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TAPIR SPECIALIST GROUP

TAPIR CONSERVATION

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FROM THE CHAIR

As you all know, the Fifth International Tapir Symposium was held in Kuala Lumpur, Malaysia, in October 2011. It was the very first time our tapir symposium was held in a Malayan tapir range country and I am happy to report it was a very successful, productive conference, with ample representation from several countries in Southeast Asia, as well as colleagues coming a long way from Latin America, United States and Europe.

As a consequence of the symposium in Malaysia and the high quality of the Malayan tapir papers presented during the conference, we decided to keep the momentum and dedicate this issue of Tapir Conservation to the endangered Malayan tapir! This issue includes a compilation of papers that provides a most detailed overview of the status of Malayan tapirs in the wild, the main threats faced by these animals and what is currently being done to promote the conservation of the species and its remaining habitat in Southeast Asia.

As for this Letter from the Chair, I would like to take this opportunity to give you a brief overview of the main results of the Fifth International Tapir Symposium in Malaysia.

The International Tapir Symposium is held every three years and it is without a question the main event of the IUCN/SSC Tapir Specialist Group. The main goals of the conference are to expand and maintain of a global network of tapir researchers and supporters and develop plans for them to work together and, most importantly, to increase awareness about tapirs on a global level through scientific, social, economic and political initiatives. The conference brings together a multi-faceted group of tapir experts and conservationists, including field biologists and researchers, educators, husbandry and captive management specialists, veterinarians, geneticists, governmental authorities and non-governmental organization representatives, academicians, politicians, and other key players in the development and implementation of tapir research, conservation and management programs. Participants work together for five very intense days and carry out overviews of current tapir research, conservation and management issues, generating the necessary information to promote action planning and design priorities for the conservation of tapirs and their remaining habitats in Central and South America, and Southeast Asia. New approaches that include protected areas development and management, community-based conservation and education initiatives, population genetics, wildlife medicine, fundraising, and action planning, as well as environmental education, marketing, and public relation messages for tapir conservation are addressed and discussed.

The Fifth Symposium was extremely successful! We had a total of 92 participants from 22 countries worldwide (Argentina, Australia, Brazil, Costa Rica, Denmark, Ecuador, France, French Guiana, Guatemala, Honduras, Indonesia, Japan, Malaysia, Mexico, Myanmar, Netherlands, Peru, Singapore, Spain, Thailand, United Kingdom, and United States).

The specific objectives of the Fifth Symposium were the following: (1) Exchange and discussion of current data on field and captive tapir studies through the presentation of papers, posters and keynote speeches by tapir conservationists (field and captivity); (2) Compilation and prioritization of key research, conservation, management and financial issues affecting the plight of tapir species worldwide; (3) Formulation of a list of specific areas, regions and projects that need attention, synergizing efforts from field and captive communities to maximize worldwide conservation initiatives; (4) Creation of committees, taskforces and working groups made up of tapir conservationists who are committed to addressing specific tapir conservation issues; (5) Formulation of a 3-year TSG Strategic Plan (2012-2014) that allows for the conference recommendations to be carried out and evaluated in future meetings; and, (6) Selection of a venue for the Sixth International Tapir Symposium.

The first part of the conference included paper and poster presentations as well as TSG Reports. Papers and posters covered a wide range of issues relevant to the conservation of tapirs and their remaining habitats, such as tapir ecology, field research, population management, threat assessments, husbandry and captive management, veterinary issues, genetics, implementation of action plans, habitat evaluations, research methodologies, identification of priority

areas for tapir conservation, Geographical Information Systems (GIS), environmental education etc. Paper sessions were organized by tapir species. In total, 17 papers were presented, 8 on Malayan tapirs, three on lowland tapirs, one on mountain tapirs, and five on Baird´s tapirs. Eleven posters were exhibited throughout the conference and presenters were on hand to discuss their respective posters during the coffee breaks. Paper and poster presenters represented all four tapir species and many different tapir range countries in Central and South America and Southeast Asia.

The TSG Reports session included the following presentations: Claire Martin and Nathan Herschler from the Emerging Wildlife Conservation Leaders Program (EWCL) in the United States presented the incredible Tapir Press Kit they have developed for the TSG; Anders Gonçalves da Silva and Gabriela Pinheiro provided an overview of the activities of the TSG Genetic Committee; Anders Gonçalves da Silva presented the recent changes and improvements on the TSG´s main publication, the Tapir Conservation newsletter; Patrícia Medici made presentations about the recent achievements of the TSG Marketing & Education Committee, the National Red List for Tapirs in Brazil, and provided the audience with an overview of the TSG´s action planning activities at both the species and national levels; Jessica Amanzo, Fernando Nogales, Manolo García, José Trinidad Suazo, and Paula Gonzalez Ciccia provided the audience with updates on the development of National Action Plans for Tapirs in Peru, Ecuador, Guatemala, Honduras and Argentina respectively.

The second part of the conference was devoted to workshops addressing specific topics including: (1) TSG Action Plan Implementation; (2) Ex-Situ Conservation and Management; (3) Tapir Conservation outside Protected Areas; (4) Implementation of Conservation Strategies in Landscape Planning; and, (5) Assessing Structural and Functional Landscape Connectivity for Tapirs.

The Workshop on Action Plan Implementation was organized by the TSG Action Plan Implementation Taskforce and facilitated by Bengt Holst, an active member of the Tapir Specialist Group and Convener of the European Network of the IUCN/SSC Conservation Breeding Specialist Group (CBSG), and Patrícia Medici, Coordinator of the Taskforce. During this session we reviewed the Tapir Action Plans developed during previous PHVA workshops (http://www.tapirs.org/action-plan/index.html) and evaluated the progress we have made on their implementation.

The Workshop on Ex-Situ Conservation and Management was organized and moderated by Michele Stancer, Chair of the AZA Tapir Taxon Advisory Group (TAG), and included six presentations covering topics such as the captive management, breeding and transfer plans of captive tapirs in North America, the value of studbook keeping as a tool for the management of tapirs in captivity, the challenge of dealing with Tuberculosis in captivity, and genetic issues.

The Workshop on Tapir Conservation outside Protected Areas was designed and moderated by Dr. Eduardo Naranjo from ECOSUR, El Colegio de la Frontera Sur in Mexico. This workshop included four presentations by conservation professionals from Southeast Asia (Sivananthan Elagupillay, Malaysia, and Wilson Novarino, Indonesia), Central (Eduardo Naranjo, Mexico) and South America (Andrés Tapia, Ecuador) who provided their insights in terms of priorities for the conservation of tapir species outside protected areas.

The Workshop on Implementation of Conservation Strategies in Landscape Planning was organized and moderated by Dr. Carl Traeholt, Coordinator of the Malayan Tapir Project in Malaysia (Copenhagen Zoo). This session included four presentations by conservationists from Malaysia. Christian Schriver from CSC Consult in Malaysia talked about applications for the successful implementation of biodiversity conservation at the landscape level. Dr. Melvin Gumal from WCS Malaysia presented lessons learned with tiger conservation at the landscape level in Malaysia. Lim Teck Wyn from Resource Stewardship Consultants in Malaysia spoke about strategic planning and the creation of forest reserves in Peninsular Malaysia. Finally, José Manuel Mora and José Trinidad Suazo, Minister of Conservation and Forest Development of Honduras, made a presentation about the strategy for the implementation of the National Action Plan for Tapir Conservation in Honduras.

The Workshop on Assessing Structural and Functional Landscape Connectivity for Tapirs was designed and moderated by Manolo García and Fernando Castillo from Guatemala. The main goal of this workshop was to develop landscape connectivity assessment parameters and tools for the conservation and management of tapir species and their habitat. Results from this workshop will be extremely useful to assign landscape resistance values for connectivity modeling for tapirs.

Five keynote speakers made presentations throughout the conference: (1) Lord Gathorne Cranbrook, an icon of wildlife ecology and conservation in Southeast Asia, gave a most interesting speech about large mammals and the extinction crisis in Southeast Asia; (2) Y.BHG. Misliah Binti Mohamad Basir, Deputy Director General of the Malaysian Department of Wildlife and National Parks (DWNP), gave a speech about Malayan tapir conservation issues in Peninsular Malaysia; (3) Jeffrey Flocken from the International Fund for Animal Welfare (IFAW) in the United States

and also member of the Tapir Specialist Group´s Steering Committee together with (4) Claire Martin from the Walt Disney Company, also in the USA presented an extremely interesting overview on how to approach and work with different types of funders; (5) Matthew Colbert from the University of Texas at Austin and TSG Evolution Consultant spoke about methods to assess age and maturity in tapirs based on dental eruption and cranial suture closure.

The last session of the conference was the TSG Strategic Planning 2012-2014 Workshop. The main goals of this session were to review the TSG Strategic Plan 2009-2011 developed during the Fourth International Tapir Symposium in Mexico in 2008 and evaluate what the TSG has accomplished over the past three years and then develop a new Strategic Plan for the group. Participants were requested to ask themselves "What goals should we accomplish as a group in order to be more effective in terms of tapir conservation worldwide?" and "What should be our main actions and initiatives in order to reach those goals during the next three years?" This session focuses on the functioning and short-term activities of the TSG itself. Long-term issues regarding the conservation of the four tapir species were carefully addressed during the Tapir Population and Habitat Viability Assessment (PHVA) Workshops held for each tapir species between 2003 and 2007. Workshop facilitators Bengt Holst and Patrícia Medici guided the process of discussing issues brought up by participants and developing goals and priority actions to deal with them. We worked with five different working groups: (1) Communication/ Marketing/Fundraising; (2) TSG Membership/TSG Structure/External Links; (3) Follow up on Tapir Action Plans; (4) Research/Protocols/Guidelines; and, (5) Education/Training.

The main outcome of TSG Strategic Planning 2012-2014 workshop was a list of priority actions and goals that will "guide & drive" the work of the IUCN/ SSC Tapir Specialist Group over the next three years (2012-2014), creating and detailing specific tasks for each one of the TSG's different committees, taskforces and working groups. The final version TGS Strategic Plan 2012-2014 is available online on the TSG Website (http://www.tapirs.org/symposium/index.html).

The main organizers of the Fifth International Tapir Symposium were the IUCN/SSC Tapir Specialist Group, Malaysian Department of Wildlife and National Parks (DWNP), Copenhagen Zoo in Denmark, Association of Zoos & Aquariums (AZA) Tapir Taxon Advisory Group (TAG), and European Association of Zoos & Aquaria (EAZA) Tapir Taxon Advisory Group (TAG). The Houston Zoo Inc. in the United States and the Copenhagen Zoo in Denmark provided institutional support for the process of raising and administering the funding for the conference.

The Fifth International Tapir Symposium had the financial and/or institutional support from 46 conservation organizations worldwide, including 42 zoological institutions - mostly tapir holding institutions in the United States (28), Europe (10), and Latin America (4) - as well as a governmental agencies (2) and non-governmental organizations (2). In addition, 48 other organizations sponsored the attendance of several participants. These organizations included zoological institutions, universities, research institutes, governmental agencies, international and national NGOs, conservation projects, private donors and corporations in North America, Europe, Latin America and Southeast Asia.

Thanks to the generous support from all these organizations we were able to cover the conference's expenses and sponsor the attendance of key participants from several tapir range countries, who otherwise would not have been able to attend the conference. I will never, ever have enough words to articulate how grateful we are for the support provided by all these organizations and for their belief that conserving tapirs is important! A complete list of institutional and financial supporters of the Fifth International Tapir Symposium can be found on the Symposium Final Report available for download on the TSG Website (http://www.tapirs.org/symposium/index.html).

On a final note, I would like to let you all know that the Sixth International Tapir Symposium will be held in BRAZIL in 2014. We do not have a date yet, but it will be most probably sometime around October/November. The symposium will be held in Campo Grande, the capital of Mato Grosso do Sul State, where I am based. Campo Grande is right next to the Pantanal, the largest continuous freshwater wetland on the planet, where I am currently working on tapirs! We will make sure to organize pre- and post-conference trips to the Pantanal and other amazing nature sites in the surroundings of Campo Grande! See you in 2014!!!

All the best,

Patrícia Medici
Chair, IUCN/SSC Tapir Specialist Group (TSG)

SPOTLIGHT

Past and present extinctions and the lessons we can learn from fossil records

Louys, J. 2012. The Future of Mammals in Southeast Asia: Conservation Insights from the Fossil Record Paleontology in Ecology and Conservation. Pages 227-238 in J. Louys, editor. Paleontology in ecology and conservation. Springer, Berlin Heidelberg, Germany.

It is often said that history repeats itself. While this is certainly true for the human history, it might also apply to species extinction. Southeast Asia, with one of the highest mammal diversities on the planet, also is the region with the highest proportion of endangered mammals and is undergoing rapid changes through deforestation and hunting. In his book chapter Louys examined distribution of extinct, endangered and vulnerable large mammals from region from the Pleistocene to the present to see if there were any common patterns that could indicate the vulnerability of different species.

Most extinct species showed an expansion from Indochina (Thailand north of the Isthmus of Kra, Cambodia, Laos, Vietnam, Burma and southern China) into Sundaland (Borneo, Java, Sumatra, Malaysia and Thailand south of the Isthmusof Kra) in the early Pleistocene and a subsequent range contraction during the late Pleistocene. Three critically endangered species (Javan rhino, Sumatran rhino and the orangutan) also saw a large range extension during the early and middle Pleistocene with a pan-Southeast Asian distribution by the late Pleistocene. Only in recent history were the ranges of these species severely reduced through habitat loss and poaching. A very similar pattern can be seen for the endangered species considered (giant panda, hog deer, Eld's deer, Asian elephant, Malayan tapir and the tiger) with the exception of the Asian elephant, showed a range extension through the middle Pleistocene with most of them having a pan-Southeast Asian distribution towards the late Pleistocene and a drastic decline in recent history. The Malayan tapir for example could be found from southern China to Java and Borneo during the Pleistocene while it is now restricted to Sumatra, Peninsular Malaysia, Thailand and Myanmar. Vulnerable species (Indian rhino, sun bear and serow) on the other hand have a current distribution similar to the Pleistocene distribution (sun bear) or larger than the Pleistocene distribution (serow), except for Indian rhino that has disappeared from Southeast Asia and is now only found in India, Nepal and Buthan.

Extinction of large mammals during the late Pleistocene was largely driven by a change in climate in the late Pleistocene that converted grasslands and open woodlands into forests. The surviving species were therefore more adapted to forest conditions. Ironically it is now deforestation that is driving extinction in Southeast Asia. The comparison shows that three of the endangered species, the giant panda, the tiger, the Malayan tapir and possibly the Eld's deer, show a similar pattern of range reduction to species that are critically endangered or went extinct, indicating that these species need immediate conservation actions.

Mathias Tobler

DEBATE

Throughout the history of Earth species have emerged and others have gone extinct. With a changing climate the habitat will eventually change too. The last glacial period occurred in the upper Pleistocene from approximately 110.000 years from about 12.500 years ago. During the peak of the last glacial period a huge amount of water occurred as ice in the northern hemisphere, and sea-water levels were much lower than it is today. During this period the Great Sundaland included West Malaysia, Borneo, Sumatra and Java and the sea that separates these landmasses from each other today were great savannahs during the glacial period. Animals could move freely between Peninsular Malaysia, Borneo, Sumatra and Java and fossils of many common species have been found in all these places. Tiger, gaur and tapir existed on Borneo along with Sumatran rhinoceros, banteng and elephant and reintroducing, for example, tapirs back into Borneo is an intriguing albeit controversial proposition.

Equipped with the experience of successful reintroduction of other species to areas with a recent extinction record (e.g. Arabian oryx into Saudi Arabia; Florida panther into Florida; wolves into Yellowstone National Park; Przewalski's horse into Mongolia) it is possible that reintroducing tapirs into Borneo could also be successful. On the other hand, does it provide

any conservation relevance and is there a risk of undermining the conservation of other species?

The Editors raise this question in this "debate forum" and would like to receive feedback, comments and thoughts about it. If you decide to write any comments, please keep it factual and relevant.

Carl Traeholt

CONSERVATION

The Malayan Tapir, *Tapirus (Acrocodia) indicus* : Once in Borneo, and again in Borneo?

Earl of Cranbrook

Tapirs (*Tapiridae*) form a distinctive, ancient and primitive family of Even-toed ungulates Perissodactyla, with the first recognisable ancestor (*Protapirus*) appearing across the Holarctic region in the Oligocene, i.e., about 30 million years ago (Ma). Living tapirs have an astonishing relict distribution, with three (possibly four) species in Central and South America and one other, Malayan tapir *Tapirus (Acrocodia) indicus*, in a small part of South-east Asia comprising southern Burma, peninsular Thailand, Peninsular Malaysia and the island of Sumatra, Indonesia. Although for many years all tapirs have been treated as one genus, molecular evidence (DNA) indicates that the split between American and Asian clades occurred 23-21 Ma. About 3 Ma, at the Plio-Pleistocene transition, the western tapirs entered South America and diversified. At the same time, in Palaearctic Asia the ancestral *Acrocodia* clade divided and both lineages penetrated the natural barrier of the Qinling range to invade the South-east Asian biogeographical region. Representatives of the lineage that includes Malayan tapir spread southwards to reach Java by 700,000 years ago (ka). Dated excavations provide a chronology of sites, showing that tapirs were present across continental South-east Asia from central Burma eastwards, and in Java, through the climatic vicissitudes of the Pleistocene Ice Ages to the Holocene. At different sites, tapir remains are associated with a progressive variety of archaic and modern mammal species, illustrating their ecological flexibility. Malayan tapir has also been found in controlled excavations at cave sites in Sarawak and Sabah.

These discoveries will be described in detail. Reliable C14 dates and stratigraphy confirm that Malayan tapirs were present in Borneo from 40 ka to the near present.

Although widespread, their remains are scarce at all sites, and there is no evidence that they were abundant anywhere at any time. Published anecdotes indicate the presence of Malayan tapirs in the 19th century from West Kalimantan through Sarawak and Brunei to Sabah, where they persisted as late as 1929. Their extinction has therefore been recent. It is possible that the last tapirs were incidental casualties in the ferocious hunting of rhinoceroses in the 1930s, and subsequent years. Malayan tapirs are solitary animals. Although shy in the wild, they are tractable in captivity. In Peninsular Malaysia, DWNP maintains a centre for displaced and rescued tapirs at Sungei Dusun. Because designated protected areas in Peninsular Malaysia are already fully stocked by natural populations, there are no plans to return these animals to the wild. Given that the Malayan tapir was so recently exterminated in the East Malaysian States, translocation and reintroduction of animals from Sungei Dusun is an option to be considered seriously. Sponsorship could be sought from reputable commercial enterprises. Possible locations will be discussed. Such a reintroduction could become a flagship enterprise for Asian large mammal conservation.

Earl of Cranbrook
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CONTRIBUTIONS

Vocal behaviour and communication of the Malayan tapir (*Tapirus indicus*)

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Abstact

The purpose of this study was to investigate the vocal repertoire of the Malayan tapir (*Tapirus indicus*), and to describe the observed calls by physical parameters and appearance in spectrogram. Vocalizations from five animals at Sungai Dusun Wildlife Conservation Centre were recorded for 14 days, prior to morning feeding. Four distinct call types were observed, two of which were categorised as whistling-type calls, the other two call types were categorised as non-whistling-type calls. Two other whistling-type calls were observed, but it was not possible to determine whether they were different, or if their differences were due to individual differences between the animals. The effects of distance on the number of high order harmonics were studied, and showed that the higher harmonics of the whistling-type calls would be severely dampened within 50m. This, and the fact that the majority of the recorded calls were whistling-type calls with higher harmonic rather than non-whistling-type calls without harmonics, supports the hypothesis that Malayan tapirs originally were adapted to life in the open, rather than life in forests.

Introduction

Zooarchaeological evidences of Malayan tapir, *Tapirus indicus*, suggest that the species, along with Sumatran and Javan rhinoceroses, *Rhinoceros sondaicus*, roamed semi-open woodland in Southern China to the Indonesian island of Java and possibly the great plains of Sundaland (Corlett, 2010; Cranbrook, 2010, 1986; Cranbrook and Piper, 2009, 2007; Louys and Meijaard, 2010). The massive de-glaciations during the upper Pleistocene resulted in rising seawater that eventually isolated Peninsular Malaysia from Borneo, Sumatra and Java (Cranbrook, 2010; Cranbrook and Piper, 2009) forcing ungulate species into rainforest habitat. The late Quaternary concentration of extinctions, however, was not seen in Southeast Asia, where the fossil record shows losses of genera and species of large mammals extending over a long period (Cranbrook and Piper, 2011). Instead, selective pressures for evolutionary adaptation appears to have given rise to regional radiations, the emergence of new species and the local divergence of prospecies (Cranbrook and Piper, 2011). The surviving species of large ungulates e.g. Malayan tapirs, Javan rhinoceros, *Rhinoceros sondaicus*, Sumatran rhinoceros, *Dicerorhinus sumatrensis* and gaur, *Bos gaurus* likely had to adapt to rainforest habitat within a relatively short period of time and in some places with greater success than others.

Fossil evidences of Malayan tapirs, Javan rhinoceros, Rhinoceros sondaicus, and gaur, Bos gaurus, from caves on Borneo suggest the three species were present on Borneo until upper Holocene (Cranbrook, 2010, 1986; Cranbrook and Piper, 2009, 2007). Whereas hunting contributed to their extinction (Cranbrook, 2010; Cranbrook and Piper, 2009) the causes that lead to the Bornean extinction of these charismatic species remain unknown. Malayan tapir and other large ungulates may have been better adapted to semi-open woodland or savannahs that dominated Southeast Asia during the Pleistocene until the lower Holocene and if so, some physiological and behavioural traits may provide evidence of this.

Vocal characteristics can be used to assess evolutionary adaptation, systematic relationships among individuals of a species and to reconstruct their phylogeny (Barker et al., 2008; Daren et al., 2008; Geissman, 2002; Wiley and Richards, 1978). Animals use vocalization as a way of identification and communication and is common amongst social animals such as horses, primates and whales. Vocal communication, however, is also observed in species that are considered "solitary", such as the Sumatran rhino, *Dicerorhinus sumatrensis* (Penny, 1987), a close relative to the Malayan tapir. The Malayan tapir belongs to the order of Perissodactyla along with horses

and rhinos and since vocalization amongst horses and rhinos is used as a mean of communication (Lemasson et al., 2009; Budde and Klump, 2002; Metrione et al., 2007; Policht et al., 2008), and recognition (Proops et al., 2008), it is possibly important to the Malayan tapir as well. In 1965 Hunsaker and Hahn studied general vocalization in captive Lowland tapirs (*Tapirus terrestris*), but no further studies on tapir vocalization were conducted, probably due to the difficulties of studying shy, nocturnal and highly illusive animals in a dense tropical forest (Traeholt, 2008). With a well-developed sense of hearing, but poor eyesight (The New Encyclopaedia of Mammals, 2001; Grzimek's Encyclopaedia, 2003) vocal communication is likely very important for tapirs, yet the vocal behaviour and communication in Malayan tapirs is not well-understood. The purpose of this study is to describe calls used in vocal communication in Malayan tapirs (*T. indicus*) by means of physical parameters and appearances in spectrograms and to review how it associates with rainforest habitat. The possibilities for individual differences in these parameters will also be investigated, along with differences in vocal behaviour between the test animals.

Methods

The study took place in Sungai Dusun Wildlife Conservation Centre, Malaysia (SDWC). The SDWC has three enclosures at ¼Ha, 4Ha and 40Ha, respectively. Each enclosure is built around natural forest habitat.

4Ha enclosure: This enclosure is square with a clearing of approximately 1000m2 with a few palms, bushes and trees. The rest of the enclosure is dense tropical forest.

40Ha enclosure: This enclosure is semi-circular with a path next to the fence leading into the 4Ha enclosure. The habitat consists of dense tropical forest.

SDWC held six Malayan tapirs; One 1-year old male alone in the stable, one adult male in the ¼ Ha enclosure (designated as '¼Ha in the rest of the report), an adult male ('Junior') and adult female ('Pradong') in the 4Ha enclosure and an adult male ('Boy') with an adult female ('Mala') in the 40Ha enclosure.

Most vocalizations were recorded prior to feeding time when the tapirs in the 4 and 40Ha enclosures vocalized most actively. No recordings was made after nightfall, because it was impossible to distinguish between individual vocalises.

Recording methods

Calls were recorded with a Marantz PMD671 recorder and an omnidirectional Sennheiser ME60 microphone. Recordings took place for 14 days, between 07:00 and 10:00 in the morning before feeding. Individual tapirs were identified along with distances between the recorder and the animals. Recordings were made 1-50m from the study animals, at different positions:

40Ha: 0-46m in a straight line from the gate with the animal visible within 15m from the gate at all times. This recording site was covered by tree canopies, and had some background noise primarily from insects.

4Ha: 1-2m from a marking stick placed on the inside of the enclosure.There was considerable background noise primarily from insects, but no canopy cover.

Calls were described by their duration, frequency range and the number and shape of harmonics. All measurements and readings were done manually in Batsound – Sound Analysis v. 4.01©.

Results

The calls were categorized into six different call types. Four whistling-type sounds: whistle, whine, squeal 1, squeal 2 and two non-harmonic sounds: burp and hiccup. These six types were distinguished with respect to appearance in the spectrogram (Figure 1), along with frequencies and duration (Table 1). A seventh type of call was also observed; a composite call (different whistling-type calls ending in one of the two non-harmonic calls), but there was not sufficient data for measurements.

The whistle is a harmonic whistling sound that has a stable, well defined f_{min} throughout its duration, and a somewhat stable f_{max}. The whine starts out as a harmonic whistling-sound and then turns into a downward sweep. F_{max} for this type of call shows a declining trend from the beginning to the end of the call. Both whistle and whine are easily distinguished from the other six types of calls by their appearance in the spectrogram.

Squeal 1 and squeal 2 are very similar in appearance; they both start out as harmonic and then turn into a downward sweep. There is a great variation in the appearance of these two calls with a graduation from calls beginning with an upward sweep turning into a downward sweep, to calls with a short stable f_{max} turning into a downward sweep. The two calls differ significantly (Welsh variance-weighted ANOVA) from each other in duration, and f_{max} (See Table 1 for values of f_{max}, f_{min}, f_{Emax} and duration). Neither F_{min} nor f_{Emax} for the two squeal-type calls are significantly different from each other.

Several higher order harmonics were observed for the whistling-sounds; for the whistle up to eight harmonics were observed (1st harmonic and 7 higher orders), for whine up to eight harmonics, squeal 1 up to five harmonics and for squeal 2 up to six harmonics were observed.

The two types of non-harmonic calls had a larger variation in their f_{max} than the whistling sounds. F_{min}, f_{Emax} and durations for these two types of calls can

Table 1. F_{max}, F_{min} and F_{Emax} of the 1st harmonic are shown in kHz and duration shown in seconds for the six call-types; whistle, whine, squeal 1, squeal 2, burp and hiccup. All shown with ±1SD. The sample sizes (n) for the different call-types in the particular comparisons for the different call types are shown to the right of the compared parameter.

Type	F_{max} (kHz)	n	F_{min} (kHz)	n	F_{Emax} (kHz)	n	Duration (s)	n
Whistle	3.0 ±0.4	59	2.0 ±0.3	59	2.2 ±0.4	59	0.48 ±0.11	59
Whine	2.9 ±0.2	53	0.5 ±0.2	52	2.2 ±0.4	53	0.70 ±0.16	53
Squeal 1	3.9 ±0.2	12	0.5 ±0.2	8	3.1 ±0.9	14	0.29 ±0.07	14
Squeal 2	3.2 ±0.2	50	0.8 ±0.5	33	2.7 ±0.4	50	0.46 ±0.07	50
Burp	2.4 ±0.5	3	0.8 ±0.1	3	1.6 ±0.2	3	0.58 ±0.21	3
Hiccup	5.7 ±2.6	10	0.6 ±0.6	11	1.1 ±0.5	14	0.34 ±0.11	14

be seen in Table 1. The burp-type call is seen as a somewhat long, flat and dense call with frequencies that do not fluctuate with the duration of the call, as it is seen with the whine, squeal 1 and squeal 2. The hiccup is composed of two well defined narrow vertical parts, with the two parts separated.

According to the Dunnett's T3 multiple comparison, the burp-type calls are significantly lower than hiccup and Squeal 1 concerning f_{max}. The hiccup-type calls were not significantly different from any of the whistling sounds concerning f_{max}. Burp-type calls were significantly lower than the whistle-type calls regarding f_{min}. F_{min} for both non-harmonic calls were significantly lower than whistle-type calls ($p<0.0001$) With respect to f_{Emax}, burp and hiccup did not differ from each other, but they were both significantly lower than the four whistling sounds ($p<0.0001$).

A comparison of the four parameters (f_{max}, f_{min} f_{Emax} and duration) for whistle-type calls produced by the two females 'Mala' and 'Pradong' showed that f_{Emax} was significantly different between these two individuals (*Welch's* $p=0.0337$).

The number of harmonics were also counted at different distances for the three whistling-types. These data showed that the average number of harmonics for 'Whistle' declined significantly from 6 ±1 harmonics at distances of 11-15m to 1 ±0 harmonics at distances of 46-50m (*One-way ANOVA* $p=0.0004$), no data were available for 0-5m and 21-45m. Squeal 1 showed no significant decline in average number of harmonics at distances of 6-10m and 16-20m (*One-way ANOVA* $p=0.8546$). Squeal 2 showed a decline in the number of harmonics between distances of 6-10m and 16-20m, but not between 11-15m and any of the two (*Welsh's* $p= 0.0114$).

Several observations of behaviour were made; 'Mala' was observed repeating the whine-type calls repeatedly for up to 60min, stopping only when she got fed. She would remain 10-15m from the gate, pacing in the area where she would normally be fed.'¼Ha' was observed one morning facing the back of the ¼ Ha enclosure and into the 4Ha enclosure, producing whistling-type calls. Facing the back of his enclosure meant that he was turned perpendicular to the usual calling direction. The two individuals in the 4Ha enclosure, 'Pradong' and 'Junior', had not appeared yet, and it seemed as if he was calling for them rather than for food. '¼Ha' and 'Junior' would often touch each other through the fence in the morning when 'Junior' appeared, as if to greet each other.

Discussion

Prior to morning feeding six different signals were recorded and described by the maximum frequency of the 1st harmonic (f_{max}), the minimum frequency of the 1st harmonic (f_{min}), the frequency with the highest energy in the 1st harmonic (f_{Emax}) and the duration of the 1st harmonic. The six different calls were; whistle, whine, squeal 1, squeal 2, burp and hiccup. Another type of call, the composite call, was also recorded, but there was not enough data to measure all four parameters.

The comparisons of appearance and the four parameters show that whistle, whine, burp and hiccup are clearly different types of calls. The duration for whistle is shorter than whine and burp, but this might not be a meaningful measurement. An estimate of the duration in the spectrogram suggests that the duration should be around 1.0s, rather than 0.48s. It seems that there is a bigger gab between the maximum energy and the average energy in this call type, than there is in the other call types, thus making the measuring method inadequate for this call type. The method was used because it was considered the best general method and seemed to be accurate with respect to the other five signal types. Of 30 whistle-type calls, 'Mala' and 'Pradong' produced almost half of the calls each (only a few were produced by '¼Ha and 'Junior').

An individual comparison of the four parameters for whistle-type calls coming from 'Mala' and 'Pradong' showed significant difference between 'Mala' and 'Pradong' for f_{Emax}, but not in any of the other three parameters. This suggests individual difference in this type of call, although the main sound components (f_{min}, f_{max} and duration) are similar i.e. there is a difference

in "pronunciation". Unfortunately, the sample sizes in the parameter comparison for the whistle-type signals were small i.e. 'Mala' = 10 calls, and 'Pradong' = 8 calls, respectively.

All identified 'whines' were produced by 'Mala'. Considering the circumstances during which she was whining, it appeared as if she was calling for food rather than directing it at other tapirs. This type of call could be some kind of begging/calling for food, and it is important to study if this kind of call is used by other adult individuals in other situations, or if used by young tapirs still suckling, thus begging for food or attention.

Although very similar in appearance, squeal 1 and squeal 2 had significantly different f_{max} and durations, suggesting that these are indeed different types of calls. The squeals do not differ significantly at f_{min}, but since "whistle" does, they are easy to distinguish from "whistle". Squeal 1 and squeal 2 are not different in f_{Emax} either. 'Pradong' was responsible for 90% of the 10 squeal 1-type signals, and 'Mala' was responsible for the last 10%. 'Mala' was responsible for 89% of 47 squeal 2-type signals and 'Pradong' was responsible for 4% and this suggests that the differences in f_{max} and duration between squeal 1 and squeal 2 are an expression of individual differences rather than differences between signal types. Unfortunately the sample sizes for squeal 1 were small (12 f_{max} signals, 14 duration records and 10 for comparison of distribution between the five recorded individuals), whereas the sample sizes for squeal 2 were 50 signals for both f_{max} and duration, and 47 for comparison of distribution between individuals squealing making it a more meaningful sample size.

The f_{Emax} of both non-harmonic calls (burp and hiccup) are significantly lower than the four whistling-type signals. The f_{max}-value is the only parameter that is significantly different between the two non-harmonic calls, despite the large variance in f_{max} for the hiccup. Despite the small sample size for "burp calls" the different spectrograms appearances implies that the two non-whistling-type calls are different from each other.

Whereas composite-calls were recorded there was not enough data to describe these call-types. All recordings were made in the morning just before feeding, and three composite calls were recorded, which suggests that the Malayan tapir make use of additional call-types than were recorded in this study.

Hunsaker& Hahn (1965) conducted at study on vocalization of South American tapirs (*Tapirus terrestris*) in San Diego Zoo and recorded four different signal types. One of these was defined as a "sliding squeal". This call type had a F_{Emax} (dominant frequency in Hunsaker& Hahn) and duration quite similar to the squeal 2-type signal recorded in this study. Hunsaker& Hahn (1965) also described a non-harmonic call, which they called "species specific clicks". This signal appears in the spectrogram similar to the "hiccup" in this study; with two narrow vertical lines, slightly apart (Hunsaker& Hahn, 1965). Frequency range and duration is also similar to the hiccup-type call described in this paper. This indicates that these two call-types could be similar for the two species, perhaps sharing vocal evolution as suggested in gibbons and birds (Konrad and Geismann, 2006; Podos et al, 2004). Unfortunately, Hunsaker& Hahn (2006) did not describe the measuring method in their paper, and it is uncertain if it corresponds to the measuring methods used in this study. Consequently, it is not possible to conclude that similarities and differences in the calls between Malayan and South American tapirs are due to different sampling methodologies or because they are closely related species.

Comparisons of the number of higher order harmonics (including 1st) at different distances for the whistle-type calls and squeal 2 show that there is a significant reduction in the number of higher harmonics over distances of approximately 20m. At 45-50m only the 1st harmonic would be visible in most calls, and it would be distorted in some calls (the distorted calls were not used in measurements of the four parameters). There was not sufficient data to compare parameters for the non-harmonic calls at different distances with the whistling-type calls or compare calls recorded with or without obstacles in the form of trees and bushes. However, since sound of low frequency travel further than sound of high frequency in air and are damped less by physical obstructions, low frequency calls are expected to be less effected than the whistling-

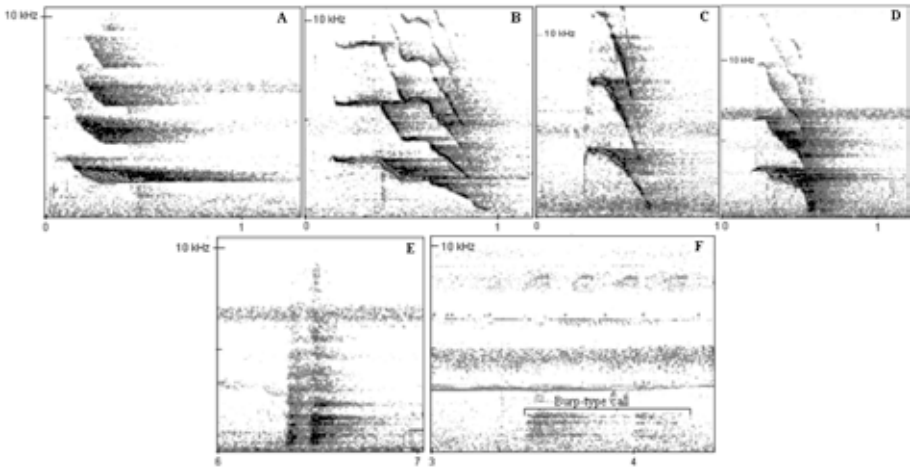

Figure 1 A: whistle, B: Whine, C: Squeal 1, D Squeal 2, E: Hiccup and F: Burp. Spectrograms are taken fromBatSound ©, Hanning window FFT size 1024, with time (seconds) on the x-axis and frequency (kHz) on the y-axis (note that the different spectrograms have different scales).

type calls and, hence, more effective in tropical rainforest habitats. If low frequency vocalisation is indeed more effective in a forest environment, it is interesting that out of 336 categorized calls 85% are high frequency whistling-type calls. This could indicate that vocalisation is not sufficiently important for the survival of Malay tapirs to affect evolutionary fitness, or Malay tapirs are still in the evolutionary process of adapting to rainforest habitat. The Malay tapir's tendency to use high-frequency vocalisation may be a rudiment from its original adaptation to semi-open deciduous forest habitat that dominated Sundaland until 10.000 years ago (Corlett, 2010; Cranbrook, 2010, 1986; Cranbrook and Piper, 2009, 2007). In an open habitat the high frequency sounds do not have the same draw backs as in forested habitat.

There is also the possibility that tapirs only use vocalization for short-distances communication, in which case, the distortion of the calls will not be significant. Tapirs are considered solitary and the evolution of "social communication" is unlikely to take place. There are incidents, however, were adults accompany each other during mating season, and it is likely that these individuals use vocalization to communicate with each other. 'Pradong' and 'Junior' were often seen more than 50m apart in the 10 acre enclosure and the male in the ¼ acre enclosure was observed calling in a direction towards the 10 acre enclosure before 'Pradong' and 'Junior' showed up for their morning feed. The male in the ¼ acre enclosure and 'Junior' would often greet each other through the fence in the morning. 'Mala' and 'Boy' (in the 100 acres) also spent time apart and together, with 'Boy' only occasionally showing up for morning feeding. This is, of course, not a natural environment, with 'Pradong' and 'Junior', and 'Mala' and 'Boy' confined to enclosures with supplementary feeding, but the 100 acre enclosure makes it possible for the animals to exhibit a large part of their natural behaviour, including avoiding each other.

This study reveals that Malay tapir utilizes at least four different and distinct call-types in their vocal repertoire - whistle, whine, burp and hiccup – with a few more types of call undetermined. Whether the differences between squeal 1 and squeal 2 is due to individual differences between animals or whether they are in fact two different call-types cannot be determined in this study.

Distances of 50m had a dramatic effect on the number of higher harmonics in the whistling-type calls, indicating that these types of calls might not be well suited for life in the tropical forest. Whereas this study aimed at describing the vocalization of Malay tapirs, the limited samples size and study duration made it impossible to capture the entire scope of vocalization and communication in the Malayan tapirs. Data from more individuals under different circumstances, for example at aggressive encounters, mating or between mother and young, is necessary in order two fully describe the vocal communication and behaviour of the Malayan tapir.

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Displacement of the Malayan Tapir (*Tapirus indicus*) in Peninsular Malaysia from 2006 to 2010

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Introduction

Peninsular Malaysia is the centre of the Malayan Tapir's, *Tapirus indicus*, distribution range. Tapirs are found in every forest type, including peat swamps up to lower montane forest (Holden et al., 2003; Kawanishi et al., 2002; Novarino et al., 2004; Traeholt and Sanusi, 2009; Williams, 1979). The Department of Wildlife and National Parks' (DWNP) wildlife inventories have recorded signs of tapirs in lowland areas and up to 1430m near Gunung Tahan, 1,720m at Gunung Benom in Krau Wildlife Reserve and 1730m at Gunung Bintang Hijau. Tapirs were recorded in forest fringes as well as logged disturbed forest, and occasionally passing through rubber and oil palm plantations. William and Petrides (1980) reported that tapirs were found in all states of Peninsular Malaysia, and although its current distribution range, according to states, remains similar, its effective range has been reduced to primarily the main range, Belum forest complex (including Ulu Muda), greater Taman Negara forest complex, Pahang peat swamp forest and Endau-Rompin forest complex (DWNP, 2009).

The first report on displaced Malayan tapir in Peninsular Malaysia was published in 1991 (Zainal Zahari *et al*., 2001) and to date, this remains the only study on large mammal displacement in Peninsular Malaysia. It reviews displacement of Asian elephant (*Elephas maximus*), Sumatran rhinoceros (*Dicerorhinus sumatrensis*) and Malayan tapir (*Tapirus indicus*) suggesting that the trend of displacement of large mammals in Peninsular Malaysia follows a standard pattern; an initial increase followed by a slight decrease that reflects the possible effect of management intervention (Zainal Zahari *et al*., 2001). The study also reiterated that the displacement is related to home range size, the largest being that of the Asian elephant (*E. maximus*), followed by the Sumatran rhinoceros (*D. sumatrensis*) and, subsequently, the Malayan tapir (*T. indicus*). The estimated home range of the Malayan tapir is 13 km^2 (Williams, 1979, 1978).

Loss of habitat through forest clearing for agricultural purposes and illegal hunting are considered the main reasons for declining populations of large

mammals (Bradshaw *et al*., 2009; Dermawan, 2001; Fuller *et al*., 2004; Kinnaird *et al*., 2003; Khan, 1997; Koh *et al*., 2009; Novarino *et al*., 2004). In addition, agricultural and urban development often leads to habitat fragmentations, which also contributes to population decline of many large mammals, including tapirs (Dobson *et al*., 2006; Kawanishi *et al*., 2002). Habitat fragmentation could lead to isolation in forest areas with insufficient food resources forcing individuals of large mammals to alter home-ranges and risk crossing highways or venturing into urban areas. Malayan tapirs have been recorded in secondary forest, palm oil and rubber plantations as well as semi-urban areas (Holden *et al*., 2003; Novarino *et al*., 2004; Traeholt personal observation). Secondary forest, however, is not necessarily unattractive to Malayan tapirs. As Zainal Zahari *et al*. (2001) suggests, habitat alteration caused by selective logging activities may result in an increased abundance of saplings as compared to a primary forest. In such cases, it is the physical disturbance from heavy machinery and human presence that seems to drive away tapirs rather than the location's suitability.

This study quantifies the displacement of Malayan tapir in the period from 2006-2010 based on records from the Department of Wildlife and National Parks, Malaysia.

Methodology

DWNP's database was searched for "displacement of tapirs" and "tapirs", which includes monthly reports from State offices, information on wildlife disturbance cases, local zoos and reports from the general public (phone, email, e-service, presence). "Displaced" tapirs also include individuals that were rescued or captured and subsequently relocated to zoos, the conservation centre or, for the healthy individuals, released into forested areas or wildlife reserves.

Results

The total number of displaced Malayan tapirs for the 2006-2010 period was 142 individual with the number generally increasing gradually from 2006 to 2010 (Fig.1). The highest and lowest numbers of displaced Malayan tapir was recorded in 2008 and 2006, with 39 and 15 individuals, respectively. The five states with the highest number of displaced individuals were Pahang (46), followed by Johor (32), Negeri Sembilan (21), Selangor (17) and Terengganu (15) (Fig. 2). These states also enjoys the highest degree of urbanization and agricultural development, where the original extent of forest cover has declined the most (JPSM, 2008).

Zainal Zahari *et al*. (2001) reported that Pahang had the highest number of displacement of large mammals over a 25 year period. The current study reveals that the highest reported number of Malayan tapir displacements still occurs in Pahang (Fig. 2). The highest displacement rate occurs in human settlement and agricultural areas with 48% and 31% of the total displacements, respectively (Fig. 3). "Human settlement" is defined as villages and traditional indigenous settlements of the *orang asli*.

Of the total of 142 recorded displacements, 95 individuals were returned to the wild, 12 were rescued but died due to injuries sustained prior to capture, 15 were already dead upon the arrival of DWNP's officers (primarily road accidents), and 20 individuals were

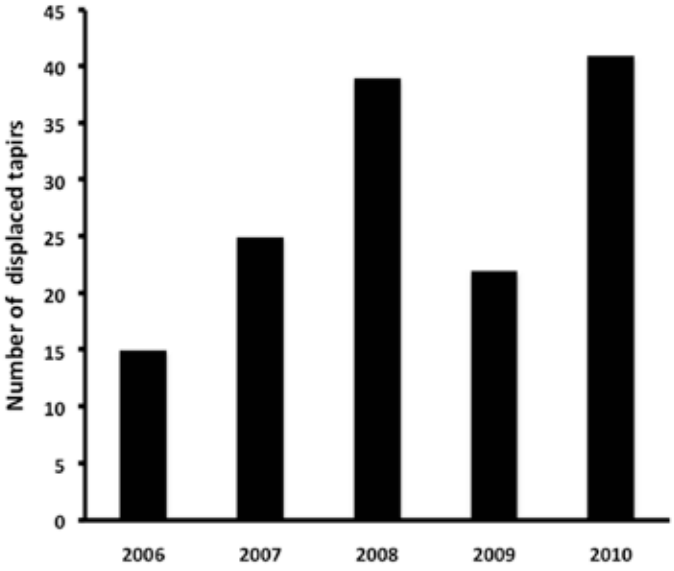

Figure 1: The number of displaced Malayan tapirs in Peninsular Malaysia from 2006 to 2010.

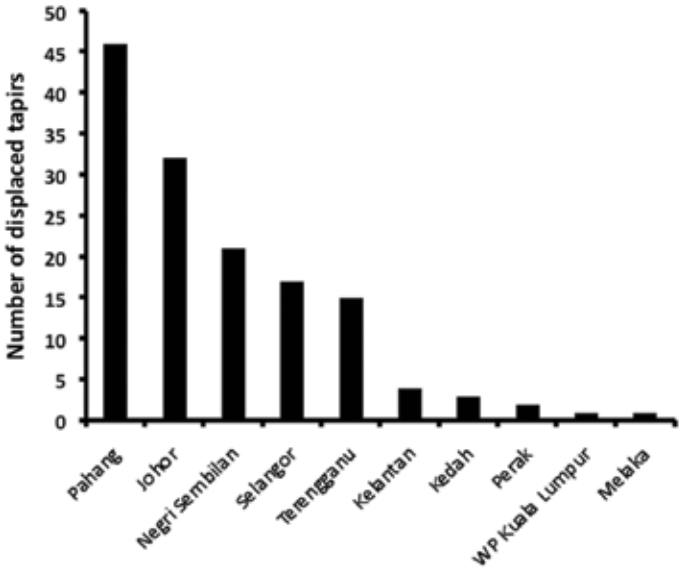

Figure 2: The number of displaced Malayan tapirs in different states of Peninsular Malaysia from 2006 to 2010.

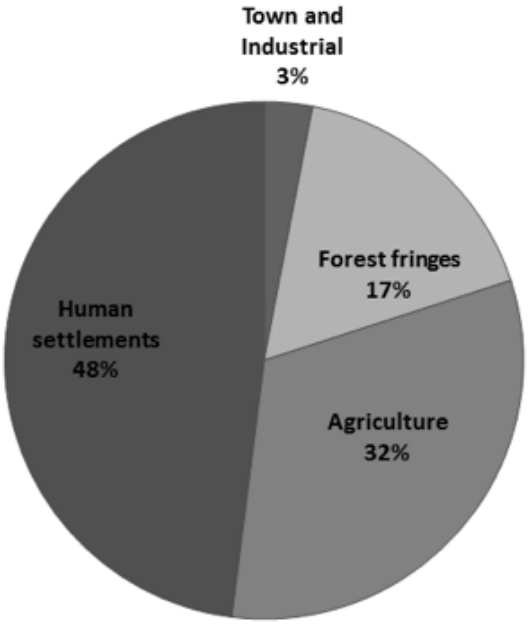

Figure 3: The percentage of displaced Malayan tapirs according to the site of occurrence.

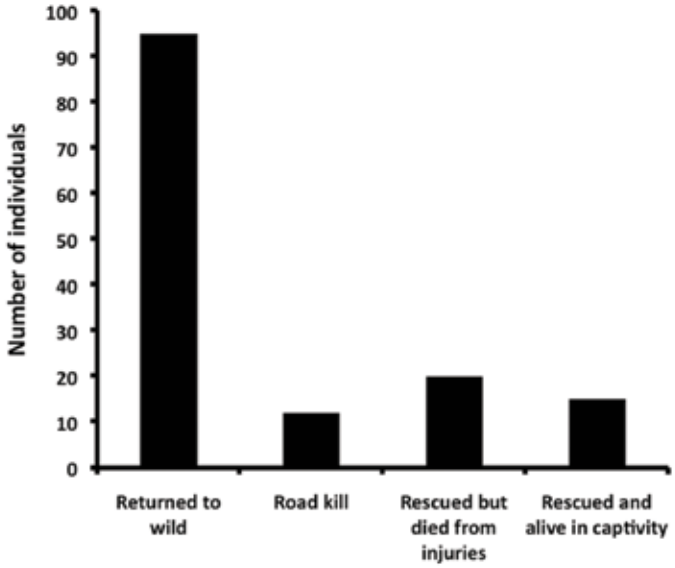

Figure 4: The actions taken and the fate of displaced Malayan tapirs in the period 2006-2010 in Peninsular Malaysia.

rescued and brought into captive facilities for treatment and rehabilitation (Fig. 4). All individuals that were rescued in healthy condition and close to natural forest habitats were released immediately again. Individuals in need of veterinarian treatment and care were brought into captivity with some undergoing a rehabilitation process and others retained as captive breeding stock. Of the 32 individuals brought into captive facilities, Sungai Dusun Wildlife Conservation Centre received 11 individuals, seven individuals were sent to Melaka Zoo, eight were released after rescue and six died a few days later as a result of injuries sustained prior to capture.

Discussion

The largest remaining natural habitat on Peninsular Malaysia is found in Pahang state. Yet, 46 (32.4%) Malayan tapir individuals were recorded as displaced in Pahang (Fig. 2), which is also the highest number in the country. Most of these records (63%) were from areas near to Pahang's state capital, Kuantan, that has experienced rapid development of new townships and industrial complexes in areas surrounding it. Similar displacement trends appear in other states with, originally, large natural habitats such as Johor, Negri Sembilan, Selangor and Terengganu that are also subject to rapid urban and industrial development (Fig. 2). At the same time, most of the displaced individuals occurred in semi-urban and agricultural areas (Fig. 3), which suggests that habitat loss and fragmentation are indeed key reasons for wildlife displacements in Peninsular Malaysia. The average annual forest loss in Malaysia during the 1990s was estimated to be modest at approximately 1.2% (FAO, 2009) and, while this loss is largely attributable to planned land-use changes in line with national development policies, the change in land-use has been dramatic enough to cause an increasing trend in large mammal displacements. There is a strong positive correlation between the percentage of agricultural land in a state and the number of displaced tapirs (Fig. 5; Pearson's R =

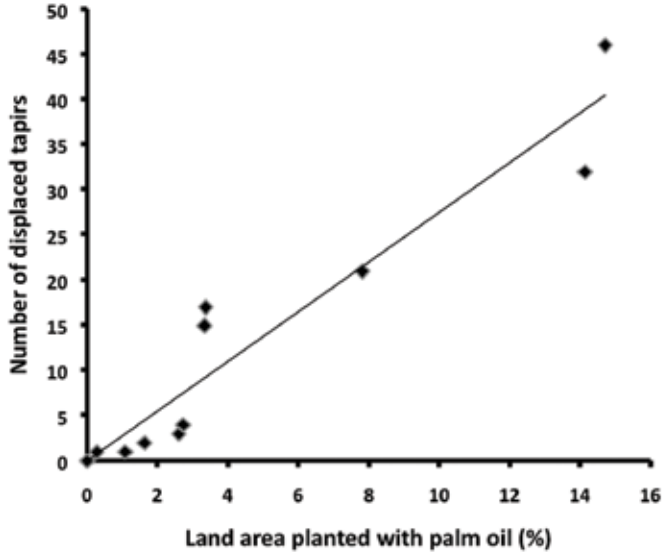

Figure 5. The correlation between agricultural development in % of land-area per state and the number of recorded tapir displacements (Pearson's R = 0.96). Palm oil is not necessarily the reason for tapir displacement, however, it is by far Malaysia's largest production crop in terms of hectares and competes with tapirs for the same type of habitat. The effect of habitat loss is similar irrespective of the type of agricultural or urban development that may take place in an area.

Figure 6. A wildlife viaduct constructed to mitigate the fragmentation effect of highway development in forested areas. The viaduct is designed to allow wildlife to disperse safely between forested areas on both sides of the highway and reduce the number of serious traffic accidents.

0.96). As expected, states without tapirs (Melaka, 3.2% forest; Pulau Pinang, 7.6% forest; Perlis, 13.7% forest; Federal Territory of Kuala Lumpur and Putrajaya, 9.6% forest) did not have displacement problems in the 2006-2010 period.

From 2006-2010 Perak recorded only two cases of displaced Malayan tapir, while Kedah and Kelantan recorded three and four cases respectively (Fig. 2). Whereas 18% of Perak state is considered agricultural land and only half of the state is covered by forest (JPSM, 2008), most of the forest is found in large continuous blocks of forests in the area known as the Banjaran Titiwangsa-Banjaran Bintang-Banjaran Nakawan range (Fig. 7). Albeit to a lesser extent, similar contiguous forests complexes are found in the states of Kelantan and Kedah, where displacement records are also very low (Fig. 2). In contrast to this, the forests in Pahang and Johor are becoming increasingly fragmented with most tapir habitats found as part of protected areas such as Taman Negara National Park, Krau Wildlife Reserve and Endau-Rompin state parks.

DWNP's "displacement records" do not capture all incidents of displaced animals. Naturally, some incidents are never reported whereas others may be false claims. To ensure records are reliable and usable, the details of "complainers" were recorded; including name, contact number, address and location, after which DWNP staff and the "complainer" make a site visit to verify the reported displacement. Signs of Malayan tapir (e.g. feeding signs, feces, footprints) are recorded along with location waypoint, nearest forest reserve and type of adjacent habitat. Therefore, we consider the data that forms the foundation of this study to be reliable.

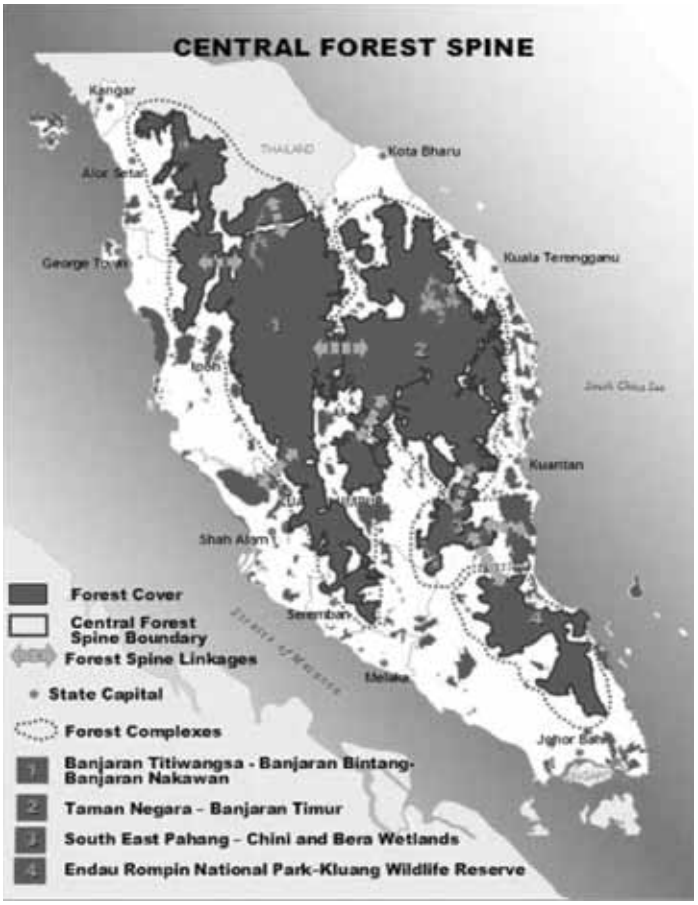

Figure 7. Peninsular Malaysia illustrated with the main forest complexes

Local communities frequently file reports to DWNP, when they spot a Malayan tapir wandering through orchards or village areas. Since many villages and orchards are often found near the tapirs' natural habitats, such incidents are common. The question remains if these can be considered "displaced" individuals that warrants DWNP's intervention? With many villagers depending on home-grown crops, potential human-wildlife conflicts often necessitates DWNP's proactive interference, even if roaming tapirs are not essentially "displaced" in ecological terms.

As a response to the increasing number of displaced Malayan tapirs, DWNP has made several initiatives aimed at reducing wildlife related problems emerging from habitat loss and fragmentation. Since the displacement of tapirs and other large mammals species often leads to human-wildlife conflicts and serious road accidents, three wildlife viaducts were built in 2006 to act as safe highway crossing points for wildlife within northern forest complex (Fig. 6). Another three viaducts are being built along the Kuala Lipis – Gua Musang highway to the west of Taman Negara National Park. DWNP anticipates that these wildlife viaducts effectively reduces the negative effects of fragmentation resulting from infrastructure development, because they allow for animal dispersal that simulates natural

circumstances. Other mitigation actions consists of erecting "wildlife crossing" signboards at known wildlife crossing hotspots, setting up electric fences and conducting public awareness programmes, such as the Biodiversity Education Programme and the Local Community extension programme.

At policy level, Malaysia has formulated various plans with a potential to improve wildlife conservation and management tremendously. The National Tiger Action Plan 2008-2020 lays out specific actions for securing viable tiger populations, including its prey, in Malaysia for the next century and beyond (DWNP, 2008). In 2005, the National Physical Plan (DTCP, 2005) identified the Central Forest Spine as the core forest area to conserve and to reconnect important fragmented forest complexes for better protection of the environment and biodiversity (Fig. 7). In the implementation of the Central Forest Spine plan, DWNP plays a key role.

In conclusion, the displacement of tapirs in Peninsular Malaysia increased in the 2006-2010 period, which is primarily due to habitat loss and fragmentation. However, if there is effective implementation of two key National Plans i.e. the "National Tiger Action Plan" and the "National Physical Plan" the future seems bright for Malayan tapirs. In the meantime, DWNP continues to mitigate the effect of habitat loss and fragmentation by promoting the construction of wildlife viaducts[1], carrying out translocation of displaced individuals, putting up road signs and electric fences and, finally, conducting awareness programs.

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[1] Currently, there are ongoing studies aiming to measure the effect of wildlife viaducts to evaluate if wildlife do indeed make use of this type of facility.

A preliminary investigation of the status and threats to Malayan tapir *Tapirus indicus* in the Taninthayi Nature Reserve, Myanmar.

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Abstract

The Tenasserim Range along the Thailand – Myanmar border is one of largest forested landscapes(>110,000km2) in the global range of the Malayan Tapir *Tapirus indicus* but little is known about their status, distribution and current threats there. On the Myanmar side of the border, only one protected area, the 1700 km2 Taninthayi Nature Reserve, conserves tropical rainforests and affords biodiversity protection. During March to June 2011 surveys were conducted using camera-traps, tracks and sign, and interview methods. Over 60 km of trails were walked and tapir tracks and/or sign were detected at three of twelve survey routes. Over 630 trap nights recorded 2774 pictures of 19 species of mammals, including tapirs. At least three individual tapirs were recorded by camera-traps in two mineral licks in the core zone of the Reserve. A third of 119 interviewees reported having eaten tapir meat in the last 14 years. At least 26 tapirs were killed by local hunters and elephant capturers within the last two decades. Tapirs were also accidentally killed in pit fall traps and during commercial logging operations prior to the Reserve being gazetted. The short-term conservation priority for tapirs is to reduce poaching and accidental killings of tapirs. In response to the threat, continuation of a ranger-training program is needed to raise capacity for law enforcement. Occupancy surveys and studies of the impact of infrastructure development on tapir habitats along with developing a tapir conservation awareness program for local people is needed in the medium-term future. In the long-term a regional conservation plan is recommended to guide effective conservation of Myanmar's Malayan tapir population and other important rainforest fauna.

Key words: Malayan Tapir, Myanmar, surveys, camera-traps, hunting, conservation management

Introduction

The Malayan Tapir *Tapirus indicus* occupies a patchy range that includes Myanmar. The species is considered globally threatened (IUCN, 2010) due to population decline caused by habitat loss and fragmentation and increasing hunting pressure throughout its range (IUCN/SSC, 2008). Malayan Tapir has been listed under CITES Appendix I. In Myanmar, the species is considered Totally Protected under the Protection of Wildlife and Protected Areas Law (State Law and Order Restoration Council Law No.583/94, 1994). However, the past and present distribution of tapir, ecology and potential threats in its natural habitats is poorly understood. Within Myanmar, the species is entirely restricted to the southern peninsular region, south of latitude 18oN (Yin, 1967), a land area between Thailand and the Indian Ocean. In this region there exists only one actively managed protected area, the Taninthayi Nature Reserve. Gazetted in 2005 the Reserve abuts extensive forest reserves to the south and north, and to the east lies adjacent to Thongpaphum Wildlife Sanctuary in Thailand's Western Forest Complex(Ministry of Forestry, 2009). To improve understanding of the distribution, abundance, ecology of Malayan Tapir a preliminary field investigation was carried out from March to June, 2011, to identify the major threats to Malayan tapirs in the Taninthayi Nature Reserve as well as learn about the status, abundance and distribution of the species in the area.

Study area

Taninthayi Nature Reserve covers 1700 km^2 located between Ye -Dawei (Tavoy) road in the west along with the Andaman Sea and Myanmar - Thailand border in the east (Ministry of Forestry, 2009). The Reserve is located administratively in Yebyu and Dawei townships of Dawei district in the northern part of Taninthayi Region in the south of Myanmar. The Reserve is geographically located between 14˚20'50" N

and 14˚57'55" N and 98˚ 5'10" E and 98˚ 31'32" E (Ministry of Forestry, 2009).

The climate in the study area is seasonally tropical monsoon with average annual rainfall near the study site of 5,326 mm, with about 145 rainy days from May to October. Average temperature ranges from 25 to 28 ˚C with the hottest month being March and the coldest in January.

Elevation ranges from 15m at the western boundary of the Reserve to 1400 m at the Myanmar – Thailand border. The terrain is rolling to hilly along the border areas and most of the southern portions are rugged to very steep and mountainous. The slopes in most parts of the area exceed 37. The Reserve is almost completely covered by tropical rain forest in the higher elevation of the mountain range. The forest is associated with deciduous hardwood and bamboo forest in the lowland. The canopy layer (40-60 m) is dominated by evergreen tree species including *Dipterocarpus costatus*, *Dipterocarpus turbinatus*, *Hopea odorata*, *Dysoxylum excelsum*, *Sweintonia schwenkii* in association with deciduous species, *Parkia sumatrana* and *Tetrameles nudiflora*. Understory species are mostly evergreen with the common understory species being *Polyalthia simiarum*, *Shima wallichii*, *Diospyros brandisiana* and *Cinnamomum iners* while some shrub and treelet species includes *Microtropis bivalves*, *M. discolor*, *Leea indica*, *L. xora* and *L. diversofolia*. Several rattan species of the genus Calamus, and some bamboo species such as *Dentrocalamus longispathus* and *Gigantochloa apus* of bamboo species are found in the study area (Maxwell, 2001, Thein, 2007).

Table 1. Deforestation in and around the Taninthayi Nature Reserve from 1990 – 2006 (Assessments made from Landsat 5 TM scenes of 1990, 2000 and 2006: RS/GIS section: 2009).

Areas	Reserve Area Only (ha)			10 km Buffer Only (ha)		
Year	1990	2000	2006	1990	2000	2006
Total evergreen forest cover	151330	136681	132409	54129	49459	44235
Annual deforestation rate (ha)		-1465	-712		-467	-871

Methods

Interviews

A total of 13,587 people live in 2,761 households inside 23 villages near the western and southern boundaries of the Reserve. The Mon, Karen (Kayin), Dawei and Bamah ethnic groups are the largest entities. Overall, Dawei people are the most dominant ethnic group, representing about 40% of the population residing in the area (Ministry of Forestry, 2009). Interviews were conducted at villages around the Reserve to obtain general information on livelihoods, the past and present status of Malayan tapirs, and potential threats to tapirs from human use and other factors. Interviews were mainly conducted with hunters and forest users,

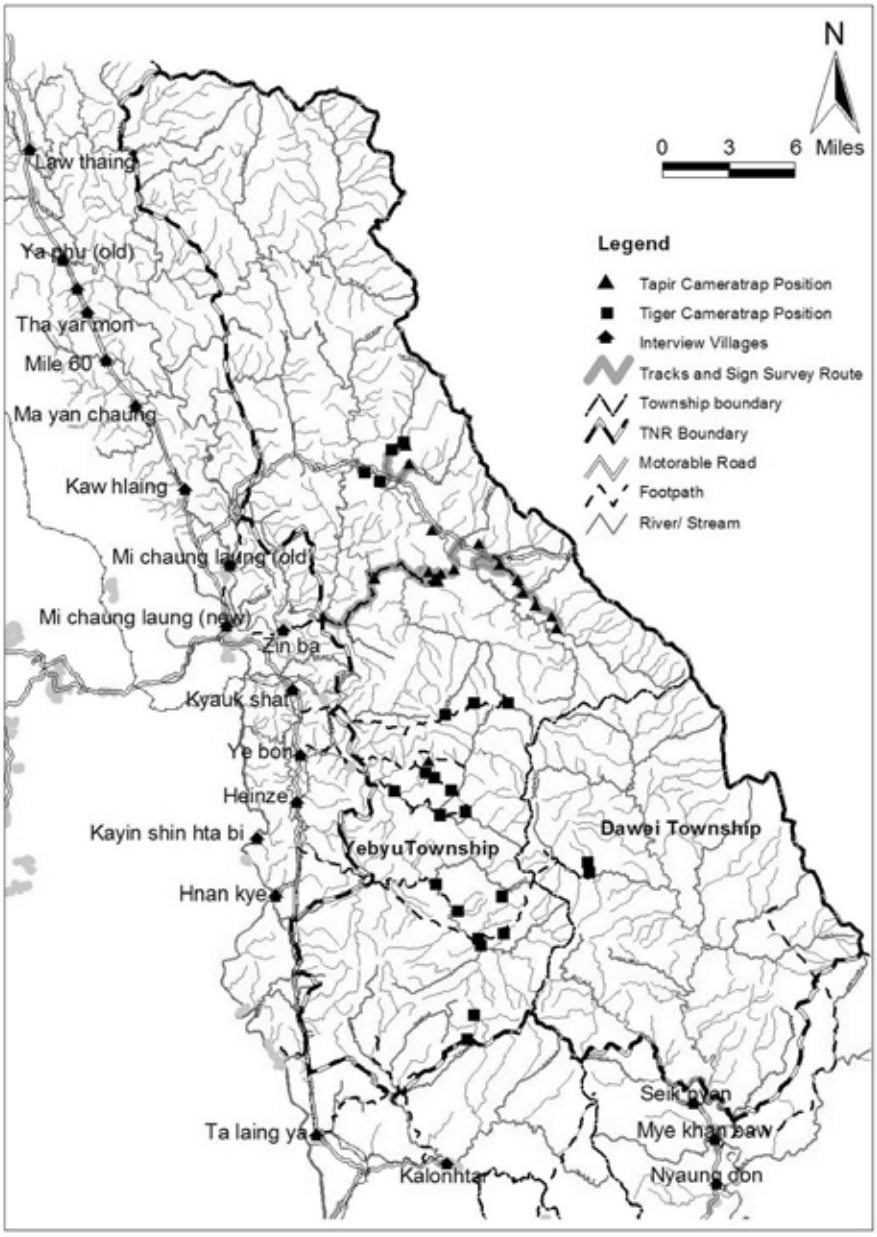

Figure 1. Interview, camera-trap and track and sign survey locations in the Taninthayi Nature Reserve.

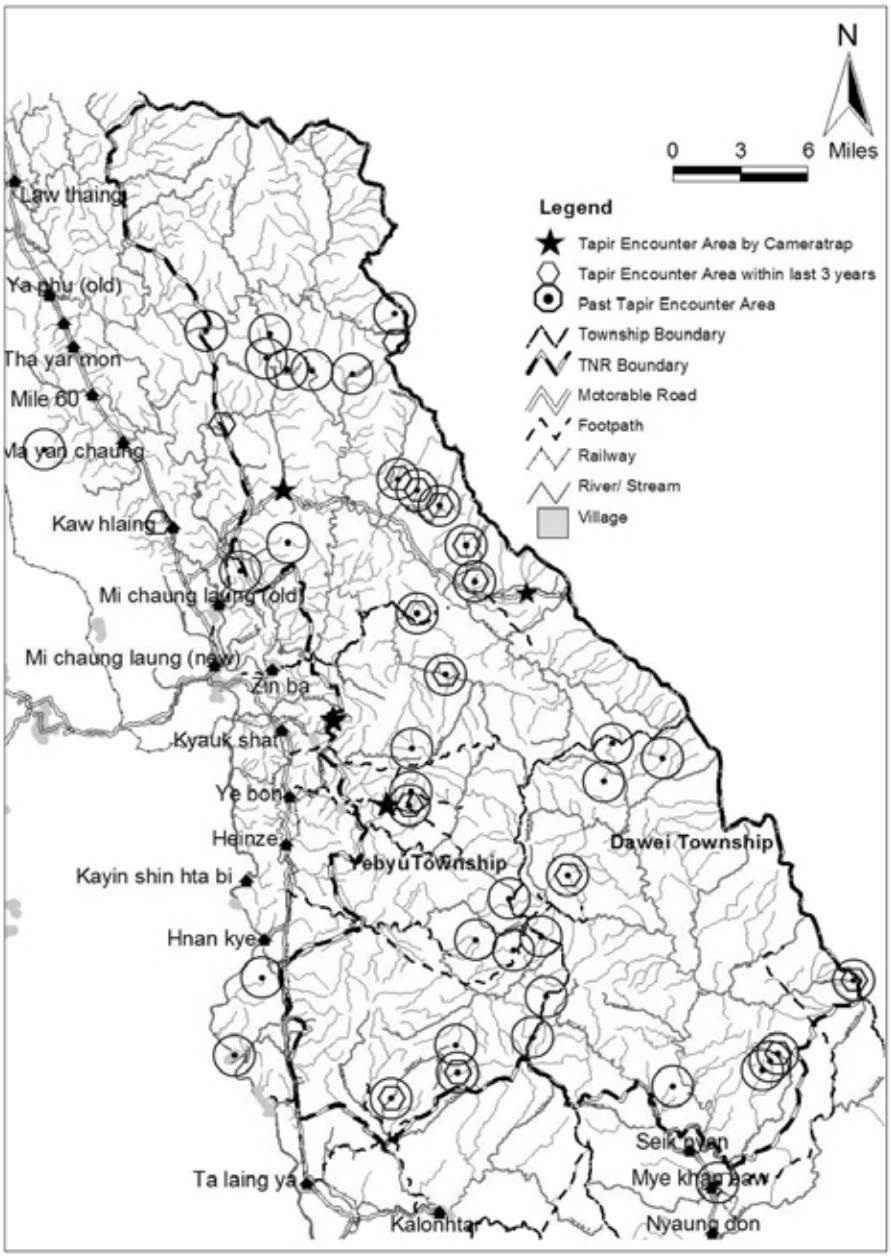

Figure 2. Past and present distribution of tapirs in the Taninthayi Nature Reserve, Myanmar.

especially long-time residents, who spend much time in the forest.

Camera-trapping

Camera-traps were placed to maximize capture rates for tapirs, based on results from previous survey reports and local information (Lynam, 1999, Trolle *et al.*, 2008, Traeholt & Mohamed, 2009) and other shy, cryptic and nocturnal large mammals. Camera-traps were placed in habitats potentially important to tapirs and at sites with a high probability of detecting tapirs (e.g. mineral salt licks, existing animal trails and mountain ridges) (Novarino *et al.*, 2005). Ten camera-traps (Bushnell Trophy Cam model # 119435/ 119445/ 119455) were used in the survey. Each camera-trap were mounted on a sturdy tree <5 meters away from the place to be monitored. The distance and sensing angle were tested before setting up the cameras. Cameras were set up to operate 24 hours, with 3 seconds time interval between pictures to minimize the chance of missing tapirs traveling in pairs (Holden *et al.*, 2003). Traps imprinted the date and time on every photo. No bait or lure was used to attract tapirs to the camera stations. Initially camera-traps were retrieved after 30 days but due to security concerns, some camera-traps had to be left in the forest for additional time. Information on tapirs generated by a previous tiger survey augmented the available data from our surveys.

Tracks and sign

Information from tracks and sign was used to define the extent of habitat use by tapirs away from camera-trap locations. Tapir tracks and dung piles were recorded along predetermined routes following trails, stream-beds and mountain ridges. Only fresh, clear and positively identifiable tracks were recorded. A field guide (Greenworld, 2003) was used for making positive identification of tapir tracks. Dung piles of tapirs were identified by local guides.

Results

Interviews

A total of 119 individuals from 21 communities and 2 military camps were interviewed about livelihoods, tapir distributions and threats (Fig. 1). Livelihoods of local people living around the Reserve consist mainly of horticulture crops such as betel nut, cashew nut, citrus species and rubber. But local people rely heavily on natural resources and augment their livelihoods by harvesting natural forest resources, such as timber and bamboo, or hunting wildlife for trade. Poachers from Thailand, local villagers and local officials also hunt in the Reserve. Security officials hunt gaur, sambar, wild pigs, barking deer, monkeys and small wildlife such as civet species or jungle fowl partly for their own use but mostly for sale at village markets in Kanbauk and Kalaingaung in Myanmar, with some trade going to Ban I-Taung across the border in Thailand. A fifth of

households around the Reserve keep home-made guns (282 guns reported used from 1,509 households) for use in hunting and self-defense.

Most Karen respondents were knowledgeable about tapirs, while Mon, Dawei and Bamah respondents were less familiar with tapirs. Over 90% of interviewees had encountered tapirs within the last 14 years. Out of 30 tapirs encountered, 10 were hunted, 15 were trapped inside elephant pit fall traps and killed, and a further 5 were trapped but released or not killed. Local elders advise their youth to avoid killing tapirs based on the belief that killing a tapir brings bad luck or even death. But some locals hunt tapir for local meat trade and almost a third of the respondents (29%) had eaten tapir meat. Large (5m x 2m x 2.5m) pit fall traps set to catch elephants during the period 1981 to 1996 cause accidental death of tapirs and other wildlife. The pit falls were covered with lengths of bamboo, small tree branches and camouflaged with forest debris but lie exposed now. Some respondents reported eating meat of tapirs trapped inside elephant pitfall traps while others intentionally hunt tapirs with weapons. Respondents who ate tapir meat noted that the meat is not good tasting and quite fibrous with tendons.

Camera-trapping

Tapirs were recorded 153 times from 631 trap-nights of sampling at nineteen camera-trap locations (Fig. 1). Altogether camera-traps recorded 19 species of mammals, a bird and a reptile for a total of 2,774 photo-records. Tapirs were the fifth most frequently detected species in camera-traps after Sambar (*Cervus unicolour*), Wild pig (*Sus scrofa*), Asian elephant (*Elephas maximus*) and Malay porcupine (*Hystrix brachyura*).

Tapirs may have permanent scarring on ears or on legs and flanks that facilitate distinguishing individuals (Lynam, 1999, Holden *et al*., 2003). Using scarring patterns, at least three individual tapirs were recognizable at two locations; two individuals (1 male and 1 female) were recorded upstream of the Khotama mineral saltlick (N 14° 45'03.7" E 098° 15' 24.1" elevation 177m asl) and one individual of unknown sex was recorded at Byak Ka Than salt lick near Make stream (N 14° 39'47.136" E 098° 16'40.097" elevation 146m asl). All detections of tapirs by camera-traps occurred between 20:00 and 06:00hrs. At the Khotama mineral lick where 149 detections of tapirs were made, peaks of activity were during the periods 21:00 – 22:00hrs, 0:00 – 02:00hrs and 05:00 – 06:00hrs.

Track and sign counts

Between 8th March and 18th May 2011, twelve transects totaling 62km were walked in search of large mammal tracks and sign (Fig. 1). A total of 208 encounters of tracks or sign of 12 species or groups of large mammals were recorded (Sambar, Muntjac spp., Chevrotain spp., Porcupine spp., Civet spp. Wild boar, Otter spp, Gaur, bear spp., Asian elephant, Tapir, and Serow). Tapirs were detected from single encounters of tracks or dung along each of three of the twelve transects.

Discussion

Tapir distribution

Despite its significant national and regional importance for biodiversity (Tordoff *et al*., 2005) southern Myanmar was unavailable for wildlife surveys for most of the last 60 years. In the last decade tiger-focused surveys detected Malayan tapirs from mixed evergreen – bamboo forests in the Pe River Valley and Htaung Pru Forest Reserve, to the south of the Taninthayi Nature Reserve (Lynam, 2003). In this study, due to security constraints it was not possible to survey areas >5km from the pipeline service track (Fig. 1). Our surveys from four areas inside the core zone of the Reserve detected a minimum of three individual tapirs. These individuals were repeatedly detected in camera-traps set at two major mineral licks, thus confirming the importance of mineral licks for tapirs (Holden *et al*., 2003, Novarino *et al*., 2005, Traeholt & Mohamed, 2009). Camera-trap surveys done for tigers along streams, ridges and a hot spring in four other locations in the southern part of the Reserve prior to our surveys (Fig. 1) failed to detect tapirs (Maung, 2011).

The past and present records of tapirs in the Reserve are shown in Fig. 2. Of 41 locations where tapirs were historically recorded, there was indirect evidence from recent reports of tapir presence from 13 locations (32%), plus an additional three new reported locations. The recent reports come from areas close to roads and human habitations in the lowlands in the west of the Reserve through to core forest upland areas at the Thai – Myanmar border in the east. This suggests that the range of tapirs inside the Reserve may have contracted in recent years and begs consideration of the threats facing the species that has led to this situation.

Threats to tapirs

Natural predators of tapirs at Reserve may include large carnivores confirmed from camera-trap records in this study (Dhole *Cuon alpinus*), others recorded by previous surveys (Tiger *Panthera tigris*; Maung 2011) or potentially present but not yet confirmed (Leopards *Panthera pardus*). However, one old report suggests of tapirs, that carnivores "appear not to be keen on hunting it" (Peacock, 1933).

Tapirs are threatened primarily by opportunistic hunting and accidental death caused by old disused or seldom used traps for elephants. Hunting appears to

be a recent phenomena since historical reports indicate tapirs were seldom hunted in the past (Peacock, 1933). During the camera trap survey, four photographs of hunters were observed at three locations, including locations where tapirs were recorded; Khotama and Make Byat Ka Than, and at the U Kyaing mine area. According to interview responses, abandoned pit fall traps have trapped tapir, elephants, tigers, leopards, gaurs, sambars, wild pigs, macaques, and people. It is estimated that 500 elephant pit fall traps remain abandoned and open in the Reserve thus posing a continuing threat to wildlife and people. The number of tapirs reported illegally or accidentally killed in the Reserve is equivalent to the estimated population (25 – 30) of a site at Krau Wildlife Reserve, Malaysia (Traeholt & Mohamed., 2009).

Satellite imagery indicates the deforestation rate inside the Reserve between 2000 – 2006 was about half that between 1990 and 2000 (Table 1). During 2010 – 2011 99 tonnes of timber was confiscated from illegal loggers and by patrol staff. Thus proactive enforcement may have helped to further reduced deforestation rates inside the Reserve. In contrast, deforestation inside the 10km buffer zone increased between the same periods due to expansion of shifting cultivation, logging, and mining activities (Ministry of Forestry, 2009). Also, there have been massive changes in land use patterns in forest reserves adjacent to the Reserve. Parts of these reserves have been entirely converted to rubber and oil palm estates, creating forest edges and fragmenting forest corridors. A planned infrastructure project will result in a loss of a 200m wide corridor of forest from the port of Dawei to the Thailand border passing within a few kilometres of the southern boundary of the TNR, thus completely severing the forest connectivity between the Reserve and forest reserves to the south.

Wild tapirs are susceptible to some diseases of cattle and horses (Janssen *et al*., 1999, Janssen, 2003, Kaewamatawong *et al*., 2010). In 2004 an anthrax and foot and mouth disease epidemic affected the Kalaingaung Township. Currently an unidentified disease is currently affecting cattle in the Gangawtaung area (U Shwe, pers. comm.) Although livestock are not grazed inside the TNR, smuggling of domestic cattle through the Reserve to the Thai border may cause the spread of such diseases to tapirs and other wild ungulates.

Conclusions

This preliminary study has confirmed the presence of a resident population of Malayan Tapir from the Taninthayi Nature Reserve, the only actively managed protected area in southern Myanmar. Our surveys involving Forest Department rangers have identified some of the key mineral licks used by tapirs inside the core zone, and established that hunting and accidental deaths are the main threats to the population, with potential habitat loss threatening future connectivity of the population with other forest reserves to the south. The immediate conservation priorities for tapirs in the Taninthayi Nature Reserve are:

1. Locate, map and deactivate (filling) old elephant pitfalls in the Reserve to reduce the risk of accidental death of tapirs
2. Increase the frequency and spatial coverage of anti-poaching patrols in the core zone
3. Determine the impact of the proposed transportation corridor on movement of tapirs and other large mammals between the Reserve and forest reserves to the south
4. Development of a National Tapir Action Plan that will identify short-term and medium term priorities such as surveys, behavioural ecology studies, habitat types and occupancy rates as well as viability of corridors and monitoring of potential cattle borne diseases in adjacent farms. A National Tapir Action Plan should contribute to the regional conservation strategy for southern Myanmar.

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TAPIR SPECIALIST GROUP

INSTRUCTIONS FOR AUTHORS

Scope

The Tapir Conservation, the Newsletter of the IUCN/SSC Tapir Specialist Group aims to provide information regarding all aspects of tapir natural history. Items of news, recent events, recent publications, thesis abstracts, workshop proceedings etc concerning tapirs are welcome. Manuscripts should be submitted in MS Word (.doc, at this moment we cannot accept documents in .docx format).

The Newsletter will publish original work by:

- Scientists, wildlife biologists, park managers and other contributors on any aspect of tapir natural history including distribution, ecology, evolution, genetics, habitat, husbandry, management, policy and taxonomy.

Preference is given to material that has the potential to improve conservation management and enhances understanding of tapir conservation in its respective range countries.
The primary languages of the Newsletter are English and Spanish. Abstracts in English are preferred.

Papers and Short Communications

Full Papers (2,000-5,000 words) and Short Communications (200-2,000 words) are invited on topics relevant to the Newsletter's focus, including:

- Research on the status, ecology or behaviour of tapirs.
- Research on the status or ecology of tapir habitats, including soil composition, mineral deposits (e.g., salt licks) and topography.
- Husbandry and captive management.
- Veterinarian and genetic aspects.
- Reviews of conservation plans, policy and legislation.
- Conservation management plans for species, habitats or areas.
- Tapirs and local communities (e.g., hunting, bush meat and cultural aspects).
- Research on the ecological role of tapir, for example, seed dispersers, prey for predators and facilitators of forest regrowth.
- Natural history and taxonomy of tapirs (e.g., evolution, palaeontology and extinction).

How to Submit a Manuscript
Manuscripts should be submitted in ***electronic format*** by e-mail to the contributions editor at the email provided. Hard copies will not be accepted.
Contributions Editor:
Carl Traeholt
e-mail: ctraeholt@pd.jaring.my

In the covering e-mail, the Lead Author must confirm that:

a) the submitted manuscript has not been published elsewhere,

b) all of the authors have read the submitted manuscript and agreed to its submission,
all research was conducted with the necessary approval and permit from the appropriate authorities and adhere to appropriate animal manipulation guides.

Review and Editing

All contributors are strongly advised to ensure that their spelling and grammar is checked by native English or Spanish speaker(s) before the manuscript is submitted to the Contributions Editor. The Editorial Team reserves the right to reject manuscripts that are poorly written.

All manuscripts will be subject to peer review by a minimum of two reviewers. Authors are welcome to suggest appropriate reviewers; however, the Contributions Editor reserves the right to appoint reviewers that seem appropriate and competent for the task.

Proofs will be sent to authors as a portable document format (PDF) file attached to an e-mail note. Corrected proofs should be returned to the Editor within 3 days of receipt. Minor corrections can be communicated by e-mail.

The Editorial Team welcomes contributions to the other sections of the Newsletter:

News
Concise reports (<300 words) on news of general interest to tapir research and conservation. This may include announcements of new initiatives; for example, the launch of new projects, conferences, funding opportunities, new relevant publications and discoveries.

Letters to the Editor
Informative contributions (<650 words) in response to material published in the Newsletter.

Preparation of Manuscripts

Contributions in English should make use of UK English spelling [if in doubt, Microsoft Word and similar software can be set to check spelling and grammar for "English (UK)" language]. The cover page should contain the title and full mailing address, e-mail address and address of the Lead Author and all additional authors. All pages should be numbered consecutively, and the order of the sections of the manuscript should be: cover page, main text, acknowledgement, tables, figures and plates.

Title
This should be a succinct description of the work, in no more than 20 words.

Abstract
Full Papers only. This should describe, in 100-200 words, the aims, methods, major findings and conclusions. It should be informative and

INSTRUCTIONS FOR AUTHORS

intelligible without reference to the text, and should not contain any references or undefined abbreviations.

Keywords
Up to five pertinent words, in alphabetical order.

Format
For ease of layout, please submit all manuscripts with a minimum of formatting (e.g. avoid specific formats for headings etc); however, the following is needed:

- Manuscripts should be double-spaced.
- Submissions can be in 'doc, 'rtf' or 'wpd' format, preferably as one file attached to one covering email.
- **Avoid** writing headlines in CAPITAL letters.
- Font type and size should be Times New Roman # 12
- Font type for tables should be Arial and 0.5 dot lines.
- 1 inch (2.54 cm) margins for all margins
- Number pages consecutively starting with the title page , numbers should be on the bottom right hand corner
- Font type for tables should be Arial and 0.5 dot lines.
- Pictures and illustrations should be in as high resolution as possible to allow for proper downscaling and submitted as separate files in EPS or JPG format.

References
References should be cited in the text as, for example, MacArthur & Wilson (1967) or (Foerster, 1998). For three or more authors use the first author's surname followed by *et al.*; for example, Herrera *et al.* (1999). Multiple references should be in *chronological order*. The reference list should be in *alphabetical order*, and article titles and the titles of serial publications should be given in full. In cases where an author is referenced multiple times the most recent publication should be listed first. Please check that all listed references are used in the text and vice versa. The following are examples of house style:

Journal Article
Herrera, J.C., Taber, A., Wallace, R.B. & Painter, L. 1999. Lowland tapir (*Tapirus terrestris*) behavioural ecology in a southern Amazonian tropical forest. Vida Silv. Tropicale 8:31-37.

Chapter in Book
Janssen, D.L., Rideout, B.A. & Edwards, M.S. 1999. Tapir Medicine. In: M.E. Fowler & R. E. Miller (eds.) Zoo and Wild Animal Medicine, pp.562-568. W.B. Saunders Co., Philadelphia, USA.

Book
MacArthur, R.H. & Wilson, E.O. (1967) *The Theory of Island Biogeography*. Princeton University Press, Princeton, USA.

Thesis/Dissertation
Foerster. C.R. 1998. Ambito de Hogar, Patron de Movimentso y Dieta de la Danta Centroamericana (Tapirus bairdii) en el Parque Nacional Corcovado, Costa Rica. M.S. thesis. Universidad Nacional, Heredia, Costa Rica.

Report
Santiapilli, C. & Ramono, W.S. 1989. The Status and Conservation of the Malayan tapir (*Tapirus indicus*) in Sumatra, Indonesia. Unpublished Report, Worldwide Fund for Nature, Bogor, Indonesia.

Web
IUCN (2007) *2007 IUCN Red List of Threatened Species*. Http://www.redlist.org [accessed 1 May 2009].

Tables, figures and plates
These should be self-explanatory, each on a separate page and with an appropriate caption. Figures should be in black and white. Plates will only be included in an article if they form part of evidence that is integral to the subject studied (e.g., a camera-trap photograph of a rare situation), if they are of good quality, and if they do not need to be printed in colour.

Species names
The first time a species is mentioned, its scientific name should follow without intervening punctuation: e.g., Malay tapir *Tapirus indicus*. English names should be in lower case throughout except where they incorporate a proper name (e.g., Asian elephant, Malay tapir).

Abbreviations
Full expansion should be given at first mention in the text.

Units of measurement
Use metric units only for measurements of area, mass, height, distance etc.

Copyright
The copyright for all published articles will be held by the publisher unless otherwise stated.

Publisher
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www.tapirs.org

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