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Cover photo: The Tawny Coster, *Acraea terpsicore*, has appeared on Borneo, where it has possibly established itself recently **© Muhammad Iqbal**

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Guest editorial

Promoting women in leadership positions for conservation of Indonesian biodiversity

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Throughout the professional history of ecology and wildlife biology and management, the vast majority of positions have traditionally been held by men and, consequently, men have dominated the overall contributions to peer-reviewed journals (Nicholson et.al., 2008). In the early part of the 20th century, most women who worked as field biologists were junior collaborators or assistants. Beginning in the 1980s, the role of women in these fields began to rapidly evolve and, over the last 40 years, the number of women choosing careers in biological sciences doubled (Hill et al. 2010; Chambers and Summers 2015). This positive development is also a result of the United Nation's "Sustainable Development Goals" that specifically highlight the urgent need to support and empower women in their efforts to conserve natural resources. This need is recognized as being particularly pressing in southern Asia (UNESCO, 2015).

In emerging economy countries with a large rural population, at the community level, many women have an interwoven relationship with natural resources and are often better positioned than men to care for their sustainable management. Consequently, women can bring diverse and valuable perspectives to conservation work and to the workplace (Sodhi et al., 2010; Casadevall and Handelsman, 2014; Chambers and Summers, 2015), and contribute innovative and meaningful ideas for solving environmental problems. In many instances, at community level, women are often better at communicating such issues. The presence of women in conservation initiatives has been found to increase collaboration, cohesion and conflict resolution in natural resource management groups (Westermann et al., 2005; Chambers and Summers, 2015). Because of women's traditional roles in rural societies, they are also more affected by increasing ecosystem degradation, but are often ill prepared to assume local leadership roles (D'Ormesson, 1992). However, some women have been successful in either achieving leadership positions, or in working with communities to develop these capacities within the context of local culture (Wacker, 1994). It is time to ensure that success quickly go beyond isolated local efforts to address surmounting environmental and sustainability challenges.

Fortunately, women in many countries, including Indonesia, are increasingly interested in and pursue professional positions in natural resource management and research. For example, the majority of students entering natural resource programs at the Department of Biology at Andalas University in Padang, Sumatra are now women (Novarino, personal communication). Unfortunately, and for a variety of reasons, many women end their professional careers before they have the opportunity to advance to leadership positions and to contribute publications to peer-reviewed journals.

There are many great examples of successful women working in natural resources in Indonesia. However, as in other countries, the proportion attaining leadership positions is much lower than male counterparts (Hill et al., 2015). Compared to male coworkers, the impediments for women in any career are lower salaries and slower advancement. In addition, studies report that significant life events, such as having and raising children, are well-described barriers to both recruiting and retaining women in the sciences, including biological professions (Ceci and Williams, 2011). In many cases, women serve as primary caregivers for children and/or elderly relatives. Such challenges affect women inherently and socially more than men, and in some scientific fields women are stereotyped as less capable and with lower "intrinsic aptitude," which can affect their ability to compete successfully with

Figure 1. Female participants unite at the 2nd International Wildlife Symposium, West Sumatra, 1 November 2015. © Chris Bugbee

male counterparts (Reppert, 2005; Leslie et al., 2015; Chambers and Summers, 2015). Cultural traditions that prevent women from pursuing professional careers must be considered when encouraging Indonesian women to continue their professional careers in natural resources after completing their education. Increasing women's participation and leadership roles can add much needed support and dedication to nature conservation and natural resource management. In many cases it is an essential prerequisite for sustainable development. Identifying barriers that prevent retention and advancement of women in these fields, and finding ways to overcome such obstacles, is an important step in conserving Indonesia's biodiversity.

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Westermann, O., J. Ashby, and J. Pretty (2005). Gender and social capital: The importance of gender differences for the maturity and effectiveness of natural resource management groups. *World Development* **33(11):** 1783-1799.

News and notes

In the wake of one of the worst modern time ecological disasters, the 1997 extensive forest fires in Malaysia and Indonesia, the focus on how this may contribute to climate change became increasingly common. With the even bigger forest fire disaster in 2015, many new publications reporting on Carbon-stock loss and measurements emerged. Some of these, along with other relevant publications and conservation news are provided in the following.

The disastrous wildfires rightfully take up most of the “News” section. Unfortunately, the lessons from the 1997 disaster were not heeded, and the question posed in our “Editorial” (see Traeholt and Novarino (2014). Preparing for *El Niño* - Will Indonesia be ready? *Journal of Indonesian Natural History* **2(2)**: 3) was clearly answered. Despite the human and economic cost of the 1997 disaster, 2015 became the year when this disaster was revisited, with even higher human, social and economic costs. One have to wonder if this second ecological and human disaster will merely become the 2nd incident in a future long strong of incidents? While the solution is theoretically straight forward, the practical circumstances on the ground is much more challenging. Combined with the conglomerate of economic interests, the implementation of policies, plans and laws continue to sputter.

Sumatran rhino declared extinct in Malaysia

The Sumatran rhino, *Dicerorhinus sumatrensis*, has been listed as Critically Endangered on the IUCN red-list for decades. Since the early 1980s, a concerted effort to develop a holistic Sumatran rhino conservation rescue plan was undertaken. Unfortunately, 30 years and millions of dollars later, a new paper declares the Sumatran rhino extinct in West Malaysia. To conservation biologists working in Malaysia, this does not come as a surprise, since neither rhinos nor signs of them have been recorded for more than a decade. Unfortunately, the most important task in conserving the Sumatran rhino in Malaysia --- effective anti-poaching measures --- never took place, and as a result this magnificent species has follow the last Javan rhino in Vietnam into oblivion. Rhino poaching is a new phenomenon; in fact it has been a major conservation crime for decades, and thousands are slaughtered in Africa for their horns and transported, primarily, to the Chinese and Vietnamese markets as traditional medicine. With this knowledge, there has been an astonishing lack of action on the ground by the Malaysian authorities. In the end, it must be concluded that Sumatran rhinos, along with several other species, are not important enough in Malaysia’s constricted quest for financial prosperity.

Havmøller et al., (2015). Will current conservation responses save the Critically Endangered Sumatran rhinoceros *Dicerorhinus sumatrensis*? *Oryx*: (5 pp.) - doi:10.1017/S0030605315000472

Wildlife criminals take aim at another cat species

With the number of tigers dwindling across its range, combined with an increase in tiger anti-poaching activities, it appears that the illegal trade in exotic large cats have shifted its focus to another species. According to a new study published in the journal *Biodiversity and Conservation* the trade of clouded leopard, *Neofelis nebulosa*, is likely higher than that of tigers. Whereas international and domestic trade regulations are in place across the region, the authors claim that loopholes in the legislations permit legal trade in Asian big cats in “exceptional circumstances”. The study highlights that these legal loopholes apply to *all* Asian big cat species, and that this also has potential to compromise wild animal welfare. The authors suggest, as a precautionary measure, regional authorities should extend existing bans on Asian big cat trade, so that they include commercial trade in captive bred individuals too.

D’Cruze, N. and D.W. Macdonald (2015). Clouded in mystery: the global trade in clouded leopards. *Biodiversity and Conservation*. Doi: 10.1007/s10531-015-1010-9

Using local communities for monitoring and control in conservation’s blind spots

Although official on-the-ground environmental monitoring is absent over much of the world, many people living in these regions observe, manage, and protect their environment. The autonomous monitoring processes associated with these activities are seldom documented and appear poorly recognized by conservation professionals. This is what this paper about, where the authors study the activities in three villages in the Mamberamo-Foja region (Mamberamo Regency) of Papua (Indonesian New Guinea). The important results

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of the study is that local monitoring contributes to effective protection and deters unregulated exploitation. In addition, monitoring is often combined with other activities: for example, hunting regularly includes areas judged vulnerable to incursions by neighbouring communities. Enforcement of the community rules and assessment of resource status also help prevent local overexploitation within the communities. Whereas the study provides very convincing evidence of local people effectively protecting large areas in a relatively natural state, it remains difficult to measure the real effect, since there are no "baseline" material available to compare against. The value of these autonomous monitoring and protection processes, their neglect, and the need for explicit recognition, however, ought to receive more credit and attention from the conservation community in general. As the authors argue, the "tragedy of the unseen sentinels" is undermined, not because these local systems are invisible, but because no one recognizes what they see.

Sheil, D., M. Boissière, and G. Beaudoin (2015). Unseen sentinels: local monitoring and control in conservation's blind spots. *Ecology and Society* **20(2)**: 39.
http://dx.doi.org/10.5751/ES-07625-200239

The importance of seed dispersers in forest restoration

An estimated 63% of Southeast Asian forests are classed as disturbed and secondary as a result of human activity. Many of these forests, however, remain important for biodiversity conservation and ecosystem services. This paper looks at the role of large animals as seed dispersers in natural regeneration, especially in relation to important late successional shade-tolerant species, which might otherwise be excluded from disturbed sites. The irony, however, is that many large animals are lost from the very areas that require them. Using camera traps and field observations to relate large animal distribution to prevailing vegetation conditions, the authors investigated the persistence of a suite of threatened large mammals that are known seed-dispersers in a degraded site in lowland south-central Sumatra. The study revealed that, whereas most species were more frequently detected in intact habitats, most were also able to occupy habitats with high levels of disturbance in relatively high population densities. They conclude that severe habitat degradation does not necessarily lead to the immediate loss of large-bodied seed dispersers, but suggest protection from, specifically hunting, must be built into management plans for restoration concessions.

Lindsell, J. A., Lee, D. C., Powell, V. J. and Gemita, E. 2015. Availability of large seed-dispersers for restoration of degraded tropical forest. *Tropical Conservation Science* **8(1)**: 17-27.

Imaging tropical peat-lands in Indonesia

Much of the disastrous massive forest-fires in Indonesia and Malaysia in 1997 was caused by peat development. This lead to an increase in studies about carbon storage in peat swamp forests. Current estimates of carbon (C) storage in peatland systems worldwide indicate tropical peatlands comprise about 15 % of the global peat carbon pool. Although estimates are uncertain due to data gaps regarding organic peat soil thickness and C content, it is accepted that Indonesian peatlands are considered the largest pool of tropical peat carbon (C), counting for an estimated 65 % of all tropical peat. The effect of the 1997 fires along with the continuation of peatland development has made it the largest source of carbon dioxide emissions from degrading peat worldwide, posing a major concern regarding long-term sources of greenhouse gases to the atmosphere. The authors used ground penetrating radar (GPR), and electrical resistivity imaging (ERI) with direct observations from core samples (including C analysis) to assess peatland thickness in West Kalimantan (Indonesia) and determine how geophysical imaging may enhance traditional coring methods for estimating C storage in peatland systems. They found peatland thicknesses estimated from GPR and ERI varied by less than 3% compared to direct coring, even for small peat-mineral soil interface gradients (i.e. below 0.02). They also observed that geophysical data provided information on peat matrix attributes, such as thickness of organomineral horizons between peat and underlying substrate, the presence of wood layers, buttressed trees and soil type. They concluded that, while such information is important, these attributes could further constrain quantification of C-content and aid responsible peatland management in Indonesia.

Comas et al., 2015). Imaging tropical peatlands in Indonesia using ground penetrating radar (GPR) and electrical resistivity imaging (ERI): implications for carbon stock estimates and peat soil characterization. *Biogeosciences Discussions* **12**, 191–229

Modelling Carbon accumulation in tropical peatlands

Tropical peat-lands cover an estimated 440.000 km^2 (~10% of global peat-land area) and are significant in the global carbon cycle by storing about 40–90 Gt C in peat. Over the past several decades, tropical peatlands have experienced high rates of deforestation and conversion, which is often associated with lowering the water table and peat burning, releasing large amounts of carbon stored in peat to the atmosphere. However, how dynamic is the carbon storage in tropical peatlands over time? The authors developed a first model of long-term carbon accumulation in tropical peatlands by modifying the Holocene Peat Model (HPM), which has been successfully applied to northern temperate peatlands. Tropical HPM (HPMTrop) is a one-dimensional, non-linear, dynamic model with a monthly time step that simulates peat mass remaining in annual peat cohorts over millennia as a balance between monthly vegetation inputs (litter) and monthly decomposition. They included model parameters based on published data on vegetation characteristics, including net primary production partitioned into leaves, wood, and roots; and initial litter decomposition rates, and concluded that the HPMTrop outputs were consistent with field observations from Indonesia. Simulated long-term carbon accumulation rates for 11,000-year-old inland, and 5,000-year-old coastal peatlands were about 0.3 and 0.59 Mg C ha^{-1} yr^{-1}, and the resulting peat carbon stocks at the end of the 11,000-year and 5,000year simulations were 3,300 and 2,900 Mg C ha^{-1}, respectively. The important conclusion is that the simulated carbon loss caused by coastal peatswamp forest conversion into oil palm plantation with periodic burning was 1,400 Mg C ha^{1} over 100 years, which is equivalent to ~2,900 years of C accumulation in a hectare of coastal peatlands. The rehabilitation effort of Indonesia's peatlands will need some serious innovation to be able to re-establish the C-storage effect of its tropical peatlands.

Kurnianto et al. (2015). Carbon accumulation of tropical peatlands over millennia: a modelling approach. *Global Change Biology* **21**, 431–444. doi: 10.1111/gcb.12672

Trends and biases in reported conservation interventions - ten years of evidence

The impact of conservation intervention is often obscured by social, practical and political realities. Most successes are immediately reported, be it a single picture of a newly discovered species in Africa, or a picture of a tiger in an area of Sumatra, where it was considered absent. Outright failures, however, are rarely reported, even if the lessons learnt from unsuccessful conservation interventions can be extremely useful to other similar projects. About 10 years ago *Conservation Evidence* was launched with an aim to provide a format for practitioners to publish the results of their work, irrespective of the project outcomes. This paper reviews the trends and biases in the studies published between 2004 and March 2014; 246 papers describing 439 conservation interventions in 35 countries. This seems to have been achieved as over 70% of the 609 authors were practitioners. As well as publishing the results of successful interventions, the journal encourages authors to report interventions that were unsuccessful and this was the case for almost a third (31%) of all those published. These results provide especially valuable information to practitioners. The majority of papers submitted to and published in *Conservation Evidence* have focussed on plants and birds (59%). There is a clear need for more studies testing interventions for fish, reptiles, amphibians and fungi. Similarly, few studies so far have focused on the social aspects of conservation.

Spooner F., Smith R.K. and W.J. Sutherland (2015). Trends and biases in reported conservation interventions: summarising ten years of Conservation Evidence. *Conservation Evidence* **12:** 2-7.

Ice melt, sea level rise and super-storms

There were probably no where in the World that could possibly claim to feel the effect of Global warming than Indonesia. The 2015 *El Niño* effect, while not a direct result of Global warming, was worse than ever, and the extreme fluctuations rain/dry seasons is one of the many direct results of Global warming. In a new publication Hansen et al (2015) provides additional evidence from paleoclimate data that the current international climate change agreement is not nearly enough to arrest the escalating negative effects of a warming Earth. There is evidence of ice melt, sea level rise to 5–9m, and extreme storms in the prior interglacial period that was less than 1^{o}C warmer than today. Human-made climate forcing is stronger and more rapid than paleo forcings, but much can be learned by combining insights from paleoclimate, climate modeling, and on-going observations. The authors argue that ice sheets in contact with the ocean

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are vulnerable to non-linear disintegration in response to ocean warming, and claim that ice sheet mass loss can be approximated by a doubling time up to sea level rise of at least several meters. Doubling times of 10, 20 or 40 years yield sea level rise of several meters in 50, 100 or 200 years. Paleoclimate data reveal that subsurface ocean warming causes ice shelf melt and ice sheet discharge. The climate model presented exposes amplifying feedbacks in the Southern Ocean that slow Antarctic bottom water formation and increase ocean temperature near ice shelf grounding lines, while cooling the surface ocean and increasing sea ice cover and water column stability. Ocean surface cooling, in the North Atlantic as well as the Southern Ocean, increases tropospheric horizontal temperature gradients, eddy kinetic energy and baroclinicity, which drive more powerful storms. The Southern Ocean's role in affecting atmospheric CO_2 amount is a tight control knob on global climate. The millennial (500–2000 year) time scale of deep ocean ventilation affects the time scale for natural CO_2 change, thus the time scale for paleo global climate, ice sheet and sea level changes. This millennial carbon cycle time scale should not be misinterpreted as the ice sheet time scale for response to a rapid human-made climate forcing. Recent ice sheet melt rates have a doubling time near the lower end of the 10–40 year range. The authors conclude that 2°C global warming above the pre-industrial level, which would spur more ice shelf melt, is highly dangerous.

Hansen et al. (2015). Ice melt, sea level rise and superstorms: evidence from paleoclimate data, climate modelling, and modern observations that 2°C global warming is highly dangerous. *Atmos. Chem. Phys. Discuss.* **15**: 20059–20179,

Hope for Sumatran tigers?

The Natural Resources Conservation Agency of South Sumatra (NRCA) is striving to meet the national target of increasing the population of the Sumatran tiger *(Panthera tigris sumatrae)* by 10 percent. Between 1998 and 2000, as many as 66 Sumatran tigers were reported to have been killed in the national parks. After years of constant decline, resulting primarily from a combination of illegal poaching and habitat loss, the head of the NRCA, Nunu Anugrah, announced that protecting the remaining 400-500 individuals and their habitat will receive additional attention and commitment in the immediate future.

According to Nunu Anugrah, the Natural Conservation Board has already decided on permanent pilot areas to increase the population of the Sumatran tiger. These areas include the forests of Jambi, Kerinci Sebalat, Mount Leuser in Aceh, Bengkulu, the Sembilang National Park, and the Dangku Musi Banyuasin Wildlife Sanctuary in South Sumatra. Time will tell if the necessary conservation intervention will take place in due time to prevent further population decline.

Sumatran rhino returned to Way Kambas

The only remaining Sumatran rhino left outside Indonesia and Sabah (Malaysia) arrived in his ancestral home of Indonesia, making the long journey from Cincinnati, Ohio, where he was born 8 years ago. The return of *Harapan* is part of a mission to help save his critically endangered species from extinction.

Harapan was born at Cincinnati's zoo and spent nearly the past two years as the last Sumatran rhino in the Western Hemisphere. He arrived at Jakarta's Soekarno-Hatta airport in a special travel crate aboard a Cathay Pacific jet, after which he was trucked to Merak and from there ferried to Sumatra. There, *Harapan* would be handed over to Indonesian authorities at the Sumatran rhino sanctuary at Way Kambas National Park.

With the return of the 1,800-pound (816-kilogram) rhino the captive breeding program for the species at the Cincinnati Zoo ended. To date, it has been the most successful captive breeding programme, having produced three rhinos, among them Harapan's older brother. The latter was returned to Way Kambas in 2007 and became a father there in 2012.

There are currently three females at the Way Kambas facilities, and it is hoped that *Harapan* will be able to add to the reproductive success at the centre. Ratu, a 12-year-old female rhino born in the wild, is now pregnant with her second calf and is expected to give birth in May, 2016. If the birth proceeds successfully, it will be Ratu's second birth, after her successful delivery of a male calf in 2012. This was also the first Sumatran rhino born in an Asian breeding facility in more than 140 years.

After a major effort to breed the species in overseas facilities failed to produce meaningful results, Indonesia has said it does not want to be dependent on other countries in conservation efforts by sending anymore rhinos to be bred abroad. However, it says it welcomes any technological or scientific assistance for the Sumatran rhino breeding program.

Javan rhinos give birth to new calves in Ujung Kulon National Park

Three critically endangered Javan rhino calves have been filmed in Ujung Kulon National Park, Indonesia. This raises hopes for the future of the world's rarest rhino after years of population decline. One female calf and two males were spotted in recent months in Ujung Kulon and were all likely born in the past year, according to park chief Mohammad Haryono. The rhinos were filmed with their mothers by camera traps set up to track the creatures, and the calves were all born from different mothers. Haryono said the discovery of the calves -- filmed in April, May and July (2015) -- brings the population of the Javan rhino to 60, all of which live in Ujung Kulon. The calves are believed to be born inside a sanctuary, which was established last year in the park and comprises 5,100 hectares rainforest and freshwater streams. The animals had previously been living mainly in one corner of the park, however, not necessarily optimal habitat for the species, and the "sanctuary" expanded the area suitable for them and relocated farmers to reduce the chances of animal-human conflict.

The Javan rhino, whose folds of loose skin give it the appearance of wearing armor plating, once numbered in the thousands and roamed across Southeast Asia. Poaching and human encroachment on its habitat have led to a dramatic population decline, as with other rhino species around the world. The only other place that had Javan rhinos until recently was Vietnam, but unfortunately, lack of commitment and dedicated vigilance resulted in the last Vietnamese Javan rhino being killed by illegal poachers a few years ago. Today, Ujung Kulon National Park the only remaining habitat with the species that continues to be listed as "Critically Endangered" on the IUCN red-list. Poaching, in particular, continues to be severe threat, with rhino horns fetching high prices on the black market for use in traditional Asian medicine. It remains to be seen if the continued protection of the last Javan rhinos will be adequate if poachers decide to target Ujung Kulon National Park.

Trained Sumatran elephant killed for its tusks

On the **22 September, 2015, t**he AFP reported that a critically endangered Sumatran elephant, who had patrolled Indonesia's jungles to help protect threatened habitats, was killed for his tusks. The elephant was known as Yongki, and was a tame creature who worked with teams of elephant keepers. Unfortunately, he was found dead close to the camp where he lived in a national park on the western island of Sumatra, according to park official Timbul Batubara. The killing of Yongki sparing a surge of anger social media. Yongki's one-meter (three-foot) tusks had been hacked off, leaving just bloody stumps, while his legs still bore the chains put on him by his keepers to ensure he stayed in the camp. His body, which was found with no bullet wounds but a blue tongue, which suggests that he had been poisoned. Illegal ivory hunters commonly use this practice in Sumatra.

Yongki, aged about 35, was well-known among the local "mahouts". The elephant was involved in patrols aimed at reducing tensions, with the tame elephants stopping wild elephants from rampaging through villages. The patrols also help rangers keep a lookout for illegal logging and poaching that threaten Indonesia's vast rain forests.

There are estimated to be less than 3,000 Sumatran elephants remaining in the wild. They are frequently targeted by poachers for their tusks, which fetch a high price for use in Chinese traditional medicine. The species is listed as Critically Endangered on the IUCN red-list.

Indonesia's forest fires

According to estimates released this week by Guido van der Werf on the Global Fire Emissions Database, there have been nearly 100,000 active fire detections in Indonesia so far in 2015, which since September have generated emissions each day exceeding the average daily emissions from all U.S. economic activity. Indonesia is now on track to experience more fires this year than it did during the 2006 fire season, one of its worst on record. On 26 of the past 44 days daily estimated GHG emissions from fires in Indonesia surpassed average daily emissions from the entire US economy (approximately 15.95 Mt CO_2 per day). A massive spike in emissions can be seen on October 14, when 4,719 fires were observed. The emissions spikes is caused by burning peatlands.

Global Forest Watch Fires shows that more than half of these fires have occurred on peatland areas, concentrated mainly in South Sumatra, South and Central Kalimantan, and Papua. These regions continue to suffer major fires as the fire alerts density map below shows, with few signs that occurrences are diminishing.

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The burning of tropical peatlands is so significant for greenhouse gas emissions because these areas store some of the highest quantities of carbon on Earth, accumulated over thousands of years. Draining and burning these lands for agricultural expansion leads to huge spikes in greenhouse gas emissions. Fires also emit methane, a greenhouse gas 21 times more potent than carbon dioxide (CO_2), but peat fires may emit up to 10 times more methane than fires occurring on other types of land. Taken together, the impact of peat fires on global warming may be more than 200 times greater than fires on other lands.

What does a climate catastrophe look like in a real world context? Since September 2015, daily emissions from Indonesia's fires exceeded daily emissions from the entire U.S. economy on 26 days. To put it into perspective, the U.S. economy is 20 times larger than Indonesia's. Van der Werf pointed out in a recent report that emissions from these fires over a three-week period are also already higher than the total annual CO_2 emissions of Germany.

One can only hope that the Indonesian Government continue with the dedicated efforts to put in places preventative measures to avoid future similar incidents, and follow up with concerted efforts to implement policies and laws concerning land-use development believed to initiate forest fires.

Vast forest fires in Indonesia spawn ecological disaster (*from Andi Jatmiko And Niniek Karmini*)

On November 16, 2015, Phys.org reported that the extensive forest fires have caused immeasurable ecological disaster. The devastating forest fires in Indonesia and Malaysia in 2015 engulfed the region in a thick and dangerous layer of smoke. Millions were affected as "passive smokers" resulting from problems hundreds of kilometres away. However, for local farmers, it was a season of smoke where months without sunlight caused crops to under-perform and, in some cases, entirely fail to produce crops of a high enough standard for trade. This year's devastating fires have already surpassed the 1997 disaster and has inflicted a staggering toll on the region's environment, economy and human health. It is estimated that 2.1 million hectares (21,000 km^2) of forests and other land burned, 21 died as a direct result of the fires and more than half a million people fell ill with respiratory conditions. The economic loss from damaged crops, hundreds of cancelled flights and a decline in tourists arrivals is estimated at far more than 9 billion US$.

Many of the fires were set illegally by various parties believed to put greed and profit ahead of the country's laws and citizens' health. Authorities are investigating more than 300 plantation companies and 83 suspects have been arrested, and to date the licenses of three plantation companies have been revoked and those of 11 others have been suspended.

Since July, 2015, approximately 50,000 fires were detected by satellite, most of which occurred on the islands of Sumatra and Borneo. An absence of rain from the El Niño effect made them worse. The resulting smoke caused the visibility to fall below 50 meters in some areas, forcing 13 airports around the country to close, and in late October, the Pollution Standards Index hit a record high of 3,300 in Central Kalimantan provinces. In addition, nearly 20,000 schools closed in the worst-hit provinces, affecting about 2.4 million students.

The fires also likely affected many endangered or threatened species, including orangutan and Sumatran rhino. It also sent enormous amounts of greenhouse-gas emissions into the air. Much of the forests lost were peat-land, which stores a particularly large amount of carbon.

To fight the fires, Indonesia used everything from helicopters to elephants outfitted with water pumps and hoses. Russia leased two amphibious jets, and Singapore, Malaysia, Australia and Japan also sent aircraft, fire-fighters or chemicals and experts to help out. More than 30,000 soldiers and fire-fighting personnel were deployed, and the disaster agency spent US$36.5 million. Ultimately, it was seasonal rains that ended this year's crisis.

Indonesia's Fire and Haze Crisis

World Bank, November 25, 2015

Indonesia's fire and haze crisis this year has been described by many in the international community as an environmental disaster. Large parts of the country's forests and land area have burned out of control since August 2015, impacting the health, education and livelihoods of millions of Indonesians living in the areas with the worst burning. This has also resulted in billions of dollars' worth of damages and losses.

Fires and the resulting haze have caused Indonesia and neighbouring countries significant economic, social and environmental costs. The full extent of these costs and the long-term impacts are not yet known. The World Bank is helping to assess the costs of the fires and haze in a variety of sectors. Early estimates of the total economic costs of the fires in 2015 in Indonesia alone exceed US $16 billion. This is more than double the damage and losses from the 2004 tsunami (which affected provinces in Indonesia and other countries), and equal to about 1.8% of Indonesia's Gross Domestic Product (GDP). This estimate includes losses to agriculture, forestry, transport, trade, industry, tourism, and other sectors. Some of these costs are direct damage and losses to crops, forests, houses and infrastructure, as well as the cost of responding to the fires. Many of the economic losses result from the disruption of air, land and sea travel due to the haze. These damages and losses are expected to have serious impact on the economic growth rate of affected provinces and the government's efforts to reduce poverty in the hardest-hit regions, such as Central Kalimantan.

Air quality during high burning periods in villages near the fires regularly exceed the maximum level of 1000 on the international Pollutant Standard Index (PSI) – this is more than three times the amount considered "hazardous." The toxic smoke causes widespread respiratory, eye, and skin ailments and is especially hazardous for the very young and the elderly; the toxic air they breathe include carbon dioxide, cyanide, and ammonium. The long-term health impacts are not yet known but are expected to be highly significant.

Businesses and schools across the region close due to the haze, crippling many low-income families and prompting them to fall back into poverty. Approximately 5 million students have been impacted by school closures in 2015.

More than 2.6 million hectares of forest, peat, and other land have burned in 2015 -- an area 4.5 times the size of Bali. Burned peat areas can be restored, but short-term impact include the loss of timber and non-timber forest products, and the loss of habitat for pollinators, wildlife, and grazing lands. While not yet fully analysed, the costs related to biodiversity may exceed US $295 million for 2015. The long-term impact on wildlife and biodiversity is also not fully known, but thousands of hectares of habitat for orang-utans and other endangered species have been destroyed.

In terms of global impact, forest and peat fires are a major source of greenhouse gas (GHG) emissions. Daily emissions from Indonesia's fires in October 2015 exceeded the emissions from the entire US economy – that is more than 15.95 million tons of CO_2 emissions per day. If Indonesia could stop the fires it would meet its stated target to reduce GHG emissions by 29% by the year 2030.

Global Species Management Planning Workshops for Banteng, Anoa and Babirusa, January 2016

The IUCN Wild Cattle Specialist Group, together with the Ministry of Forestry and Environment, Indonesia will be conducting a Global Species Management Planning (GSMP) Workshops for Banteng, Anoa and Babirusa. The event will take place 25-30th January 2016, and includes a Population Viability Analysis. The venue will be Royal Safari Garden Hotel, Cisarua, Bogor.

Statistics bootcamp, Baluran National Park (April, 2016)

The Biodiversity Conservation Society Sarawak (BCSS) in collaboration with Baluran National Park and Copenhagen Zoo will be holding a Statistics bootcamp from the 4-14th of April, 2016 at Baluran National Park Head Quarters. The number of participants will be limited to 20. For more information and registration , please contact Mike Meredith: stats.bcss@gmail.com

Statistics bootcamp, Singapore (July, 2016)

A Boot Camp is planned as a *post*-conference workshop following the Conservation Asia 2016 event, a joint meeting of Association of Tropical Biology and Conservation (Asia-Pacific Chapter) and Society for Conservation Biology (Asia Section). The bootcamp will take place from 4-15th July at National University of Singapore. More details of workshops can be found at: http://www.conservationasia2016.org/#!workshops/c10yh

Applications are open to those attending the main meeting, and signing up for the workshop is part of the registration process for the main meeting.
http://www.conservationasia2016.org/#!home/c1dmp

Orangutan PHVA Workshop, Bogor (May 2016)

The IUCN Conservation Breeding Specialist Group (CBSG), together with the Ministry of Forestry and

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Environment, will conduct a population and habitat viability workshop for orangutan in Indonesia from 23-27th of May, 2016. For more information, please contact: Phone: +6251 840 1645; Email: info@forina.or.id. Or visit: www. http://forina.or.id/phvaou/category/intro/

VORTEX population simulation - training workshop

Following the orangutan PHVA, Bogor, the CBSG will conduct a 2-day training workshop for conservation biologists that are interested in knowing more about VORTEX programme. The venue and exact time will be announced at the same site as the orangutan PHVA workshop site.

Invite to join Women for the Conservation of Indonesian Biodiversity (WCIB)

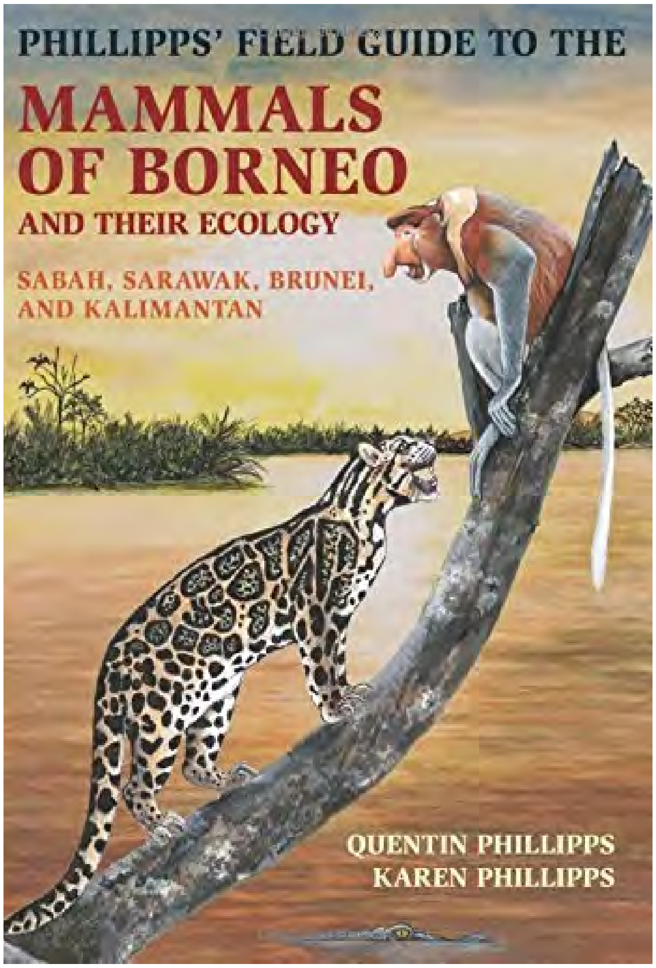
Creating professional networks has many benefits including creating connections and opportunities, sharing knowledge and experiences, boosting profiles and referrals, and increasing confidence and positive influences. Networks have proven to leverage efforts, diminish learning curves and catalyze synergies. Therefore, linking female natural resource and conservation professionals at a global level is urgently required. It is necessary to recognize outstanding women in Indonesian biodiversity conservation and encourage young women to enter and remain in this professional field.

The goals of Women for the Conservation of Indonesian Biodiversity are:

- Train and mentor women in conservation science and natural resource management
- Provide a support network/ advise during professional challenges
- Empower women to manage and conserve natural resources
- Ensure the best science is the basis for conservation and development decisions
- Conserve biodiversity and natural resources throughout Indonesia
- Provide a forum for how to best assist/ advise women in the future

This network is available to anyone working with or interested in biodiversity conservation in Indonesia. We encourage our male colleagues and supervisors to join and show they are committed to gender equality and support the advancement of women in natural resource fields. To join or for more information please email: WCIB@googlegroups.com

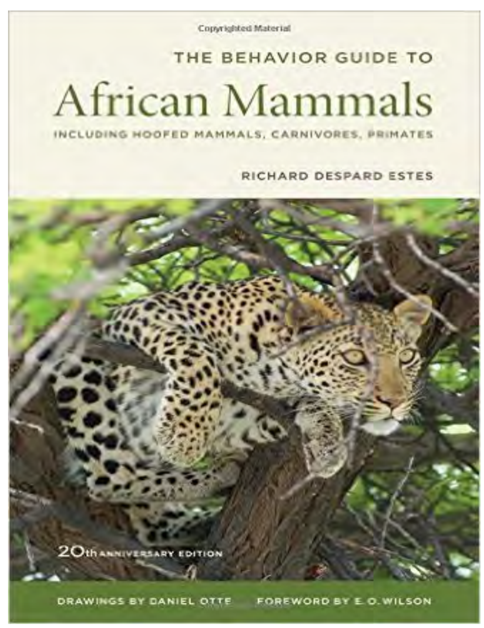
Book Review



It is tempting to exclaim **"FINALLY".** The long wait for a book that combines the "field guide" format with wider behavioural ecology of a species is over. Quentin Phillipps and Karen Phillipps, both known for co-authoring other natural history books about Bornean wildlife, have endeavoured to write a book about Borneo's mammals that includes information about their ecology. It is said to be "*the most comprehensive, up-to-date, and easily accessible field guide to the mammals of Borneo -- the ideal travel companion for anyone visiting this region of the world*". It covers Sabah, Sarawak, Brunei, and Kalimantan, providing essential information on 277 species of land and marine mammals and features 141 detailed colour plates on 400 pages. Detailed facing-page species accounts describe taxonomy, size, range, distribution, habits, and status. This unique at-a-glance guide also includes distribution maps, habitat plates, regional maps, fast-find graphic indexes, top mammal sites, and a complete overview of the vegetation, climate, and ecology of Borneo.

The task of providing information about mammals' ecology is huge, and the authors fall short of matching the monumental standard of the classic "*The Behavior Guide to African Mammals*" by Richard D. Estes. To be fair, however, it must be noted that the available information about the behavioural ecology of Bornean mammals is dwarfed by the piles of publications available for most African mammals. Consequently, many "popular" mammals such as orangutan, proboscis monkey, gibbons, Sumatran rhino and Bornean elephants are described comprehensively, including conservation status and actions, whereas less known species are afforded information similar to a standard guidebook. However, the authors could improve a future edition of the book significantly by providing comprehensive information about *every* mammal species, where this is possible. There exists a number of species, where comprehensive studies have taken place and extensive knowledge readily available, for example, long-time macaque, pig-tailed macaque, porcupines, various civets and leopard cat, just to mention a few.

The book begins with a few useful chapters. Particularly important are the chapters on Borneo's general ecology i.e. the interactions between plants and mammals. Even if these chapters only touches the surface of very complicated topics, such as seed-dispersal and migration, they add a very important holistic context to the information about each species.



Richard D. Estes set a benchmark for books about the "behaviour guide" subject. His book on African mammals has become a classic.

The authors have also included a range of extinct species in the book. This may seem rather peculiar and somewhat irrelevant to the general reader. However, the opening chapters include a short history of the Pleistocene era and how the great Sundaland emerged and disappeared again. The past, undoubtedly, provides contemporary conservation biologists with important information that ought to be considered in modern mammal conservation initiatives, and this justifies the relevance of these chapters. The only problem with including extinct species is that it opens "Pandoras box" --- why are some species included, e.g. extinct rhinos and elephants, and not others?

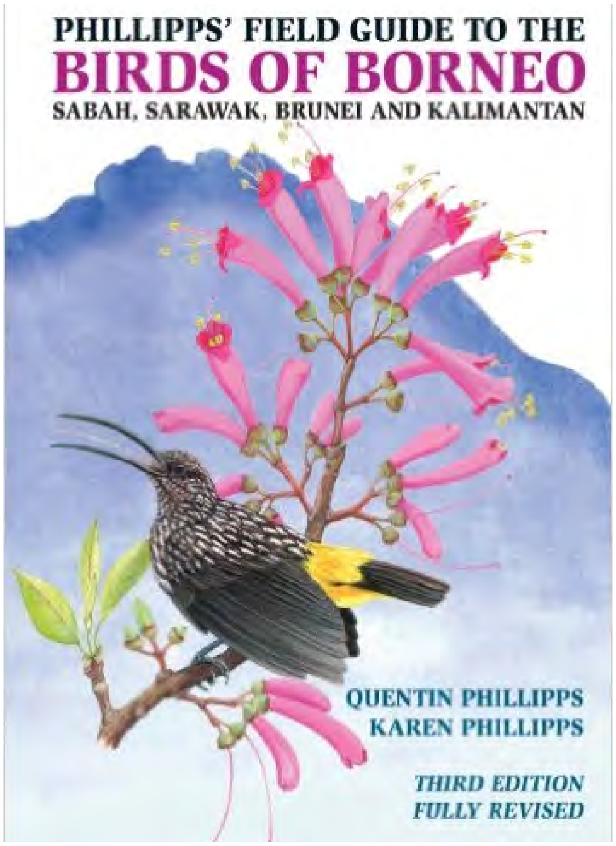
Understandably, every book has its limitation and cannot include every detail of each past and present mammal species. In this case, however, the book will benefit if the authors account for their choices, or divide it according to certain criteria along with providing justification for highlighting these, for example, large herbivores or "primates".

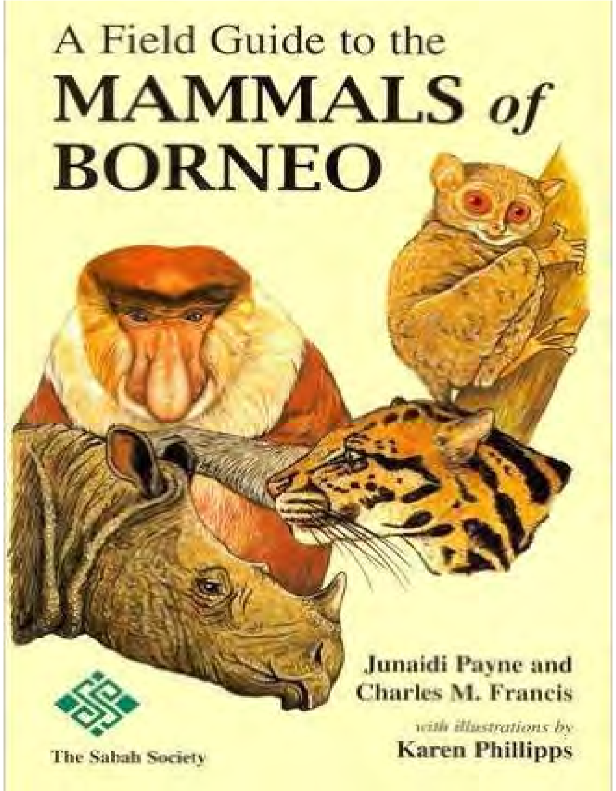
One of the book's biggest attraction is Karen Phillipps marvellous colour sketches. All species, maps, plants, drawings and illustrations are in colour. Another big plus is the conservation information provided, even if only for a few select species.

Despite a few short-comings this book is an awesome and welcome addition to all with an interest in Southeast Asian mammals.

Authors: Quentin Phillipps and Karen Phillipps
Paperback: 400 pages
Publisher: Natural History Publications (Borneo)
ISBN: 978-983-812-166-8 (Borneo)
USA Publisher: Princeton University Press
ISBN-13: 978-0691169415
Language: English

Reviewed by Carl Traeholt





Other books by the same authors.

The Society for Conservation Biology Asia section

The Association for Tropical Biology and Conservation Asia-Pacific chapter

National University of Singapore, Singapore

29 June - 2 July 2016

The Society for Conservation Biology (SCB) Asia section and the Association for Tropical Biology and Conservation (ATBC) Asia-Pacific chapter invite you to join us at the National University of Singapore for the Asia Chapter Meeting, “Sustainable Landscapes for People, Business and Biodiversity”, 29 June - 2 July 2016.

The SCB and ATBC are the two largest non-profit international professional organizations devoted to the conservation of biodiversity, with >10,000 members worldwide. This is the first time that SCB Asia-Pacific and ATBC Asia regional chapters will jointly host a meeting. Conservation Asia 2016 will attract up to 500 delegates from up to 80 countries. Participants will be conservation managers, agribusiness and extractive industry leaders, policy makers, conservation scientists and students from the academic, business, NGO and government communities.

The conference theme of "sustainable landscapes for people, business and biodiversity" reflects the complexity of environmental challenges facing the Asian region. Over the past 30 years, Asia has experienced spectacular increases in economic growth and human wellbeing, sustained in part through resource extraction and crop expansion. One consequence of this has been high rates of deforestation, habitat degradation, pollution, and species extinctions across Asia. This conference will be an opportunity for researchers and practitioners to engage in scientific discourse over some of the most urgent (and contentious) environmental and conservation issues facing Asia, including (but not limited to) environment-industry trade-offs; public-private approaches to the sustainable management of natural capital; environmental markets and innovative conservation financing; urban ecology; communicating conservation science; the illegal wildlife trade; and the human dimension of conservation.

The conference will directly draw upon Singapore’s uniqueness as a regional leader in numerous sectors, from finance to research and development. It will ensure participation of leaders from the natural resources sector, especially stakeholders that have exotic plantations located in biodiversity-rich Asian landscapes. The operations of these plantations are having a profound impact on biodiversity, making constructive engagement by conservation practitioners and scientists with these companies critically important.

In order to facilitate scientific exchange, the conference is encouraging innovative symposium formats such as panel discussions, speed talks, and debates in addition to traditional 15 minute talks. The choice of format will be under the discretion of each symposium organizer, depending upon which method is expected to be the most effective for the topic and stakeholders present.

http://www.conservationasia2016.org/#!home/c1dmp

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Utilising non-timber forest products to conserve Indonesia's peat swamp forests and reduce carbon emissions

Wim Giesen

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Abstak

Degradasi dan konversi hutan rawa gambut Sumatera dan Kalimantan telah menyebabkan meningkatnya emisi CO_2 dan menempatkan Indonesia sebagai emitor utama dalam peningkatan emisi gas rumah kaca. Pengeringan lahan gambut tidak hanya meningkatkan proses oksidasi dan resiko kebakaran, tetapi juga mengakibatkan terjadinya penurunan permukaan tanah dan mengakibatkan genangan. 7 juta ha lahan gambut di Sumatera dan Kalimantan telah memiliki izin untuk dikembangkan sebagai areal perkebunan seperti kelapa sawit serta Akasia yang membutuhkan pembangunan drainase serta berkontribusi untuk emisi CO_2 dan penurunan permukaan. Menanam spesies hutan rawa gambut yang bernilai guna namun tidak membutuhkan sistim drainase dalam program budidaya tanaman di areal gambut "Paludiculture", bisa menjadi suatu hal menarik secara ekonomi dan alternatif yang berkelanjutan. 1376 jenis tanaman telah tercatat di kawasan hutan gambut dataran rendah di Asia Tenggara. 534 (38.8%) jenis tanaman telah diketahui pemanfaatannya, diantaranya untuk kayu (222 jenis), obat-obatan (121), makanan (165 jenis, seperti buah-buahan, biji dan minyak). Banyak diantaranya memiliki kegunaan ganda dan 81 jenis dari hasil hutan bukan kayu ini dilaporkan sebagai "sumber perekonomian utama". Kajian nilai ekonomis awal bahwa berdasarkan laba yang diperoleh, beberapa spesies asli tanamam hutan gambut yang alami berpotensi dapat bersaing dengan kelapa sawit dan Akasia. Jelutung rawa (*Dyera polyphylla*) adalah alternatif yang menarik bagi masyarakat setempat yang menawarkan keuntungan yang lebih dari sisi tenaga kerja dibandingkan kelapa sawit.

Abstract

Degradation and conversion of peat swamp forests of Sumatra and Kalimantan has led to enhanced CO_2 emissions and contributed to Indonesia being a major emitter of greenhouse gases. Drainage of peatland not only increases oxidation and fire risk, but leads to soil subsidence and undrainable conditions. 7 Mha of peatland on Sumatra and Kalimantan are licensed for plantation crops such as oil palm and Acacia that require drainage and contribute to CO_2 emissions and subsidence. Planting useful peat swamp forest species that do not require drainage in a 'paludiculture' (swamp cultivation) programme could provide an economically attractive and sustainable alternative.1376 plant species have been recorded in lowland Southeast Asian peat swamp forests. 534 (38.8%) species have a known use, for timber (222 species), medicine (221), food (165, e.g. fruits, nuts, oils) and other uses (165, e.g. latex, fuel, dyes). Many have multiple uses and 81 non-timber forest product species have a reported 'major economic use'. An initial economic assessment indicates that based on returns, some indigenous peat swamp forest species are potentially competitive with oil palm and Acacia. Swamp jelutung (*Dyera polyphylla*) is an attractive alternative for local communities as the return on labour is greater than for oil palm.

Keywords: *peatland rehabilitation, Indonesia, useful plants, peat swamps, paludiculture*

Introduction

Peatland areas extend over 13 Mha in coastal lowlands of the islands of Sumatra and Borneo (Silvius et al. 1987, Miettinen and Liew 2010) where they commonly occur in domes of up to 6-15m depth. These peatlands were originally forested, and most (84%) of Indonesia's peat swamp forest (PSF) is classified as forestry land, of which 28% is protected forest (mainly in Papua), 47% production forest and 25% conversion forest (Mawdsley et al. 2013). Logging of PSFs peaked in the early 1990s and by 2010, 69-72% of Sumatra's PSF had disappeared, with only 4.6% remaining as 'pristine forest'; on Kalimantan (Indonesian Borneo) the situation is similar, with 50-53% of the PSF having

Received 7th October, 2015; Revision revision accepted 27th November, 2015.

disappeared and only 2.1% remaining in a pristine condition (Miettinen and Liew, 2010; Posa et al., 2011). Since 2000, there has been a major expansion of plantations into peatland, especially for oil palm (*Elaeis guineensis*), northern or red wattle (*Acacia crassicarpa*) for pulp, and to a lesser extent for (smallholder) rubber (*Hevea brasiliensis* (Miettinen et al. 2012). Plantation licenses have been issued for over 7 million hectares of peatland (Mawdsley et al. 2013), of which about half is considered deep peat (>2m), while a further 2.5 million hectares of mostly shallow peatland have been cultivated by smallholders (Miettenen and Liew 2010; Mawdsley et al. 2013). By mid-2012, only parts of these licensed areas have been developed, extending over about 2.0-2.5 million hectares (Mawdsley et al. 2013). Peat with a depth of 3m or more is officially protected by Presidential Regulation 32 of 1990 (Silvius and Giesen 1996), but this legal status has not reduced peat degradation or development.

Peatland use commonly involves drainage of peat, either to facilitate the extraction of logs, or because rubber, Acacia and oil palm require water tables to be lowered 50-60 cm below the peat surface to facilitate growth and productivity (Sheil et al. 2009). Drainage leads to peat compaction, subsidence, irreversible desiccation and oxidation and in unmanaged conditions often accompanied by fires. According to the Indonesian Council on Climate Change (press release 10th September 2009) "[CO_2] Emission from peatland amounts to 45% and forestry 35% of Indonesia's greenhouse gas emission." This has made Indonesia the 3rd largest CO_2 emitter world-wide (Hooijer et al. 2006, Hooijer et al. 2010). Perhaps the greatest threat posed by drainage-based development of peatland is that 70% of peatland in Indonesia has a mineral sub-soil that lies close to mean sea level and cannot be drained by gravity alone. It is estimated that, after 25 years, 46% of peatland will be below the drainage base-level, and after 100 years this may increase to 85% (Hooijer et al. 2012). While careful water management in plantations may reduce current emissions (Kalsim, 2009), gains remain small (20% reduction; Hooijer et al 2012). The need for lower water tables for oil palm, Acacia and rubber plantations means that these will always be net emitters of carbon, and initial gains are often entirely lost upon harvest (Hooijer et al. 2012).

The Government of Indonesia (GOI) has recognized these issues and seeks alternatives, with agencies and government programmes assessing sustainable alternatives. At the same time, initiatives by NGOs in degraded peat landscapes include testing PSF species for replanting and peatland rehabilitation programmes. However, the number of species used to date in peatland trials (by GOI agencies) and rehabilitation (by NGOs) has been very limited (<40) and often does not include useful species or reflect the true potential of PSFs (Giesen, 2013).

Paludiculture is a swamp cultivation approach developed in northern temperate areas as a means of rehabilitating degraded peatland, while making these economically useful at the same time (Wichtmann and Joosten, 2007, Schäfer 2011). In many cases, this involves the planting of, for example, common reed (*Phragmites communis*) and alder (*Alnus glutinosa*) on degraded albeit rehydrated peatland to prevent further peat degradation and loss. An assessment by Barthelmes et al. (2014) suggests a whopping 450,000km² with a potential for paludiculture Worldwide, with about 90,000km² in Indonesia alone.

This paper assesses opportunities for paludiculture on degraded Indonesian peatland. The paper aims at identifying PSF species with a non-timber forest product potential that can possibly compete financially with oil palm, rubber and Acacia that are currently the preferred crop planted on peatland.

Methods

In this study, a PSF plant species data base was cross-referenced with existing literature on plant use in the region. This was followed by a review of existing and past attempts to cultivate PSF species on degraded peatland and assessing its economic potential. Over the past five years, a PSF plant species database[1] was compiled from species habitat records in key taxonomic references (Flora Malesiana [FM], Tree Flora of Malaya, Flora of Java), scientific papers and grey literature/ reports on peat swamp forests. Species records with ambiguous taxonomy or locality were excluded. Taxonomy follows Flora Malesiana, or when outdated (FM began in the 1950s) the contemporary The Plant List (2010) Version 1 (http://www.theplantlist.org/). It was assessed if a species was restricted to the lowland peat swamp habitat, by referring to habitat listed in the key taxonomic references mentioned above, and cross-checked with herbarium records accessible via the Global Biodiversity Information Facility Version 1.2.6 (http://data.gbif.org/), in which all major herbaria with Southeast Asia collections collaborate. Some leniency

[1]The database was developed in Microsoft Excel

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was afforded in cases when some records list 'swamp' as habitat type, although strictly speaking, this could refer to freshwater swamps on mineral soils. In such cases, the information was used to remove a species from the list.

PSF plant uses was based on existing literature, especially Heyne (1950) and the Plant Resources of South-East Asia Programme (PROSEA) that was active from 1990-2004 and involved FRIM (Malaysia), LIPI (Indonesia), IEBR-NCSR (Vietnam), UNITECH (Papua New Guinea), PCARRD (The Philippines), TISTR (Thailand) and Wageningen Agricultural University (the Netherlands). The PROSEA programme developed 19 volumes on plant uses, listing 7000+ species and arranged by commodity groups. Peatland cultivation programmes by the Ministry of Forestry, Forestry Research Institute (FORDA, Bogor, West Java), Swamp Agricultural Research Agency (BALLITRA, Banjarbaru, South Kalimantan), University Gadjah Mada (Yogyakarta, Central Java), University Tanjungpura (Pontianak, West Kalimantan) and the World Agroforestry Centre (ICRAF, SEA Regional Office, Bogor) were assessed.

An assessment was also made of the number of PSF species with a major (past or present) economic use. This was based on criteria used by the PROSEA programme that lists species according to major or minor use, and by existing research programmes that focus on species with promising economic potential (e.g. ICRAF programmes).

Results

The peat swamp database is based on 135 references and includes 1467 plant species. Of these, 1376 are lowland swamp species, including 1326 angiosperms and 720 trees and shrubs. Of 1376 lowland peat swamp forest species belonging to 136 plant families, the main ones are Rubiaceae (79 species), Myrtaceae (61), Dipterocarpaceae (55), Myristicaceae (54), Lauraceae (49), Arecaceae (40), Euphorbiaceae and Anacardiaceae (each 38). Of these 1376 species, 110 (8.3%) were found to be restricted to the lowland peat swamp habitat.

Cross-referencing with plant use references reveals a list of 534 useful PSF species, of which 514 occur in Indonesia. The main uses are timber (222 species), medicine (221), and food (165), while a category of 'other uses' includes 192 species. Many species have multiple uses. Figure 1 indicates species per use (or commodity) sub-category for food, medicinal and 'other use' species. Fuel wood was not included in the assessment, because it is too ubiquitous with limited economic value. A total of 81 species yielding non-timber forest products were recognized as having a major economic use, either by PROSEA (64 species) or by the present study (17 species). These are listed in Table 1 and include 22 fruit and nut species, 11 weaving and fibre species, 7 edible oil/fat, 7 latex, 6 incense, 6 starch, 6 resin, 4 tannin and dye, 4 vegetable, 3 rattan, 3 tea and spice, and 2 fuel oil producing species.

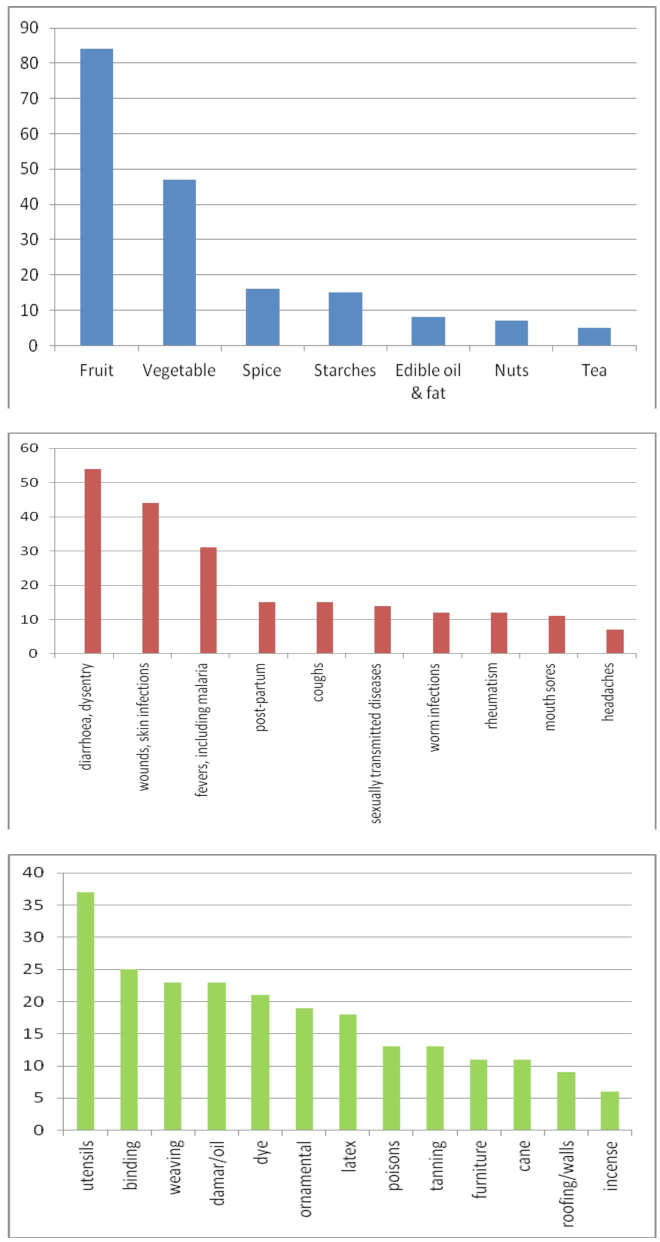

Figure 1. Non-timber Forest Product species in Indonesian peat swamp forests

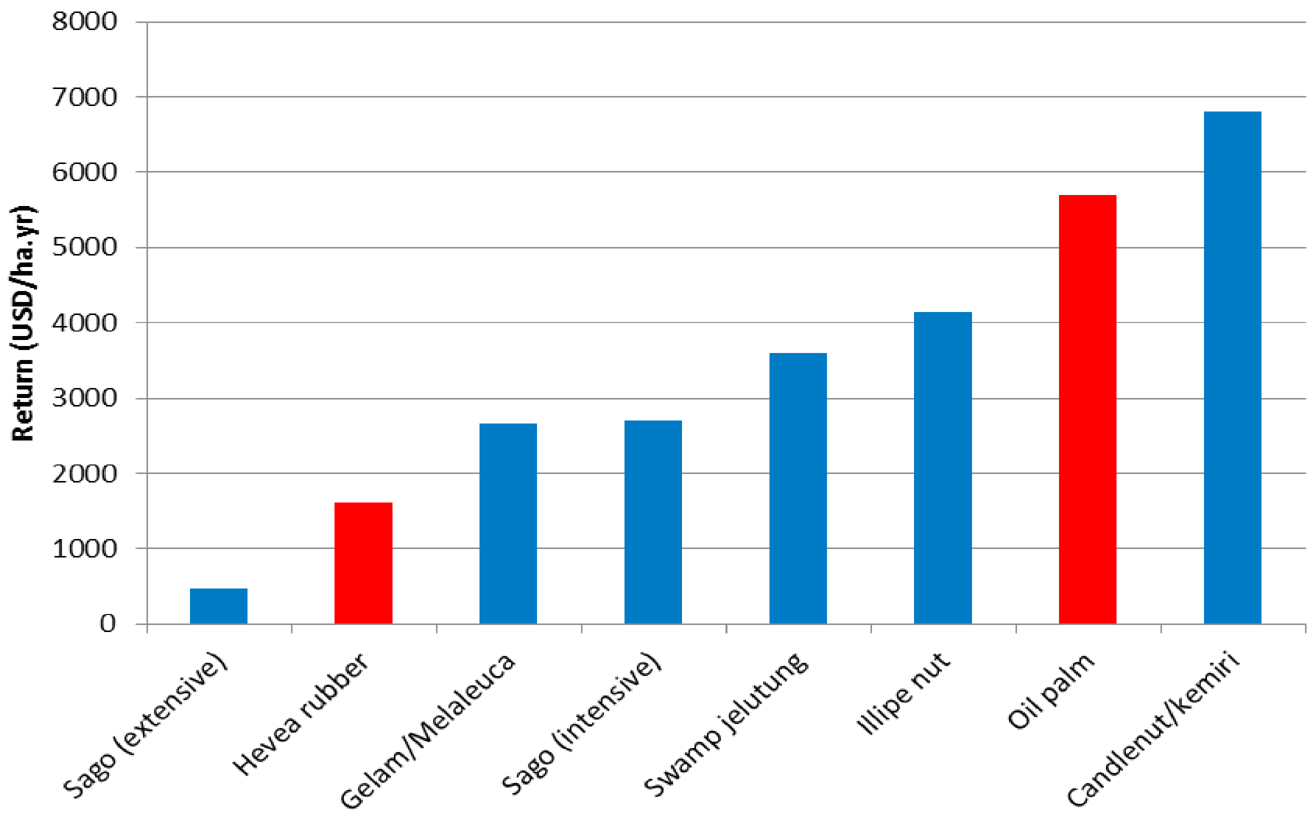

Figure 2. Financial returns of agricultural commodities grown on peat. **Sago**: Flach and Schuiling 1989, Sonderegger and Lanting 2011; **Hevea rubber**: Sonderegger and Lanting 2011; **Gelam/Melaleuca**: Duc and Hufschmidt 1993; **Swamp jelutung**: Sofiyuddin et al. (2012); **Illipe nut**: Smythies 1961, Blicher-Mathiesen 1994; **Oil palm**: Sheil et al. 2009, Sofiyuddin et al.2012b; **Candlenut/Kemiri**: Manap et al.2009, Kibazohi and Sangwan 2011.

Discussion

Few records exist of the total number of PSF plant species, with most enumerations specific to one locality, and taxonomic uncertainties and frequent revisions make comparisons difficult. However, the total number of lowland peat swamp forest plant species identified in this study (1376) is comparable to that of Posa et al. (2011), who listed 1524 species for Southeast Asia PSFs, and Anderson (1963) who recorded 1706 herbarium numbers[1] collected in PSFs of Sarawak and Brunei. The percentage of useful species (534 out of 1376) is 38.8% of the lowland PSF flora. This compares to 81 % for non-fuel wood use of the mixed freshwater and peat swamp forests at Danau Sentarum National Park in West Kalimantan, Indonesian Borneo (Giesen and Aglionby, 2000). Similar information from other Southeast Asian swamp forests is lacking, but from *terra firma* in Amazonia, Prance et al. (1987) recorded that indigenous people used 48.6-78.7 % of the tree species >10 cm dbh on a 1-ha plot inventoried. Peters (1994) reports that one in six species found in Southeast Asian forests, including dry land forests, produces edible fruit, nut, oil seed, medicine, latex, gum or other non-timber forest resource.

[1]This included duplicates and 5% sterile specimens

Promising species for rehabilitation programmes

The 81 species with major economic benefits are listed in Table 1 and considered to be promising for use in existing and planned peat swamp rehabilitation programmes (e.g. Ex-Mega Rice Project Area in Central Kalimantan; buffer zone of Berbak National Park in Jambi, Sumatra; Tripa peat swamp in Aceh, Sumatra). Many of these species, however, are not typically recognised as common to PSFs. Some, such as candlenut (*Aleurites moluccana*), rambutan (*Nephelium lappaceum*), mangosteen (*Garcinia mangostana*) and longan (*Dimocarpus longan*) are commonly grown in community gardens and backyards, and few are aware that these species are found in peat swamps. However,

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as evident from the assessment of PSF species, only a relatively small percentage of angiosperms found in PSFs are restricted to peatland. Posa et al. (2011) recorded 172 (11%) species restricted to PSF, while in the present study, 110 (8.3%) species restricted to lowland PSFs were recorded. Many species are shared with other habitats, including non-flooded lowlands, heath forest (*kerangas*), montane forests and village gardens.

The aim of this study was to identify useful plant species suitable for rehabilitating degraded peatland. Therefore, the emphasis was on identifying species yielding Non-timber Forest Products (NTFPs). The list of 81 "potentially useful species" does not include timber or pulp species, because timber and pulp production require actions (e.g. clear felling) detrimental to peat conservation (Hooijer et al. 2012). Nevertheless, PSFs include many high value timber species (e.g. ramin, *Gonystylus bancanus* and a range of dipterocarp species) and species with the potential for pulp production. Medicinal plants are not included in the 81 "potentially useful species", because the medicinal plants market is notoriously difficult to develop and specific beneficial compounds are often synthesized after their discovery. The potential for bio-prospecting PSFs for medicinal plants may be significant, though, because peat swamp plants produce chemical compounds (e.g. alkaloids) to deter herbivory at a much higher level than species in non-flooded areas. This is especially evident, when the same species occurs both on mineral and peat soils: on peat they are more toxic (pers. comm. C. Yule, March 2013), and novel properties have been identified. For example, *Calophyllum teysmannii* (var. inophylloide was found to have anti-HIV properties and a promising new line of coumarins used in chemotherapy was developed for medical purposes (Fuller et al.1994).

There exists alternatives for Acacia, oil palm and Hevea rubber, the three main commodities cultivated on Indonesian peatland. A recent study by Suhartati et al. (2012) identified six indigenous pulp species that may provide promising alternatives to *Acacia crassicarpa* on peat, namely *Campnosperma coriaceum*, *Cratoxylum arborescens*, *Endospermum diadenum*, *Macaranga gigantea* and *Macaranga hypoleuca*, and *Neolamarckia cadamba*. Candlenut or kemiri *Aleurites moluccana* is a promising oil producing alternative on degraded peat and may produce more oil and economic revenue per hectare of land than oil palm. Trials by University Gadjah Mada (Yogyakarta) were carried out on hydrated 1-3m deep peat in West Kalimantan from 2003-2009 with various illipe nut (tengkawang) species that produce a high value edible fat. The trials focused primarily on *Shorea pinanga*, *S. macrophylla* and *S. stenoptera*, as well as *Shorea guiso*, *S. teysmanniana*, *S. compressa*, and *Vatica mangachapoi*. Of these, *S. guiso*, *S. teysmanniana* and *V. mangachapoi* occur naturally in PSFs, but all seven species performed well on peat, with girth increments similar to that on mineral soils (pers. comm. O. Karyanto, UGM, 2013). It is likely that the other four tengkawang species also occur in peatland, but they have not yet been recorded, most likely due to their irregular flowering and fruiting patterns. At its origin, *Hevea brasiliensis* is considered a swamp species and can be productively cultivated on hydrated peat, although shallowly drained peat (e.g. 20-40 cm at Padang Island, Riau, Sumatra) may increase productivity (Sonderegger and Lanting 2011; Giesen 2013).

Economics of peat swamp NTFPs

The question remains if NTFPs can compete with the main plantation crops economically on peatland. There have been few economic studies on NTFPs in peat swamps: on sago (*Metroxylon sagu*) and Hevea rubber (Sonderegger and Lanting, 2011) and swamp jelutung (*Dyera polyphylla*) (Sofiyuddin et al. 2012). Production figures are known for other commodities on mineral soil, such as tengkawang (illipe nuts), paperbark (gelam or *Melaleuca cajuputi*) and candlenut (*Aleurites moluccana*), and these can be interpolated for peat soils. Productivity on hydrated peat is often lower than on mineral soils, and sago, for example, is found to be 25% less productive on hydrated peat (Flach and Schuiling, 1989). Not all commodities are less productive on peat than on mineral soil. Asia Pulp and Paper manages *Acacia crassicarpa* plantations with an average production of 25 tons/ha/yr (max. 35 tons/ha/yr), with the best results being on deep peat (pers. comm. C. Munoz, APP, 2013).

Figure 2 displays returns (USD/ha/yr) for plant products on peat, including rubber, palm oil, sago, swamp jelutung, gelam, illipe nut and candle-nut. These figures are from peatland studies (Duc and Hufschmidt 1993, Sonderegger and Lanting 2011, Sofiyuddin et al. 2012), or from studies on mineral soils, with production figures adjusted downward (-25%) to reflect a possible lower productivity on peat. Values have been corrected for inflation to reflect 2014 prices. In addition, illipe nut displays mast fruiting every 3-4 years, so the average non-mast return (460-3000 USD/ha/yr) was combined with the average mast fruiting return (8800-11500 USD/ha/yr) on a 3.5:1 basis (Smythies 1961, Blicher-Mathiesen 1994). Therefore, returns vary from USD 480/ha/yr for extensive, low input sago on Padang Island (Sonderegger and Lanting, 2011) to USD 6800/ha/yr for candle-nut (combined data from Manap et al. 2009 and Kibazohi and Sangwan 2011). Several commodities (e.g. candlenut, illipe nut and swamp jelutung) appear in the same level as oil palm.

Other economic aspects need to be taken into account too. In a comparative economic study of swamp jelutung and oil palm on degraded peat (Sofiyuddin et al. 2012), swamp jelutung returns were 37% lower than oil palm, but labour return was higher i.e. US$ 16.46 per person day for swamp jelutung against US$ 16.06 for oil palm. For smallholders with adequate access to land, return on labour is often more important than return per hectare per year, while for plantation companies the return per hectare is more significant, because licensing is usually area based. Research and selection trials on swamp jelutung could further boost production, as commodities such as palm oil Acacia and Hevea rubber have benefited from many decades of research, selective breeding and cloning. Initial trials with indigenous swamp forest species have been undertaken, but yield optimisation with regards to swamp jelutong remains in its infancy and there is a great scope for further knowledge expansion. A study by Turjaman et al. (2006) in Central Kalimantan, for example, found that inoculation of growth medium with arbuscular mycorrhizal fungi boosts the growth rate of swamp jelutung.

Swamp jelutung, illipe nut and oil palm trees become less productive and need to be replaced over time; oil palm after 25-30 years (Basiron and Weng 2004), swamp jelutung after 30-40 years, while illipe produces nuts much longer, although it is not yet known how many years it will still be commercially productive. Replacement of any crop is an additional cost. For oil palm it means that the palms are uprooted and removed from the site. For swamp jelutung, however, the timber is much sought after for fine carpentry, carving and pencils and felling leads to added benefits. It can fetch up to US$ 700-800/m³. Likewise, most of the Shorea species producing illipe nuts also produce a valuable timber (PROSEA, 1990-2004).

Additional benefits can be secured by using peat adapted species in programmes that include rehabilitating the hydrology of degraded peatland, thereby curbing and preventing peat loss. These benefits may be monetized, for example, on payment for carbon credits under an REDD+ scheme. Areas rehabilitated under a paludiculture programme provide health benefits and leads to fewer transport disruptions by reducing the number of fires and, consequently, lowering the volumes of smoke. Costs for regular deepening and upgrading of drainage are avoided under a paludiculture regime. This knowledge is also embraced by the palm oil industry, where the Roundtable on Sustainable Palm Oil (RSPO) recently prohibited RSPO members from peat development (Schrier-Uijl et al. 2013). In addition, the Indonesian President issued a decree to prevent further peat development, precisely because there is very clear links to increased number of wildfires and smoke problems and excessive peat development.

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Table 1. Peat swamp forest plant species with significant commercial potential. Some species exhibit potential economic returns that are at par with palm oil.

Family	Species	Common name	PROSEA No.	Main use
Anacardiaceae	Mangifera caesia Jack	binjai (I)	2	Fruit
Anacardiaceae	Mangifera foetida Lour.	limus,membacang (I), horse mango (E)	2	Fruit
Anacardiaceae	Mangifera griffithii Hook. f.	asam rawa (I)	2	Fruit
Anacardiaceae	Mangifera quadrifida Jack	asam kumbang (I)	2	Fruit
Apocynaceae	Dyera costulata (Miq.) Hook.f.	jelutung (I)	18	Latex
Apocynaceae	Dyera polyphylla (Miq.) Steenis (D. lowii)	jelutung rawa (I)	18	Latex
Araceae	Cyrtosperma merkusii (Hassk.) Schott (C. lasioides)	taro rawa (I), swamp taro (E)	9	Starch (non-seed)
Araucariaceae	Agathis borneensis Warb. (A. dammara)	damar sigi, damar pilau (I)	18	Resin
Arecaceae	Calamus caesius Blume	rotan sega (I)	6	Rattan
Arecaceae	Caryota mitis Lour.	sarai (I), fishtail palm (E)	9	Starch (non-seed)
Arecaceae	Caryota urens L.	sarai (I), fishtail palm (E)	9	Starch (non-seed)
Arecaceae	Korthalsia flagellaris Miq.	rotan dahan(-an) (I)	6	Rattan
Arecaceae	Korthalsia laciniosa (Griff.) Mart. (K. grandis)	rotan dahan(-an) (I)	6	Rattan
Arecaceae	Metroxylon sagu Rottb.	sagu (I) rumbia (Sum), sago (E)	9	Starch (non-seed)
Blechnaceae	Stenochlaena palustris (Burm. f.) Bedd.	pakis (I)	15	Vegetable
Burseraceae	Canarium asperum Benth.	kembang rekisi (I)	18	Resin
Burseraceae	Canarium hirsutum Willd.	kanari jaki, ki bonteng (I), white dhup (E)	18	Resin
Burseraceae	Canarium littorale Blume	kayu ariong (I)		Nuts
Caesalpiniaceae	Sindora velutina Baker	sepetir beludu (I)	18	Resin
Chloranthaceae	Chloranthus erectus (Buch.-Ham.) Verdcourt	keras tulang (I)	16	Tea
Clusiaceae	Garcinia mangostana L.	manggis (I), mangosteen (E)	2	Fruit
Combretaceae	Terminalia catappa Linné	ketapang (I)	3	Tannin, seed
Convolvulaceae	Ipomoea aquatica Forsk. (I. reptans)	kangkong (I)	8, 12(2)	Vegetable
Cucurbitaceae	Momordia charantia L.	bitter melon (E)	8, 12(1)	Vegetable
Cyperaceae	Actinoscirpus grossus (L.f.) Goetgh. & D.A. Simpson (Scirpus grossus)	mensiang, walingi (I), greater club rush (E)	17	Weaving
Cyperaceae	Cyperus rotundus L. (rotundatus)	teki ladang (I), red nut sedge (E)	9, 12(1)	Starch (non-seed)
Cyperaceae	Eleocharis dulcis (Burm.f.) Henschel.	purun tikus (I), water chestnut (E)	9	Starch (non-seed)
Cyperaceae	Lepironia articulata (Retz.) Domin.	purun (I), grey sedge (E)	17	Weaving
Cyperaceae	Scirpodendron ghaeri (Gartn.) Merr.	rumbai (I)	17	Weaving
Dipterocarpaceae	Dipterocarpus gracilis Blume	keruing kesat (I)	18	Resin
Dipterocarpaceae	Shorea compressaBurck	tengkawang		Oil bearing illipe nuts
Dipterocarpaceae	Shorea macrophylla (de Vriese) P.S.Ashton	tengkawang hantelok		Oil bearing illipe nuts
Dipterocarpaceae	Shorea pinanga Scheff.	tengkawang rambai		Oil bearing illipe nuts
Dipterocarpaceae	Shorea seminis (De Vriese) Sloot.	tengkawang terendak (I)	14	Oil bearing illipe nuts
Dipterocarpaceae	Shorea stenopteraBurck	tengkawang tungkal		Oil bearing illipe nuts
Dipterocarpaceae	Shorea teysmannianaDyer ex Brandis	tengkawang		Oil bearing illipe nuts
Dipterocarpaceae	Vatica mangachapoiBlanco	tengkawang		Oil bearing illipe nuts
Dipterocarpaceae	Vatica rassak (Korth.) Blume	resak (I)		Dammar/resin
Ericaceae	Gaultheria leucocarpa Blume	gandapura (I)	19	Essential oil
Ericaceae	Vaccinium bracteatum Thunb.	rangkas (I), sea bilberry (E)	2	Fruit

Euphorbiaceae	Aleurites moluccana (L.) Willd.	kemiri (I), candlenut (E)	13	Edible nut
Euphorbiaceae	Elateriospermum tapos Blume	tapas, tapus (I)		Nuts
Euphorbiaceae	Macaranga tanarius (L.) Müll.Arg.	hanuwa, mapu (I), hairy mahang (E)	3, 12(3)	Dye
Flacourtiaceae	Flacourtia rukam Zoll. & Mor.	rukam (I), India plum (E)	2	Fruit
Juncaceae	Juncus effusus Linné	sumpu (I), soft rush, common rush (E)	17	Weaving
Lauraceae	Nothaphoebe coriacea (Kosterm.) Kosterm. (Alseodaphne)	gemor (I)		Incense bark
Lauraceae	Nothaphoebe umbelliflora (Blume) Blume	gemor (I)		Incense bark
Marantaceae	Donax canniformis (G.Forst.) K.Schum.	bemban (I), common donax (E)	17	Weaving
Meliaceae	Sandoricum koetjape (Burm.f.) Merr.	sentul (I), santol (E)	2	Fruit
Menispermaceae	Fibraurea tinctoria Lour. (F. chloroleuca)	akar kuning (I), peron (Jav)	3	Dye
Moraceae	Artocarpus elasticus Reinw. Ex Blume	terap nasi, benda (I) terap (E)	17	Fibre
Myrtaceae	Melaleuca cajuputi Powell	gelam (I), paperbark (E)	19	Essential oil
Myrtaceae	Rhodomyrtus tomentosa (Aiton) Hassk.	kemunting (I)	2	Fruit
Myrtaceae	Syzygium aqueum (Burm.f.) Alston	water apple (E), jambu air (I)	2	Fruit
Myrtaceae	Syzygium polyanthum (Wight) Walp. (Eugenia polyantha)	salam, daun salam (I), Indonesian laurel	13	Spice
Nepenthaceae	Nepenthes ampullaria Jack	Katung Semar berbentuk termos (I), narrow-lid pitcher plant (E)	17	Fibre
Nepenthaceae	Nepenthes rafflesiana Jack	kantong semar Raffles (I), Raffles' pitcher plant (E)	17	Fibre
Nepholepidaceae	Nephrolepis biserrata (Sw.) Schott	pakis (I)		Vegetable
Olacaceae	Anacolosa frutescens (Blume) Blume	kopi gunung, belian landak (I)	2	Fruit
Pandanaceae	Pandanus atrocarpus Griff. (Benstonea atrocarpa)	mengkuang (I), menguang pandan (E)	17	Fibre
Pandanaceae	Pandanus furcatus Roxb.	cangkuang, pandan kowan (I)	17	Fibre
Phyllanthaceae	Aporosa frutescens Blume	sebasah (I)	3	Dye
Phyllanthaceae	Baccaurea motleyana (Müll.Arg.) Müll.Arg.	tampoi (I)	2	Fruit
Phyllanthaceae	Baccaurea racemosa (Reinw. ex Blume) Müll.Arg.	tampoi (I)	2	Fruit
Proteaceae	Finschia chloroxantha Diels	Finschia nuts (E)	2	Nuts
Rubiaceae	Uncaria gambir (Hunter) Roxb.	gambir (I),	3	Dye
Sapindaceae	Dimocarpus longan Lour.	leng-keng (I), longan (E)	2	Fruit
Sapindaceae	Nephelium cuspidatum Blume	kedet, rambutan kabung (I)	2	Fruit
Sapindaceae	Nephelium lappaceum L.	rambutan (I), (E)	2	Fruit
Sapindaceae	Nephelium maingayi Hiern	ridan, penjaih (I)	2	Fruit
Sapindaceae	Pometia pinnata Forst. & Forst.	kasai (daun besar) (I), kayu sapi (Jav)		Nuts
Sapotaceae	Madhuca motleyana (de Vriese) J.F.Macbr. (Ganua motleyana)	nyatoh ketiau (I)	18	Latex
Sapotaceae	Palaquium gutta (Hook.f.) Burck	nyatoh taban merah (I)	18	Latex
Sapotaceae	Palaquium leiocarpum Boerlage	jongkang (I)	18	Latex
Sapotaceae	Palaquium obovatum (Griffith) Engler	nyatoh putih (I)	18	Latex
Sapotaceae	Payena leerii (Teijsm. & Binn.) Kurz	balam beringin (I), balam suntei (Sum)	18	Latex
Thymelaeaceae	Aquilaria beccariana van Tiegh.	gaharu (I), eaglewood, agarwood (E)		Incense
Thymelaeaceae	Aquilaria filaria (Oken.) Merr.	gaharu (I), eaglewood, agarwood (E)		Incense
Thymelaeaceae	Gonystylus bancanus (Miq.) Kurz.	ramin (I)		Incense
Thymelaeaceae	Wikstroemia tenuiramis Miq.	gaharu cengkeh (I)		Incense
Urticaceae	Poikilospermum suaveolens (Blume) Merr.	mentawan (I)	16	Tea

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Structure and composition of amphibian communities in human modified landscape at Gianyar regency, Bali

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Abstract

Landscape modification has affected amphibian communities which then accommodate specialist or generalist species. This research aimed to observe the response of amphibian communities along a gradient habitat of human modified landscapes (settlements, rice fields, farmland/cropland, and monoculture stands) in Gianyar Regency, Bali. Observations were carried out in July-October 2014 using the standard Visual Encountered Survey method. In addition, the body condition of generalist species were also assessed. Eleven amphibian species (n=751 individuals) consisting of 5 families were found. Amphibian species were dominated by *Duttaphrynus melanostictus* (31.8%), *Microhylla palmipes* (21.84%), and *Fejervarya limnocharis* (17.84%). The amphibian community could be found in three separate habitats i.e. settlements-farmland/cropland, monoculture stands, and rice fields. Non-aquatic species in monoculture stands have the highest diversity (Shannon-Wiener index H' 1.12), with lowest found in residential areas (H' 0.31). The diversity of amphibian tend to increases when (1) close to water sources, (2) vegetation cover increased, and (3) anthropogenic disturbance factor decreased. *Occidozyga lima* was a specialist, as it was only found in specific habitat type (rice fields), whereas *D. melanostictus* was a generalist as it was found in all habitat types with high encountered rates. Further observations on the body condition of the generalist (*D. melanostictus*) showed that landscape modification in human modified landscape tend to increase abundance of the species but decrease its body size.

Abstrak

Modifikasi lanskap berdampak pada komunitas amfibi dan memunculkan jenis spesialis dan generalis. Penelitian ini bertujuan untuk mengamati respon komunitas amfibi pada gradien habitat lanskap yang dimodifikasi manusia (permukiman, persawahan, tegalan, dan tegakan monokultur) di Kabupaten Gianyar, Bali. Pengamatan dilakukan selama bulan Juli-Oktober 2014 menggunakan metode standar Visual Encountered Survey. Selain itu, dilakukan juga pengamatan kondisi tubuh spesies generalis. Sebelas spesies amfibi (n=751 individu) dari 5 famili berhasil dijumpai. Komunitas amfibi didominasi oleh jenis *Duttaphrynus melanostictus* (31.8%), *Microhylla palmipes* (21.84%) dan *Fejervarya limnocharis* (17.84%). Komunitas amfibi bisa ditemukan di tiga habitat terpisah yaitu permukiman-tegalan, tegakan monokultur, dan persawahan. Keanekaragaman amfibi non-akuatik tertinggi terdapat pada tegakan monokultur (indeks Shannon-Wiener H'1.12) dan terendah pada permukiman (H' 0.31). Keanekaragaman amfibi cenderung meningkat bila (1) dekat dengan sumber air, (2) terjadi peningkatan tutupan vegetasi, dan (3) penurunan faktor gangguan manusia. *Occidozyga lima* merupakan spesies spesialis karena hanya ditemukan pada satu tipe habitat (persawahan) sedangkan *D. melanostictus* merupakan spesies generalis karena ditemukan di semua tipe lanskap dan dengan kecepatan penemuan yang tinggi. Pengamatan lebih lanjut terhadap kondisi tubuh jenis generalis (*D. melanostictus*) menunjukan bahwa modifikasi lanskap cenderung meningkatkan kelimpahan individu akan tetapi menurunkan ukuran tubuh.

Kata kunci: amfibi, gangguan, generalis, Gianyar, lanskap modifikasi, ukuran tubuh

Introduction

With a growing human population, natural landscapes will be increasingly modified to meet the demand for urban and agricultural development. Human modified landscape (Forman and Godron, 1986) will potentially change the quality of the habitat in the landscape (Bennett and Saunders, 2010), which, in turn, will affect existing wildlife in the area. Modification of natural landscape as a result from human disturbance is referred as "human modified landscape" (Forman and Godron, 1986). Each

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landscape type within a human modified landscape, i.e. plantations, rice-fields, settlements, will have different environmental characteristics that depend on biotic and abiotic factors, as well as the level of disturbance. Different modified landscape characteristics might lead to different responses of species in terms of composition and community structure (Richardson, 2012). It can have direct negative impact on amphibian populations (Hamer and McDonell, 2008; Kolozsvary and Swihart, 1999), because it affects the condition of micro-habitats (Petranka, 1999) and interfere with amphibians' ability to migrate and orientate themselves (Andrews et al., 2008). Landscape modification can also trigger more adapted species (either generalists or specialists) to then occupy such niches. Information about the condition of generalists could illustrate the response of any species on modified landscape.

A decade ago, the information and understanding of the relationship between amphibians communities and their surroundings, as well as their response to the loss of habitat due to human modifications, were extremely limited (Hazel, 2003). Most of the research on amphibian community response to altered landscapes were conducted in developed country and in temperate regions (Hartel and Moga, 2007; Hartel et al., 2010, 2014). In contrast, there have been relatively few studies on this topic in Indonesia. Kurnia (2012) reported the distribution of amphibians along different types of human modified landscape in West Java. Other research (Wanger et al. 2009; Wanger 2010) were confined to a specific modified landscape only.

As a developing country, the natural landscape of Indonesia has undergone major changes. Bali, as one of the most populated island in Indonesia, has been experiencing rapid changes to its landscape, for both agriculture and tourism development. Information about amphibians on Bali is limited to a few field guides (Iskandar, 1998; McKay, 2006) , and there have been no recent reports and studies on amphibian community ecology on this island. Considering Bali consists of a very high degree of human modified landscape, it provides an excellent opportunity to study the response of amphibians to various degrees of landscape and habitat modification. Therefore, this study was carried out to (1) identify the amphibian communities along a landscape with various degrees of modification, (2) determine the impact on amphibian communities from altered habitat characteristics, and (3) determine the effect of habitat modification on the body weight of selected generalist species.

Methods

The study area was located in five of the seven sub-districts of Gianyar Regency: i.e. Gianyar, Blahbatuh, Sukawati, Ubud and Tampaksiring (Fig. 1). Locations were selected based on elevation i.e. in lowlands areas from 0-800 meters above sea level. We selected a habitat gradient based on four stages of modification levels: intact (monoculture stands), variegated (gardens/fields landscape), fragmented (rice fields), and relictual (settlements), as suggested by McIntryre and Hobbs (1999). In the research area, the land use system consisted of monoculture tree stands of *Paraserianthes falcataria* (intact), cropland/farmland dominated by annual or semi-annual crops (variegated), rice fields with continuous watering *subak* system (fragmented), and traditional Balinese settlements and their gardens (relictual).

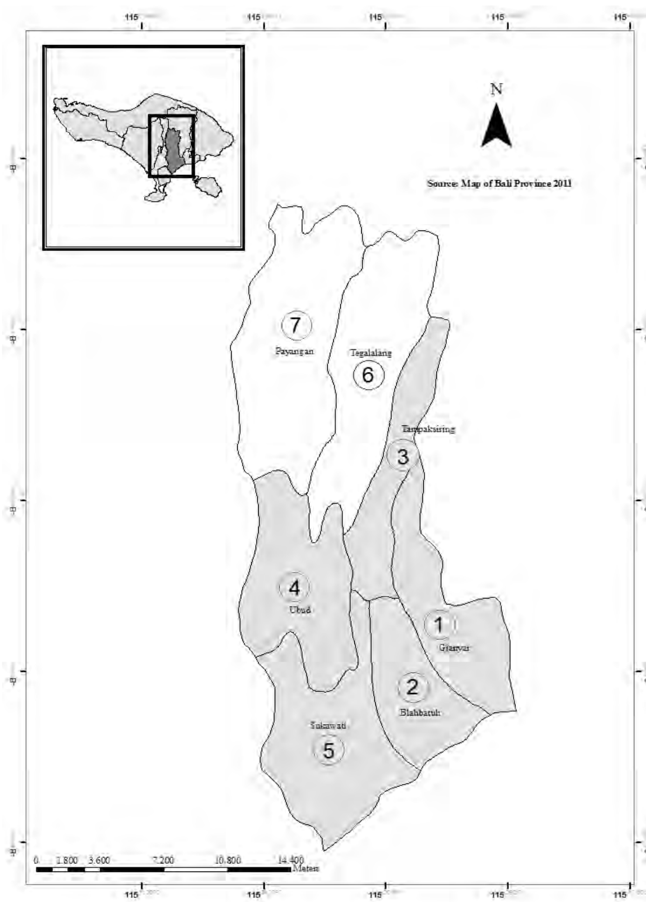

Figure 1. The study area in Gianyar Regency, Bali, Indonesia.

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Samplings were carried out during the dry season from July to October 2014. Ten observation points for each modified landscape were selected using stratified random sampling. Surveys were carried out in the morning (6:00 to 8:00am) and evening (7:00 to 9:00pm) for three consecutive days for each point. Amphibians were observed using the standard VES (Visual Encountered Surveys) method for 2 hours/day (Crump and Scott, 1994) by three observers. For every captured amphibian, we recorded coordinates, date and duration of survey, activity, substrates, species name and other supporting information, such as the weather and individual spoilage.

Identification of amphibians was carried out using Iskandar (1998), McKay (2006), and Kusrini (2013). All individuals were captured and identified to the species level. No specimens was collected, and, after identification, all individuals were released in the same area as where they had been caught. Encounter frequency was recorded as individuals per time unit. The encounter frequencies were arbitrarily categorized into frequent (1.36-0.92 ind/min.), common (0.46-0.91 ind/min.), and rare (0.001-0.045 ind/min.).

Habitat characteristics such as vegetation cover, presence of water source, and degree of disturbance were also recorded. Canopy cover and undergrowth covers, including woody shrubs, bushes and grasses, were measured for vegetation cover using line intercept techniques (Whitman and Siggeirsson, 1954). In each land use system, we selected a 20x20m plot and set 10 transects 2m apart. For each captured amphibian, the distance to the nearest water source was also recorded. The degree of disturbance was quantified by measuring the distance of each observation point to the nearest settlements, roads as well as the size of the area of each point. All coordinate data and area size were taken using Garmin Etrex 30 and analysed using ArcGis 9.3.
Pre-survey indicated that *Duttaphrynus melanostictus* was abundant and widely distributed. This species was selected for further study on trend of body weight along modified landscape gradient. Snout-vent length SVL of D. melanostictus were measured by using a caliper to the nearest 0.05 mm, and then weighed using digital scale to the nearest 0.1 g. All captured individuals were released on site after measurements.

Shannon-Wiener diversity indices (Magurran, 2004) were calculated for each type of habitat. Differences of species richness among the modified landscapes were examined using Kruskal-Wallis test (Fowler et al., 2006). The amphibian community similarities for each land use type were assessed using single linkage method of Euclidean Distance (Ludwig & Reynolds, 1988). To explain the correlation of each environmental character measured to amphibian community parameters (abundance, species richness, and species diversity) we used Spearman rank correlation coefficient with a significance level of $P \leq 0.05$. We conducted similar analysis to assess the correlation between disturbance factors to amphibian communities.

To assess body condition of *D. melanostictus*, we used a body mass index (i.e. ratio of the body weight to body length). We used the result to determine the correlation of landscape modification level to body condition of generalist species using Spearman rank correlation coefficient with an significance level of $P \leq 0.05$. All statistical test were processed by SPSS 16.

Results

Amphibian Communities along Habitat Gradient in Human Modified Landscape

Eleven species (n=751 individuals) of amphibians were found in the study area, consisted of five families: Bufonidae, Microhylidae, Ranidae, Dicroglossidae and Rhacophoridae, categorized further according to their habitat, i.e. terrestrial, aquatic, and arboreal species (Table 1). *D. melanostictus* dominated the amphibian community in settlements (n=163 individuals, 91.1%), while *Microhylla palmipes* was dominant in rice fields (n=145, 32.7%).

The Shannon-Wienner diversity index (H') of amphibians in all four habitat type combined was 1.89. Comparing among habitats, the highest diversity index was in monoculture stands (H'=1.12) and the lowest was in settlements (H'=0.31). Amphibian community characters differed among type of landscape modifications, in term of number of individuals ($P<0.05$; df=3) and number of species ($P<0.05$; df=3). The amphibian community in the rice fields was the most different, compared to other habitat types (56% of similarity), whereas settlements and farmland/ cropland amphibian communities had the highest value of similarity (85.34%) (Fig. 2).

Amphibians and Habitat Characters

The characters of habitat were significantly different among type of landscape modifications (water source:

Table 1. Richness and abundance of amphibians along habitat gradient habitat in human modified landscape Gianyar, Bali. Aq: Aquatic; Ar: Arboreal; Tr: Terrestrial.

		Number of Individuals				Number of Species			
Level of Modification	**Land use**	**Aq**	**Ar**	**Tr**	**Total**	**Aq**	**Ar**	**Tr**	**Total**
Low	Monoculture stands	9	12	60	81	2	1	3	6
	Farmland/cropland	9	7	31	47	4	1	1	6
	Rice fields	270	3	171	444	6	1	4	11
High	Settlements	1	0	178	179	1	0	3	4

Table 2. Relative encounter rate of amphibian species found in different habitat type habitat in human modified landscape Gianyar, Bali. +++ (frequent) : 1.36-0. 92 ind/min.; ++ (common): 0.46-0.91 ind/min.; +(rare): 0.001-0.45 ind/men.; - : 0 (not found).

Species	Settlements	Rice Fields	Farmland/Cropland	Monoculture Stands
Bufonidae				
Duttaphrynus melanostictus	+++	+	+	+
Ingerophrynus biporcatus	+	+	-	+
Ranidae				
Fejervarya cancrivora	+	++	+	-
Fejervarya limnocharis	-	+++	+	+
Hylarana chalconota	-	+	+	-
Hylarana nicobariensis	-	+	+	+
Occidozyga lima	-	+	-	-
Occidozyga sumatrana	-	+	-	-
Microhilydae				
Microhylla achantina	+	+	-	-
Microhylla palmipes	-	+++	-	+
Rhacophoridae				
Polypedates leucomystax	-	+	+	+

Table 3. Average ± Standard Deviation of body size of *D. melanostictus* along habitat type in human modified landscape Gianyar, Bali

Level of Modification	Land Use	n	Body Weight (g)	Snout-Vent Length (cm)	Body Mass Index
High	Settlements	163	4.90±4.16	55.90±20.54	0.09±0.15
	Rice fields	7	24.70±8.24	58.71±7.54	0.42±0.11
	Cropland/farmland	31	45.30±26.19	66.56±13.04	0.97±0.18
Low	Monoculture stands	38	61.60±18.93	64.00±8.81	1.01±0.15

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P<0.05; df=3; average of canopy cover P<0.05; df=3; average of undergrowth coverage: P<0.05; df=3). Distance to water source was negatively correlated to amphibian diversity (rs=-0.532; P<0.01), indicating more amphibians were found closer to water sources. Increased canopy cover resulted in a decline in the number of individuals (rs= -0.643; P<0.01), but an increase in the number of species (rs= 0.768; P<0.01). Meanwhile, when undergrowth coverage increased, the number of individuals (rs= 0.414; P<0.01) and diversity of amphibians (rs= 0.806; P<0.01) also increased.

The impact of the disturbance factor differed according to various characteristics. The impact of distance from the roads to amphibian community did not differ among types of landscape modification (P=0.180; df=3). However, area-size (P<0.05; df=3) and distance from the settlements (P<0.05; df=3) were significantly different among human modified landscape. Number of species (rs=0.481; P<0.01) and diversity of amphibians (H') (rs=0.546; P<0.05) tend to increase when size of landscape area increases and moves further from settlements (number of species rs=0.499, P<0.01;H' of amphibians rs= 0.546; P<0.01). The diversity of amphibian tend to decrease if the area is closer to roads (rs=0.328; P<0.05).

Body Size of D. melanostictus along Gradient Habitat in Modified Landscape

As a generalist, *D. melanostictus* was abundant and can be found in all types of landscape modification (Table 2). On the other hand *O. lima* was only found on rice fields and considered as specialist for that habitat type.

Our results showed that there was a correlation between level of landscape modification or disturbance, and the number of individuals, as well as body condition. The number of individuals of *D. melanostictus* tend to increase in higher levels of modification (n=163 in settlements, n=38 in monoculture stands). Body size of *D. melanostictus* tend to decrease with increasing level of landscape modification (rs=-0.796; P<0.01) (Details of *D. melanostictus* body size in Table 3). Body weights (rs= -0.719; P<0.01) and the SVL of *D. melanostictus* (SVL) (rs=-0.221; P<0.01) will decrease when level of landscape modification increased (Table 3).

Discussion

Amphibian Communities along Gradient of Modified Landscape

The pattern in number of species and number of individual amphibians in a habitat gradient of human modified landscape at Gianyar was similar to research in West Java (Kurnia, 2012). In general, the abundance (number of individuals), richness (number of species), and H' of amphibians tend to decline as habitat modification moves from intact to relictual stages.

However, there was an exception to this general pattern, as rice fields, which were considered to be highly modified, had high species diversity. According to Burton and Likens (1971), the presence of amphibians cannot be separated from the presence of water. At the time of research, rice plants were 3-4 week old, thus the rice fields were still under low water level. This condition was favorable for amphibians. Compared to other studies (see Wanger et al., 2011 in Lore Lindu National Park Central Sulawesi; Kurnia, 2012 in West Java), the diversity and number of amphibians captured in rice fields of Gianyar were higher. In planting rice, the Balinese practice local wisdom called *subak* and used organic farming system, thus the agricultural land was void of chemicals. These conditions might be the reason why the diversity of amphibians in these rice-fields tended to be higher in Bali.

Relationship Between Amphibians and Environmental Characters

The presence of amphibian communities was related to the environmental variables in each habitat. Three habitat variables were associated with amphibian community, i.e. water sources, canopy cover, and undergrowth cover. The presence of water was closely connected with the presence of amphibians (Burton and Likens, 1971; Paton, 2000; Wadlle, 2006) and diversity (Trimble and van Aarde, 2004; Pilliod et al., 2003).

The presence of vegetation cover will largely determined the presence of amphibians. As canopy cover increase, the number of amphibian species will also increase (Cushman, 2005; Searcy et al., 2012; Trimble and van Aarde, 2004). Improvement of canopy cover could reduce the intensity of ultraviolet (Pilliod et al., 2003), and increase the abundance of insects that serve as food for amphibians (Greenberg, 2001; Lorimer, 1989; Runkle, 1982). However, the increase in species number will decrease the number of individuals due to competition between species (Scheiner et al., 2000). Increased coverage of undergrowth tends to increase abundance and diversity (H') of amphibians since undergrowth is needed for dipersal (Paton, 2000) and reduce dehydration on amphibians (Pilliod et al., 2003).

Area size, settlement, and distance to roads are some of the disturbance factors mostly cited as the cause of landscape change (Forman and Godron, 1986). According to the theory of island biogeography (MacArthur and Wilson, 1967), big areas are better in retaining stable physical and biological processes than small areas, which provide a strong influence for the organism (Ricketts, 2001). Moreover, broader areas are connected to home range (Hanson, 2012); the larger the area, the higher number of amphibian species can be found.

The existence of the settlements reflected the maximum human activities on the landscape. The limited habitat for wildlife inside settlements area had resulted in only certain species being able to live (Banville and Bateman, 2012). This factor makes amphibians avoid human settlements (Cushman, 2005; Botejue and Wattavidanage, 2012).

Other disturbance factors that also affect amphibians are the existence of roads (Andrews et al., 2008; Cushman, 2005). Roads will reduce the ability of reproduction and resilience of amphibians due to pollution (Andrews et al., 2008). In addition, roads also increased the mortality reulsting from traffic incidents during amphibian dispersal (Fahrig et al., 1994; Gibbs and Steen, 2005; Glista et al., 2008; Mazerolle, 2009).

Body Size of D. melanostictus and Level of Habitat Modification in Human Modified Landscape

Devictor et al. (2008) stated that a change of habitat will trigger different responses to habitat specialization by generalist and specialist species. Generalist species are species that are able to grow well in limited resources, use limited habitat elements, or found across different habitat types (Hibbitts et al., 2013; Jonsen and Fahrig, 1997). In human dominated landscape of Gianyar, the generalist species *D. melanostictus* was found in large numbers with the highest encounter rate (i.e. 0.92 ind/minute). *D. melanostictus* was found in large numbers in a landscape that had the highest level of modification (settlements). The survival success of *D. melanostictus* in these settlements might be related to their capability to use the limited resources in the area, combined with its ability to disperse widely (van Looy et al., 2012). This species has been known to be tolerant to disturbances and resource limitations compared to other species of amphibians in Java and Bali (Iskandar, 1998).

Jonsen and Fahrig (1997) reported that the number of individual of generalist species will increase when disturbance increased, mostly because competition between species was the lowest at higher level of habitat modification. Thus, the number of competitor in settlement area was low, while the number of *D. melanostictus* increased. Habitat change (modified landscape) can cause the emergence of morphological differences in many taxa (Schauble, 2004). In this study, *D. melanostictus'* body condition changed along the modified landscape gradient (low to high), in line with the results of other studies (Gray and Smith, 2005; Karraker and Welsh, 2006). The body condition (weight, SVL, body mass index) was smaller, perhaps due to the existence of interspecific competition, when it will reduce the opportunity to use otherwise available resources (Josen and Fahrig, 1997).

The variability of body size, shown by body mass index, might be dependant on the availability of food. Increasing the modification level of the landscape will reduce vegetated area and, subsequently, the abundance of insects (Badrinarayanan et al., 2001) that serves as prey for Bufonidae (Clarke, 1974; Isailovic et al., 2012). The lowest body mass index of *D. melanostictus* in settlements and the highest body mass index in monoculture stands might be dependant on the availability of prey. In some species of Anura, there were positive relationships between body size of a predator and the body size of prey (Gray & Smith, 2005; Quiroga et al., 2009). This study did not conduct prey analysis, and further research on the availability of prey and prey size, are needed to assess the relationship between amphibian body size and its prey.

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The interactions between long-tailed macaques (*Macaca fascicularis*) and tourists in Baluran National Park, Indonesia

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Introduction

The long-tailed macaque (*Macaca fascicularis*) is common in many countries in South-East Asia and classified as "Least concern" on the IUCN Red List (IUCN, 2015). The population size is declining and in 2008 the long-tailed macaques was the first species to be classified as widespread and rapidly declining (Eudey, 2008). Information is needed about the distribution, population sizes and population trends of the long-tailed macaque in the wild (Eudey, 2008).

There are many studies concerning the ecology and occurrence of long-tailed macaques (e.g. Yeager, 1996; Lucas and Corlett, 1998; de Ruiter and Geffen, 1998; van Schaik et al., 1983), but the past years of drastic changes and reduction to habitats may have had a negative impact on distribution and density of the species. The human encroachment on natural habitats has caused an increase in human-macaque conflicts (Nekaris et al., 2013; Lane et al., 2011; Fuentes et al., 2008; Fuentes et al., 2007).

In Baluran National Park, East Java, Indonesia there is an abundance of long-tailed macaques. According to park staff, many conflicts between tourists and macaques occur, especially at the most frequently visited Bekol savannah and Bama beach, where the macaque population appears to be largest. Park staff suggests that excessive feeding of the macaques by tourists has caused the population to increase to "unnatural" sizes and is concerned that this could result in negative effects on the ecosystem processes in the area.

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There is little information on the occurrence and behaviour of the long-tailed macaque in Baluran National Park, and the ecological role and effects of macaques on the park's ecosystem processes remains poorly understood.

This study identifies the occurrence of long-tailed macaques in high tourist density areas of Baluran NP, as well as investigates the behaviour of macaques in areas with high visitor density.

Methods

This study took place from 14th-29th July, 2015. Daily excursions were undertaken in the park between 7am and 5pm, to identify macaque focus groups and estimate their population sizes. All observations were carried out from the main road and tourists trails concurrently by three observers. We observed the focus groups from a distance, where our presence did not trigger any signs of disturbance reaction. "Disturbance reaction" was defined as a) open mouth threat and yawning (Angst,1975), b) kra vocalisations by leading males (Palombit 1992), and c) the push-forward effect, where groups move away according to distance of researcher i.e. as researcher approaches, group moves forward (Williamson and Feistner, 2003). We paused our approach when the macaques exhibited "disturbance reaction" behaviour and resumed follows when they ceased. We used *ad libitum* sampling (Altmann, 1974) to record "reactions" and distance as well as physical anomalies such as missing limbs or snare wounds.

We spent two days searching for groups along the

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main access road at the western part of the park. The locations of the encounters were recorded using GPS (Garmin Cs62), and all groups were named according to the location where they were encountered. The population size of each recorded group was estimated with repeated total counts (Roos and Reeve, 2003) along with *ad libitum* observations. No discrimination to age/sex class was given and individuals were not identified. All outermost locations, where groups were encountered or footprints recorded, were used to estimate a groups' approximate home range.

Human-macaque interactions were observed at Bekol savannah and Bama beach for 1hr/day for four days within one week. We used continuous all-occurrence sampling (Altmann, 1974) with two behaviours; tourist feeding macaque and macaque showing aggression towards tourists. "Aggression" was defined as contact aggression and open mouth threat. We also used *ad libitum* sampling for the observation of tourists-macaque interactions (Altmann, 1974). Concurrently, we estimated the number of tourists and macaques present at any given study time with no age/sex class discrimination, and calculated the correlation coefficient (r) of the samples.

Results

Group size and home-ranges

We identified nine groups and estimated the group sizes (averages of repeated counts), home ranges and densities (Table 1). We counted 859 individuals in the nine groups (Table 1). The four highlighted focus groups were encountered in high-tourist-density areas. The "Kantor" group was observed both on the main road and along the public road. Groups 6-9 were only encountered along the main road. Of the focus groups "Bekol-2" had the smallest estimated home-range (1km^2), and "Bekol-1" the largest density with 90 individuals per km^2 (Table 1). The 417 individuals in the four focal groups utilised an estimated home range averaging 1.75km^2/group (Fig.1), with an average density of 59 individuals/km^2/group and a maximum group size of 180 individuals (Table 1). The average group size consisted of 104 individuals/group.

Table 1. Macaque group sizes (*n*), approximate home ranges size (HR), densities (*n*/km^2) and focal groups (bold).

Group name	*n*	HR (km^2)	Density
Kantor	100*		
Bekol 1	**180**	**2**	**90**
Bekol 2	**53**	**1**	**53**
Bama	**84**	**2**	**42**
Manting	**100**	**2**	**50**
Waduk 1	70		
Waduk 2	66		
Curah tangis	106		
Bitakol	100*		
Total	**859**		

*Approximate number

Close follows of the macaques without provoking any reactions from the study group were possible in the main tourist areas only --- that is, Bama and Bekol. Outside these areas, an immediate "push-forward effect" took place and groups moved away when we approached and maintained a distance of 20-30m. Leading males and mature females exhibited disturbance reactions, such as kra vocalisations and contact calls (Palombit, 1992), yawning, and "open mouth" threat.

We recorded several types of physical anomalies, such as missing tails and limb(s), and three individuals were observed with a metal snare around their stomach that had caused deep flesh wounds.

The three groups Bekol-1, Bama and Manting have

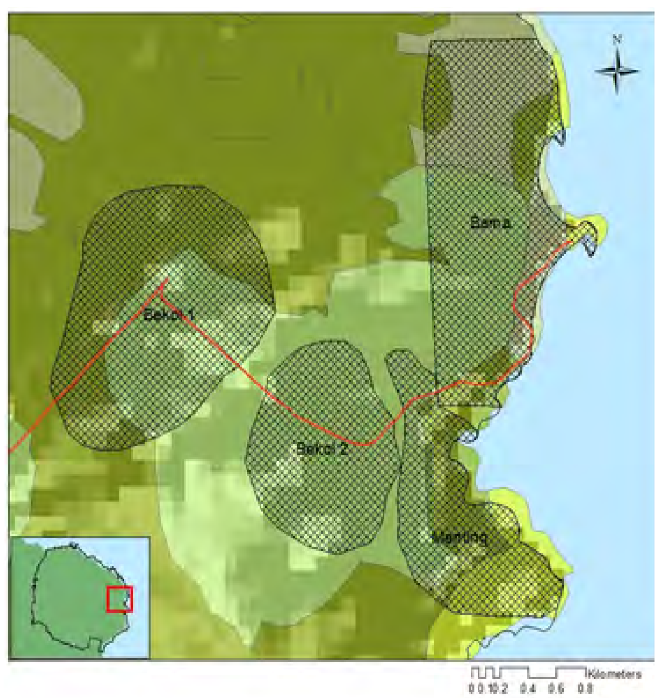

Figure 1. Home-ranges of Bekol-1, Bekol-2, Bama and Manting groups.

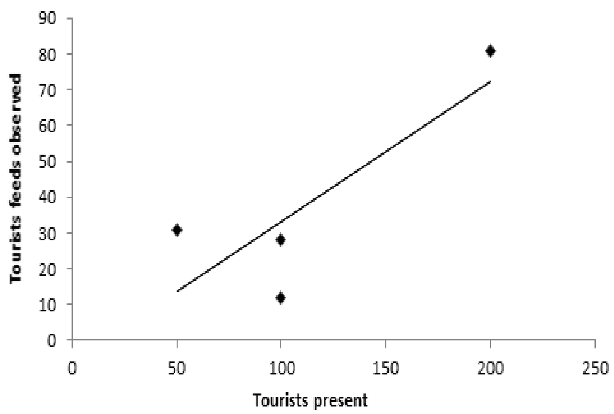

Figure 2. Amount of tourist feeds in Bekol and Bama for 1 hour/day for 4 days.

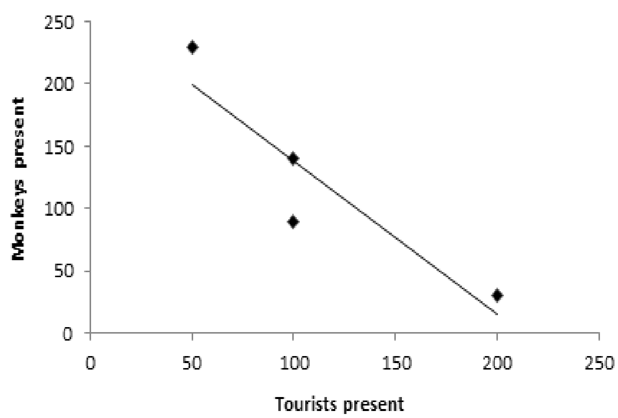

Figure 3. Monkeys present in Bekol and Bama for 1 hour/day for 4 days

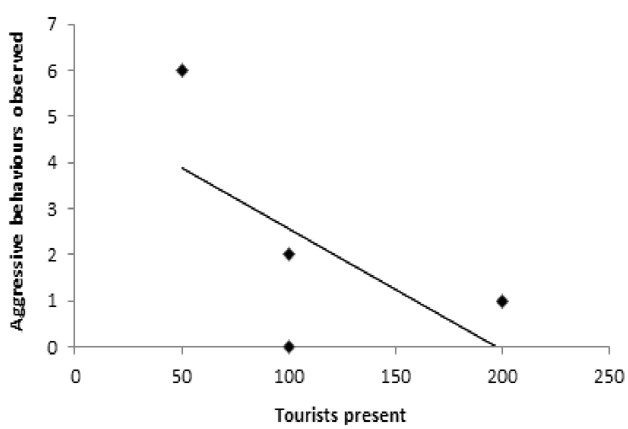

Figure 4. Amount of aggressive macaque behaviours directed towards tourists in Bekol and Bama for 1 hour/day for 4 days

similar home-range sizes that seem to overlap only minutely (Fig. 1). Bekol-2 has the smallest home range and group size, and this group has less encounters with tourists. Manting was most frequently observed in the mangrove along a birding trail, and only two times near the main road.

Human-macaque interactions

Our occurrence sampling revealed a strong positive correlation between the number of tourists and frequency of tourist feeds (r = 0.825; Fig.2), whereas the number of monkeys present was strongly negatively correlated to the number of humans present (r = -0.916; Fig.3). There was a moderate negative correlation between the number of tourists and aggressive macaques (r = -0.63; Fig.3). *Ad libitum* observations conducted for a longer period of time support these trends i.e. macaques tended to shy away from large human crowds. Bama group members retracted to the forest areas behind the berm and the mangrove, and the Bekol group dispersed into smaller units away from Bekol savannah.

Tourists fed macaques mostly rice and potato chips. On the 20th July, the number of feeding reached an average of 80/hour. During times with low visitor numbers, macaques frequently scavenged on human trash in bins and on the ground.

Discussion

This study revealed that tourist feeding of long-tailed macaques in Baluran NP is excessive and that it may impact the macaque population density by creating sustenance for extremely large groups. Our results suggest elevated population densities in tourist areas. Some groups had population sizes over 100 individuals, and one reached 180 individuals. This corresponds well with study groups in Vietnam, where provisioned reached populations sizes of 180 individuals and densities at 62 individuals/km^2 (Son, 2004). In comparison, non-provisioned study groups in Sumatra averaged 30 individuals, with few exceeding 40 individuals (van Schaik et al., 1983). Since primate group sizes are influenced by food density (Wrangham et al., 1993), groups in excess of 100 individuals are unlikely to occur. Groups exceeding 40 individuals already exhibit increase in day journey length, foraging time and experience an elevated level of social tension (van Schaik et al., 1983). Human provisioning is not the

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only possible reason for the large difference in group size and population density between Baluran and Sumatra. The difference in habitat type and the level of predator pressure may also determine group sizes (Cowlishaw and Dunbar, 2000). In a situation without human provisioning, it is expected that macaque group sizes in Baluran were significant larger than Sumatran group sizes, due to more favourable ecological conditions.

Using disturbance reactions as our guiding tool proved adequate, and we were able to observe groups foraging and interacting if we remained 20-30ms away. We recommend a habituation period before conducting further studies if more subtle behaviours and individual identification is sought.

The positive correlation between the number of tourists and the number of feeds (r = 0.825; Fig.2) suggest that, on days with many tourists, the volume of extra feed available to macaques is sufficient to modify the group sizes positively. These enlarged groups, however, may not be able to sustain themselves from natural food sources alone and, therefore, become reliant on surplus food offered by tourists. This means they will seek tourists areas, where more energetically cost-effective tourists food is plenty, rather than foraging on natural food sources. Despite being attracted to tourist food, the large Bama and Bekol groups avoided tourists on days with high visitor numbers (r = -0,916) (Fig.3) and, naturally, with fewer macaque-human interactions, the amount of aggression also decreased (r = -0.63; Fig. 4). The negative correlation between the number of humans and macaques aggression, however, seems counter-intuitive, and the reason for macaques retreating at high visitor numbers is not clear. It may be linked to the availability of excessive amounts of food that, in turn, reduces competition and allows the macaques to rapidly feed until full and retreat. It could also be related to an evolutionary inherent group vigilance that initiate retreat at a pre-determined point, irrespective of the potential benefits from scavenging human food outweigh the risks. Finally, social behaviour may determine retreat i.e. a group will follow certain dominant leaders and leave when these are full, irrespective of whether the subordinates themselves are full or not. In times with many visitors, it is likely that dominant individuals are the first to feed and become full. This may also explain why a retreated group has individuals that rests and others that continue to forage. Relying on tourists food, however, may impair macaque health and group welfare. An elevated daily intake of carbohydrates and other anthropogenic foods often results in increased adipose deposition and reduced activity rates (Zhao, 2005). In addition, larger macaque group sizes will have less group resting time than smaller group sizes (van Schaik et al., 1983), and increase inter-group conflicts and competition (Zhao, 2005).

Macaque aggressive behaviour towards humans decreased with an increase in number of tourists (r = -0.63; Fig. 4). This is likely due to the amount of tourist food is so large that all individual macaques can feast without having to compete for it. With only few tourists present, many macaques resort to actively stealing or grabbing food out of tourists' bags, cars and pockets. This type of aggressive "begging" occurred primarily on days with few tourist visits and less tourist food available. Similar aggressive behaviour has been reported in Padangtegal and Sangeh Monkey Forest temple on Bali, where tourist reports of biting, hitting and scratching macaques are common. Aggressive behaviour was also recorded on days with high visitor numbers, however, instigated by tourists actively pursuing macaques to offer them food, even when these did not want it.

Close interactions between humans and macaques can increase the risk of injuries and transmission of zoonotic diseases (Jones-Engel, 2005; Fuentes et al., 2007; Zhao, 2005) lethal to humans, for example, the Herpes-virus B. People infected with this virus sustain a mortality rate of 70% (Engel et el., 2002), and the prime instigator of human-macaque interactions leading to such inter-species disease transmissions is food (Fuentes et al., 2008). Pathogen transmission can also occur via macaques rummaging through human trash (Fuentes et al., 2008). On the other hand, macaques living in urban or rural centres as integrated components of human societies risk suffering serious injuries from snares, broken glass, cans and plastic bags. This study recorded several individuals with missing limbs and embedded strings. Many of these likely arise from illegally deployed snares and poor waste management in the park.

Long-tailed macaques are known to disperse seeds and play important roles in forest regeneration in a variety of habitats (Lucas and Corlett, 1998). Excessive feeding of macaques may encourage them to rely on easily obtainable tourist food, thereby reducing their seed dispersal activities and, consequently, cause habitat deterioration.

Our study concludes that macaques group sizes in Baluran NP are inflated due to excessive tourist feeding. This leads to a potentially more serious problem i.e. aggressive human-macaque interactions. In contrast to the anecdotal evidence, suggesting macaques solicited interactions, we observed that it was primarily visitors that solicited the macaques. To reduce the risks of injury and disease transmissions, the human-macaque interactions need to be reduced. In Singapore, for example, physical contact between humans and macaques is rare and disease transmission risk low, because it is illegal to feed macaques and the laws are rigorously enforced. In addition, visitors and locals alike are educated about the possible negative consequences of close physical interactions with macaques (Fuentes et al., 2008).

The current situation in Baluran NP necessitates an immediate management intervention aimed at reducing the feeding of macaques. The existing laws concerning feeding the macaques need to be enforced, and education and awareness programmes for visitors implemented. This combination of activities can reduce contact between macaques and humans and reduce the disease transmission risk in Baluran NP.

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Preliminary analysis of seed dispersal by dwarf cassowaries in the Arfak Mountains, Papua, Indonesia

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Introduction

The dwarf cassowary, *Casuarius bennetti*, is endemic to the mountain forests of New Guinea, New Britain, and Yapen Island, where it occurs up to about 3300 m in elevation (Beehler et al., 1986). This species has two congeners: the northern cassowary, *C. unappendiculatus*, which is endemic to the lowlands of northern New Guinea, and the southern cassowary, *C. casuarius*, found in southern New Guinea and northeast Australia. The dwarf cassowary is a large frugivorous bird but slightly smaller than the other cassowary species, with a height up to 130 cm and a weight of 25 kg (Coates, 1985; Beehler et al., 1986). Because of its large body size, humans hunt the species in most areas where it occurs.

All cassowary species are highly frugivorous (Crome, 1976; Stocker and Irvine, 1983) with 90-99% of their diet being comprised of fruit (Bentrupperbaumer, 1997; Wright, 2005). Many New Guinean rainforests trees have large fruits and seeds compared to related taxa in other tropical areas that lack cassowaries (Mack, 1993), suggesting that these birds, with their large gapes, could have had an evolutionary influence on the morphology of tree reproductive strategies. Indeed, northern and southern cassowaries are known to play important roles in seed dispersal for many forest plants and are considered keystone species in some parts of New Guinea and Australia due to their strong impacts on tree regeneration (Crome and Moore, 1990; Bentrupperbaumer, 1997; Mack and Wright, 2005; Pangau-Adam, et al., 2014). However, little is known about diet selection and seed dispersal by dwarf cassowaries.

Methods and Results

We conducted a wildlife ecology survey in the Arfak Mountains, Papua, Indonesia from 26 - 30 June 2014, where we recorded cassowary fecal droppings at elevations from 1100 - 2250m, confirming the presence of dwarf cassowary in these areas, where other cassowary species are reported to be absent (Beehler et al, 1986). We collected five fecal piles along ~16 km of survey trails and washed the piles individually to assess their contents. Seeds in the droppings were counted and identified by comparing them to specimens in the Herbarium Manokwariensis, Papua, and using the literature (Cooper, 2013). We identified seeds from 14 plant species in 11 families (Table 1). Nine of the plant species (~60%) were large-seeded, as defined by Westcott et al. (2005), demonstrating the potential importance of dwarf cassowary as seed dispersers of large-seeded plant taxa in sub-montane forests. In a fecal pile at 1210m elevation we detected seeds of *Caryota rumphiana*; this tree species is not known to occur above 500m (Heatubun, pers. comm.). Dwarf cassowaries may have been foraging in lowland forests and subsequently transported the seeds to higher altitudes. Indeed, Wright (2005) reported altitudinal movements of dwarf cassowary in Papua New Guinea, possibly in response to shifting fruit availability. Such altitudinal movements by cassowaries could facilitate lowland plant species to expand their distributions upwards in response to climate change.

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Table 1. Plant species found in dwarf cassowary fecal piles in the Arfak Mountains, Papua, Indonesia. The (*) denotes plant species with large seeds, following Westcott et al. (2005).

Family	Species	Sample type
Arecaceae	*Caryota rumphiana**	Fruit
	Calamus heteracanthus	
Clusiaceae	*Garcinia lattisima**	
Elaeocarpaceae	*Elaeocarpus sp.**	
Euphorbiaceae	*Glochidion rubrum*	
Flacortiaceae	*Sp. 1**	
Lauraceae	*Cinnanomum sp.*	
	*Endiandra montana**	
	*Tristania sp.**	
Melastomataceae	*Memecylon sp.*	
Meliaceae	*Dixocylum sp.**	
Moraceae	*Ficus carolis*	
Myrtaceae	*Syzygium sp.**	
Rosaceae	*Prunus turneriana**	
unidentified spp.		
Ferns –young shoots		Non-fruit

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A southernmost record of chestnut-cheeked starling, *Agropsar phillippensis*, in Bali, Indonesia

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Introduction

Chestnut-cheeked Starling *Agropsar (Sturnus) phillippensis* is found the south-eastern Siberia to northern Japan, winters in southern Japan, Taiwan, Philippines, Borneo, rarely in Sulawesi and the Moluccan islands (Kennedy, 2000; Robson, 2011). In breeding season, the bird occurs in open and mixed deciduous woodland, often in agricultural land, orchards, sometimes in urban parks, around villages, nesting in woodland edge or in clearings; and during non-breeding season habit in open country and cities (Craig and Feare, 2009; Feare and Craig, 1998). In Southeast Asia, the bird vagrant in Thailand, Peninsular Malaysia and Singapore (Robson, 2011).

In Indonesia, the Chestnut-cheeked starling recorded in Kalimantan, Sulawesi and the Moluccan islands (Sukmantoro et al., 2007). There are several records in East Kalimantan, one record from South Kalimantan and large flocks up to 5000 birds presumed as this species on January-February 1997 in Danau Jempang, East Kalimantan (Mann, 2008). Records from Sulawesi and the Moluccan islands are based from old records (Coates and Bishop, 2000); two old records from North Sulawesi, one from Bacan (Moluccan islands), and a specimen record from Siau (White and Bruce, 1986).

The Bali avian fauna has been updated recently (Mason, 2011), but Chestnut-cheeked starling is absent from the list. In this paper, the occurrence of Chestnut-cheeked starling in Bali is reported and discussed. To our knowledge, this record is not only first record for Bali, but also the southernmost record of this species.

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Methods

The study site is located near Gilimanuk Gas Power Plant (Pembangkit Listrik Tenaga gas or PLTG), Pemaron village, Buleleng sub-district, Buleleng district, Bali province. The area (8°10'32.7036"S, 114°26'34.3680"E) consists of open habitat and parks. A flock of up to 80 grey-whitish starlings was incidentally observed on 14 November 2014. It was not possible to identify all birds at species level with certainty, but they appeared to be a mixed flock of Chestnut-cheeked starling and Daurian starling *Agropsar (Sturnus) sturninus*. These species are known to flock together. However, among those birds, one bird photographed and identified as Chestnut-cheeked Starling.

Results and discussion

On 14 November 2014, a flock of 80 grey-whitish starlings (cf. Chestnut-cheeked Starling and Daurian Starling) was observed near Gilimanuk Gas Power Plant, Bali, All birds are relatively similar, having pale-greyish head and underparts, glossy dark purplish nape-patch and upperparts. Those characters slightly show features of Chestnut-cheeked Starling and Daurian Starling (Craig & Feare, 2009; Feare & Craig, 1998; Robson, 2011). One of them was photographed and identified as Chestnut-cheeked Starling (Figure 1). The presence of chestnut on cheeked and neck-side are are important to identify Chestnut-cheeked Starling, compare with Daurian Starling (Craig & Feare, 2009; Feare & Craig, 1998; Kennedy, 2000; Robson, 2011).
Since reported in East Kalimantan during 1996-1997, there is no recent records of Chestnut-cheeked

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Figure 1. Chestnut-cheeked starling (below) in Bali on 14 November 2014. Resemble to Daurian starling but differs from showing chestnut in cheek and neck-side (©Hery Kusumanegara).

Starling in Indonesia (Balen et al., 2011; Balen et al., 2013; Balen et al., 2014; Mann, 2008; Pratt & Beehler, 2015). Record of Chestnut-cheeked Starling in Bali is unexpected. Except in Kalimantan, the bird is vagrant in other islands in Indonesia (Coates & Bishop, 2000; White & Bruce, 1986). Vagrants of Chestnut-cheeked Starling have been recorded in eastern Russia, Indian subcontinent, northern Sulawesi, the Moluccas, peninsular Malaysia, Singapore and apparently in the U.S.A. (Feare and Craig, 1998; van der Wielen, 20007). The first birds arrive in southern Japan in late March, moving north until they arrive in the breeding areas in April to early May. In their wintering areas, the last birds are usually seen in late April (Craig & Feare, 2009; Feare and Craig 1998).

Record of Chestnut-cheeked Starling in Bali on On 14 November 2014, it is not only first record of this species in Bali, but also a southernmost record known for this species in its known range area (30S). Previous southernmost record apparently from Binuang area (30S), South Kalimantan, on 14-18 Dec 1974 (Mann, 2008). In Bali and other parts of Indonesia, recent number of local birdwatchers who having good photographic equipments are increased. Certainly, it would have been impact to improve documentations and identifications. Further careful examination in the field between other Starlings and Chestnut-cheeked Starling will possible to add new localities of Chestnut-cheeked Starling in Indonesia. So, It will give better understanding on its migration pattern into southern hemisphere.

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Tawny Coster *Acraea terpsicore* - a new species for Borneo?

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Introduction

Borneo is 830 miles long and 600 miles wide, and is divided politically into Sabah and Sarawak, which belong to the Federation of Malaysia; Brunei, a tiny independent Sultanate; and the largest proportion, Kalimantan, which is part of Indonesia (MacKinnon, 1975). As part of the Sundaland biodiversity hotspot, Borneo is home to some of the most complex and diverse forest ecosystems on Earth (Myers et al., 2000; Sodhi et al., 2004). For both Flora and Fauna, Borneo shows much closer relationships to the Asian mainland and other Sunda islands (ancient Sundaland), than to its eastern neighbour Sulawesi, although separated only by the Makassar straits c.200 km at their widest point (MacKinnon et al., 1996).

Tawny Coster *Acraea terpsicore*, or formerly known as *A. violae*, ranges from Sri Lanka and India to Vietnam, and has spread into Thailand and more recently into Peninsular Malaysia and Singapore (Kirton, 2014). It was anticipated that Tawny Coster would likely disperse further southwards from Malaysia, although its rate of colonisation could not be accurately determined due to the lack of detailed records (Tung, 2002). Currently, its known record extend to the southern part of Sumatra, as well as Java, Flores, Sumba, Timor and northern Australia (Braby et al., 2014).

Borneo has large number of butterfly species of which approximately 10% are endemic, 70% are found in former parts of Sundaland, while 20% are also found in the Philippines, Sulawesi and rest of the world (Otsuka, 2001). Although butterflies in Borneo are well studied (eg. Abang, 2006; Chung, 2013; Harmonis, 2008; Houlihan et al., 2012; Houlihan et al., 2013; Jalil et al., 2008), there have been no records of Tawny Coster here. This paper describes our observations of Tawny Coster in Borneo, adding a new species of butterfly to Borneo's already extensive list of butterfly species.

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Methods

An incidental biodiversity survey was conducted in Indonesian Borneo, located in Ketapang and Kapuas Hulu district of West Kalimantan, and Kutai Timur (East Kalimantan). Visits to Ketapang and Kapuas Hulu district were undertaken during 21st April to 2nd May, 2015, and to Kutai Timur on 11th June, 2015. During the surveys, we observed several individuals of Tawny Coster (Fig. 1). The habitats consisted primarily of rubber agroforest estates, oil palm plantations and degraded secondary forest.

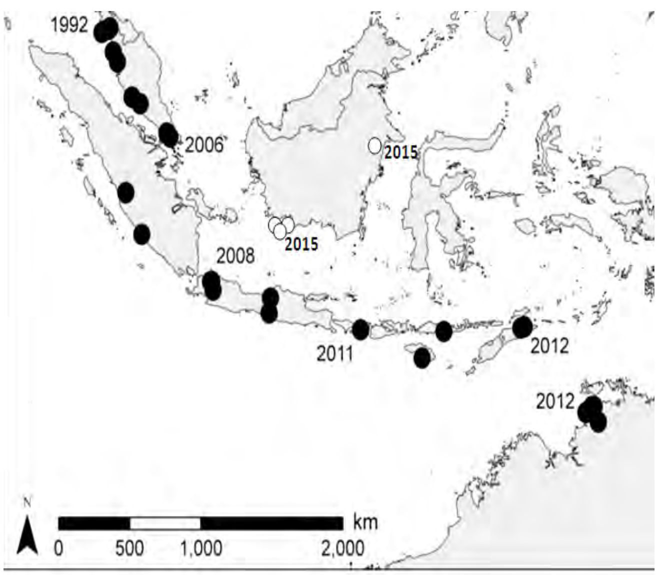

Figure 1. Distribution of Tawny Coster in South-East Asia and north-western Australia. Black circles show previous records until 2014; open circles show new records from this study in Borneo.

Table 1. Details of Tawny Coster recorded during visit on 21st April - 2nd May, 2015 and 11th June, 2015, in Kalimantan, Indonesian Borneo.

Date	Individuals	Name of site	Habitat	Coordinates
22 April	6	Sebah river	Newly clearing area for rubber, bordering with rubber agroforest	02°16'35.9"S; 110°52'07.6"E
24 April	8	Jelamu hill	Palm oil c. 5 Years old	02°01'45.3"S; 110°47'43.0"E
26 April	1	Sengkuang village	Garden	02°20'54.1"S; 110°46'49.0"E
28 April	3	Perigi village	Palm oil c. 5 Years old	02°21'02.7"S; 110°2'33.2"E
11 June	1	Bukit Pelangi	Park	0° 30' 54.5'' N 117°36'28.0''E

Figure 2. A male Tawny Coster (left) recorded in Perigi village, Kapuas Hulu district, West Kalimantan on 22nd April 2015 (©Muhammad Iqbal). A Tawny Coster on 11th June, 2015, in Bukit Pelangi, Sangatta, East Kalimantan (©Haryadi).

Results and discussion

On 21st April 2nd May, 2015, two biodiversity surveys were conducted separately in West and East Kalimantan. During the surveys, we encountered several butterflies that we subsequently identified as Tawny Coster, *Acraea terpsicore*. The species is relatively easy to identify by its black head and spotted white thorax, long fore-wings with rounded tips, round hind-wings and both fore and hind-wings are orange above with narrow black outer borders and black wing spots. The hind-wings have a broad border with white markings enclosed in it, and there are black spots on both wings (Kirton, 2014; Lewis, 1973; Ventakaraman, 2010). These characters correspond with butterfly collected in West and East Kalimantan provinces during our survey period (Fig. 2). Details of date, number of individuals, sites, habitats and coordinates of Tawy Coster from Kalimantan are presented in Table 1.

Our records suggest that the Tawny Coster may have recently spread to and established itself in Kalimantan. Braby et al. (2014) undertook a comprehensive review of the distribution range of Tawny Coster in South-East Asia and northern Australia. This review does not provide information about the Tawny Coster in Borneo. To date, our records of Tawny Coster in Kalimantan is the only known information for this species in Borneo.

It is not clear how Tawny Coster became established in South-East Asia, but there may be some explanations to this: (i) the species was accidentally and recently introduced to Indochina from India or Sri Lanka, (ii) the species naturally expanded its range out of India and colonised Thailand via Myanmar, and (iii) the species always existed in the region (e.g. Thailand and Vietnam), but has since become more abundant and widespread as a result of the ongoing modification of the habitat for agriculture. The species favours cultivated regions and degraded forests, where the larval food

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plants grow (Braby et al. 2014; Ventakaraman, 2010). In the last decade, many forested areas in Borneo have been converted to oil-palm or Acacia plantations (Koh, 2008), resulting in the creation of extensive open habitat and short grass, which provides suitable habitat for Tawny Coster.

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Contents

9 772338 865002

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