NATIONAL STATUS SURVEY FOR TIGERS IN CAMBODIA

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Introduction

Status surveys for the tiger in Cambodia were recommended as a high priority project in the Cat Specialist Group's Cat Action Plan (Nowell and Jackson 1996). Cambodia has some of the most extensive and unfragmented stretches of forest in Asia, with forest cover estimated at close to 70% in the early 1990s (UNEP 1995), high compared to neighbors Thailand (21%), Vietnam (18%) and even Laos (54%) (Collins et al. 1991). Much of the country is designated as Level I (top priority) by a joint WWF/WCS tiger habitat ranking exercise (Dinerstein et al. 1997). Cambodia clearly has the potential to support a significant national tiger population. However, as emphasized by Rabinowitz (1999) in his review of information on the status of the tiger in Indochina, "despite the extensive remaining forest cover, we know almost nothing about tiger distribution in Cambodia." Three decades of conflict have kept most of the country off-limits to the conservation community. Known threats to the tiger in the 1990s included widespread illegal logging (Global Witness 1997, DAI 1998) and widespread trade in tiger parts (Martin and Phipps 1996). Cambodian forestry officials have estimated the population at 100-200 tigers (Jackson 1997) and 150-300 (Smith et al. 1995, in Jackson 1998). However, in the government's draft national tiger action plan it is estimated that 100-200 tigers were being traded each year in the markets in Phnom Penh and Poipet (MOE 1996). The thriving trade indicates that tigers are still sufficiently numerous in Cambodia to supply it, but under such pressures time is running out.

In 1998, CAT – Cat Action Treasury organized a national survey of hunters to gather information on tiger distribution and develop a more quantitative basis for evaluating tiger status in the country. The survey estimates tiger and and other large mammal distribution and abundance based on information from hunters (Weiler et al. 1998, Duckworth and Hedges 1998). Here we present preliminary data on the geographic distribution of tigers in Cambodia (or first order habitat selection [Miquelle et al. 1999]), and make a rough estimate of potential tiger numbers. A more in-depth analysis is in preparation.

Methodology

From January to March 1998, CAT cooperated with the Wildlife Protection Office of Cambodia's Ministry of Agriculture and Forestry to interview local hunters around the country about the status of the tiger and other large mammals. The interviews were conducted by a team of five graduates of the forestry program at the Royal Agricultural College in Phnom Penh (the five have since been hired by the Ministry of Forestry). The students had done undergraduate theses on wildlife utilization in Cambodia, and were experienced at interviewing and working with local hunters in different regions of the country. The team interviewed 153 hunters in 35 districts (100 villages in 13 provinces), areas selected from maps as having good forest cover and low human populations. The team brought back information on wildlife from parts of Cambodia never before visited by biologists.

The interview questionnaire had three parts. The first part listed 29 large mammal and 6 avian species and, if a species was indicated by the hunter as present in his area, he was asked to rank its abundance as High, Medium, or Low. Photographs were used to identify species, but no ranking guidelines were given. The second part asked the hunter questions about his forest experience, to help us judge the quality of the wildlife status information and to develop a profile of Cambodian hunters.

The third part asked specific questions about tigers. Informants were asked how many times they had seen tigers, their tracks or their kills, and the most recent time tiger was seen. They were asked about incidents of livestock predation or man-eating. We asked them to estimate the number of tigers living in the areas where they hunt, and had them describe their hunting areas and outline the boundaries on local maps. We

asked if they knew how many tigers had been killed in their area in the last year, the number of people who hunt tigers, and for information on tiger trade, including prices and market destinations. Despite the sensitivity of these issues (hunting of tigers has been illegal in Cambodia since 1994), most hunters were open about their activities: a hunter from the Cardamom Mountains region took the interviewer into the forest with him and allowed him to photograph the carcass of a tiger he had shot. Interviewees were provided with small cash and food gifts for their time and trouble.

To determine distribution of tigers we digitized the individual hunting territory maps sketched out during the interviews. We extrapolated hunter reports of tiger occurrence to a larger area to include remote areas of habitat which were not reached by the interview survey. This larger area was based on forest cover maps developed by IUCN liaison officer David Ashwell (1997). He delineated forest areas greater than 10 km distance from any village using data on village location and land-use obtained in 1989 by the Mekong Secretariat (1991). These base maps were digitized by the International Resource and Information Centre (IRIC) and IUCN in Phnom Penh. Some of the forests included in our wilderness areas have been logged, according to 1997 satellite imagery analyzed by a World Bank-funded study (DAI 1998).

We scored hunter tiger abundance rankings 0 for no tigers, 1 for Low, 2 for Medium and 3 for High. These subjective rankings were averaged for each distinct geographic region and then scaled to a range of hypothesized tiger densities (zero to 1.5 resident adult tigers/100 km^2, and zero to two resident adult tigers/100 $km^{2)}$ (see Discussion).

Results

Hunters indicated tiger presence across approximately 56,000 km^2 (Figure 1), a figure derived from totalling the area of their individual hunting territories. For our analysis of tiger status, we extended potential tiger range to 65,000 km^2 (Figure 2) to incorporate remote habitat where no interviews took place (especially Northern Plains, South of Sre Pok, and Virachey regions). Forest areas within 10 km of a village were not included because habitat near villages generally had higher hunting pressure and lower prey abundance.

Based on our distribution data and hypothesized ranges of tiger density, we estimate that Cambodia harbors approximately 535-717 resident adult tigers (Table 1), significantly more than indicated by previously published estimates. Two large, sparsely inhabited areas emerge as tiger strongholds, each having an estimated 150-200 tigers: the hilly tropical rainforest in the Cardamom mountains in the southwest (elevation 200-1,500 m), and the dry and semi-deciduous forests south of the Sre Pok river in the east (Mondulkiri province). Hunters from the Cardamom mountains area reported significant levels of man-eating. Interviewees estimated over 100 incidents in three adjoining provinces during the late 1990s. The Virachey region, centered on the Virachey protected area in the mountains bordering Laos and Vietnam, is a smaller but still significant area, with tigers reported to occur at medium abundance.

In the rest of the surveyed portion of the country, tiger populations are generally characterized as low. These low density areas have higher human populations or a history of heavy logging activity. Still, tigers do occur throughout most of Cambodia (out of 153 interviews, only five people said there were no tigers in their area). In the open dry forests of the Northern Plains region, 100% of hunters had recently seen tigers and tiger tracks, reported recent trade activity, named consistent and current prices for tiger bone, and were aware of at least one tiger that had been killed around their villages in 1997.

Overall, 60% of hunters reported active trade in tiger parts where they live. The only areas not reporting trade were Kampong Thom, Northeast Buffer Zone, and Phnom Oral - the areas with the lowest estimated tiger populations. The price of a tiger was typically reported per kilogram of bone (as opposed to a whole carcass), and averaged US$169. Most hunters described tiger populations in their area as declining (74%), although some said increasing (19%), mainly in the Cardamoms. Hunting was indicated as the primary cause of the decline, with logging predominating in other areas, especially Kampong Thom and Pailin.

Table 1. Estimated number of tigers in Cambodia based on hunter interviews. Averages of relative abundance estimates by hunters were converted to estimates of average potential tiger densities. Two scales were used for potential tiger densities: zero to a high of 1.5 resident adult tigers per 100 km^2, and zero to two resident adult tigers per 100 km^2.

Region (n interviews)	Avg tiger abundance (scale 0-3)	Area in km2	Density scale zero to 1.5 resident adult tigers/100 km^2		Density scale zero to two resident adult tigers/100 km^2	
			Estd. density	Estd. no. tigers	Estd. density	Estd. no. tigers
1. Cardamom Mountains (31)	2.74	11,846	1.37	162	1.83	217
2. Phnom Oral (9)	1	6,079	0.50	30	0.67	41
3. Elephant Mountains (12)	1.33	2,176	0.66	14	0.89	19
4. Kampong Thom (11)	0.82	5,794	0.41	24	0.55	32
5. South of Sre Pok (37)	1.95	14,971	0.98	147	1.3	195
6. Northeast Buffer (8)	0.88	5,082	0.44	22	0.59	30
7. Virachey (12)	2.08	4,787	1.04	50	1.39	67
8. Northern Plains (17)	1.18	10,736	0.59	63	0.79	85
9. Pailin (16)	1.25	3,771	0.62	23	0.83	31
Totals		**65,242**		**535**		**717**

Figure 1. Distribution of hunting territories where hunters reported tigers present (total 56,000 km^2)

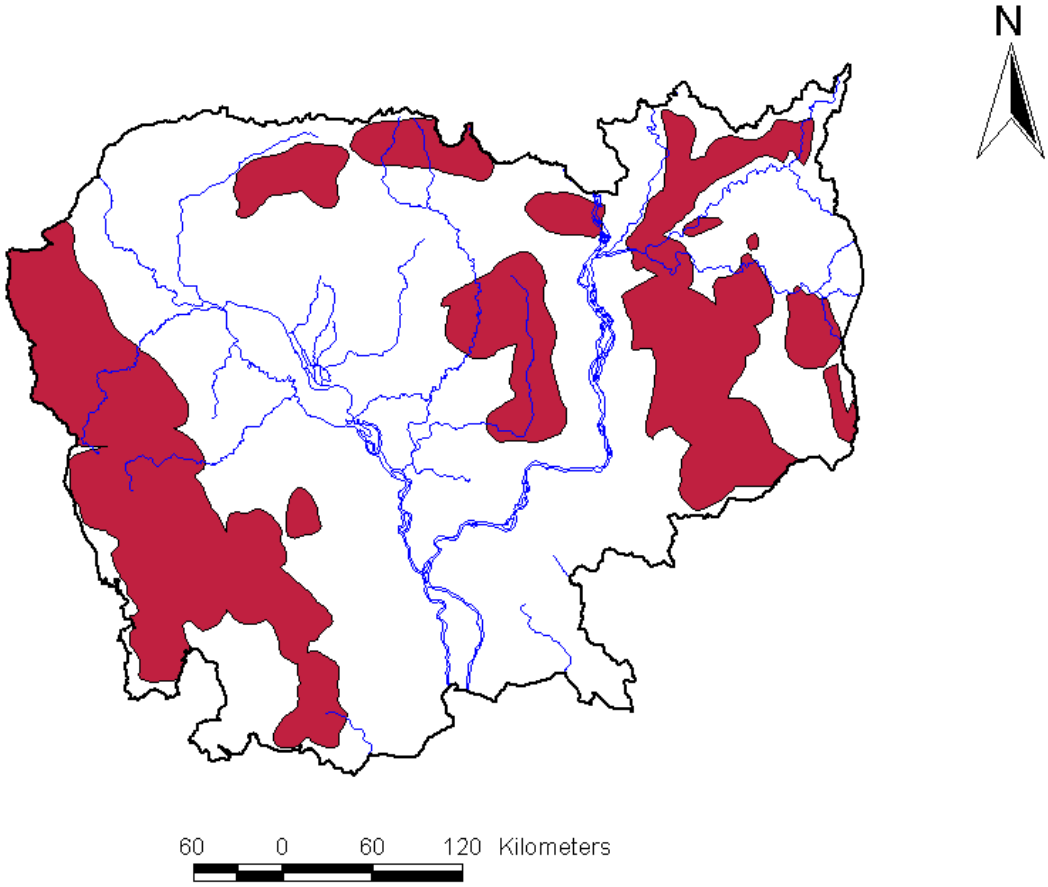
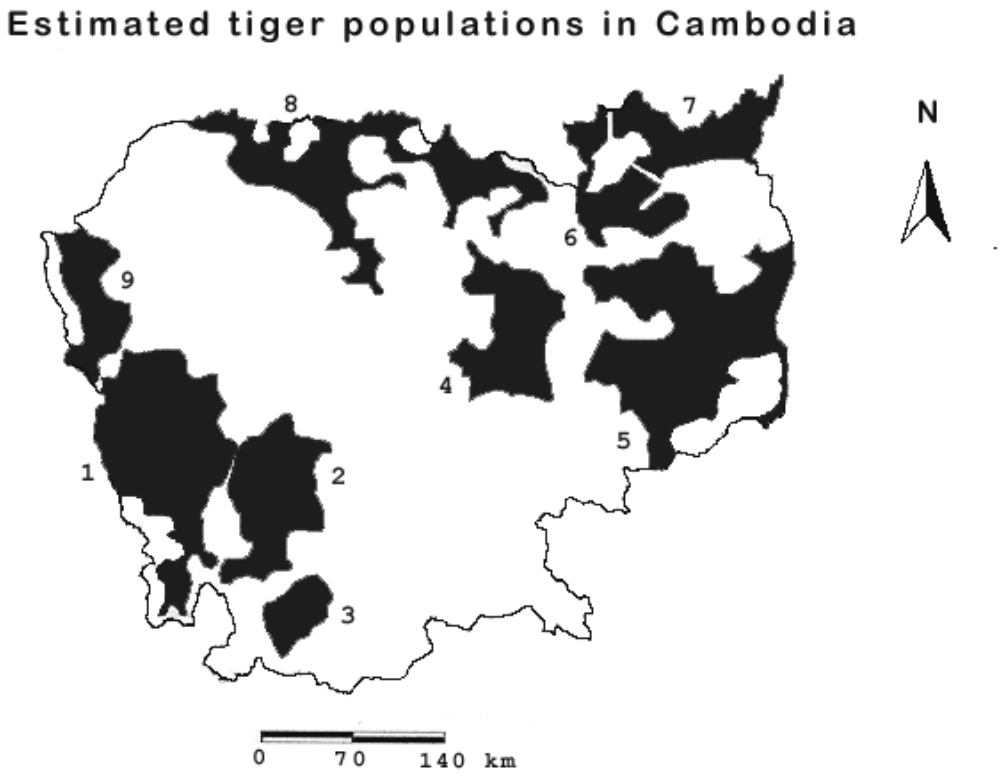


Figure 2. Distribution of nine estimated tiger populations (described in Table 1). Forest areas shown are more than 10 km distant from villages. Most of these areas (approx. 85%) were covered by our survey. Also included are other relatively remote forest areas (approx. 15%) where tigers are likely to occur but no interview data was available.



Discussion

Using interviews with knowledgeable local people to map species distribution can provide a useful tool for planning biological surveys. Recent tiger and large mammal survey efforts have focused largely on Ratanakiri province (NorthEast Buffer and Virachey regions: Desai and Vuthy 1996, Timmins and Soriyun 1998, T. Lynam pers. comm.), while the hunter interviews point to the importance of two large areas with potentially large tiger populations – the Cardamom mountains and the South of Sre Pok region.

Our estimate of approximately 535-717 tigers in Cambodia is based on three components: a subjective hunter evaluation of tiger abundance, a projection of geographic distribution of tigers, and two hypothesized maximum tiger densities (1.5-2 tigers/100 $km^{2)}$. Each of these components are discussed below.

1) **Hunter descriptions of tiger abundance.** Hunters were interviewed separately and not in groups. There was a high degree of agreement on density among hunters. By inspection there was also a strong correlation between tigers and large prey (e.g., sambar deer, banteng and gaur) distribution and abundance. Our final report will analyze the degree of concordance among hunters and the association between hunter estimates of tiger and prey distributions and abundance.

2) **Size of current tiger range.** By predicting tiger occurrence in unsurveyed areas, we risk overestimating tiger range in the country. On the other hand, the 10 km buffer from villages may have eliminated some good tiger habitat (some areas where hunters reported tiger presence were eliminated by the village distance selection criteria). Our estimate of tiger habitat is more conservative than recent estimates of forest extent of more than 100,000 km2 (UNEP 1995, DAI 1998). We have no data on the degree to which edge areas are prey depleted. Research in Thailand (Pete Cutter, Tony Lyman in progress) and Nepal (Mahendra Shrestha in progress) is working toward developing models to predict prey distribution in relation to edge and other habitat variables, and also to relate prey abundance to remote sensing data.

3) **Tiger density estimates.** High tiger densities of 3-5 adult tigers per 100/km^2 have been reported from some Asian protected areas (Franklin et al. 1999, Karanth et al. 1999, Smith et al. 1999). In Indochina, density estimates derived from field studies are available only for Thailand. Rabinowitz (1993) used an average density of one adult tiger/100 km^2 in his estimate of the tiger population in Thailand, and further reduced this density according to levels of threat. His density estimate was based on his study in Huai Kha Khaeng Wildlife Sanctuary in Thailand. Subsequent camera trapping at that site revealed about 3 tigers/100 km^2 (Saksit, personal communication). Smith et al. (1999) used an estimate of 1.5 tigers/100 km^2 for habitat with a high diversity of prey (e.g. having sambar, one other large prey species, barking deer and wild boar). We used a maximum density estimate of 1.5-2 tigers/100 km^2 . It is important to note that these density estimates are not based on field data from Cambodia. Such data are needed as are data on the abundance of prey species. If the strong relationship between prey abundance/biomass and tiger distribution and abundance exists as suggested by Miquelle et al. (1999), Karanth et al. (1999), and Smith et al. (1999), then a density in the range we suggest may be a reasonable starting point for areas reported to have a high density of prey (e.g. at least 4 species of tiger prey, at least 3 species at high density). As more quantitative measures of tiger and prey abundance are undertaken both potential and actual density estimates will be refined.

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Estimating tiger numbers is a difficult and controversial exercise. Our work falls short of the standards set by long-term scientific studies carried out in other tiger range states (Seidensticker et al. 1999). We realize the limitations of the data for each component used in making our tiger population estimates. However, for Cambodia, it represents major progress in understanding tiger status and distribution. From the perspective of the international conservation community, our estimate should help focus attention on the importance of Cambodia, and draw the investment necessary to help safeguard what is likely to be one of the world's largest tiger populations.

To use a metaphor which draws from Cambodia's conflicted past, the country is essentially at Year Zero in terms of a conservation infrastructure and knowledge base. Cambodia is new to CITES, many people are desparately poor, and there is a thriving wildlife trade. But much has changed since our survey was conducted. Pol Pot is dead, the Khmer Rouge has surrendered, and for the first time in many years Cambodia finds itself at peace. In response to international concerns about uncontrolled logging (due largely to the work of the London-based NGO Global Witness), a moratorium on logging was imposed in early 1998, backed by military force. At the same time, a total ban on the hunting of wildlife was also declared. International conservation organizations are beginning to assist have begun are returning to the country: IUCN, WWF, WCS, FFI, and the University of Minnesota are among the organizations now beginning to help build research, monitoring and enforcement capacity in Cambodia.

Our methodology of hunter interviews has much to offer as a large mammal population monitoring system. By emphasizing cooperation with hunters in monitoring wildlife status and recruiting some of these hunters as staff, government authorities can make use of their knowledge of local wildlife, and provide education and employment opportunities as an alternative to tiger hunting.

As a follow-up to our survey, the Wildlife Protection Office carried out a series of tiger conservation education and training workshops which reached more than 250 local government officials. Many of these officials heard about the importance of their tiger populations and the need to take action to conserve them. An educational poster was also printed and distributed to villages in tiger range. It stresses that hunting tigers is illegal, and argues that tigers have benefits for people, including "keeping bandits out of nearby forests".

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