Monitoring population trends of tiger and their prey species in Kerinci Seblat National Park, Sumatra

Midterm funding report to 21st Century Tiger

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Grantee:	Durrell Institute of Conservation and Ecology
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Project participants

Field monitoring team

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Sahar (Community ranger from Pelompek)

Jon (Community ranger from Pelompek)

Simbolon (Community ranger from Kumun Mudik)

Nasrul (Community ranger from Renah Kayu Embun)

Gunawan (National University of Indonesia, UNAS student, to begin undergraduate research in August 2004)

Desk-based monitoring team

Agung Nugroho (from KSNP, GIS officer)

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Introduction

Kerinci Seblat National Park (KSNP), Sumatra, is an important protected area for tigers because it is still contains large blocks of forest that continue outside the national park boundaries. Whilst these large forest blocks could support viable tiger populations, the pervasive threats of illegal logging and poaching of both tigers and their prey render the future of these species uncertain. In order to assess the impact of these different threats and the conservation strategies aimed at reducing them, information is need on the population trends of tigers and their prey. This report highlights activities over the past 6 months of Year 1 to collect baseline data on tigers and their prey populations. More specifically this project aims to:

- Implement a tiger and a prey base monitoring programme;
- Investigate the factors that determine abundance of the tiger and their prey in KSNP;
- Train Indonesian nationals in the use of GPS, and data collection through camera traps and line transect surveys;
- Continue the development of a tiger GIS database for KSNP; and
- Raise awareness about tiger conservation in KSNP.

The monitoring programme is being implemented and conducted under the following time scale (Table 1). This report covers activities to Month 6.

Table 1. Planned project activities

	Month					
Activity	**1 to 2**	**3 to 4**	**5 to 6**	**7 to 8**	**9 to 10**	**11 to 12**
1. Establish study sites						
2. Training and familiarization in field methods						
3. Data collection (camera trapping/transect)						
4. Evaluate field methods and data collection						
5. Submit report to 21st Century Tiger						
6. Final data entry						
7. GIS data transfer to KSNP and TPCU						
8. Workshop in Sumatra (KSNP HQ)						
9. Workshop in Jakarta (Dept. Forestry)						
10. Finalizing project						

First half activities

Activity 1 - Establish study sites

The current knowledge of the status of tigers and their prey populations in and around KSNP is poor. It is most likely that tigers and their prey are distributed across the whole region, but the relative abundances of these subpopulations are not known. For effective conservation management, it is important that information is available on the different abundances of tiger numbers across KSNP. However, before fieldwork could be conducted to determine these relative abundances, it was first necessary to consult the expertise of those working in KSNP to identify priority sites for monitoring. During Month 1, the project was initiated with a meeting between all collaborating governmental (Indonesian Directorate General of Forest Protection and Nature Conservation) and non-governmental conservation organizations (DICE, UNAS, Fauna & Flora International and the KS-Tiger Protection and Conservation Units, TPCUs). From this, a list of ten potential monitoring sites with different levels of threat and TPCU activity were determined.

Activity 2 - Training and familiarization in field methods

During Months 1 and 2, project personnel comprising two KSNP forest rangers, four community scouts and two Indonesian national university graduates received four weeks training in field equipment use, including GPS and camera traps, and field

survey methods. A tiger and prey monitoring programme, based on indirect sign (detection) surveys and camera trapping surveys, was then implemented for KSNP.

Funding from 21st Century Tiger and the Rufford Maurice Laing Foundation was used to implement this programme in the central section of KSNP, which covers part of Jambi and West Sumatra province. Additional funding has since been obtained from the US Fish and Wildlife Service to expand the monitoring programme to the northern and southern sections of KSNP.

Activity 3 - Data collection (camera trap and transect surveys)

Data collection began during Month 2, comparing both a presence-absence, or more accurately detection/non-detection, transect surveys and camera trap surveys.

Transect surveys

Field surveys for tigers and their prey have so far been conducted at one location, Renah Kayu Embun (RKE). The project was initiated outside of the wet season when the detection/non-detection surveys should take place, as sign is easier to detect, so a pilot study was conducted to develop this method for KSNP. These surveys are using an enhanced presence-absence method that involves repeated surveys to estimate tiger and prey detection probability and occupancy. This project is the first known study to develop and apply this emerging method for monitoring tigers and their prey. The details of this method are presented in Appendix 1 because use of this method was not originally planned for this project. This document will be translated into *bahasa* Indonesian and distributed to other tiger monitoring projects. From these surveys, all the principal tiger prey species have been recorded (Table 2). Four illegal animal traps were also encountered in this area but these were not active and, judging by the decayed wood, were probably quite old (Table 3).

Table 2. Detection/non-detection surveys from RKE

Date	Number of surveys	Total distance (km)	Average survey (km)	Tiger[a]	Tiger prey[a]
10/3/04	6	11.1	1.85	Yes[1]	Tapir[1], wild boar[1], sambar[1, 2], muntjac[1]
29/3/04	3	5.6	1.87	No	Sambar[1], tapir[1, 2], muntjac[1]

13/4/04	6	13.7	2.28	No	Pig[1], bearded pig[1, 2]
22/4/04	4	8.8	2.20	No	Muntjac[1], pig[1], tapir[2], pig-tailed macaque[4]
06/4/04	4	9.9	2.48	No	Bearded pig[1], pig[1], tapir[1, 2], sambar[1]
16/4/04	4	9.9	2.48	No	Sambar[1], bearded pig[1]

[a] 1 = print, 2 = faeces, 3 = hair, 4 = direct sighting

Table 3 . Threats encountered in RKE

Date	Threat type	Status
15/04/2004	Unknown, very old trap	Not active
15/04/2004	Bird trap	Not active
24/04/2004	Snare trap	Not active
25/04/2004	Bird trap	Not active

Camera trap surveys

To date camera trapping has been conducted in RKE. In total seven project personnel have been trained to correctly place and set camera traps (Appendix 2). Only a single tiger was photographed (Table 4; Figure 1), but this is cause for optimism in KSNP. The RKE study site was heavily hunted in 2000 and 2001 and large mammal field surveys conducted during this period recorded very few signs of tiger prey, no sign of tigers and a large number of snare traps. Consequently, the TPCUs (partly funded by 21st Century Tiger) identified and included this area in their forest patrols. The field surveys conducted by this project in 2004, encountered only old snare trap placements (Table 3), a much higher number of tiger prey signs especially nearer to the forest edge, and photographs of the main tiger prey species (Appendix 2). The single sub-adult tiger photographed (Figure 1) hopefully is a transient tiger that is searching for a territory to settle in, and is therefore a sign that this forest patch is returning to a healthy state following intervention by the TPCUs.

Table 4. Monitoring efforts of camera traps during 2004

Study site	Number of cameras	Trap days	Number of tigers
RKE	7	344	1

Figure 1. Subadult tiger recorded on Mount Raya, RKE

The low number of trap days recorded to date has been due to problems with finding a reliable camera trap producer and supplier, and this has delayed the camera trapping component of this project. However, this delay was unavoidable because we did not wish to repeat past problems that included unacceptably high levels of equipment failure and poor post-order service experienced by both DICE and ZSL. Twenty five Photoscout™ (http://www.highlandersports.com) cameras were eventually ordered during Month 4 and received during Month 6. These cameras will be operational in Month 7.

Activity 4 - Evaluate field methods and data collection

Whilst there has been on-going communication between the Project Manager and the Field Team Leader about field methods and data collection, the planned evaluation for Month 4 has not taken place. This was due to the commitments of the Project Manager in the UK. These commitments, including completion of my PhD (partly funded by 21st Century Tiger), have now been fulfilled and field method and data collection evaluation has been rescheduled for Month 6.

Other activities completed

Project presentations

During Month 1, the Project Manager and Field Team Leader gave a PowerPoint presentation at the UNAND Department of Biology to outline the aims of the monitoring programme, to recruit students and graduates and strengthen links between DICE and UNAND. A similar presentation is planned for the University of

Bengkulu Department of Biology during Month 7. This will aim to recruit students for the expansion of the monitoring programme to be established in the southern section of KSNP.

Planned second half activities

The planned second half project activities for the monitoring programme include:

Final data entry

This is an ongoing activity that is supervised by the Field Team Leader. The Project Manager and the GIS and statistical analyst, who will join the project in August 2004, will supervise the final data entry.

GIS data transfer to KSNP and TPCU

The GIS and statistical analyst and TNKS GIS officer will perform this activity under the supervision of the Project Manager.

Workshop in Sumatra (KSNP Head Office)

A workshop involving all project collaborators will be convened in Month 12 to present and discuss project results. During this time an agenda for future progress will be set. Clear and concisely written reports documenting project results and conclusions will be sent to the Indonesian Institute of Sciences, Ministry of Forestry, donors, and project partners.

Workshop in Jakarta (Department of Forestry)

The workshop to be held in KSNP Head Office will then be held in Jakarta to present the project results to the Department of Forestry.

Finalizing the project

During the final workshop all project partners will meet to review the project, its results and evaluations. This will continue work between government agencies and NGOs in formulating tiger and tiger prey conservation strategies

Collaborating Institutions

The Bureau of KSNP

Forest Service, Kerinci district

UNAND, West Sumatra province

University of Bengkulu, Bengkulu province

UNAS, Jakarta

FFI-Indonesia

KS-TPCUs

Appendix 1 - Implementing a new detection/non-detection survey method for tigers and their prey

1. Introduction

The effective monitoring of tigers and their prey requires the use of a reliable and comparable survey method between years or within seasons. Choosing the most appropriate method from among the variety of methods available will depend on the objectives of the monitoring programme. For tigers, methods available include: a mark-recapture method using camera traps to estimate absolute density in a priority site; a line transect method to estimate relative abundances in a protected area; or, a presence-absence survey method to map distribution across a region (Karanth et al. 2002, Karanth et al. 2003). The first two methods have been the focus of considerable research and development, resulting in the provision of robust estimates of abundance. In contrast, presence-absence survey methods have only recently received such attention, but their rapid development now provides an emerging method for monitoring tigers and prey at the regional level, which is the subject of this document.

An inherent problem with collecting presence-absence data is that, whilst the detection of a species can confirm its presence, the non-detection of a species cannot confirm its absence (Nichols and Karanth 2002). Failing to account for these 'false absences' can lead to biased estimates from subsequent calculations. To address this problem, MacKenzie et al. (2002) recently developed a new method using repeat presence-absence surveys to allow detection probability to be explicitly incorporated

into occupancy models. In turn, this gives an unbiased estimate of the proportion of area occupied (PAO).

The method proposed by MacKenzie et al. (2002, 2003) follows the robust mark-recapture framework designed by Pollock et al. (1990). Sites may be surveyed for a number of seasons across different years, with multiple surveys of each site being conducted within each season. Systematic changes in the occupancy state of sites are assumed to only occur between seasons, with no changes occurring within seasons (at the species level). For each survey, the detection of a species is recorded as '1' and the non-detection of a species is recorded as '0'. The sequence of detections and non-detections forms a 'detection history' for each site. Thus, a species that is detected on the first and third occasion during five surveys would have a detection history of '10100'.

2. Detection/non-detection survey design for Kerinci Seblat National Park

Kerinci Seblat National Park (KSNP) is large at 13,300km^2 and covers nine districts. This makes a regional level programme better suited to monitoring tigers and their prey in KSNP. Prior to data collection, the relevant governmental and non-governmental organizations working in KSNP met to decide the locations of potential monitoring, or survey, sites. Their final selection was determined using a stratified sampling approach that proportionally represented the four main forest habitat types in KSNP: lowland; hill; submontane; and, montane. In KSNP, the main forest types are hill (43.5%) and submontane (30%), followed by montane (16%) and lowland (10.5%). Thus, the corresponding number of survey sites in KSNP are: hill (4 survey sites); submontane (3 sites); montane (2 sites); and, lowland (1 site). The field and statistical methods that will be used for these surveys now follows.

2.1 Field method

Each individual survey site contains between 35 and 50 sampling cells of 1km^2 (N = 35-50). During the wet season, when animal prints are easier to detect, each site is independently surveyed for tigers and prey 4-5 times over a one week period (T = 4-5). During these surveys, the sampling effort within each individual cell is kept constant, at approximately two hours per cell. A detection history matrix is then

Comment [DIM1]: What is a 'survey' here again? Some sort of transect? Would it be feasible to have 4-5 people survey randomly selected transects within a cell at the same time? What are your logistical constraints with working in the area?

constructed and these data are imported into PRESENCE software (Proteus Wildlife Research Consultants, New Zealand; http://www.proteus.co.nz).

2.2 Statistical method

The distribution of tigers and their prey may be influenced by environmental covariates, which will effect their PAO. Within a geographic information system (GIS) the environmental covariates for each sampling cell can be extracted and imported into PRESENCE for inclusion in the final analysis. If these data are continuous and have a wide range then it may be necessary to logarithmically transform (Log_{10}) them. The environmental covariates included for KSNP are:

- Log_{10} distance to rivers;
- Log_{10} distance to public roads;
- Log_{10} distance to logging roads;
- Log_{10} distance to settlements;
- Log_{10} elevation;
- Log_{10} slope;
- Presence of illegal logging;
- Presence of snare traps set for tiger prey; and,
- Presence of snare traps set for tigers.

Using PRESENCE, a logistic regression analysis (incorporating detection probability) can be performed to obtain unbiased estimates of the PAO by tigers and prey, and the factors that may influence occupancy in KSNP. A number of regression models can be fit to the observed data and ranked by their Akaike Information Criterion (AIC) values to determine the most parsimonious ('best') model (Burnham & Anderson 1998). The model with the lowest AIC value provides the best description of the data with as few parameters as possible. If there are a large number of potential models with similar AIC values then it is acceptable to choose an alternative model that is within 2 units of the model with the smallest AIC value and that corresponds with a genuine research hypothesis prior to analysis. Alternatively, model averaging (Burnham and Anderson 1998) could be used to combine parameter estimates from the models considered to reflect model selection uncertainty. PRESENCE also allows

for modelling of detection probabilities. The potential effect of factors such as weather, time of year or observer on detection probability can be investigated.

Once the PAO by tiger and prey has been estimated at each survey site for Year 1, the data can be combined to estimate the PAO for the whole of KSNP. Surveying the same sites as Year 1 in the same manner during the next wet season 12 months later (or 6 months; whatever the period for which occupancy dynamics would be most interesting) will allow another estimate of occupancy. This will also allow an estimation of population vital rates (local colonization and extinction) that are associated with changes in area occupancy and therefore important in long term monitoring programmes (MacKenzie et al. 2003).

3. Survey considerations

- Choosing the number of sampling occasions (T): Studies have shown that when detection probabilities are low (< 0.3), the amount of bias associated with the PAO estimate can be reduced by $T \geq 5$. This may seem a laborious method compared to a single survey, but without being able to compensate for 'false absences', this may lead to flawed results that provide unreliable information. A small T (T = 2 or 3) may be overcome by having a large N (e.g. 200 sampling cells). However, recent research (MacKenzie, unpublished manuscript) would suggest that more precise estimates of the PAO by tigers could be achieved with the same level of field effort by conducting more repeat surveys at fewer sampling cells (e.g. 5 surveys of 80 cells instead of 2 surveys of 200 cells).
- Choosing the number of sampling cells (N): To enable a more accurate estimation of the PAO, a minimum of 30-35 cells should be surveyed. Increasing the number of cells should correspond with a better PAO estimate, so if possible a minimum of 50 cells might be wise.
- Choosing the sampling cell size: The aim should be to have a sufficient number of sampling cells that are large enough, yet can be comfortably surveyed completely within a given time limit. If it is not too difficult to survey a large area in a short space of time then it is possible to use a larger sampling cell (e.g. 5km^2). If surveying in areas with low tiger and prey densities, such as in montane or heavily hunted forest, then increasing the cell size may be a useful consideration. Larger

Comment [DIM2]: Good. Also want to think about what constitutes a survey. Is it possible to have multiple 'surveys' in the same visit?

cell sizes should increase the probability that a cell is occupied by a tiger, which in turn should yield more accurate estimates of the PAO. Changing the cell size may mean that, at the extreme end, if cells are too big then occupancy is going to be near 1, and if too small then occupancy might be close to 0.

- Choosing the sampling effort within cells: This does not have to be the number of hours spent searching for animal sign, it could be the number of kilometres walked per cell.
- Problems with closure: The detection/non-detection survey outlined in this document follows a mark-recapture survey design. This requires a population to be 'closed' during sampling, meaning that there should be no gains (births or immigrations) or losses (deaths or emigrations) in the population during sampling. If sampling occasions are spaced over a long time period then this assumption may not be met and result in biased estimates. If, for example, surveys were conducted once every month over a 5 month period (i.e. $T = 5$) then a tiger moving through the survey area during the first month would have no chance of being detected in the same area in the following month if it had already moved on to a different part of its home range. To overcome this potential problem, multiple surveys (T) should be conducted over a short time period (e.g. 4-5 surveys over a week). Sampling occasions should therefore be conducted over a short period of time (e.g. 1 week). It may be possible to have multiple 'surveys' in the same visit instead of a single survey. This could be achieved by 4-5 people surveying randomly selected transects within sampling cells at the same time that set transects are being surveyed. The type of survey will ultimately depend on the resources available (time, money, survey personnel), but whatever method is used surveys must be kept independent.
- Keeping surveys independent: A priority with short term sampling is trying to make the observations independent such that one observer cannot detect sign more easily by following sign of the previous observer (e.g. lots of observer footprints around a pugmark).

We would like to thank Darryl MacKenzie, Jim Nichols, Mike Hearn and Guy Parker for constructive comments on the new methods being used for the survey of tigers described in this document.

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Appendix 2 – Camera trap training and results

Community Field Scout Sahar testing a camera trap placement set by the Field Team Leader Yoan Dinata as part of a training exercise.

Forest dwelling bearded pig recorded near the summit of Mount Raya, RKE.

Two rare and elusive Asian wild dog which, previous to this study, had only been photographed twice during seven years of camera trapping in KSNP.

Appendix 2 – tiger prey from RKE study site

Community Field Scout (Sahar) testing a camera trap placement set by the Field Team Leader (Yoan Dinata) as part of a training exercise

Forest dwelling bearded pig recorded near the summit of Mount Raya, RKE.

The rare and elusive Asian wild dog, previous to this study this species had only been photographed twice from seven years of camera trapping in KSNP