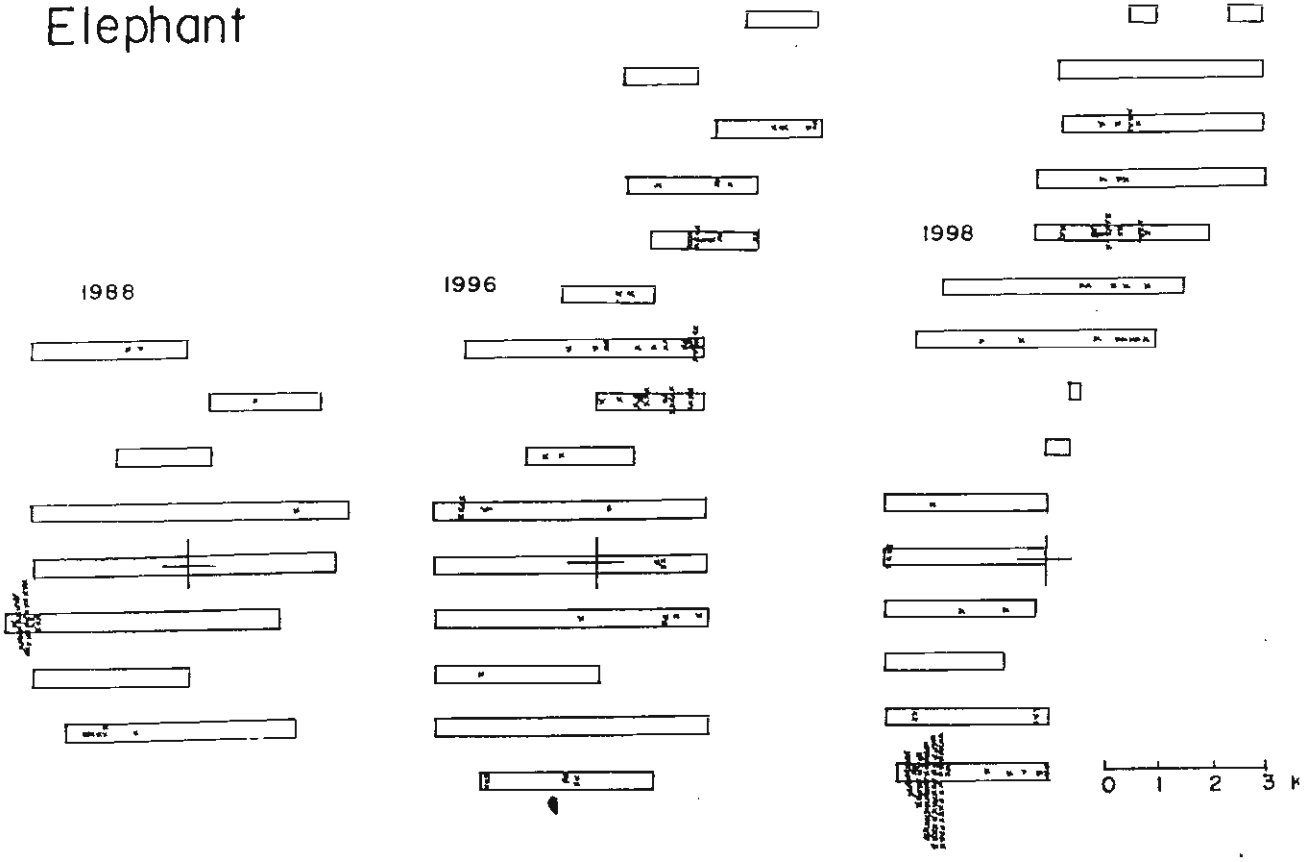


Figure 2e. Changes in the distribution of elephant through time. Each crossing (X) represent a dung found in each location along the transect. Dung were possibly accumulated during the last four months before the survey. The big "+" sign indicate the location of Khao Nang Rum Wildlife Research Station.

# COMMERCIAL USE OF WILDLIFE: AN IMPORTANT FACTOR FOR THE EXTINCTION OF DEER IN THAILAND

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## ABSTRACT

Although, commercial use of wildlife products has not been recognized as a major cause of wildlife depletion in Thailand, the historical record indicates the contrary. At least 4 million deer skins were commercially traded between Ayudhya and Japan during the 17th Century by the Dutch East India Company. Fewer deer skins were exported during the 18th Century but during the first half of the 19th Century, both deer skins and antlers were exported to China in large numbers. After the Bowring Treaty in 1855 until the 1940s, commercial trade of deer products continued between Bangkok and other European colonies in Asia through Chinese middleman. Some were also consumed locally as traditional medicine by Chinese immigrants, and some were collected as trophies following the western tradition. The deer skins and antlers traded were not separated according to species. This large-scale trade must have caused rapid declines of the deer populations in the lowland and intermontane areas and contributed to the extirpation of three species of deer in Thailand. The early wildlife conservation movement focused on the regulation of hunting so that regulations governing the commercial use of wildlife were not well developed. As a consequence, commercial uses of wildlife have contributed significantly to declines in populations even after 1960, when current wildlife regulations were implemented in Thailand. The above evidence helps support the argument that the introduction of markets for wildlife parts will jeopardize the effectiveness of wildlife conservation (GEIST, 1988 vs GRIGG, 1989).

## INTRODUCTION

One way of gaining evidence on whether the introduction of markets for wildlife parts will jeopardize wildlife conservation (GEIST, 1988 vs GRIGG, 1989) is to look at the historical record. This paper compiles available information on commercial use of deer skins documented since early Ayudhya period in the 17th Century in Thailand (formerly "Siam" until 1949). It possibly caused or influenced the extinction of three species of deer in Thailand, although the conservation impact of such use has not been recognized. Modern efforts in wildlife conservation, including implementation of wildlife law, therefore did not adequately deal with the commercial uses of wildlife. An attempt will be made to evaluate such uses as an important factor in the decimation of certain wildlife species, especially large deer. The last individual Schombergk's deer (*Cervus schomburgki*, Byth 1863), Eld's deer (*Cervus eldi*, McClelland 1842) and hog deer (*Cervus porcinus*, Zimmermann 1780) were reported in the 1930s, 1970s and about 1977, respectively (LEKAGUL & MCNEELY, 1977; BHUMPAKPHAN, 1997).

## COMMERCIAL USES OF DEER SKINS AND PRODUCTS

Table 1 summarizes available information on the commercial use of deer skins. The Japanese may have exported deer skins from Ayudhya since the 15th and 16th Centuries, as 58 Chinese junks sailed between Japan and Ayudhya during those times (ISHII & YOSHIKAWA, 1987). The Dutch East India Company was stationed in Ayudhya during 1608–1694 (SMITH, 1977). In the 17th Century, about 4 million deer skins were exported to Japan and most of them shipped by the Dutch East India Company (Table 1). In 1615, the Dutch East India Company hired a Chinese junk to carry 9,857 deer hides and other items from Ayudhya to Pattani before sending them to Japan (SMITH, 1977), while an English merchant also bought 8,260 deer skins for sale (RUANGSILP, 1984). In 1621, it was estimated that 300,000 deer skins could have been exported annually from Ayudhya to Japan (VAN NEUJEMRODE, 1871, cited in SMITH, 1977), although SMITH (1977) suspected that this number was an overestimate. It is unfortunate that there are no reliable records of the export of deer skins by the Japanese who lived in Ayudhya. One record suggested that 120,000 deer skins were exported by Japanese in 1613 (ISHII & YOSHIKAWA, 1987). As the Dutch East India Company stopped their business in Siam at the end of 17th Century, fewer deer skins were sent to Japan in 18th Century, the total amount being only about 28,540 (Table 1). Deer skins were used to make armor and tabi (two-toed socks), to

cover boxes, trunks and other items (SMITH, 1977), to make shields (BRUMMELHUIS, 1987), and to make cloth, gloves, gun bags, and lens cleaners (ISHII & YOSHIKAWA, 1987). Three grades of deer skins were recognized (SMITH, 1977) but with no species separation.

During the 18th century, Siam was at war with Burma most of the time so that the situation was not favorable for trade. There is scant information about the trade during this period (NUNN, 1922). Ayudhya as a commercial center was destroyed. Commercial uses of wildlife resources apparently ceased for about 100 years. This allowed wildlife populations, free from hunting, to recover.

When Thonburi became a capital, animal skins including deer skins were traded with the Dutch East India Company in Java in exchange for 6,000 guns in 1777 (RUANGSILP, 1979). When Bangkok became the capital in the 1780s, Thailand began to trade more with China, Singapore and Java, and many animal products were also exported. Although trade in hides was not well documented, the number of boats trading with China during the reigns of Rama I and II was very high. An annual fleet of 140 and 60-80 boats were recorded trading with China in 1822 and 1835 (TERWIEL, 1983). During 1833, 100,000 deer skins were exported. Deer skins were processed for use as mattresses and pillows (ROBERTS, 1837).

When Thailand signed the Bowring Treaty in 1855 and opened up the country to Western influence, commercial uses of wild animals continued. Early in 1857 it was noted that there was a remarkable influx of traders (TERWIEL, 1983). In 1856, there were 141 vessels, other than Chinese junks, trading with Bangkok, in 1857 there were 204, and in the following years this number gradually rose to some three to four hundred vessels (TERWIEL, 1983). In 1868, deer horns and tendons were still items for tax farming by Chinese appointed by the King (RUANGSILP, 1984; Bangkok Calendar, annually, 1868, p. 60). Many Chinese merchants also developed connections with Western traders and increasing became the compradors for western trading houses (HAMILTON & WATERS, 1997). During this period there were no good records on deer skins in trade, but the trade in animal horns, antlers and skins still continued. In 1871, very few deer skins were exported as deer populations were possibly declining (RUANGSILP, 1984; Siam Repository, V. 4, p. 187).

Since the mid 19th Century, deer products possibly were exported to European colonies where there were many Chinese, such as Penang, Singapore and Hong Kong,

and some may have been consumed by Chinese immigrants as traditional medicine in Thailand. In 1939, the British Empire took 40.65 percent of Thailand's total foreign trade, that of Hong Kong representing 4.86 per cent, Penang 14.54 percent, and Singapore 14.44 percent (THOMPSON, 1941). The Chinese have been the most prominent economic minority in Thailand for hundreds of years (HAMILTON & WATERS, 1997). There were an estimated 230,000, 300,000 and 792,000 Chinese in Siam in 1825, 1850 and 1910, respectively (SKINNER, 1957; WYATT, 1984). In a social sense, there were at least two Siams in 1910 (WYATT, 1984). There were also 451,500 Chinese immigrants during 1882–1917 and 655,800 in 1921–1950 (PHONGPAICHIT & BAKER, 1996). In 1932, Chinese comprised about 12.2% of the whole population of Thailand (WYATT, 1984). ZIMMERMAN (1931) and LANDON (1941) reported that old-fashioned Chinese medicine was common in Thailand in the 1930s and that tiger paws, snake skins, skeletons of strange-looking sea animals, and other unusual materials could be seen in these shops. During 1933–1937, GUEHLER, (1939) estimated that at least 75,000 deer skins were traded, so that at least 15,000 deer skins were traded annually. In one dry season, 3,000 skins of sambar deer and 10,000 skins of barking deer were handled at Kaeng Khoi, Saraburi Province, at the headwaters of the Pasak River, during the 30s and 40s. A total of 108,540 kg of deer horns was also exported during 1933–1937 (GUEHLER, 1939). THOMPSON (1941) mentioned that in the 1930s an alarming slaughter of barking deer took place in Peninsular Thailand by Chinese dealers. Bangkok was then believed to be the cheapest animal market in the world. Deer were also taken alive and sold in the plains by the highlanders in northern Thailand in 1912 (GRAHAM, 1912).

## HUNTING METHODS AND SOURCES OF DEER PRODUCTS

In 17th Century, deer were hunted during the rainy season in the central plain (O' KANE, 1972). Shah Sulaiman from Persia described a hunting crew of 100 people (O' KANE, 1972). Nets were set up near a group of deer and from the other direction riders and men on foot closed while shouting and making as much noise as possible. In the short time between dawn and noon, about 30 deer (possibly hog deer which they called "little short-foot") were caught (O' KANE, 1972). In early 19th Century very few guns were available in Thailand. For example, in 1844-1846, only 50 flint-lock guns were registered in Ayudhya (TERWIEL, 1989). Hunting methods in early 19th Century were probably similar to those used in the 17th Century. In the early 20th

Century, according to GRAHAM (1912), beasts of prey were trapped and shot in self defense and deer were hunted, especially when rising waters cut them off in the plains from their jungle retreats and rendered them comparatively easy prey to the hunters. LEKAGUL & MCNEELY (1977) also wrote that this method was used in the central plain of the Chao Phraya River in early 20th Century. They described that in the rainy season, when the plains were flooded, the deer had to seek refuge on small patches of raised ground above water. On such "island refuges," many species could be found, including Schomburgk's deer, hog deer and Eld'deer. The hunters would form a big party consisting of a number of men riding on water buffalos or in boats and surround an "island", and kill everything they could. The animals that escaped into the water would be chased down by men in canoes and clubbed or speared. Pictures of this hunting scene and another hunting tactic that the hunter put Schomburgk's deer antlers and hide himself in the grass so that the buck came to inspect and were killed by spears were demonstrated very nicely by LEKAGUL (1962). During the 1870s to the 1930s, large scale logging was conducted in northern Thailand (DE ' ATH, 1992; ANON, 1891a,b), large numbers of deer were possibly shot with high-quality rifles by Europeans and their Chinese counterparts who worked for the logging companies (CAMPBELL, 1935).

During the 17th Century, most deer skins were taken in central Thailand from places such as Poucelouk (Phitsanulok; GERVAISE, 1688) and Capheyn (Kamphaengphet; GERVAISE, 1688) and some in southern Thailand from Parathou (near Ban Dohn), Rion (Bion or Ban Dohn near Surat Thani) and Pattani, and eastern Thailand near Cambodia from Banae (possibly Ban Na, Nakhon Nayok) according to van Vliet in 1692 (VAN RAVENSWAAY, 1910). Some skins were given as tribute from nearby kingdoms, especially Lan Na (Chiang Mai), Lan Sang (Laos) and Lawaek (Cambodia).

There is no good information about the sources of deer skins and products in the 19 th century. As the economy of Thailand in this period could be described as export-oriented and expansive (TERWIEL, 1989), deer products would have been obtained not only in nearby central Thailand but from nearby kingdoms such as Chiang Mai, Laos and Cambodia. Wildlife products in Central Thailand were taken along the river and by ground transport as far as Kamphangphet, Pichit, Nakhon Sawan and Phetcahbun in the north, Kabinburi and Aranyaprathet in the east, Thung Yai or Trat and Chantaburi in the southeast, Phetchaburi and Ratchaburi in the southwest, and Sangklaburi, Si Sawat and Kanchanaburi in the west and northwest. Hides and leather ropes were reported to be

sent from Ratchaburi, Kanchanaburi and Suphan Buri for the royal cremation of King Rama I in 1810.

After the Bowring Treaty in the mid 19th Century, more deer products were obtained not only from central Thailand as a result of large-scale canal construction, but possibly also from northern Thailand as more areas were accessed by logging companies. The 1920s and 1930s was a great period of railway construction, and central Thailand became connected to the north, northeast, east and southern Thailand. Kaeng Khoi, Saraburi was a trading center for deer skins and products from north and northeast Thailand in the 1930s and 1940s (GUEHLER, 1939). THOMPSON (1941) mentioned several hunting locations in Southern Thailand in the 30s.

## DISCUSSION

The existing reports on commercial uses of deer skins appear to be just "the tip of the iceberg" when we consider the whole picture. Even with the small amount of information available, there is still no doubt that the volume of trade was very high indeed. It is highly likely that this astonishingly high commercial exploitation contributed to the rapid decline of deer populations in Thailand.

Undoubtedly, the extirpation of these deer was not solely the result of commercial uses of deer-skin. Since 1855, the large-scale conversion of wild lands to rice fields accelerated rapidly. The first stages of habitat conversion occurred in the lowlands of the Chao Phraya River, and along the main rivers in inter-mountain areas throughout Thailand (TAKAYA, 1987). These lowland areas are the main habitat for these deer. Schombergk's deer prefer swampy areas, hog deer prefer low-lying grassland, while Eld 's deer prefer open dry deciduous forest (LEKAGUL & MCNEELY, 1977; DHUNGEL & O' GARA, 1991). Introduction of railways also opened new areas for exploitation hitherto left undisturbed, introducing migrant populations from other parts of the country (TAKAYA, 1987; THOMPSON, 1941).

The data indicate that wildlife resources in Thailand have been over-exploited for at least the past 200 years. Not only Schomburgk's deer but also Eld's deer and hog deer might have been hunted out since the 1930s or 1940s.

The influence on the commercial use of deer skins and products on the decline of deer populations in Thailand has become obvious. The trade in deer skins and products

was monopolized by the royal court until 1855, when the trade were released to commoners who traded wildlife products through Chinese merchants. In the early 1900 s, there was concern about the disappearance of deer, and some suggestions were made to solve this problem. For example, AMBROSE (1904) suggested that efforts be made to preserve deer in the interior far away from the Chao Phraya basin and its tributaries. Other suggestions were to prevent wildlife over-utilization by regulating it like sport hunting, and establishing a hunting season (ANON., 1928; LEKAGUL, 1959; SAMABHUDDHI, 1963), or by permitting only subsistence use (ANON, 1928). As commercial use of wildlife has a different character and scale, it requires a different type of regulation. Rules and regulations on sport hunting and subsistence use did not have enough effect to allow wildlife populations to recover.

ROBINSON & REDFORD (1991) recognized five categories of wildlife use: subsistence use, local market uses, wildlife farming and ranching, sport hunting, and commercial uses. Subsistence use where people hunt wildlife for their own consumption. Local market uses happen when wildlife is exploited for sale in local markets and the capital investment is low. Sport hunting or hunting for recreation dominates the Western approach to wildlife management. Commercial uses are large in scale involve external markets and require a higher investment than local market uses. The King of Siam was the chief merchant of the country until King Rama III's time (NUNN, 1922). When the trade was extended to the common people, the commercial development of Siam was in the hands of Chinese immigrants (ZIMMERMAN, 1931; ANDREWS, 1935; LANDON, 1941; CUSHMAN, 1989; HAMILTON AND WATERS, 1997).

The first wildlife law in Thailand, the Wild Animal Reservation and Protection Act of 1960, did not have enough rules and regulations controlling commercial use of wildlife, but followed the examples of laws used in Europe and America (LEKAGUL, 1959) which largely governed sport hunting. As a result, the commercial use of wildlife kept increasing into the 1970s (RYHINER & MANNIX, 1958; WINSTON & WINSTON, 1959; TREFFLICH & ANTHONY, 1967; LENG-EE, 1974; DOMALAIN, 1977a,b). Wildlife law in Thailand not only failed to regulate commercial uses of wildlife at the national level, but also did nothing to control illegal international wildlife trade. In 1991, the commercial export of wildlife from Thailand became so high that members of the Conventional on International Trade in Endangered Species of Wild Fauna and Flora (CITES) voted sanctions to ban all trade in wildlife products with Thailand for a year. The wildlife law was updated in 1992.

Commercial use of wildlife and deer hunting by rounding up herds were significant factors contributing to the decline of wildlife populations in Thailand at least since the 17 th Century. These factors were just realized by the Western countries in the 1960s when international conservation authorities set up the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 1973 (KING, 1974). The long history of commercial use of deer skins and other wildlife products in Thailand demonstrates the importance of socio-economic, cultural, and political factors which are different from those affecting wildlife conservation in Western countries, especially in the U.S. and Europe. In Germany, where hunting rights were given to the farmers for the first time since the revolution of 1848, all game were nearly decimated so that new rules were set up to stop total destruction (SCHWENK, 1991).

Schomburgk's deer is one of the clearest examples of extinction out of 46 species of deer which have become extinct in the world in modern times. Pere David's deer (*Elaphurus davidianus*, Milne-Edwards, 1866) in Northeast China became extinct in the wild, but thriving populations still exist in captivity. At present there are four endangered and seven vulnerable species of deer in the world (IUCN, 1996). The extirpation of three species of deer in Thailand is quite remarkable. Many species of deer are abundant in spite of high hunting pressure. For example, deer populations distributed throughout Europe and North America total about 40 million (GILL, 1990). Since 1900, all species of deer in Europe and North America, with the probable exception of the North American caribou, have increased in numbers even though about 6.5 million deer are harvested per year (GILL, 1990).

The commercial use of deer skins may also cause the extirpation of Formosan sika deer (*Cervus nippon taiouanus*, Blyth 1860). During the 25 years of 1635-1659, a total of 1,621,228 deer skins or about 65,000 skins per year were known to be imported to Japan from Formosa by the Dutch East India Company (HOLLMANN). Even after the Dutch were driven from Formosa, about 50,000 deer skins were taxed annually by the Chinese General during 1661-1683 (PATEL & LIN, 1989) and they were also hunted during the Japanese occupations during 1895 and 1945 (HSU & AGORAMOORTHY, 1997). Althoough the skins could have been any of the three species of deer in Taiwan, Formosan Reeve's muntjac (*Muntiacus reevesi micrurus* Sclater 1875), Formosan sambar deer (*Cervus unicolor swinhoei* Sclater 1862), or the Formosan sika deer, the sika deer are most easily hunted as they live in more open habitat than sambar deer. Since the late 1960s, Formosan sika deer have been

extirpated from Taiwan due to intensive hunting and expansion of agriculture (McCULLOUGH, 1974).

Other examples of commercial uses of deer skins on a large scale can be found in South America. Between 1860 and 1879 over 2 million Pampas deer (*Ozotoceros bezoarticus*) skins were exported from Argentina (JACKSON & LANGGUTH, 1987; cited by REDFORD & ROBINSON, 1991). In 1996, the Pampas deer (*O. bezoarticus celer*) in Argentina was classified as internationally endangered (IUCN, 1996).


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Table 1. Numbers of deer skins (pieces), or pairs of deer horns (*) exported from Thailand.

| Year(A.D.) | Volume of trade (deer skins or horns) | Country or City imported | Reference |
|---|---|---|---|
| 1613 | 120,000 | Japan | ISHII & YOSHIKAWA (1987) |
| 1615 | 18,117 | Japan | SMITH (1977); RUANGSILP (1984) |
| 1617 | 9,000 | Japan | ANDERSON (1890); NUNN (1922) |
| 1621 | <300,000 | Japan | SMITH (1977) |
| 1622 | 32,930 | Japan | NEGOTIE JOURNAL NFJ 829 |
| 1624 | 47,730 | Japan | NEGOTIE JOURNAL NFJ 829 |
| 1625 | 62,874 | Japan | NEGOTIE JOURNAL NFJ 830 |
| 1627 | 97,875 | Japan | NEGOTIE JOURNAL NFJ 831 |
| 1633-63 | 1,970,124 | Japan | SMITH (1977) |
| 1664-94 | 1,453,000 | Japan | SMITH (1977) |
| 1712 | >11,260 | Japan | ISHII & YOSHIKAWA (1987) |
| 1745 | 2,094 | Japan | NAGAZUMI |
| 1747 | 5,230 | Japan | NAGAZUMI |
| 1751 | 656 | Japan | NAGAZUMI |
| 1756 | 9,300 | Japan | NAGAZUMI |
| 1833 | 100,000 | China | ROBERTS (1837) |
| 1850 | 30,000* | China | NUNN (1922) |
| 1892 | 13,424 | Penang, Singapore and Hong Kong | NUNN (1922) |
| 1901 | 15,952 | Penang, Singapore and Hong Kong | NUNN (1922) |
| 1919-20 | 215,658 | Penang, Singapore and Hong Kong | NUNN (1922) |
| 1933-1937 | >75,000 | Penang, Singapore and Hong Kong | GUEHLER (1939); THOMPSON (1941) |

Note: Information extracted from Negotie Journal were kindly done by Dr. Yoko Nagazumi. Negotie Journal is a daily record of transactions of the Dutch factory in Hirado and Nagasaki. Hog deer, Eld's deer and Schombergk's deer were described in 1780, 1842, and 1863, respectively and were extirpated from Thailand in 1977, 1970s, and 1930s, respectively. Ayudhya periods were between 1351-1767, Thonburi period were between 1767-1782, Bangkok period began 1782. The Bowring Treaty was on 1855.