Journal of

Indonesian Natural History

December 2016 Vol.4 No.2

Journal of Indonesian Natural History

Editors

Editorial board

The *Journal of Indonesian Natural History* is published biannually by the Department of Biology at the Andalas University, Padang, Sumatra Barat, Indonesia, in collaboration with Copenhagen Zoo, Denmark. The Department of Biology at Andalas University is dedicated to educating Indonesian biologists in the study and conservation of Indonesia's biodiversity and natural history. Copenhagen Zoo, through its Research and Conservation Division, supports *in-situ* conservation in Southeast Asia by assisting local organizations and individuals who undertake research, capacity building and the implementation of conservation programmes and projects.

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Cover photo: Adult banteng bull, *Bos javanicus*. caught on camera trap in Baluran National Park © Copenhagen Zoo

News and Notes

Human induced changes to the jet-stream

Most scientists agree that the Earth is currently undergoing a significant warming. However, in what way it will affect the various climatic parameters is still very much being debated. Ever since 2012, scientists have presented a complex idea about how a warming planet will alter our weather. If it's correct, it could have profound implications across the Northern Hemisphere and especially in its middle latitudes, where hundreds of millions of people live.

The idea is that climate change doesn't necessarily only alter meteorological variables (e.g. rainfall, heat surges), but it could possibly change the flow of weather itself. By altering massive planet-scale air patterns like the jet stream (Fig.1), which flows in waves from west to east in the Northern Hemisphere, a warming planet causes the weather to become fixed. In practise, this means that a given weather pattern, for example, drought or flood, may persist for longer, thus driving extreme weather patterns (e.g. droughts, heat waves, downpours).

While this hypothesis continues to attract criticism and stir debate, more evidence seems to suggest that the idea is not that far fetched after all. Michael Mann of Pennsylvania State University, in collaboration with scientists from the United States, Germany and the Netherlands recently published new findings that indicate that at least in the spring and summer, the large scale flow of the atmosphere is indeed changing in such a way

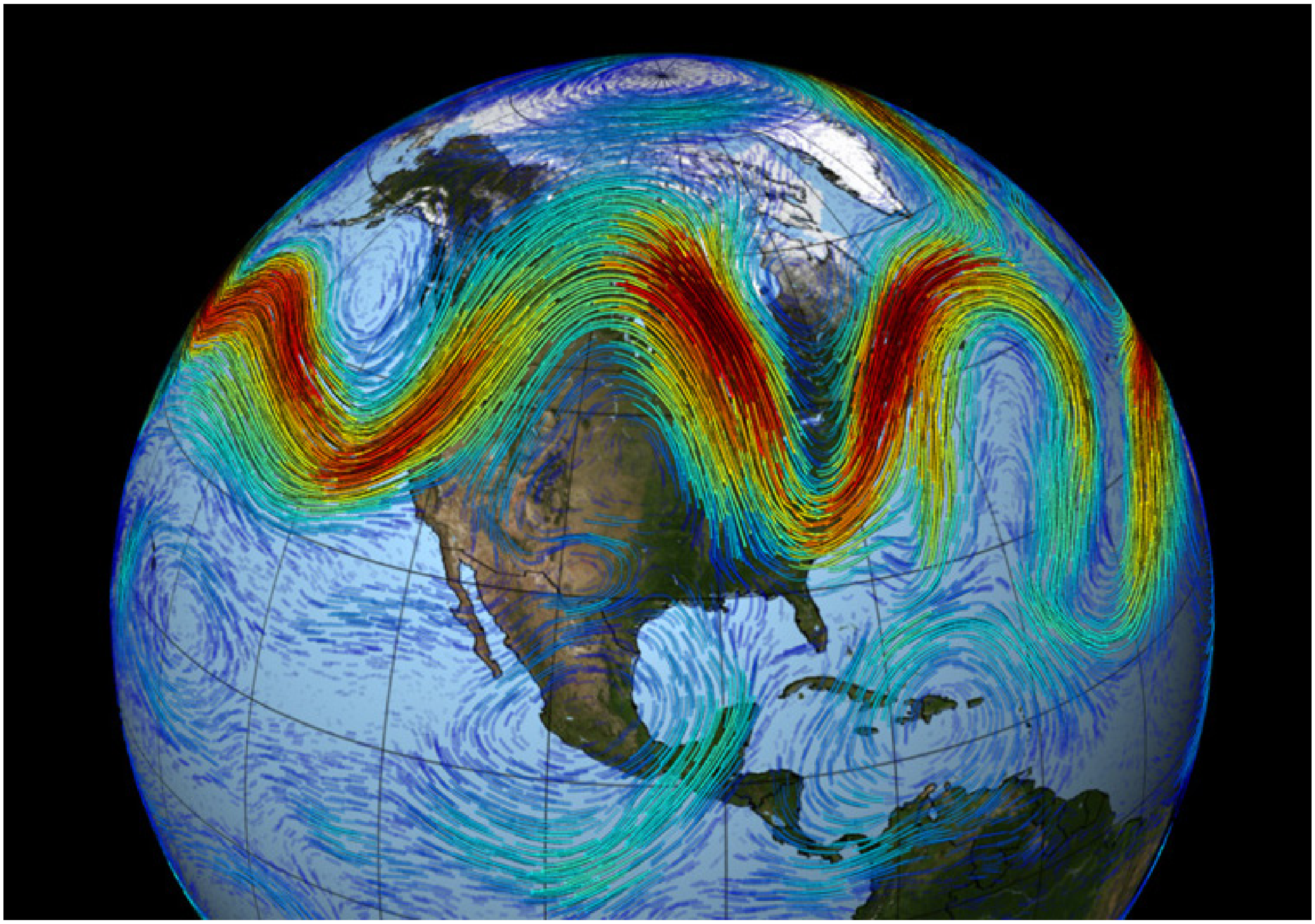

Figure 1. New research suggests that the northern hemisphere "jet stream" may be come fixed in space, due to rising global temperature, causing extreme weather patterns.

as to cause weather to get stuck more often. The idea is that the Northern Hemisphere jet stream flows in a wavy pattern from west to east, driven by the rotation of the Earth and the difference in temperature between the equator and the North Pole. The flow is stronger when that temperature difference is large. The problem arises when the Arctic warms up faster than the equator does, because the jet stream's flow can become weakened and elongated, hence causing weather extremes. The recent study predicts that this type of effect will likely occur during summertime, because the Arctic is much warmer.

Whereas an increasing number of scientists begin to praise the theory and the latest study, other have expressed considerable skepticism of these kinds of ideas. A recent study published in Nature Geoscience, for instance, called into question whether the Arctic's melting, and in particular its sea ice loss, has been causing winter cooling over Eurasia (McCusker et al, 2016), another idea that has been swept up in the debate over the jet stream and weather extremes. One of the authors of this study, John Fyfe, does not yet believe that Mann et al.'s theory is fully developed, although he confesses that it is a good start. Mann concurs and highlights that the current study only covers weather extremes in the spring and summer, and it is important that winter extremes are also included in the model in the future.

While the debate continues, so does science and the evidence that changing climate is leading to a changing pattern of atmospheric flow, with major implications for the weather. Exactly how it will play out across the Earth and who will feel the main brunt of it will probably only be known when it is too late.

Mann, M.E., Rahmstorf, S., Kornhuber, K., Steinman, B.A., Miller, S.K and D.Coumou (2017). Influence of Anthropogenic Climate Change on Planetary Wave Resonance and Extreme Weather Events. *Sci. Rep*. **7**: 45242; doi: 10.1038/srep45242 (2017).

McCusker, K.E., Fyfe, J.C. and M. Sigmond (2016). Twenty-five winters of unexpected Eurasian cooling unlikely due to Arctic sea-ice loss. *Nature Geoscience* **9**: 838–842

Antarctica is melting

Surface meltwater drains across ice sheets, forming melt ponds that can trigger ice-shelf collapse, acceleration of grounded ice flow and increased sea-level rise. Numerical models of the Antarctic Ice Sheet that incorporate meltwater's impact on ice shelves, but ignore the movement of water across the ice surface, predict a metre of global sea-level rise this century in response to atmospheric warming. I 2016, several new publications revealed increasing evidence that the Antarctic is melting --- and it is melting faster than ever. Kingslake et al. (2017) provide compelling evidence of widespread drainage of meltwater across the surface of the ice sheet through surface streams and ponds as far south as 85° S and as high as 1,300 metres above sea level. The teams findings were based on satellite imagery from 1973 onwards and aerial photography from 1947 onwards and are consistent with similar results published earlier in 2016 by Marsh et al (2016). Since surface drainage has persisted for decades, transporting water up to 120 kilometes from grounded ice onto and across ice shelves, feeding vast melt ponds up to 80 kilometres long. Large-scale surface drainage could deliver water to areas of ice shelves vulnerable to collapse, as recorded by Elsworth and Suckale (2016). There is nothing new in Antarctic surface melt ponds formation, however, Kingslake et al. discovered that ponds often form part of widespread, large-scale surface drainage systems. In a warming climate, enhanced surface drainage could accelerate future ice-mass loss from Antarctic, potentially via positive feedbacks between the extent of exposed rock, melting and thinning of the ice sheet.

With the ongoing Global temperature rise, Antarctic is getting warmer, providing new potential "settlement" opportunities for a range of microbes and other organisms. The ramification of this rapid icemelt on the sealevel is also well documented, however, the general response to the climate change challenge remains insignificant and sluggish across most of the world today.

Marsh, O.J., Fricker, H.A., Siegfried, M.R., Christianson, K., Nicholls, K.W., Corr, H.F.J and G. Catania (2016). High basal melting forming a channel at the grounding line of Ross Ice Shelf, Antarctica. *Geophysical Research Letters* **43(1)**: 250-255. DOI: 10.1002/2015GL066612

Elsworth, C. W., and J. Suckale (2016), Rapid ice flow rearrangement induced by subglacial drainage in West Antarctica, *Geophysical Research Letters* 43((22): 11, 697–11,707. doi:10.1002/2016GL070430.

Kingslake, J., Ely, J.C., Das, I and R.E. Bell (2017). Widespread movement of meltwater onto and across Antarctic ice shelves. *Nature* **544**: 349-352.

Antarctica is greening

On the 17th of January, 1773, the British maritime explorer, James Cook, became the first recorded human being to cross the Antarctic circle. For two months, Captain Cook and his crew, on board the two ships *Resolution* and *Adventure*, sailed along the ice-shelf in the hope of finding a gateway to the great southern continent (Fig.2). Captain Cook made two more attempts to find a passage through the ice in 1774 and 1775 before returning to England on the 30th of July, 1775. During the height of three southern summers, the sea ice stretched all the way to the Antarctic Circle and at the furthest southern point Captain Cook wrote that the ice "*extended east and west far beyond the reach of our sight, while the southern half of the horizon was illuminated by rays of light which were reflected from the ice to a considerable height...It was indeed my opinion that this ice extends quite to the Pole, or perhaps joins to some land to which it has been fixed since creation*". Little did he know two and half century later, Antarctica is greening.

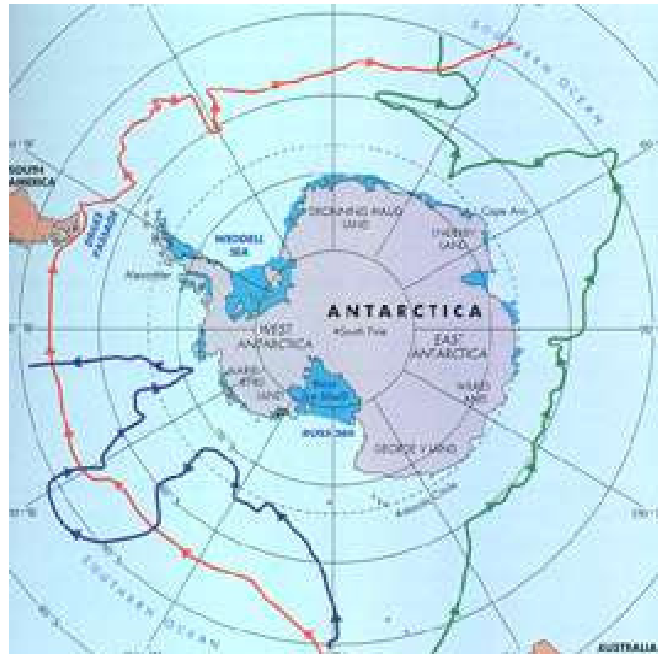

Figure 2. Captain Cook's journeys in his attempt to find the souther continent in 1773-1775.

Plant life only exists on about 0.3% of Antarctica and for centuries, it has been known as the desolate southernmost continent. However, a new study reveals that plant life has returned to Antarctica and is growing rapidly due to climate change. A team of scientists studying moss have found a sharp increase in biological activity in the last 50 years. They tested five cores from three sites and found major biological changes had occurred over the past 50 years right across the Antarctic Peninsula.

The recorded an increasing temperature over the past 50 years that have had a significant effect on the moss banks growing in the region. The team predicts that if this continues, and with increasing amounts of ice-free land from continued glacier retreat, the Antarctic Peninsula will be a much greener place in the near future.

Recent climate change on the Antarctic Peninsula is well documented, with warming and other changes such as increased precipitation and wind strength (see above news). Although weather records mostly began in the 1950s, biological records preserved in moss bank cores can provide a longer-term trends in climate change. The study analysed data for the last 150 years, and found clear evidence of increased biological activity in the past half century. This could result in Antarctic greening to similar levels as in the Arctic, where well-established observations have been ongoing for decades. The same group of researchers published a study focussing on one site in 2013, and the new research confirms that their unprecedented finding can be applied to a much larger region.

Amesbury, M.J., Roland, T.P., Royles, J, Hodgson, D.A., Convey, P., Griffiths, H. and D.J. Charman (2017). Widespread biological response to rapid warming on the Antarctic Peninsula. *Current Biology* **27**: 1616-1622. DOI: 10.1016/j.cub.2017.04.034

Carbon trading - current trends

In December, 2015, 195 nations signed on the Paris Climate Accord. This milestone agreement allows each nation to pursue its own way to limit CO2 excretion. One of the more common approaches is to tax CO2 indirectly by creating a carbon market, or directly by associating carbon with a tax. Forty countries and 24 sub-national regions (e.g. states, provinces) have already or are scheduled to make CO2 polluters pay with a national or regional price on carbon. Together, these carbon pricing initiatives cover almost 7Gt of carbon dioxide or about 13 percent of annual global GHG emissions. One notorious absentee from such systems, which most of the developed nations have implemented, including China and South Africa, is USA.

The World Bank, in collaboration with Ecofys and Vivid Economics, published its *State and Trends of Carbon Pricing* (2016). The Report summarises every Nation in the Paris Climate Accord's progress in reducing carbon excretion through putting a price on carbon itself. Whereas USA are notoriously absent and with the current government threatening to withdraw from the Paris Climate Accord, some states are taking independent steps towards developing a carbon free economy, along with most other nations in the world.

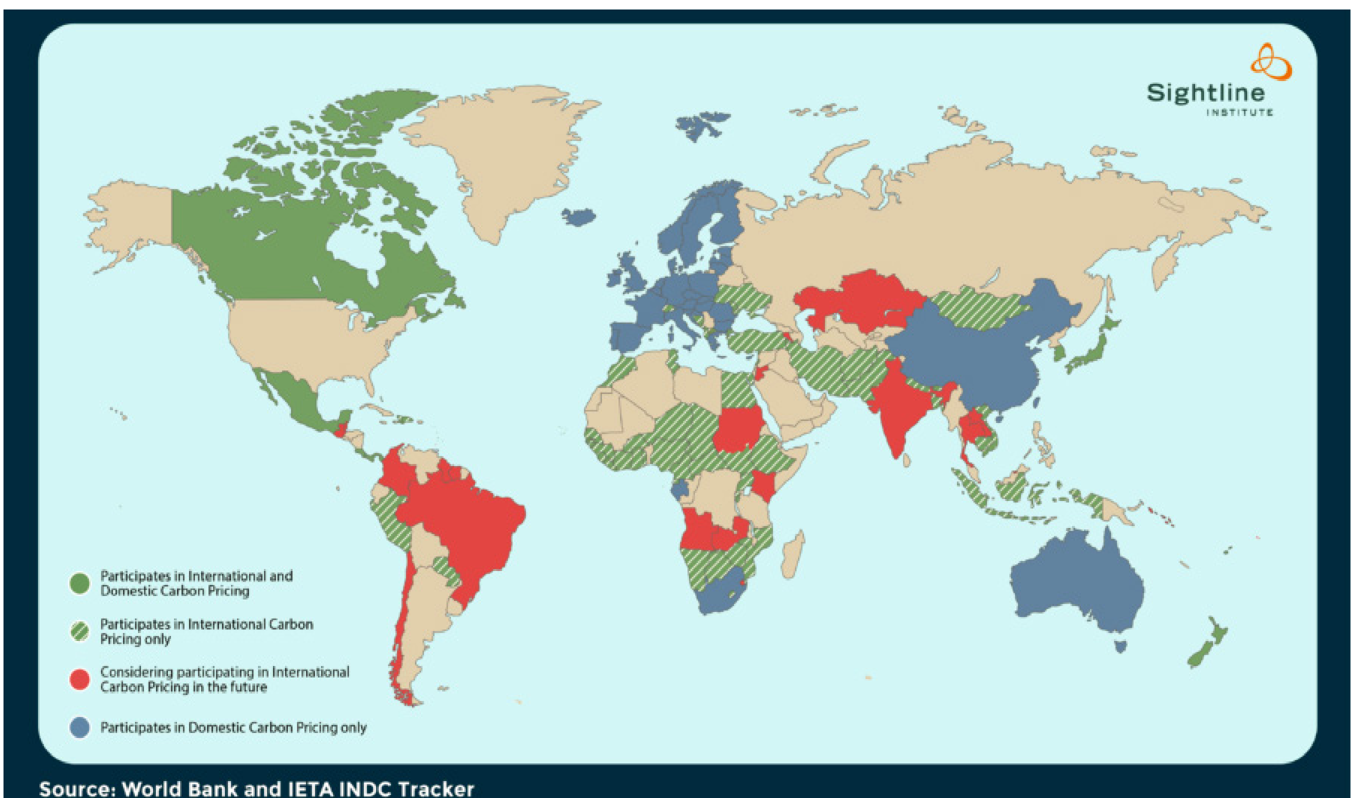

Figure 3. An increasing number of countries are using carbon price to regulate excessive CO_2 excretion and to meet the Paris climate goals. One noticeable absentee is the world's largest CO_2 polluter, USA.

Indonesia is one of the World's top contributors of CO2 as a nation. Per capita, however, Indonesia ranks as one of the lowest in the World. Nevertheless, Indonesia is exploring carbon trading opportunities, in stark contrast to wealthier countries like Thailand and Malaysia.

Globally, roughly two-thirds of covered emissions are covered by a cap-and-trade program, about one-third are covered by a carbon tax, and about one-quarter of the jurisdictions use both. Indonesia has the opportunity to implement both the systems in the near future.

World Bank, Ecofys and Vivid Economics (2016). State and Trends of Carbon Pricing. World Bank, Washington, DC.

Conservation priorities for SE Asia

Southeast Asian biodiversity is a global priority for conservation, due to the high levels of diversity and endemism, combined with some of the greatest levels of threat. Conservation planning is essential to ensure that hotspots of biodiversity and endemism have the protection needed to prevent deforestation, hunting and other forms of exploitation in some of the Southeast Asia's most diverse areas, yet this requires data which in many cases does not exist.

Growing volumes of online available data provides the ability to develop accurate models of species distributions, and gain new perspectives on regional diversity patterns and provide essential baseline data for planning and conservation.

Here, using the best available information I develop maps of the ranges of 2471 vertebrate (birds, mammals, reptiles and amphibians) and 1198 plant species, and explore patterns of biodiversity and the adequacy of protection. Each taxon shows different patterns of diversity, and no taxa provided an effective surrogate for diversity patterns in different groups. I show that for the majority of biodiversity hotspots fall outside protected areas, with between 10 and 55% of areas with at least > 75% of the maximum number of species unprotected. The percentage of species ranges protected areas also varies by taxa, from a maximum of 40% to reptiles with a mean of only 13.5% of species ranges protected. Furthermore comparison between my predictions and IUCN maps of diversity differed greatly for all taxa examined, with IUCN hotspots covering a much larger portion of the region and potentially overestimating the ranges of many species. Further efforts are needed to better protect centres of diversity, and the inclusion of these methods into regional conservation planning may greatly assist in increasing the effectiveness of conservation.

Hughes, A.C. (2017). Mapping priorities for conservation in Southeast Asia. *Biological Conservation* 209: 395–405.

Biological trade-offs and socio-economy of

trophy hunting

Although the contribution of trophy hunting as a conservation tool is widely recognised, there is perpetual debate and polarization on its sustainability. This review integrates five themes mostly considered in isolation, as independent research fields in wildlife conservation: (1)trophy quality and population ecology of hunted species, (2)behavioural ecology of hunted populations and associated avoidance mechanisms, (3)physiological stress in hunted populations, (4)genetic variability and desirable traits, and (5)socio-economic imperatives in wildlife conservation. We searched for

articles on search engines using specific key words and found 350 articles from which 175 were used for this review under five key themes. Population and trophy quality trends of commonly hunted species seem to be declining in some

countries. Elevated hunting pressure is reported to influence the flight and foraging behaviour of wildlife thus compromising fitness of hunted species. Selective harvesting through trophy hunted is attributed to the decline in desirable phenotypic traits and increased physiological stress in most hunted species. Though it provides financial

resources need for conservation in some countries, trophy hunting works well in areas where animal populations are healthy and not threatened by illegal harvesting and other disturbances. There remains much polarity on the sustainability of trophy hunting in modern-day conservation. More research need to be conducted across the five themes examined in this review for broader analytical analysis and comparison purposes. A new research agenda is needed regarding wildlife sustainable use principles and their sustainability and acceptability in modern-day conservation.

Muposhi, V.K., Gandiwa, E., Makuza, S.M. and P. Bartels (2017). Ecological, physiological, genetic trade-offs and socio-ecnomic implications of trophy hunting as a conservation toll: a narrative review. *The Journal of Animal & Plant Sciences* **27(1)**: 1-14.

Disrupting criminal wildlife trading networks

The onslaught on the World's wildlife continues despite numerous initiatives aimed at curbing it. We build a model that integrates rhino horn trade with rhino population dynamics in order to evaluate the impact of various management policies on rhino sustainability. In our model, an agent-based sub-model of horn trade from the poaching event up through a purchase of rhino horn in Asia impacts rhino abundance. A data-validated, individual-based sub-model of the rhino population of South Africa provides these abundance values. We evaluate policies that consist of different combinations of legal trade initiatives, demand reduction marketing campaigns, increased anti-poaching measures within protected areas, and transnational policing initiatives aimed at disrupting those criminal syndicates engaged in horn trafficking. Simulation runs of our model over the next 35 years produces a sustainable rhino population under only one management policy. This policy includes both a transnational policing effort aimed at dismantling those criminal networks engaged in rhino horn traffickingÐcoupled with increases in legal economic opportunities for people living next to protected areas where rhinos live. This multi-faceted approach should be the focus of the international debate on strategies to combat the current slaughter of rhino rather than thebinary debate about whether rhino horn trade should be legalized. This approach to the evaluation of wildlife management policies may be useful to apply to other species threatened by wildlife trafficking.

Haas T.C. And S.M. Ferreira (2016) Combating Rhino Horn Trafficking: The Need to Disrupt Criminal Networks. *PLoS ONE* **11(11)**: e0167040. doi:10.1371/journal.pone.0167040

Hunting in SE Asia

Although deforestation and forest degradation have long been considered the most significant threats to tropical biodiversity, across Southeast Asia (Northeast India, Indochina, Sundaland, Philippines) substantial areas of natural habitat have few wild animals (>1 kg), bar a few hunting-tolerant species. To document hunting impacts on vertebrate populations regionally, we conducted an extensive literature review, including papers in local journals and reports of governmental and nongovernmental agencies. Evidence from multiple sites indicated animal populations declined precipitously across the region since approximately 1980, and many species are now extirpated from substantial portions of their former ranges. Hunting is by far the greatest immediate threat to the survival of most of the region's endangered vertebrates. Causes of recent overhunting include improved access to forests and markets, improved hunting technology, and escalating demand for wild meat, wildlife-derived medicinal products, and wild animals as pets. Although hunters often take common species, such as pigs or rats, for their own consumption, they take rarer species opportunistically and sell surplus meat and commercially valuable products. There is also widespread targeted hunting of high-value species. Consequently, as currently practiced, hunting cannot be considered sustainable anywhere in the region, and in most places enforcement of protected-area and protected-species legislation is weak. The international community's focus on cross-border trade fails to address overexploitation of wildlife because hunting and the sale of wild meat is largely a local issue and most of the harvest is consumed in villages, rural towns, and nearby cities. In addition to improved enforcement, efforts to engage hunters and manage wildlife populations through sustainable hunting practices are urgently needed. Unless there is a step change in efforts to reduce wildlife exploitation to sustainable levels, the region will likely lose most of its iconic species, and many others besides, within the next few years.

Harrison, R. D., Sreekar, R., Brodie, J. F., Brook, S., Luskin, M., O'Kelly, H., Rao, M., Scheffers, B. and Velho, N. (2016), Impacts of hunting on tropical forests in Southeast Asia. Conservation Biology, 30: 972–981. doi: 10.1111/cobi.12785

Abstract

Hunting is a major driver of biodiversity loss, but a systematic large-scale estimate of hunting-induced defaunation is lacking. We synthesized 176 studies to quantify hunting-induced declines of mammal and bird populations across the tropics. Bird and mammal abundances declined by 58% (25 to 76%) and by 83% (72 to 90%) in hunted compared with unhunted areas. Bird and mammal populations were depleted within 7 and 40 kilometers from hunters' access points (roads and settlements). Additionally, hunting pressure was higher in areas with better accessibility to major towns where wild meat could be traded. Mammal population densities were lower outside protected areas, particularly because of commercial hunting. Strategies to sustainably manage wild meat hunting in both protected and unprotected tropical ecosystems are urgently needed to avoid further defaunation.

Benítez-López, A., Alkemade, R., Schipper, A. M., Ingram, D. J. , Verweij, P. A., Eikelboom, J. A. J. and M.A.J Huijbregts (2017). The impact of hunting on tropical mammal and bird populations. *Science* **356(6334)**: 180-183. doi:10.1126/science.aaj1891

Trade in illegally-sourced tortoises and freshwater turtles in Jakarta - the need for legal reform in Indonesia

John Morgan

TRAFFIC, Southeast Asia Regional Office, Unit 3-2, 1st Floor, Jalan SS23/11, 47400 Petaling Jaya, Selangor, Malaysia.

Corresponding author: John Morgan, Email: *john_morgan78@hotmail.com*

Abstract

Indonesia is a well-known hub for wildlife trade with Jakarta at its heart. Wild caught tortoises and freshwater turtles are among most commonly traded species in Indonesia's wildlife markets and, as a result, are facing a major conservation crisis. During three surveys carried out by TRAFFIC in 2004, 2010 and 2015 in Jakarta's wildlife markets and reptile shops, a total of 9850 individual tortoises and freshwater turtles were recorded, consisting of 87 different species. The majority of these were non-native species. Just over half of the species were considered threatened by extinction and 63% appeared in the CITES appendices. The fact that the majority of the trade is illegal, featuring either nationally protected or illegally imported CITES listed animals, does not seem to deter smugglers, traders or buyers. As the Indonesian laws pertaining to capturing, selling and owning protected native species are comprehensive, the open nature of this illegal trade points to inadequacies in law enforcement, or insufficient penalties that act as deterrents. In contrast, the current national wildlife legislation does not offer any protection for non-native species, which effectively creates a loophole in the legal system. The Indonesian authorities are urged to recognise the repercussions of its lax enforcement on a global scale and act accordingly. Legislative changes are needed to ensure that this loophole is eliminated, which currently enables legal trade in illegally sourced and imported, CITES listed species in Indonesia.

Abstrak

Indonesia cukup dikenal sebagai hub untuk perdagangan satwa liar dengan Jakarta sebagai pusatnya. Tangkapan liar kura-kura dan labi-labi air tawar ada di antara spesies yang paling sering diperdagangkan di pasar satwa liar Indonesia, dan sebagai hasilnya, menghadapi krisis konservasi utama. Selama tiga kali survei yang dilakukan oleh TRAFFIC pada tahun 2004, 2010 dan 2015 di pasar satwa liar Jakarta dan toko reptil, total 9850 individu kura-kura dan labi-labi air tawar tercatat, yang terdiri dari 87 spesies yang berbeda. Mayoritas dari mereka bukanlah species asli indonesia. Lebih dari setengah dari spesies berstatus terancam punah dan 63% muncul dalam lampiran CITES. Fakta bahwa mayoritas perdagangan ilegal, baik yang dilindungi secara nasional ataupun hewan dilarang impor yang terdapat dalam daftar CITES, tampaknya tidak menghalangi para penyelundup, pedagang atau pembeli. Sebagai hukum, Indonesia mengatur secara komprehensif berkaitan dengan menangkap, menjual dan memiliki spesies asli yang dilindungi. Masih terbukanya perdagangan ilegal sehubungan kurangnya penegakan hukum, atau tidak setimpalnya hukum yang bisa bertindak sebagai pencegah. Sebaliknya, undang-undang satwa liar nasional saat ini tidak memberi perlindungan untuk spesies yang tidak-asli, yang secara efektif menberi celah dalam sistem hukum. Pihak berwenang Indonesia didesak untuk mengakui dampak dari lemahnya penegakan pada skala global dan aturan yeng berkaitan. Perubahan peraturan diperlukan untuk memastikan bahwa celah ini segera ditutupi, yang saat ini masih memungkinkan perdagangan secara resmi bagi sumber yang didapatkan illegal dan megimpor jenis yang telah terdaftar dalam CITES Indonesia.

Keywords: *Illegal trade, tortoise, legal reform, Indonesia*

Introduction

Indonesia is a notorious hub for wildlife trade with Jakarta at its heart (Stengel et al., 2011; Chng et al., 2015). A myriad of retail outlets in the form of animal markets, specialist pet shops and live animal exhibitions selling both native and alien species, can be found in this capital city. A wide variety of animals are traded openly, regardless of regulation. Animals are commonly sold for food,

Received 26th October, 2016; Revision received and accepted 27th February, 2017.

traditional medicine or as exotic pets (Chng et al., 2015; Shepherd and Nijman, 2007). The sheer volume of trade, as well as the large numbers of threatened species on sale, is of particular conservation concern.

Tortoises and freshwater turtles are among the species traded in Indonesia's wildlife markets and are facing a conservation crisis with more than half of the 320 species currently threatened by extinction (van Dijk et al., 2014) and many of them prohibited from trade. Nevertheless, numerous protected species are still on sale in large numbers in Jakarta's retail outlets, despite being prohibited from trade under Indonesia's legislation. Alien species prohibited from international trade are also openly displayed for sale in these trade centres.

This paper examines the reasons behind the open availability of species prohibited from trade in Indonesia and recommendations for improved regulatory measures are provided.

Methods

TRAFFIC carried out three sets of systematic surveys of trade in live tortoises and freshwater turtles in Jakarta over an 11-year period (2004, 2010 and 2015) in order to document species composition, volumes and trends (Morgan, *in press*; Nijman and Shepherd 2007; Stengel et al., 2011). Data were collected following the same methodology each time (see Nijman and Shepherd, 2007). The only differences in the surveys were the duration of time spent surveying and the frequency of the visits. Red-eared Slider (*Trachemys scripta elegans*) and Chinese softshell turtle (*Pelodiscus sinensis*) were removed from the analysis as they are known to be captive-bred in large numbers for the international pet trade and for consumption (Nijman and Shepherd 2015).

Surveyors recorded all species and the volume of each at two animal markets (Jatinegara and Barito), two tropical fish markets (Jalan Sumenep and Jalan Gunung Sahari) and three reptile shops in Central Jakarta. Species not identified to a genus level were omitted from analysis. Due to the sensitive nature of the illegal wildlife industry, information on prices, origins and buyers was collected in an *ad hoc* manner.

An analysis of Indonesia's legislation, especially with regards to the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) was carried out as well. The reasons for ongoing availability of non-native species prohibited from international trade by CITES were compiled and analysed, and recommendations for improved regulation were developed.

Results

From the three survey periods, a total of 9850 individual tortoises and freshwater turtles were recorded, belonging to 87 different species. The majority of these were alien species, with only 26% (n = 23) native to Indonesia. Approximately half of the species (n = 44) were listed as either Critically Endangered, Endangered or Vulnerable on the IUCN Red List. Furthermore, 63% (n = 55) of the species appeared in the appendices of the Convention on International Trade in Endangered Species (CITES).

Examination of the results from the three survey periods individually provides a worrying trend. Since the first survey in 2004, the number of species on sale had increased by 36% in 2015 (47 to 64). The number of species listed in the CITES Appendices rose by 38% (29 to 40); the number of CITES Appendix I listed species rose by 33% (6 to 8) and the number of alien species almost doubled (25 to 49) (Morgan, *in press*). Conversely, in 2004, 47% of the species on sale were native to Indonesia, but this declined to 29% in 2010 and 24% in 2015. In 2004, the majority of alien species observed originated from Africa (excluding Madagascar) (13%) and Asia (excluding Indonesia) (13%). In 2010, Asian species (21%) were observed more than African species (16%). In 2015, a shift toward North American species (25%) was apparent with Asian species close behind (22%).

Across the three surveys, the Southeast Asian box turtle (*Cuora ambonensis*), a non-protected species native to Indonesia, was the most prevalent (n = 1357), however, the following four most abundant were all alien: Indian star tortoise (*Geochelone elegans*) (1293); Spur-thighed tortoise (*Geochelone sulcate*) (892); Radiated tortoise (*Astrochelys radiata*) (611) and Leopard tortoise (*Stigmochelys pardalis*) (495) (Table 1). In 2004, there was only one alien species in the top five most commonly observed species: namely the Indian star tortoise. In the two subsequent surveys, there was only one native species in the top five, which was the Southeast Asian box tortoise. The Radiated tortoise is a Critically Endangered species from Madagascar that is listed in CITES Appendix I --- that is, there is no permitted international commercial trade in the species, yet it was among the most commonly traded species in Jakarta. Even one of the world's rarest tortoises, the Critically Endangered ploughshare tortoise (*Astrochelys yniphora*) from Madagascar, also listed in CITES Appendix I, was observed 15 times across the three survey periods.

Discussion

As the volume of native Indonesian species recorded in 2015 remained comparable to those in the 2010 surveys, it would appear that the main driver for the increase in non-native species is purely increased demand for more exotic species. Indonesia's fast growing economy sees an emerging middle class where more affluent consumers are increasingly able to afford to buy and keep expensive wildlife (Shepherd and Nijman 2007; Brodjonegoro et al., 2016). The fact that the majority of the trade is illegal, featuring either nationally protected or illegally imported CITES listed animals, does not seem to deter smugglers, traders or buyers. For some exotic pet owners, the more expensive or rare an animal is, the higher its desirability. Often the possession of these animals is seen as a status symbol that represent power or wealth (Hall et al., 2008; Collar et al., 2012).

As the Indonesian laws pertaining to the capture, selling and owning protected native species are reasonably sufficient, the open nature of illegal trade points to inadequacies in law enforcement.

Table 1. The five most commonly observed species during surveys of Jakarta's markets and reptile shops in 2004, 2010 and 2015. A shift from native to non-native species is evident across the three surveys.

Species		CITES Appendix	Numbers observed (with top 5 ranking)			TOTAL
			2004	2010	2015	
Chelodina oblonga	Native	NL	445 (1)	-	43	488
Cuora amboinensis	Native	II	395 (2)	125 (1)	837 (2)	1357 (1)
Cyclemys dentata	Native	II	241 (3)	19	133	393
Notochelys platynota	Native	II	-	110 (4)	-	110
Siebenrockiella crassicollis	Native	II	164 (5)	40	6	164
Astrochelys radiata	Non-native	I	22	125 (1)	486 (5)	633 (4)
Centrochelys sulcata	Non-native	II	8	118 (3)	767 (3)	893 (3)
Geochelone elegans	Non-native	II	238 (4)	97 (5)	937 (1)	1272 (2)
Stigmochelys pardalis	Non-native	II	4	36	495 (4)	535 (5)

While seizures of protected animals and arrests of traders do occasionally occur in Indonesia, offenders rarely receive sanctions commensurate with the crime they have committed (Nijman 2009). If the illegally traded and protected animal is not a high profile species, such as elephants, orangutans or tigers, or being sold in vast numbers, it appears as if law enforcement officials are reluctant to act. A major obstacle in Indonesia is that wildlife crime, especially when involving low-profile species, remains a low priority for the government and related enforcement agencies. Wildlife crime are most frequently afforded lower priority than issues such as eradicating poverty, providing better health care and education, especially if funding from the annual state budget is inadequate. Since the conservation laws are already in place, an attempt should be made to enforce them, failing which risks making otherwise adequate conservation laws redundant in practise.

For alien species, the challenges are more complex. The current national wildlife legislation does not offer any protection for alien species, which effectively creates a loophole in the legal system. Once an animal has been smuggled into the country, it is very difficult to prove that it has been illegally obtained and, consequently, little more can be done in terms of enforcement (de Klemm 1993). This essentially means that even CITES Appendix I listed, alien species can be kept, bought and sold legally within Indonesia. Traders are fully aware of this legal loophole and continue to exploit it. During the most recent surveys in 2015, two traders openly commented on the fact that they feel safer trading in alien species compared to protected native species. One trader claimed that in Indonesia you can even openly sell ploughshare tortoises risk free. Ideally, CITES documentation should be provided by anyone in possession of suspected illegally imported animals at the request of law enforcement officials, but as the current Indonesian law stands, this is not a requirement and so is not enforced. Until the Indonesian government revises the existing legislation empowering authorities to take the necessary measures to enforce CITES, the trade of illegally sourced CITES listed species on a national level will continue unabated. This legal loophole is not unique to Indonesia and a similar issue was recently highlighted in Thailand (Doak 2014; Nijman and Shepherd 2015). Ultimately, Indonesia, as a signatory to CITES, is obligated to uphold the existing laws and enforce them. If the existing laws are inadequate, Indonesia must develop additional suitable national legislation to implement CITES properly. Failure to comply with CITES treaty requirements could cost Indonesia economically in the form of trade sanctions. Sanctions can range from the suspension of trade in a single CITES species within a certain country to all commercial trade in CITES species. Currently, more than 30 countries are threatened by trade suspensions for various violations of the treaty (CITES, 2016).

The effective enforcement of CITES legislation at ports, border and airports should act as the first level of protection against the import or export of a CITES listed species; however, it is evident from our surveys that this is not the case. A number of factors could contribute to this, including, corruption, insufficient capacity, or just a general lack of interest on the part of customs officials in regards to CITES.

An inspection of Indonesia's Biennial CITES Reports (https://cites.org) that began in 2003 revealed that of the 328 reported cases of wildlife seizures comprising 135 different species, 90 of these were species protected under Indonesian law. Of the 45 non-protected species, 18 were seized alongside a nationally protected species. Of the remaining 27 species, only 14 were non-native and were seized in five separate confiscations. The fact that so few seizures of alien species appear in these reports, suggests negligence or lack of awareness on the part of the Indonesian authorities towards the protection of alien, CITES listed species – especially when considering the numbers observed openly for sale in Jakarta.

For Indonesia to improve their contribution to the CITES convention and effectively prevent the rampant illegal wildlife trade from taking place, numerous inadequacies in the legal system must be addressed as a matter of urgency. The existing laws relating to wildlife protection (Act No. 5, 1990) and the protected species list (Regulation No. 7, 1999) are currently under revision,and it is recommended that these laws are amended to include all CITES listed species. This will improve the regulation and control of international trade and help safeguard alien species. These legislative changes must ensure the closure of the legislative loophole that allows legal trade in illegally sourced and imported CITES listed species in Indonesia. Finally, the Indonesian authorities are urged to recognise the repercussions of its lax enforcement on a global scale and act accordingly. Wildlife crime needs to receive far higher priority and enforcement has to improve in order to mitigate this. With tortoises and freshwater turtles already in a global conservation crisis, Indonesia's actions could be key to maintaining the continued existence of many of these threatened species.

Acknowledgements

We thank the Darwin Initiative for generously supporting this work, partners Durrell Wildlife Conservation Trust and the Turtle Conservancy. I am also grateful to Stephanie Pendry, who kindly reviewed this document and provided suggestions for improvement.

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Flat-headed cats, *Prionailurus planiceps* – a literature review of their detection-rate in camera-trap studies and failure to re-detect them in Pasoh Forest Reserve, Malaysia

Jamie Wadey[1], Mariani Ramli[2,3] Jonathan Moore[1,4], Christine Fletcher[4], Ahimsa Campos-Arceiz[1]

[1]School of Environmental and Geographical Sciences, University of Nottingham Malaysia Campus, Selangor, Malaysia
[2]National University of Malaysia, Jalan Reko, 43500 Bangi, Selangor, Malaysia
[3]Copenhagen Zoo, SE Asia Programme, Kuala Lumpur, Malaysia
[4]Forest Ecology Unit, Forest Research Institute Malaysia (FRIM), Kepong, 52109, Selangor, Malaysia

Corresponding author: Jamie Wadey; Email: *jamie.wadey1@gmail.com*

Abstract

The flat-headed cat, *Prionailurus planiceps*, is globally endangered. In spite of the proliferation of camera-trap studies in Southeast Asia, few studies have detected the flat-headed cat and information on previous detections remains scattered. We combined literature review and fieldwork to (1) compile available information on previous flat-headed cat camera-trap detections, (2) try to re-detect flat-headed cat in Pasoh Forest Reserve, Malaysia, previously detected in 2013, and (3) compare three different camera-trap arrangements. Our literature review yielded a total sampling effort of 105,866 camera-trap nights and 46 flat-headed cat detections from six different areas of Borneo, Sumatra, and Peninsular Malaysia; but no camera-trap detections from Thailand and Myanmar. Re-detecting flat-headed cat more than twice only occurred in 50% of the areas. We found no previous camera-trap study that explicitly targeted flat-headed cat. Our camera-trapping in Pasoh Forest Reserve failed to re-detect flat-headed cat, even when using fish food as a bait. Our results highlight the need of field studies tailored towards slow-flowing freshwater habitats with a high number of camera-trap nights (e.g. greater than 2000 nights), to better understand the flat-headed cat distribution, ecology, and conservation status.

Abstrak

Kucing Kepala Datar, *Prionailurus planiceps*, secara global terancam punah. Bertolak belakang dengan banyaknya studi menggunakan Kamera-jebak di Asia Tenggara, hanya sedikit studi yang berhasil mendeteksi keberadaan Kucing Kepala Datar tersebut. Selain itu, informasi dari deteksi-deteksi sebelumnya tetap simpang siur. Kami menggabungkan metode studi literatur dan studi lapangan untuk (1) mengumpulkan informasi yang tersedia tentang deteksi Kamera-Jebak dari Kucing Kepala Datar sebelumnya, (2) mencoba memantau kembali Kucing Kepala Datar di Suaka Margasatwa Pasoh, Malaysia, yang sebelumnya pernah terpantau pada tahun 2013, dan (3) membandingkan tiga macam komposisi program kamera-jebak yang berbeda. Studi literatur kami berhasil mengumpulkan sampel sebanyak 105.866 malam kamera-jebak , dan 46 deteksi Kucing Kepala Datar dari 6 area yang berbeda di Borneo (Kalimantan), Sumatra, dan Semenanjung Malaysia; tapi tidak sama sekali dari Thailand dan Myanmar. Pendeteksian kembali lebih dari dua kali Kucing Kepala Datar hanya terdapat di 50% dari semua area. Kami tidak menemukan studi Kamera-jebak sebelumnya yang secara eksplisit mencoba untuk memantau Kucing Kepala Datar. Upaya studi Kamera-jebak kami di Suaka Margasatwa Pasoh gagal menghasilkan pendeteksian ulang Kucing Kepala Datar, bahkan ketika menggunakan makanan ikan sebagai umpan. Temuan kami menyorot perlunya studi lapangan yang disesuaikan khusus untuk habitat perairan tawar arus lambat dengan jumlah malam kamera-jebak yang banyak (mis. lebih dari 2.000 malam) untuk lebih mengerti penyebaran, ekologi, serta status konservasi Kucing Kepala Datar.

Keywords: *camera-trapping, camera-trap placement, Pasoh Forest Reserve, Prionailurus planiceps, sampling effort*

Introduction

The flat-headed cat (FHC) *Prionailurus planiceps* is a globally endangered species (IUCN, 2015). Its geographic range includes Borneo, Sumatra, Peninsular Malaysia, Thailand, and perhaps southern Myanmar (IUCN, 2015; Lydekker, 1895; Nowell & Jackson, 1996; Sunquist & Sunquist,

Received 6th May, 2017; Revision received and accepted May, 2017.

2009; Wilting et al., 2010a). The details of its distribution, as well as our knowledge about the FHC's ecology and behaviour, remain highly speculative due to low detection rate in field studies and ongoing range contraction due to habitat loss (Wilting et al., 2010a; Miettinen et al., 2011).

Wilting et al. (2010a) compiled the available information on the detections of FHC to model the species' distribution and concluded that most of the detections occurred within 5 km from large rivers and lakes and at elevations lower than 200 m above sea level (asl). This link to semi-aquatic environments is in line with some of the FHC anatomical traits, such as the slight webbing between its toes and dental structure, which suggest an adaptation to aquatic environments and at least a partially piscivorous diet (Muul & Lim, 1970). Southeast Asian wetlands, peat swamps, and other fresh-water environments are likely to be under-represented in camera-trap studies, which might explain the low rate of detection of FHC in camera-trap studies in the region.

The low detection rate of FHC is probably related to (1) very small population sizes and (2) the lack of studies specifically designed to target the species. Although the number of camera-trap studies in Southeast Asia has increased considerably in the past few years (e.g. Azlan & Sharma, 2006; Hedges et al., 2015a; Linkie et al., 2008, 2013; Rayan & Linkie, 2015; Rayan & Shariff, 2009), few of these studies have spatial overlap with the FHC geographic and ecological range. Camera-trap surveys of big cats have recorded other small cats very frequently; thus size is unlikely the main reason behind the rarity of FHC records from big-cat camera-trapping (Duckworth et al., 2014).

Much of the camera-trapping in Southeast Asia is based on trapping stations set up in systematic grids with either one or two camera-traps per station (Azlan & Sharma, 2006; Hedges et al., 2015a; Linkie et al., 2008, 2013; Rayan & Linkie, 2015; Rayan & Shariff, 2009). This study design provides mathematical unbiased detection rates used to calculate a species occupancy patterns and/or density in a landscape, but it might not be the best approach to maximize the chance of detecting very elusive species. To maximize the detectability of FHC in a landscape the study should include: (a) increasing the number of camera-trap placements in habitats that are considered suitable for the species, rather than based on percentage-wise number of cameras per unit area, irrespective of systematic grid arrangement, (b) an increase in the number of camera-traps per station to increment the coverage of the sampling station, (c) the use of bait to attract the species, and (d) placement of a camera-traps specifically targeting FHC (e.g. at 10-20 cm above the ground).

In 2013, we detected the presence of FHC in Pasoh Forest Reserve (hereafter 'Pasoh'), Peninsular Malaysia (Wadey et al., 2014). The FHC had already been documented in Pasoh in the 1960s, based on accounts from the indigenous community (Kemper, 1988), but subsequent studies failed to detect the species in Pasoh (e.g. Ickes & Thomas, 2003; de Koning, 2013; Lim et al., 2003; Numata et al., 2005; Rooduijn, 2015). Our recent detection of FHC in Pasoh poses an important opportunity to learn more about the species distribution and ecology. Here we present the first camera-trap study specifically designed to detect the presence of FHC, with the objectives to (1) compile publicly available (either published and or available through open source repositories) information on camera-trap detections of FHC, (2) attempt to re-detect the FHC in Pasoh, and (3) compare three types of camera-trap approaches to detect FHC and similar species.

Methods

Review of previous FHC camera-trap detections

We compiled camera-trap detections of FHC from published literature and available open source online data repositories. We searched for multiple camera-trap studies in the same study site, even if they did not report detecting FHC and recorded studies where re-detection had occurred. The standard of reporting camera-trap effort varied between publications and, in some cases, we contacted the authors to obtain additional information. In cases in which the same camera-trap data was published in multiple papers, we did not accumulate the FHC detections. From all sources we compiled information of: study site, studies' target species, total camera-trap nights, and number of FHC detections.

Study area

Pasoh, located 70 km southeast from Kuala Lumpur (2°98'N 102°31'E), is an elongated 'forest island' of approximately 135 km^2 surrounded by oil palm and rubber plantations. Most of Pasoh consists of secondary hill dipterocarp forest regenerating from timber extraction in the 1950s and is still subject to selective logging (Manokaran & Swaine, 1994; Fletcher et al., 2012). The southern part of Pasoh harbours the last large patch of primary lowland dipterocarp forest, which covers an area of approximately 25 km^2 (Fig. 1). Pasoh contains no major rivers or lakes. Since 2011, Pasoh has been a focus of the Tropical Ecology Assessment Monitoring network (TEAM), which has conducted annual camera-trap surveys (TEAM Network, 2015).

Camera-trap sampling area

Since so little is known about FHC behavioural ecology, we assumed that FHC prefer gentle terrain

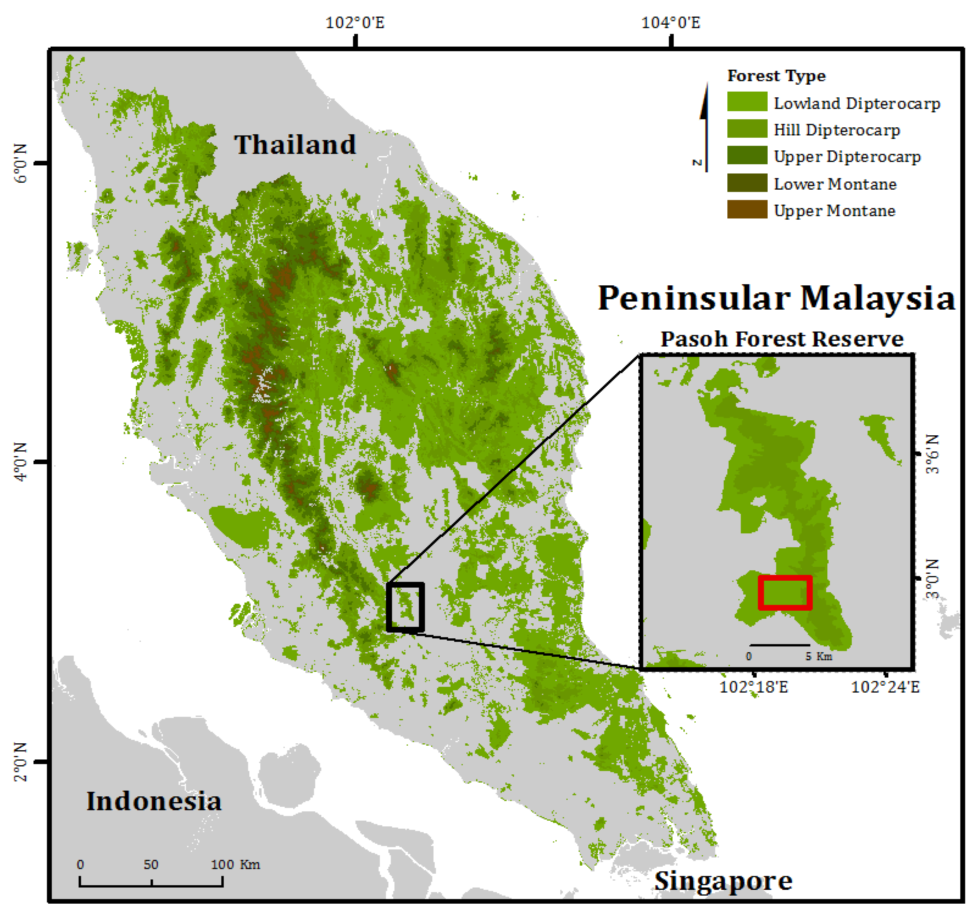


Figure 1. Map of Pasoh Forest Reserve in relation to Peninsular Malaysia. FHC camera trapping was conducted in the southern lowland extent of the reserve (red box). Remaining lowland forest outside the study area is under high encroachment pressure.

with slow-flowing streams and tidal areas that usually correlate with lower altitudes (e.g. below 200m asl (Wilting et al., 2010a). Moreover, we assumed that the FHCs are territorial and that, given their small body size, these territories are relatively small as well (Lindstedt et al., 1986). This means that FHC should be easier to detect near a location of a recent detection. Following this rationale, we selected Pasoh's southern area of lowland tropical forest (Fig. 1) as our sampling area. This area contains the only previous FHC camera-trap detection in Pasoh (Wadey et al., 2014), elevation is below 200m asl, with slow moving streams, and is waterlogged several months of the year by monsoonal rains.

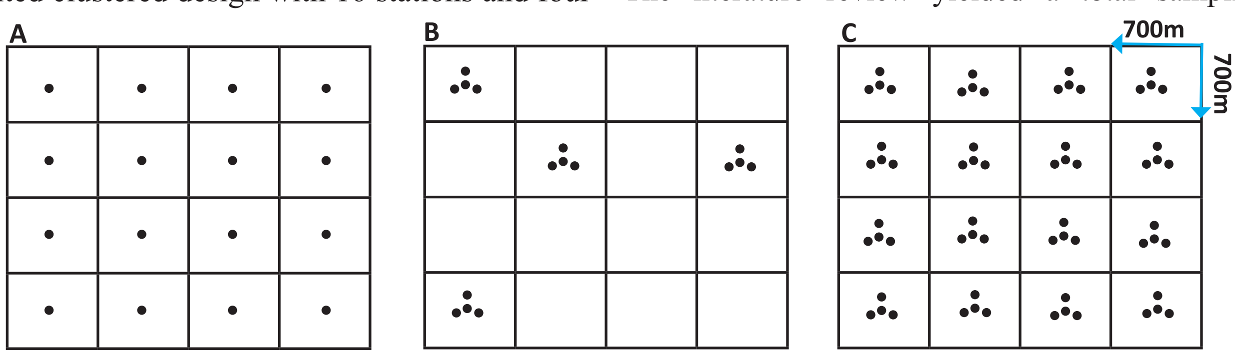
Camera-trap sampling designs

Between July 2014 and January 2015, we attempted to re-detect the presence of FHC in Pasoh near the original detection, where the habitat was either swampy or contained water pooling or slow-flowing streams. This study was independent from the annual TEAM Network (2015) survey. We deployed camera-traps following three different approaches: (1) a standard systematic design with 16 single-camera stations (Fig. 2a); (2) a targeted clustered design with 4 stations, each consisting of four cameras – one in the centre and three cameras surrounding the one in the centre (Fig. 2b); and (3) a baited clustered design with 16 stations and four cameras per station – one in the centre and three additional cameras around it (Fig. 2c). In the baited clustered design, we used one application (200g) of edible fish-bait placed in several clumps and/or smeared on fallen trees, saplings, or tree roots within 5m of 14 camera-trap stations. To reduce the chance of our trapping grid containing holes larger than a FHC home-range, we used the home-range of leopard cats *Prionailurus bengalensis*, a similar sized felid, to gauge our camera-trap spacing. Leopard-cat home-ranges have been reported to range between 2 and 5km^2 (Grassman, 2000; Rajaratnam et al., 2007). In all cases, the inter-station spacing was 700m and intra-stations spacing was 50m. Camera-trap height was standardized across all sites at 10cm from ground level (Wadey et al., 2014). Each camera-trap arrangement had an equal cumulative number of station-nights deployed, but the number of camera-trap-nights differed (Tab.1). To compare the different camera placement designs, we used an index based on the number of species (either vertebrate or carnivores) detected per sampling effort, either per station-night or camera-trap-night.

Results

Review of previous FHC camera-trap detections

The literature review yielded a total sampling



Stratified: sampling from the centre of a defined gridded area.

Targeted clustered: sampling in a perceived high probability habitat with clusters of camera traps.

Baited clustered: sampling from the centre of a defined gridded area with clusters of baited camera traps.

Figure 2. Different camera-trap designs used in the study. Black dots are individual cameras with 700-meter spacing between grids. Spacing of camera-traps within clustered designs were set at 50 meters. We define a 'cluster' as multiple camera-traps within close range i.e. 50 meters.

effort of 105,866 camera-trap nights and 46 FHC detections that translates into one detection per 2,301 camera-trap-nights for areas with at least one FHC camera-trap detection. We found 15 publications reporting camera-trap detections of FHC in six different areas of Borneo, Sumatra, and Peninsular Malaysia (Adul et al., 2015; Bernard et al., 2012; Cheyne et al., 2009a, 2009b, 2013; Cheyne & Macdonald, 2011; Gardner et al., 2014; Matsubayashi et al., 2006; Mohamed et al., 2009, 2013; Ross et al., 2013; Samejima et al., 2012; Soemarsono, 1996; Wadey et al., 2014; Wilting et al., 2010a; Yasuda et al., 2007; Tab.2). We found no published study on FHC camera-trap detections from Thailand and Myanmar and no published camera-trap study that explicitly targeted the FHC. From the 15 studies in our sample, four targeted mammal communities (Matsubayashi et al., 2006; Samejima et al., 2012; Wadey et al., 2014; Yasuda et al., 2007); three targeted carnivore communities (Matsubayashi et al., 2006; Mohamed et al., 2009, 2013; Wilting et al., 2010b); seven targeted felid communities (Adul et al., 2015; Bernard et al., 2012; Cheyne et al., 2009a, 2009b, 2013; Cheyne & Macdonald, 2011; Ross et al., 2013); one targeted banteng (*Bos javanicus*; Gardner et al., 2014); and one targeted tiger (*Panthera tigris*; Soemarsono, 1996). We found only one open source database for camera-trapping in FHC geographic range (TEAM Network, 2015) and one publication that repeated a camera-trap study at a detection site, though it did not re-detect FHC (Bernard et al., 2012; Tab.2). Most of the detections (96%, N=46) occurred in Borneo. The median number of FHC detections per study was 1.0, ranging from 0-30 (Tab.2). Re-detecting FHC more than twice only occurred in 50% of areas (Tab.2). A single study in Sabangau, Kalimantan, accounted for 33% of the camera-trap-nights and 65% of the FHC detections (Adul et al., 2015; Tab.2). Excluding Adul et al. (2015), the

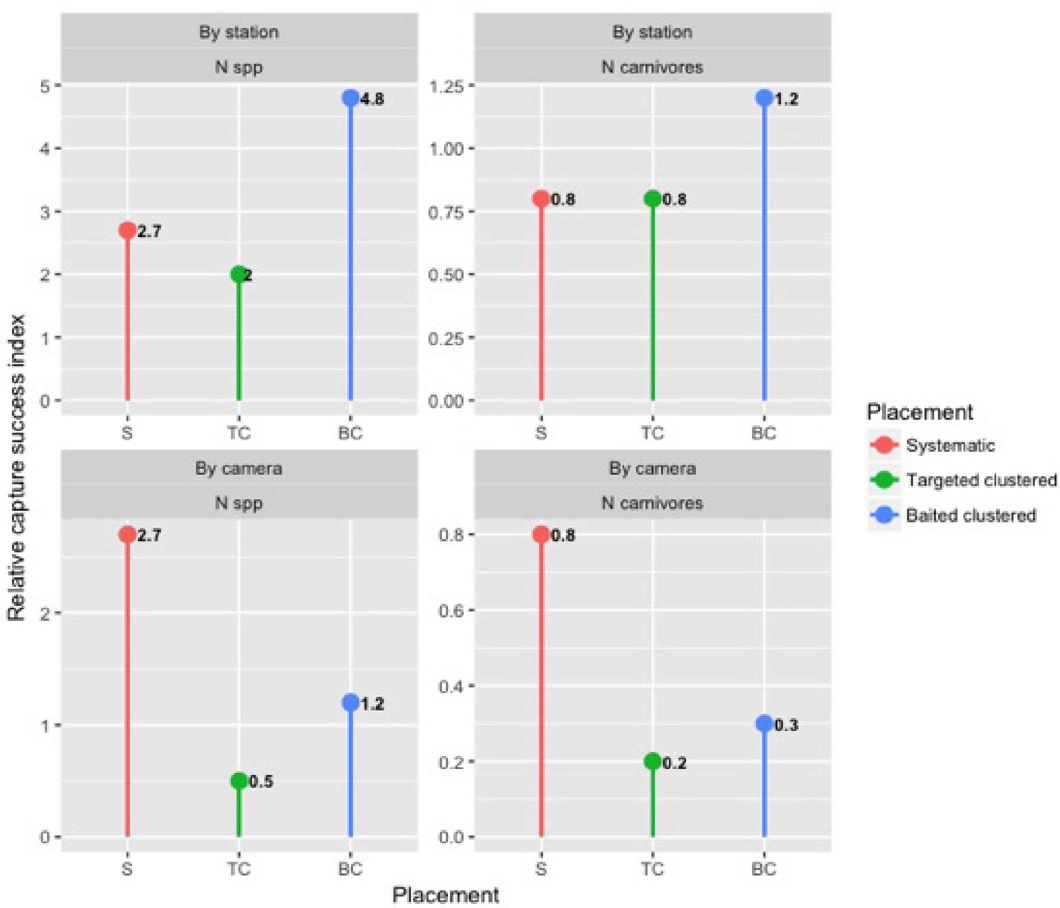


Figure 3. Comparison of relative capture success index of camera-trapping placement methods used in this study. The relative capture success index was calculated as the number of vertebrate species (“N spp”) or the number of carnivore species (“N carnivores) detected multiplied by 100 and then divided either by station • day (“By station”) or by camera • day (“By camera”).

Table 1. Summary of the different camera-trap placement approaches used in this study. Approach = type of camera trap placement; S = systematic, TC = targeted clustered, BC = baited clustered; N days = length (in days) a particular placement type was used; Cam spac = distance in kilometres between camera-trap stations; N sta = number of camera trap stations used in each placement type; Sta size = number of camera traps used in the station; N cams = total number of camera traps used for each placement type; Sta x day = sampling effort measured in the cumulative number of station-nights deployed; Cam x day = sampling effort measured in the cumulative number camera trap-nights deployed; Bait = whether bait was used in each placement type; N = no bait; Y = bait was used; N spp = total number of vertebrate species detected in each placement type; N carn = total number of carnivore species detected.

Approach	Period	Year	*N* days	Cam spac	N sta	Sta size	*N* cams	Sta x day	Cam x day	*N* spp	*N* carn	Bait
S	Jul	2014	30	0.7	16	1	16	480	480	12	4	N
TC	Aug-Nov	2014	120	0.7	4	4	16	480	1,920	9	3	N
BC	Dec-Jan	2014-2015	30	0.7	16	4	64	480	1,920	23	6	Y

detection rate of FHC is one per 4,421 camera-trap nights, with a total of 70,737 camera-trap nights and only 16 camera-trap detections.

FHC in Pasoh

This study failed to re-detect the presence of FHC in Pasoh. A total of 1,440 station-nights and 4,320 camera-trap-nights resulted in the detection of 30 vertebrate species, including 22 mammals, 7 birds, and 1 reptile species (Tab.1; Tab.4). Among the mammals, we detected nine different carnivore species, including three felids (Tab.3), but no FHC.

Comparison of camera-trap placement designs

The clustered design baited with fish recorded the highest number of both of vertebrate and carnivore species per station-night (Tab.1; Fig. 3). The systematic approach, however, detected the highest number of vertebrate and carnivore species per camera-trap night (Tab.1; Fig.3). Nine vertebrate species were detected exclusively with the fish-baited clustered approach (Tab.4), including six out of the seven bird species (Tab.4).

Discussion

Review of previous FHC camera-trap detections

This is the first camera-trap study that explicitly targeted the FHC. All previously published camera-trap information about FHCs comes from general studies targeting communities or from studies designed for other individual species (Adul et al., 2015; Bernard et al., 2012; Cheyne et al., 2009a, 2009b, 2013; Cheyne & Macdonald, 2011; Gardner et al., 2014; Matsubayashi et al., 2006; Mohamed et al., 2009, 2013; Ross et al., 2013; Samejima et al., 2012; Soemarsono, 1996; Wadey et al., 2014; Wilting et al., 2010b; Yasuda et al., 2007). This lack of specifically designed studies is concerning given that the FHC has been listed as Endangered in IUCN's Red List since 2008 (IUCN, 2015).

In spite of the intensive camera-trapping efforts across its distribution range (Linkie et al., 2013), 96% (N=46) of the published photo captures come from just four sites in Borneo (Sabangau, Dermakot, Tasik Merimbun, and Tabin; Tab.2), where the FHC has been detected repeatedly (range = 4-30 camera-trap detections per site). Outside Borneo, we only found single camera-trap detections in Way Kambas (Sumatra) and Pasoh (Peninsular Malaysia), and no camera-trap detection in Thailand and Myanmar. There might be other sites where the FHC has been photo captured, but the results have not been made publicly available. Our results highlight the need to make such relevant information publicly available, either through publications (preferably open access) or through online data repositories (e.g. TEAM Network, 2015).

Our review also revealed the high sampling efforts required to detect the FHC in community-level camera-trap studies. In Sabangau – where 65% of the 46 published records took place – the detection rate remains low, with one per 1,171 camera-trap nights (Adul et al., 2015; Cheyne et al., 2009a, 2009b, 2013; Cheyne & Macdonald, 2011). Wearn et al. (2013) estimated that 10,970 camera-trap nights are needed to obtain a FHC probability of detection equal 1.0 in Kalabakan Forest Reserve in Sabah, Boreno. This highlights the difficulty to detect the species. The lack of FHC detection in studies with small sampling efforts should therefore be interpreted with additional caution.

In this review we focused on camera-trap detections. We acknowledge that FHCs have been detected in other ways, such as direct sightings, road kills, and individuals being surrendered to the authorities (Bezuijien, 2000; Meijard et al., 2005; Oswald & Mohamed, 2013).

Failure to re-detect FHC in Pasoh

We failed to re-detect FHC in Pasoh. Considering our previous detection of the species (Wadey et al., 2014), the FHC-specific design of our camera-trap placing and the sampling effort (4,320 camera-trap night) in a relatively small area, we expected to re-detect it.

We assume that FHCs are still present in Pasoh because wild felids usually live several years (Lydekker, 1895; Sunquist & Sunquist, 2009) and the area has neither been subject to drastic habitat changes, nor has there been any reports of hunting that could decimate the population. However, hunting for the pet-trade could still have played a role in decimating an already small population of FHC. Our lack of detection might be because we were looking in the wrong place, e.g. (1) FHCs might not be territorial and hence the information on the previous detection did not increase our chance of re-detecting it; (2) the home range of FHC might be very large or have unusual shapes (e.g. following rivers); (3) our general assumptions about FHC habitat preferences (lowland, near water) might be wrong; or (4) the population size is extremely low.

The results of both our review and fieldwork bring up the question of why are FHCs so difficult to detect? Is it because researchers are not looking at the right place (e.g. peatswamp forests, mangroves and wetlands); is it because we are not looking in the right way (e.g. detections as by-catch from studies of larger mammals); or is it just that FHCs actually occur at very low densities? And, if the later is true, are these low densities natural and associated with high specialization to resource-poor habitats (Kennedy et al., 2011) or the result of recent human activities (e.g. habitat loss or human-triggered trophic cascades (Andren, 1994; Crooks & Soulé, 1999)?

Notes on the different camera-trap approaches

We used several camera-trap approaches in a rather *ad hoc* manner. Our study design only allows for limited comparisons, because more than one factor changes between the different approaches (e.g. besides having bait, the baited clustered placement differs from the other placements in the number of cameras used per station. Nevertheless, some general patterns emerge about the different approaches. For example: (1) the standard systematic approach (1-2 cameras per station) is the most cost-effective approach when the amount of camera-traps available is limited, both for carnivores and for the rest of the terrestrial mammal community; (2) the use of the edible fish-bait increased the number of species detected, suggesting that it is a good approach to confirm presence of a species.

Adding food bait to camera-traps, however, can lead to biased population estimates (du Preez et al., 2014; Karanth et al., 2011). Bait, however, increases the detection probability of certain species (Nichols & Karanth, 2002) and can be very effective to detect rare or "elusive species". Scented and audio lures present opportunities (Hedges et al., 2015b) that remain largely unexplored for felids, including FHC (J. Sanderson pers. comm.). Even though we did not detect the FHC in this study, we recommend further exploring the use of baits with camera-trapping to detect FHC and other illusive species.

Implications for conservation

This study shows that, even in places where FHCs are assumed to occur or have been recently detected, they remain difficult to re-detect. In parts of their predicted distribution, there is little recent evidence of actual presence. The species conservation status

Table 2. Results table of camera-trap detections on FHC from literature and open source repositories.

Study area	Survey year	Study target	Trap nights	Detections	Publications & open source repositories
Deramakot, Sabah	2003-05	Mammal Community	981	2	Yasuda et al. 2007; Matsubayashi et al. 2006
Deramakot, Sabah	2008-09	Mammal Community	1,916	4	Mohamed et al. 2009; Wilting et al. 2010b; Mohamed et al. 2013
Deramakot, Sabah	2008-09	Mammal Community	15,400	1	Samejima et al. 2012
Pasoh, N. Sembilan	2002-03	Mammal Community	3,659	0	Yasuda et al. 2007
Pasoh, N. Sembilan	2011	Mammal Community	900	0	TEAM Network, 2015
Pasoh, N. Sembilan	2012	Mammal Community	900	0	TEAM Network, 2015
Pasoh, N. Sembilan	2013	Mammal Community	3,600	1	Wadey et al. 2014 TEAM Network, 2015
Pasoh, N. Sembilan	2014	Mammal Community	1,800	0	TEAM Network, 2015
Pasoh, N. Sembilan	2015	Mammal Community	1,800	0	TEAM Network, 2015
Pasoh, N. Sembilan	2015	FHC	4,320	0	Wadey et al. [current study]
Sabangau, Kalimantan	2008-12	Felid Community	35,129	30	Cheyne et al. 2009a; Cheyne et al. 2009b; Cheyne & Macdonald, 2011; Cheyne et al. 2013; Adul et al. 2015
Tabin, Sabah	2002	Mammal Community	574	2	Yasuda et al. 2007
Tabin, Sabah	2009-10	Felid Community	3,733	0	Bernard et al. 2012
Tabin, Sabah	2009-10	Felid Community	6,172	1	Ross et al. 2013
Tabin, Sabah	2011-12	Banteng	10,248	1	Gardner et al. 2014
Tasek Merimbun, Brunei	2001-03	Mammal Community	334	4	Yasuda et al. 2007
Way Kambas, Lampung	1996	Tiger	N/A	1	Soemarsono, 1996
		Total	**105,866**	**46**	**18**

Table 3. Carnivore species detected in Pasoh using different camera-trap placement approaches: S = systematic, TC = targeted clustered, BC = baited clustered; IUCN status: LC = Least Concern, NT = Near Threatened, VU = Vulnerable. Baited clustered (BC) used fish-bait. Body mass details (Francis, 2008). ✔ = detected.

Family	Scientific name	Common name (IUCN)	IUCN status	Body mass (kg)	S	TC	BC
Prionodontidae	*Prionodon linsang*	banded linsang	LC	0.6-0.8	✔		
Herpestidae	*Herpestes brachyurus*	short-tailed mongoose	LC	1-2		✔	✔
Viverridae	*Hemigalus derbyanus*	banded civet	VU	1-3			✔
	Paradoxurus hermaphroditus	Asian palm civet	LC	2-3		✔	✔
	Viverra tangalunga	Malay civet	LC	4-5	✔		✔
Mustelidae	*Martes flavigula*	yellow-throated marten	LC	1.3-3	✔		
Felidae	*Prionailurus bengalensis*	leopard cat	LC	3-5		✔	✔
	Pardofelis marmorata	marble cat	VU	2-4			✔
	Panthera pardus	leopard	NT	45-65	✔		
Total		**(9 spp)**			**4**	**3**	**6**

Table 4. Species detected in Pasoh using different camera-trap placement approaches: S = systematic, TC = targeted clustered, BC = baited clustered. IUCN status: LC = Least Concern, NT = Near Threatened, VU = Vulnerable. Baited clustered (BC) used fish-bait. ✔ = detected.

Group	Family	Scientific Name	Common Name (IUCN)	IUCN Status	S	TC	BC	BC
Reptiles	Varanidae	*Varanus salvator*	Monitor lizard	LC			✔	
Birds	Bucerotidae	*Anthracoceros albirostris*	Oriental pied hornbill	LC			✔	
	Columbidae	*Chalcophaps indica*	Emerald dove	LC			✔	
	Eupetidae	*Eupetes macrocerus*	Rail-babbler	NT			✔	
	Phasianidae	*Gallus gallus*	Red jungle-fowl	LC	✔		✔	
	Phasianidae	*Lophura ignita*	Crested fireback	NT			✔	
	Pellorneidae	*Pellorneum capistratum*	Black-capped babbler	LC			✔	
	Accipitridae	*Spilornis cheela*	Crested serpent eagle	LC			✔	
Tree-shrews	Tupaiidae	*Tupaia glis*	Common tree-shrew	LC	✔	✔	✔	
Rodents	Hystricidae	*Atherurus macrourus*	Brush-tail porcupine	LC			✔	
	Hystricidae	*Hystrix brachyura*	Malay Porcupine	LC		✔	✔	✔
	Sciuridae	*Lariscus insignis*	Three-striped ground squirrel	LC		✔	✔	
	Muridae	*Leopoldamys sabanus*	Long-tailed giant rat	LC	✔		✔	✔
Herbivores	Tragulidae	*Tragulus kanchil*	Lesser mouse-deer	LC	✔		✔	✔
	Cervidae	*Muntiacus muntjak*	Barking deer	LC	✔			
	Cervidae	*Rusa unicolor*	Samba deer	VU	✔			
	Tapiridae	*Tapirus indicus*	Malay tapir	EN	✔			✔
Pigs	Suidae	*Sus scrofa*	Wild boar	LC	✔	✔	✔	✔
Primates		*Macaca fascicularis*	Long-tailed macaque	LC			✔	✔
		Macaca nemestrina	Southern pig-tailed macaque	VU	✔	✔	✔	✔
Carnivores	Herpestidae	*Herpestes brachyurus*	Short-tailed Mongoose	LC		✔	✔	
	Prionodontidae	*Prionodon linsang*	Banded Linsang	LC	✔			
	Viverridae	*Hemigalus derbyanus*	Banded Civet	VU			✔	
	Viverridae	*P. hermaphroditus*	Asian Palm Civet	LC		✔	✔	✔
		Viverra megaspila	Large Spotted Civet	VU		✔		
		Viverra tangalunga	Malay Civet	LC	✔		✔	
	Mustelidae	*Martes flavigula*	Yellow-throated Marten	LC	✔			
	Felidae	*Prionailurus bengalensis*	Leopard Cat	LC		✔	✔	
		Pardofelis marmorata	Marble Cat	VU			✔	
		Panthera pardus	Leopard	NT	✔			
		Total	**30**		**13**	**10**	**23**	**8**

requires attention – its situation might be worse than generally assumed and warrants careful review and possibly reassessment. For example, its presence in southern Myanmar and Thailand, remains anecdotal (Zaw et al., 2014; Tantipisanuh et al., 2014). Ascertaining the real status of the species will require studies specifically designed to target FHC at suitable sites (e.g. Sabangau, Tasik Merimbun, or Deramakot) and particularly concerning the species' population ecology, distribution pattern and behaviour. We encourage funding bodies to give high priority to this little known felid that probably plays important ecosystem functions as a highly specialized predator in Southeast Asian peatswamp forests and wetlands. The Roundtable Sustainable Palm Oil (RSPO)'s remediation and compensation procedures could offer additional opportunities to restore FHC habitat (RSPO, 2014).

Overall, the FHC is a highly endangered species living in also highly threatened habitats, such as Southeast Asian peatswamp forests (IUCN, 2015; Wilting et al, 2010a). We see potential here to use conservation marketing (Wright et al., 2015) to brand FHC as the ghost cats of Southeast Asia, i.e. as a flagship species for the conservation of Southeast Asian peatswamp forests and wetlands.

Acknowledgements

This study was conducted with no formal funding and relied on the generosity of TEAM, Copenhagen Zoo and The University of Nottingham Malaysia Campus's Tropical Conservation Ecology lab for the use of their camera-traps and field equipment. Research permits were kindly granted by the Forestry Department of Negeri Sembilan. We thank all the field assistants: Khairul M, John S, Boi B, EJ, Black WHG, Alnisia J, and Cedric Tan. We are also grateful to Jim Sanderson for the discussions and advice on the usage of baits to target the FHC and to Natalia Huang, Jared Stabach and Alison Thieme for suggestions and comments on different aspects of the manuscript.

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54th Annual Meeting: July 9-14, 2017 in Mérida, México

Short communications

Parasitic helminths (nematodosis) in banteng, *Bos javanicus*, and domestic cattle in Baluran National Park

Dyah Ayu Kurniawati[1], Suprianto[2], Misro[1] and Haryawan Agung Wahyudi[1]

[1]Copenhagen Zoo, Indonesia Programme, Baluran National Park, East Java
[2]Baluran National Park, East Java

Corresponding author: Dyah Ayu Kurniawati, Email: *fatimahazzaman@gmail.com*

Introduction

The once widespread wild banteng, *Bos javanicus,* has been extensively persecuted by humans on Java. Today it is only found in four areas of Java, namely the national parks Ujung Kulon, Betiri Meru, Alas Purwo and Baluran (IUCN, 2008). The drastic decline has resulted in banteng being listed as "Endangered" on the IUCN Red list (IUCN, 2008), with a Global population of less than 5000 individuals. On Java, some individuals roam landscapes outside protected areas and have caused conflicts between local communities and banteng (pers. comm. Alas Purwo National Park). In such cases, authorities have been forced to capture and translocate conflict animals at a high cost or risk that communities will eventually kill bantengs that they perceive as conflict animals.

Baluran National Park (BNP) is located on the north-eastern tip of Java and considered one of the strongholds for banteng in Indonesia. It spans 25.000ha of a variety of habitats such as evergreen, teak and mangrove forests, but it dominated by and famous for its extensive savannah and open woodland habitat, which is unique to tropical Southeast Asia. This offers prime grazing grounds for the park's many ungulates, including banteng. A banteng census in 1996 estimated a population of 312-338 individuals, which declined rapidly to only 34 individuals in 2007 (BTN, 2010). Subsequently, 38 individuals were recorded in 2013 and 46 individuals in 2015 (Wahyudi et al, 2015), suggesting that with the recent management improvement the banteng population is slowly recovering.

BNP is not only prime grazing grounds for banteng, but local communities use the park as grazing grounds. A rapid survey recorded approx. 3000 cattle that graze the park daily (Rademaker et al., *in press;* Wahyudi et al., 2016). Whereas most of the cattle are concentrated in the north-western part of the park, the intrusion has expanding into more areas where banteng and other wildlife are also common. Grazing cattle was detected in 7766.6ha of the park, and there is significant habitat utilisation overlap between banteng and cattle (Wahyudi et al 2015, Wahyudi et al 2016). The grazing overlap can result in a competition for food, hybridization, disruption of wildlife migration patterns and disease transfer (Komberec, 1976; Schmidt et al, 2005; Vile et al, 2005).

Helminthiasis is a common cattle disease reported across the world. It is usually transmitted between various hosts by intermixing and overlapping grazing grounds (Walker et al, 2014). They are transmitted by infective larvae on shared pastures that are ingested, or through the penetration of skin or through an intermediary host (Anderson, 2000) Helminth infestations affect the health of wildlife and domestic animals by inhibiting the growth and development, lower body mass in calves and is often fatal in young animals (Stein et al, 2002; Subekti, 2004). Helminths can also affect the

Received 12th January, 2017; Revision received and accepted March, 2017.

immune system negatively and aggravate secondary infections that are often not serious (Enzewa and Joles, 2011). Despite the well documented negative impact to the health of domestic cattle and wildlife, the study of disease transmission in wildlife and livestock rarely discuss helminths infections (Vile et al, 2002; Kock, 2005; Wambawa, 2005). This study aims to assess the risk of disease transmission between cattle helminth and banteng in Baluran National Park.

Methods

Study Area

BNP is located in the District of Banyuputih, East Java, Indonesia. It spans over 25,000 ha and is located at 7°55'17.76S and 114°23'15.27E (BTN baluran, 2012). BNP contains a range of habitats, ranging from mangroves, coastal forest, swamp forest, woodland savannah, sub-montane forest (primary), monsoon evergreen forest, sea-grass beds and coral reefs (BTN baluran, 1995). The climate is dominated by an 9 months dry season with less than 60mm rainfall and 3 months of rainy season (BTN Baluran, 2014). At 1247m, Baluran Mountain is the park's highest peak and dominates the largely flat landscape in the rest of the park. The fauna remains poorly studied, however, to date 22 species of mammals and 233 species of birds have been recorded. Due to its variety of habitat, a total of 475 species of plants have been recorded, a very large number for this relatively small park. There are also an estimated 3000 heads of cattle and only 40-50 banteng (Wahyudi et al, 2015).

Stool collection and analysis

Faecal samples were taken from 40 cows found to graze in BNP. They were collected in Labuhan Merak, Balanan and Wonorejo zones. A total of 18 faecal samples was collected from bateng in the Perengan, Bitakol and Balanan zones. All samples were collected from fresh dung only (<4 hours) and stored in 10% formalin solution before analysis. We used "floating" method to extract and isolate the worms and eggs. The extracted worms and eggs were observed under a microscope and identified. The degree of infection in cattle and banteng was calculated as,

$$i = n/N \times 100$$

i = degree of infection in %
n = number of positive samples
N = total number of samples

Results

Six different species of helminths were identified from a total of 58 dung samples (Tab.1). Infections were recorded in 85.00% of all cattle dung samples, whereas only 33.30% of the banteng dung samples were infected. All six species of helminths were recorded in cattle dung, which was dominated by *Oesophagustomum sp*. This species was found in 62.50% of the samples, followed by *Bunostomum sp* (35.00%) (Tab. 1). In contrast, only two species were recorded in banteng dung and *Oesophagustomum sp* was also the most commonly recorded (35.30%) (Tab. 1).

Discussion

At 85% infection rate, the prevalence of helminth on cattle from BNP was high compared to that recorded from cattle in Way Kambas National

Table 1. The various Helmint species recorded and the degree of infection in cattle and banteng dungs.
N_{cattle} = 40; $N_{banteng}$ = 18

Species	Cattle	Banteng
Oesophagustomum sp	25 (62.50%)	6 (35.30%)
Bunostomum sp	14 (35.00%)	0
Haemonchus sp	8 (20.00%)	1 (5.80%)
Trichostrongylus sp	7 (17.50%)	0
Strongyloides sp	2 (5.00%)	0
Trichuris sp	1 (2.50%)	0

Park (70%) (Putratama, 2009). The species recorded in this study are considered common in cattle (Rahman and Mondal, 1983; Farooq et al, 2014) and *Oesophagustomum sp* was also the most common species recorded in other studies in Pakistan (Farooq , 2012) and Bali (Sugama and Suyasa, 2011).

The relative low number of infections in banteng (33.30%) is somewhat surprising, considering a similar research in BNP recorded an infection level at 56.00% (Hahang, 2004). In addition, banteng were only infected by two types of helminths in contrast to six for cattle (Tab.1) although the dominating infectious species was the same (*Oesophagustomum sp*).

The reason for the difference between cattle infestation and banteng is not clear. However, all cows are herded back to night enclosures that are often cramped and with poor sanitation. Here, all cows are forced to rest, defecate, drink and eating in the same place and the water basin was often observed to be contaminated with faeces and mud. During the rainy season, cattle faeces and urine become mixed with the soil and form extensive mud pools. This forms the perfect conditions for helminthial transmission from an infected individual to healthy individuals. Despite appalling husbandry conditions, there is regular no de-worming exercises undertaken.

A preliminary banteng occupancy survey was undertaken in 2015 and 2016 and concluded that there are significant grazing overlap between banteng and cattle (Wahyudi et al 2015, Wahyudi et al 2016). Parasitic infestations through the faecal-oral route is very common and with a heavily infected cattle population sharing grazing grounds with banteng, the conditions for helminthial cross infections are ideal (Hutchings et al., 2003; Judge et al., 2005). In addition, the poor husbandry standards provided in the villages also increases the risk spreading other infectious diseases, such as other parasitic nematodes and micro parasites (e.g. bacteria) are often stacked in the pasture with the faeces (Fedorka-Cray et al., 1995; Cellini et al., 1999; Coleman and Cooke, 2001; O'Brien et al., 2002 ; Judge et al., 2005). In 2016, the BNP suffered extreme wet conditions. Wet humid climate provide excellent conditions for helminthial life-cycles as well as induce better dispersal during the infective stage (Pfukenyi and Mukaratirwa, 2013). Rain induced dispersal of faeces also increases infection rates (Seo et al.2015).

The relatively low number of infected banteng may result from being in limited contact with infected cows, as well as their tendency to avoid cattle and herders. In some cases, cattle and other herbivores actively choose grazing areas that are not contaminated with faeces (Hutching et al, 2003). Finally, banteng may not be as susceptible to infection by all the same helminth species as domestic cattle, perhaps due to a more diverse diet.

This study reveals that the domestic cattle that illegally occupy a third of the parks grazing grounds are seriously infected with helminths and with a high probability of other diseases too. With the increasing encroachment of infected cattle and overlap with banteng and other ungulate grazing grounds, BNP faces a serious risk of loosing the endangered banteng. Due to the sheer number of cattle, combined with the poor husbandry condition, no veterinarian and the relatively small size of BNP, a disease outbreak can exterminate one of Indonesia's last remaining wild and genetically diverse populations of banteng. In addition, *Haemonchus sp* frequently encountered in sheep and goats, can also infect cows and some species of deer (Eve and Kellog, 1977; Anderson, 2000). In addition to banteng, this puts the park's deer population at risk too.

This study focused only on helminths infection and dispersal routes, however, this alone should be enough to persuade BNP's management to act swiftly to arrest the onset of disease transfers from domestic livestock to the park's endangered wildlife species. Once the diseases have been transmitted to wildlife, it is almost impossible to eradicate again and BNP will eventually loose some of its most charismatic species.

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Habitat overlap between banteng (*Bos javanicus javanicus*) and domestic cattle in Baluran National Park, East Java

Hariyawan Agung Wahyudi[1], **Dyah Ayu Kurniawati**[1], **Supriyanto**[2] and **Sutadi**[2]

[1]Copenhagen Zoo Baluran Programme, Jl Raya Banyuwangi-Situbondo, Desa Wonorejo, Situbondo, Jawa Timur, Indonesia
[2] Baluran National Park, Jl Raya Banyuwangi-Situbondo, Desa Wonorejo, Situbondo, Jawa Timur, Indonesia

Corresponding author: Hariyawan Agung Wahyudi, Email: *ha.wahyudi@gmail.com*

Introduction

Banteng (*Bos javanicus*), an Asian wild cattle, is considered the ancestor to domestic cattle in Southeast Asia (Nowak, 1991). Three subspecies of banteng are generally recognized: *B. javanicus javanicus* (Java and Bali), *B. javanicus lowi* (Borneo) and *B. javanicus birmanicus* (Asian mainland) (Lekagul and McNeely, 1977). With a total wild population estimated to number less than 8000, banteng is listed as "Endangered" on the IUCN Red-list (Gardner et al., 2016). In Java, banteng are primarily found in small isolated populations in reserves and protected areas with human settlements. There are only four habitats left with important banteng populations: Ujungkulon NP, Meru Betiri NP, Alas Purwo NP and Baluran NP.

Comparison between population data in 2002 and in 2006 indicated a dramatic decline of banteng in Baluran NP. This was clearly reflected in the age structure of the population in 2002. The confirmed sub-adults numbered only 10 (8%) a total of 126 individuals (Pudyatmoko et al, 2007). Sabarno (2007) suggested that limited water supply, habitat changes and illegal hunting were the main causes for the population decline in Baluran NP.

Baluran's dry season spans over eight months with the rainy season peaking during December - January. There are only a few permanent waterholes in Baluran NP. The crater of Mount Baluran NP gives rise to a permanent spring that delivers a steady stream of high quality water throughout the year. It is, however, difficult to access by large herbivores. A few waterholes are located near the sea with poor quality water and the limited number of permanent good quality waterholes in Baluran NP makes it an ongoing management challenge.

In addition to the water scarcity, large ungulates also faced decreasing quality pastures, due to the ongoing spread of the invasive African acacia, *Acacia nilotica*. This fast growing tree was introduced in the late 1960s and, without natural predators, it has spread across much of the once large tracts of open savannah as well as patches of woodland savannah. In total, the spread of *Acacia nilotica* has reduced the savannah area with more than 50% from total area of 10,000 hectares. The significant decline of main grazing grounds resulted in nutrients deficiency for many herbivores in the peak of dry season. Although poaching has decreased in the past decade, illegal hunting continue to take a toll on Baluran's banteng population. The park management has recorded 11 banteng killed by hunters in the past decade, with many more unknown killings that were never recorded.

In spite of these serious setbacks, the most critical threat to their long-term survival have emerged from an increasing number of livestock in the park. Wind and Amir (1977) reported that banteng was abundant in the northern parts of Baluran NP in the late 1970s. At the change of the millennium

Received 20th December, 2016; Revision received and accepted 25th May, 2017.

the presence of illegal cattle herders continued to increase (Sabarno, 2002), to the extent that it changed the banteng distribution on the north side of Mount Baluran. In 2000, banteng was reportedly absent from this area (Anonim, 2000). In 2016, it was estimated that approx. 3000 heads of cattle graze in Baluran NP every day (Rademaker et al., 2017).

The presence of domestic cattle followed the human settlements inside Baluran NP, specifically at Labuhan Merak and Gunung Masigit. The communities have resided in this area since 1975, when this area was managed by PT. Gunung Kumitir as a plantation area. Lack of coordinated intervention by government authorities has resulted in land tenure conflicts that have become increasingly difficult to settle. Ex-plantation workers continue to live in this area although their permits, Hak Guna Usaha (HGU) for PT Gunung Kumitir, expired in year 2000. The number of settlers increased significantly during the period 1986-2000 and continue to grow to this day. In 2009, there were 328 families with 1069 persons in these illegal settlements (Wianti 2013).

For banteng conservation, this poses a major risk to the long-term survival of the species. The interaction between domestic livestock and banteng have already resulted in transmission of diseases, such as nematodosis (Kurniawati et al., 2016). An outbreak of a more sinister type of disease can wipe out the entire banteng population within a short time. Furthermore, the competition for some of bantengs favourite grazing grounds with high quality pioneer grasses (Prosser e al., 2016) usually favours cattle, because banteng are exceptionally shy around human presence (Gardner, 2015).

This preliminary study aimed at assessing to which degree banteng and domestic cattle compete for grazing areas in Baluran National Park. This can have profound implication on banteng conservation, since they are known to shy away from human activities (Gardener, 2015), thereby loosing more vital grazing ground, or risk suffering a serious disease outbreak. This study forms part of a larger study on wildlife conservation in Baluran NP.

Methods

A field survey was conducted from January - early December 2016 in an area measuring approx. 12,900 hectares. The area was divided into 1x1km grids, based on the park's Resort Based Management System already in use since 2009. Within each cell, signs of domestic cattle, including footprints, faeces and direct encounter were recorded. The location of domestic cattle detections were recorded using GPS (Garmin 64s). Surveys were conducted in habitat types preferred by herders due to optimal grazing grounds for their cattle, such as savannah and woodland savannah. A total of 120 camera trap were deployed in the survey area, to increase the possibility of banteng/cattle detection. The results were mapped and overlaid with a map of banteng occupancy in 2015 and 2016 (Wahyudi and Sutadi, 2015; 2016). The overlap area was estimated using ArcGIS 10.3.

To get information about the total cattle population, a rapid interview with cattle owners were conducted in every settlement. Banteng detection/non-detection data were analyzed to estimate site occupancy. Totally, 72% of surveyed area are occupied by banteng. However, domestic cattle were detected present in some locations where banteng also be present.

Results

Domestic cattle were detected in 86 grid cells with an estimated total area of 7,766 hectares. The domestic cattle is mostly distributed near the border of national park and near the settlements inside Baluran NP at the northern side (Fig. 1). There are three groups of local villagers who shepherd domestic cattle; Wonorejo village at southern part of NP, Karangtekok village at north west part of NP and settlers who live inside NP at Labuhan Merak and Balanan at the northern side of NP. Villagers herd their cattle every morning to grazing areas and return in the afternoon. There are no fixed grazing locations, but it varies depending on availability of grass.

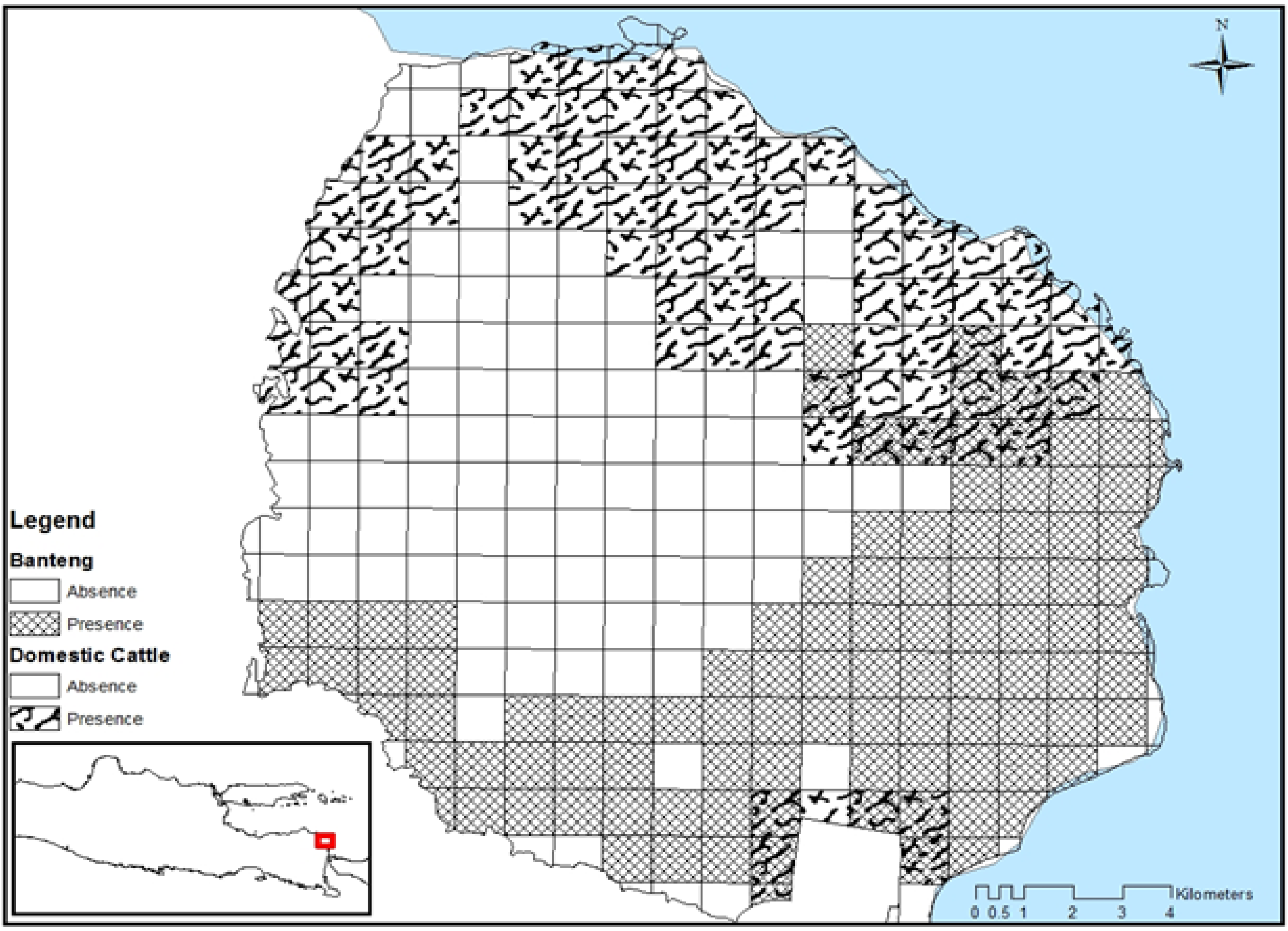

Figure 1. Distribution of banteng and domestic cattle in Baluran National Park. Cattle are present in almost a third of the park and overlap significantly with banteng in the north-eastern and southern sectors.

In the dry season, grazing area increased significantly and cattle were recorded deep inside Baluran NP, where there is plenty of good quality of grass. Furthermore, the limited amount surface water forced settlers to herd cattle further up towards the natural springs at Mount Baluran. Our analysis reveals that cattle used the same grazing areas as banteng in 14 grid cells, with a total area of 1,311 hectares. The habitat overlap is detected in the south as well as the north-eastern parts of Baluran NP (Fig.1). The number of domestic cattle in Labuhan Merak and Balanan, two villages located inside Baluran NP, is 1496 (Tab.1). This only accounts for approx. half of the total number of cattle that graze the park. In addition to the cattle from Labuhan Merak and Balanan, many enter from villages adjacent to Baluran NP. The daily total number of cattle grazing inside the park is approx. 3000 heads, with 179 from Wonorejo village.

Table 1. The number of cattle in the two villages located inside Baluran National Park.

Village	Number of cattle
Labuhan Merak	1308
Balanan	188

Discussion

For the communities in Labuhan Merak and Gunung Masigit, cattle is the livestock of choice, although many goats and chicken are also kept. Owners usually have 4-5 cows per person (Wianti,

Figure 2. The presence of domestic cattle deep inside Baluran National Park recorded on camera traps in November, 2016. An estimated 3000 heads of cattle illegally graze in the park daily.

2013) and already in the early 1990s, more than 1600 cows and 400 goats were herded into Baluran NP (Hafis, 1992). The increasing trend continued throughout the 1990s and into the new millennium (Sabarno, 2007). A steep increase emerged with the "gaduh" system, in which case cattle are managed collectively following agreed rules. With the introduction of this practice, local farmers also agreed to manage and breed external investors' livestock and share the economic benefit later (Wianti, 2013).

The presence of large numbers of domestic cattle inside Baluran NP has resulted in negative impacts to the native ungulates. Grazing competition between domestic cattle and wild herbivores has increased drastically, changed grass composition in key grazing area and increased the potential transfer disease between domestic cattle and wildlife (Alikodra, 1980).

Banteng usually graze in open, dry, deciduous forests whenever present. Although grazers by preference, they consume other material (e.g. fruits, browse) depending on the availability (Purwantara et al., 2011). Our results reveals that the domestic cattle distribution overlaps significantly with banteng presence in an area spanning more than 1,300 hectares. The habitat in the overlapping grid cells constitute mixed woodland savannah, which is bantengs' preferred habitat in Baluran NP (Wahyudi, 2015). Cattle prefer flat areas and tend to avoid rocky hillsides. Cattle also spend more time in areas closer to water sources (Fowler, 2002).

Livestock and wildlife contribute to modifying the savannah vegetation by grazing. Grazing and browsing is essential to maintaining and conserving the ecological integrity of open savannah landscapes. Without sufficient and extensive grazing pressure, small trees and woody vegetation will eventually dominate the savannah and suppress the growth of grasses. Following the removal of grasses and suppression of bush growth, there will be very little dry organic matter left in the dry season to fuel potential wildfires. It is an essential condition for frequent landscape fires that there is sufficient fuel. Less frequent fire causes the primary browsing, grazing and trampling to be a more extensive disturbance, through keeping the invasion of trees and grasses away (Kellman and Tackaberry, 1997; McNaughton, 1985, 1986, 1992, 1993; Osborne, 2000). However, the productivity of savannah areas in Baluran NP is considered low. Based on a 2006 study, Bekol savannah only produced a biomass of 113.5 kg/day, which is lower than ideal productivity (150 kg/day) according to Wind and Amir (1977) (PEH Baluran NP, 2006).

Competition between domestic cattle and banteng in grazing increasing significantly because of invasion of *Acacia nilotica*. Since introduced as fire break in late 1960s, *A. nilotica* had spread and covered more than 6000 hectares of savannah ecosystem or more than 50% area of savannah. If the population of domestic cattle being uncontrolled, banteng will lose competition in grazing (Sabarno, 2002).

Habitat overlap between banteng and domestic cattle in Baluran NP raised new potential problem in wildlife conservation, which are potential cross breeding between banteng and cattle, as well as potential transfer disease. The close contact between banteng and cattle can lead to serious disease transmissions, where anthrax, brucellosis, septicaemia epizootica, infectious bovine rhinotracheitis, bovine viral diarrhea and helminthiasis have already been recorded in region's domestic cattle. Helminthiasis, can lead to gastrointestinal disturbance, malnutrition, growth disorder and elevated mortalitiesin young individuals. Potential transfer disease, especially herlminthiasis between domestic cattle and banteng in Baluran NP is relatively high, since Helminthiasis prevalence in cattle around Baluran is 96% (Kurniawati et al, 2016).

Several strategic actions were implemented by Baluran NP management to reduce the negative impact of domestic cattle. To accommodate the settlers in northern side of NP as well as local community around national park, Baluran NP provide a traditional zones in a total area of 1,340.21 hectares (5.36% from total area of national park), consists of 748.92 terrestrial zone and 591.29 hectares of marine zone. Baluran NP also have an agreement with settlers to allow them to manage traditional zone (Balai Taman Nasional Baluran, 2012). Community awareness also conducted followed by grass planting program to support community farming. Likely, the program has not succeed to prevent local communities trespassed the zone (Sabarno, 2002).

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First record of flat-headed cat (*Prionailurus planiceps*) in Tasek Bera, Malaysia

Mariani Ramli[1,2] and Carl Traeholt[2]

[1]Department of Wildlife and National Parks, Malaysia

[2]Copenhagen Zoo, Southeast Asia Programme, Research and Conservation Division.

Corresponding author: Mariani Ramli, Email: *bam_arrogancia@yahoo.com*

Introduction

The flat-headed cat (*Prionailurus planiceps)* is found roaming from southern Thailand, West Malaysia, Sumatra and Borneo (Bezuijen, 2000, 2003; Cheyne et al., 2009; Malim and Yasuma, 2000; Meijard et al., 2005; Mohamed et al., 2009; Traeholt, 2001; Traeholt and Lim, 1999; Yasuda et al., 2007). Although there exists few reliable sources are available on the species historical and current distribution it was listed as Endangered on the IUCN Red List (IUCN, 2015).

It is a unique species with distinctly elongated, flattened head and small, rounded ears that makes this unusual member of the cat family (Muul and Lim, 1970) (Fig. 1). Like its bigger cousin, the fishing cat (*Prionailurus viverrinus*), it is well adapted to a semi-aquatic lifestyle, where they are reported to feed mainly on fish and amphibians (Lim and Rahman, 1961; Rasmussen, 2014; Traeholt and Idris, 2011).

In Peninsular Malaysia flat-headed cats have been recorded from Selangor peat swamp forest, Pulau Kukup, Johor (unpubl. Johor National Parks), Pahang peat swamp forest, Sg. Pulai Forest Reserve, and Krau Wildlife Reserve (Chow, 2010; Traeholt and Lim, 1999; Wilting et al, 2009). A road killed flat-headed cat was also recorded on the main highway between Karak and Temerloh, Pahang (unpubl. data) and another road kill was recorded outside Kuantan (Kalim et al., 2011).

In 1994, Tasek Bera was declared as Malaysia's first of six Ramsar sites. Whereas the total Ramsar area covers 31,255 hectares, approx. 6,800 hectares constitute freshwater wetland, of which the majority is (approx. 80%) is peat swamp forest. Today, approx. 2000 indigenous Semelai people inhabits the area. The lake and forest environment are now greatly disturbed by shifting cultivation, illegal logging and excessive human resources exploitation (fishing, harvest of non-timber forest products, tourism).

This study presents the first picture recorded of flat-headed cat using camera trap in Tasek Bera Malaysia.

Figure 1. Captive flat-headed Cat in Sg. Dusun Conservation Centre, Selangor, Malaysia.

Received 10th May, 2016; Revision received and accepted 6th October, 2017.

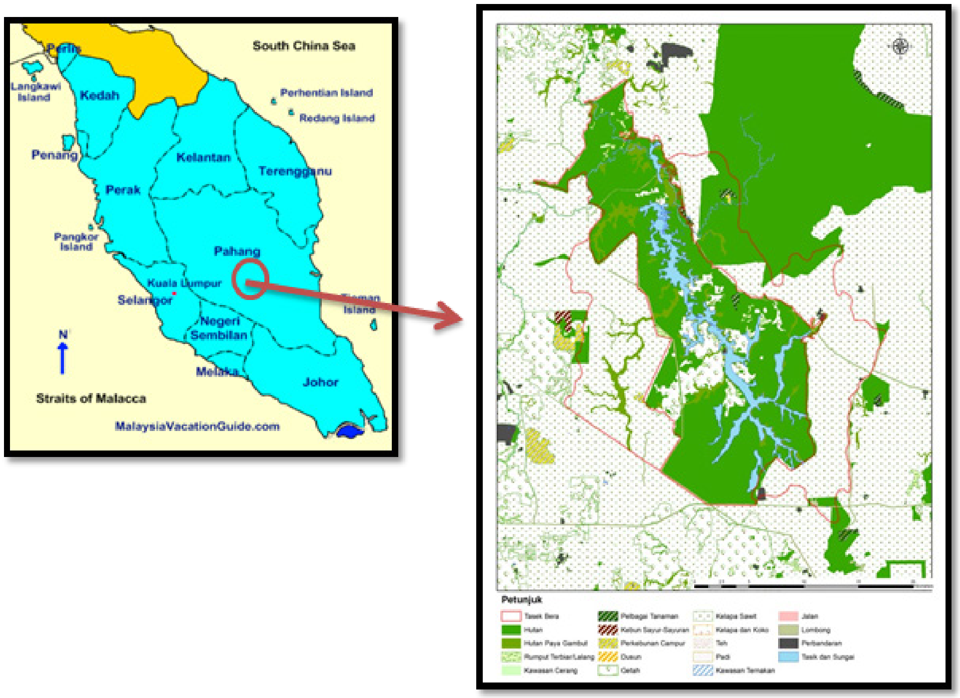

Figure 2. Tasek Bera study site is accessible from the East-West highway, linking Kuala Lumpur with Kuantan in the state of Pahang.

Methods

Study site

The camera trap study was undertaken in Tasek Bera Ramsar site at 3˚5'N, 102˚38'E in the Malaysian state of Pahang (Fig. 2)

A total of 20 camera traps (Scoutguard 550-V, 560-P) were deployed at 5 different locations. Cameras were set at a height of 40-50 cm above the ground in areas with low risk of flooding and where we presumed was a good flat-headed cat prey base. All cameras were set on dual recording i.e. both video and still pictures. The cameras were active 24/7 for a period of 103 days. Videos and pictures were sorted and analysed using a ReNamer software described by Sanderson and Trolle (2005).

Results and Discussion

A total of 1800 camera-trap-nights yielded 1277 videos and 5282 nominally independent pictures. This revealed 40 vertebrates species (Tab.1), including flat-headed cat. The most commonly photographed species was wild pigs (107) followed by Argus pheasant (66) and red jungle fowl (32).We recorded a total of six (6) pictures of flat-headed cat. The flat-headed cat detection at 06:22hrs on the 10th of June, 2014, and at 06:21hrs on the 19th July, 2014, was from same trap-location in lowland dipterocarp forest (Fig.3). One flat-headed cat record was located approx. 1.5km from an oil palm plantation, lending credibility to previous but rare accounts of the species near plantations (Khan, 1986). It may also be a result of the ongoing habitat loss that forces the species into exploring new potential habitats. Apart from the human disturbance factor, oil palm plantations may indeed offer adequate habitat for flat-headed cats. The many shallow streams and canals provide prime habitat for certain fish and amphibians, the main prey of this illusive species.

Fundamental threats to the long-term survival of the species continue to be associated with the loss and fragmentation of peat forest, wetlands and wet lowland forest. To date, however a greater understanding of the distribution and ecology is needed in the short-term to inform longer-term conservation actions and mitigate site-specific threats.

Table 1: List of vertebrate species recorded in the study.

Scientific Name	Common Name	No. photos
Sus scrofa	Wild pig	107
Argusianus argus	Great argus pheasant	66
Gallus gallus	Red jungle fowl	32
Tupaia glis	Common tree shrew	21
Macaca fascicularis	Long-tailed macaque	19
Chalchophaps indica	Emerald dove	16
Macaca nemestrina	Pig-tailed macaque	12
Rattus sp.	Rat sp.	12
Varanus salvator	Water monitor lizard	12
Lariscus insignis	Three-striped ground squirrel	8
Leopoldamys sabanus	Long-tailed giant rat	7
Tragulus kanchil	Lesser mouse-deer	7
Tragulus napu	Greater mouse-deer	5
Herpestes brachyurus	Short-tailed mongoose	4
Hystrix brachyura	Malayan porcupine	4
Callosciurus notatus	Plantain squirrel	4
Helarctos malayanus	Sun bear	4
Muntiacus muntjak	Barking deer	3
Paradoxurus hermaphroditus	Asian palm civet	3
Prionailurus bengalensis	Leopard cat	3
Prionailurus planiceps	Flat-headed cat	2
Trachypithecus obscurus	Spectacled leaf monkey	2
Gallus gallus domesticus	Domestic chicken	2
Viverra tangalunga	Malay civet	2
Polyplectron malacense	Malayan peacock-pheasant	1
Accipiter trivirgatus	Crested Goshawk	1
Echinosorex gymnurus	Moonrat	1
Prionodon linsang	Banded linsang	1
Lophura erythrophthalma	Crestless fireback	1
Stachyris nigricollis	Black-throated babbler	1
Centropus sinensis	Greater coucal	1
Tapirus indicus	Malayan Tapir	1
Arctictis binturong	Bear cat	1
Manis javanica	Malayan pangolin	1
Copsychus malabaricus	White-rumped Shama	1
Muscicapidae sp	Flycatcher sp.	1
Lutra sp.	Otter sp.	1
Copsychus saularis	Oriental Magpie Robin	1
Picidae sp.	Woodpecker sp.	1
	Total	**372**

Figure 3. A flat-headed cat (red circle) was recorded twice at the same location 39 days apart. It appeared to be foraging and is likely the same individual.

Acknowledgements

This work constituted part of the collaboration between Copenhagen Zoo, Denmark and the Department of Wildlife and National Parks., Malaysia. Research permits were generously granted by the Department of Wildlife and National Parks. We thank Jim Sanderson, Small Wild Cat Conservation Foundation, for help in the identification of the species; and the team involved in fieldwork activities.

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