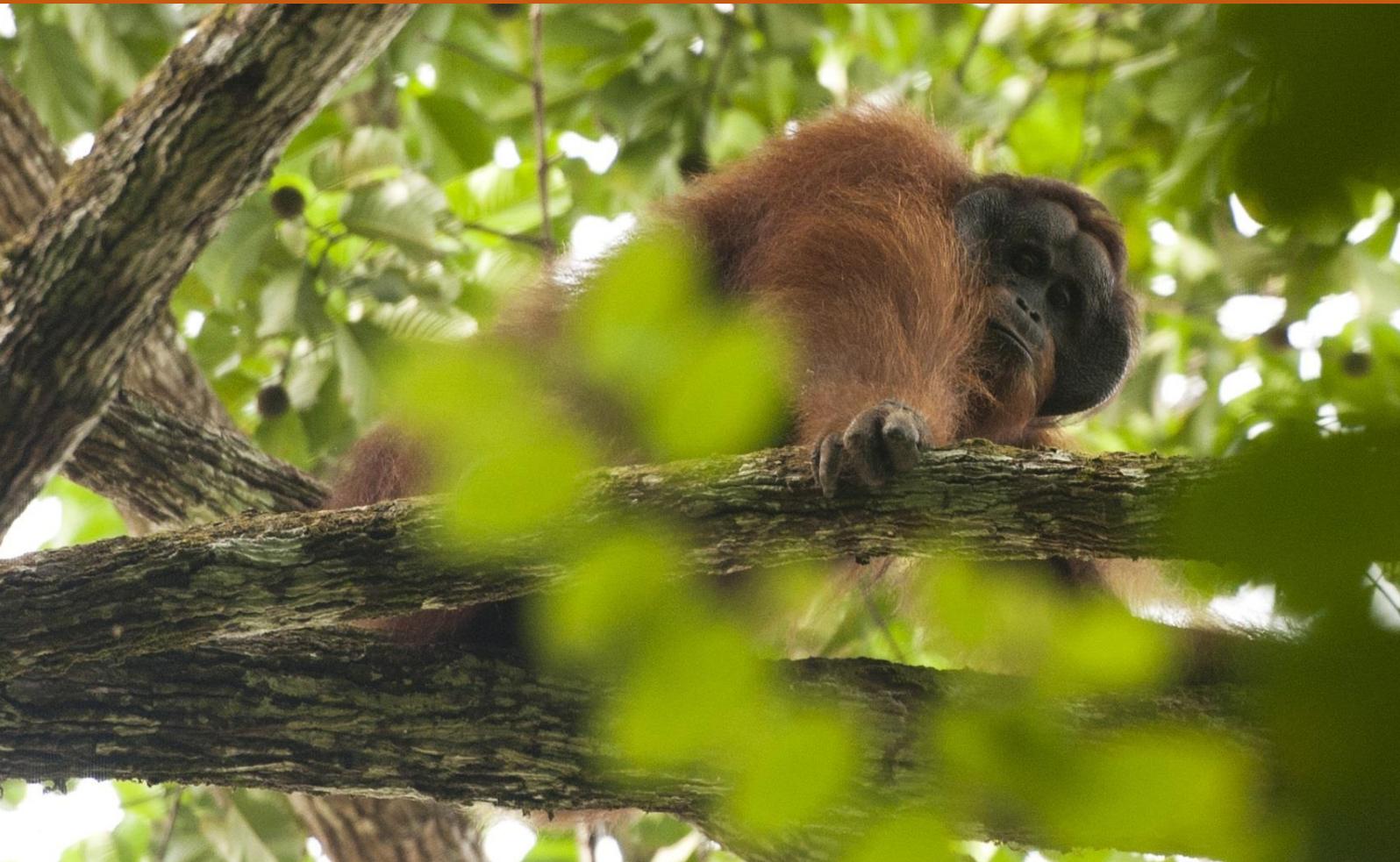


Assessing and Addressing the Impact of Large-scale Land Acquisitions on Ape Conservation: Borneo Case Study

Nicola K. Abram

Contributors: Sophia Kiyoko Nakano, Susan Lusiana and Jamie Faselt



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Cover: Flanged male orangutan in the forest canopy of the Lower Kinabatangan Wildlife Sanctuary. Cover and all other photos in this report are credited to Hutan/Kinabatangan Orangutan Conservation Programme (KOCP).

ABOUT THIS REPORT

This report is part of the International Institute for Environment & Development (IIED) project on *Assessing and addressing the impact of large-scale land acquisitions on ape conservation*, funded by the Arcus Foundation. This project has two case studies from the Cameroon in Africa and the island of Borneo in South-east Asia. According to the terms of reference, the objectives of the two case studies were to:

- Build an evidence base on the geographic overlap between areas currently targeted for agribusiness investments and areas of importance for ape conservation;
- Identify the scale, trends and drivers of agribusiness investments;
- Identify the impact that agribusiness investments are having on ape conservation and build in-country engagement and awareness on this issue;
- Assess opportunities and constraints in legal frameworks and political economy; and,
- Identify key issues generated by the interface between agribusiness investments and ape conservation in order to highlight lessons learned and help the Arcus Foundation develop a global strategy on ape conservation in the context of large-scale land acquisitions.

The Borneo case study was undertaken by Ridge to Reef, Living Landscape Alliance, Borneo Futures, Hutan, and the grant administered by Land Empowerment Animals People (LEAP). As part of the case study four reports were developed. These included:

1. An analysis of the geographical overlap between Bornean orangutan habitat and areas demarcated for large-scale oil palm developments, as well as the extent to which orangutan habitat lies within existing protected areas in Kalimantan, Sarawak and Sabah (Abram *et al.*, 2017);
2. An analysis of how legal frameworks and political economies interact with the oil palm industry and orangutan conservation in Malaysian and Indonesian Borneo (Jonas, 2017);
3. A fine-scale analysis of these issues in the Lower Kinabatangan region in eastern Sabah (Abram & Ancrenaz, 2017), which is globally renowned for its orangutan population, but has undergone significant forest loss to small- and large-scale oil palm plantations.
4. A synthesises report that draws on key findings from the three reports and provides targeted recommendations for synergising oil palm development and orangutan conservation (Jonas *et al.* 2017).

The production of the reports listed from 1 to 3 above, although were for IIED and funded by the Arcus Foundation, the contents do not necessarily reflect the views of either IIED or the Arcus Foundation, and responsibility for the information and views expressed therein lies entirely with the authors.

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REPORT WRITTEN BY:

Dr. Nicola K. Abram

NICOLA KAREN ABRAM (PHD) is an interdisciplinary conservation scientist from the UK based in Sabah, Malaysian Borneo. Nicola has been conducting research in Borneo since 2010. She specialises in interdisciplinary spatial planning that aims to better understand synergies that promote biodiversity conservation and sustainable development agendas, as well as human-environment linkages in multi-use landscapes; and has a significant portfolio of peer-review publications and reports on these subjects. Nicola is a Technical Coordinator for spatial planning for the organisation *Forever Sabah*, and she is also the founder and a co-director of the UK not-for-profit *Living Landscape Alliance*; as well as a collaborating scientist to *Borneo Futures*.

livinglandscapealliance.org
nicola_abram@hotmail.com

CONTRIBUTORS:

SOPHIA KIYOKO NAKANO is an independent consultant from the USA with a Bachelor's in liberal arts and a major in International Studies. Sophia has lived in Ecuador, and also in Sabah Borneo for the last couple of years. Sophia came to Sabah to initially teach, but has also volunteered on social/environmental projects in Sabah under *Forever Sabah*.

SUSAN LUSIANA is an independent research consultant from Indonesia. Susan works for *People Fish and Forest Indonesia* as programme manager of the North Kalimantan Mangrove rehabilitation project. Previously she worked with *Wetlands International Indonesia* on their Responsible Shrimp Culture Improvement Program in East and North Kalimantan; and has been involved in school programmes on sustainable agriculture for other Indonesia-based organisations. She has more than nine years' experience in sustainable agriculture and aquaculture, and community development issues in Indonesia.

JAMIE FASELT has a Bachelor of Science in biology from Ursinus College, USA. At the time of writing, Jamie was a recipient of a 2015-2016 Thomas J. Watson Fellowship supporting – among other activities – her travel and work on social and environmental projects. As a part of her Fellowship, Jamie spent three months in Borneo exploring the intersection of local communities, biodiversity conservation and oil palm development.

ACRONYMS AND ABBREVIATIONS

ACOP	Annual Communications of Progress
EIA	Environmental Impact Assessment
GIS	Geographical Information System
HCV	High Conservation Values
HGU	Hak Guna Usaha
ISPO	Indonesian Sustainable Palm Oil
LCDA	Land Custody and Development Authority
NGO	Non Governmental Organisations
MaxEnt	Maximum Entropy Modelling
RSPO	Roundtable for Sustainable Palm Oil
SIA	Social Impact Assessment
SALCRA	Sarawak Land Consolidation and Rehabilitation Authority
WWF	World Wildlife Fund

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EXECUTIVE SUMMARY

Indonesia and Malaysia are currently the only two countries with wild orangutan populations. These two countries are also the world's two leading palm oil producers, and oil palm plantations have often displaced orangutan habitat in Borneo and Sumatra. While revenue from oil palm can provide economic benefits at national and local levels, the oil palm sector has been underpinned by poor land allocation procedures and corruption, which has had a negative impact on species such as orangutan and biodiversity more generally. Indonesia has more than 8.4 million hectares of oil palm, and aspires to a potential 18 million hectares; whereas Malaysia has more than five million hectares (as of 2012) with a target of 6.6 million hectares by 2020.

Despite the orangutan being fully protected under Indonesian and Malaysian law, no law prevents the destruction or degradation of orangutan habitat in either country. Unless both nations implement progressive solutions to improve land use allocation for oil palm, curb forest conversion and protect habitats, the viability of this critically-endangered species will be tenuous at best. Species Actions Plans adopted by Indonesia and the state of Sabah (in the Malaysian portion of Borneo) aimed to have stabilised orangutan populations by 2017 and 2015, respectively. However, it will require greater political will to strengthen legislation to effectively protect orangutan habitat and give them a more viable future.

This report is a part of a wider study: *Assessing and Addressing the Impact of Large-scale Land Acquisitions on Ape Conservation in Borneo*. Specifically, this report provides a summary of the geographical overlap between Bornean orangutan habitat and areas demarcated for large-scale oil palm developments, as well as the extent to which orangutan habitat and known populations lie within existing protected areas in Kalimantan (the Indonesian portion of Borneo) and Sarawak and Sabah (which belong to Malaysia).

In the 1960s and 1970s, the Bornean orangutan population was estimated to be around 156,000 individuals. More recent population estimates are in the range of 45,000-69,000 individuals – across all sub-species – implying a population loss of 56-71 per cent over the past few decades. For this study, we used orangutan distribution data based on 2010 estimates. In total, predicted orangutan distribution extended across 16.3 million hectares (22 per cent of Borneo's land mass); located mainly in Kalimantan (78 per cent of orangutan habitat), with a further 17 per cent in Sabah, and a remaining five per cent in Sarawak. Only 25 per cent of orangutan habitat fell within protected areas – grossly inadequate for the long-term survival of this species. Sabah had proportionally the greatest amount of its orangutan habitat protected (37 per cent), followed by Sarawak (29 per cent), then Kalimantan (22 per cent). The remaining orangutan distribution in Borneo was found within known oil palm concessions (18 per cent), which is likely a gross underestimate; with the rest (57 per cent) occurring in industrial tree plantation concessions, timber concessions, and other land use types.

According to land use and land cover data for 2010, Borneo had a total area of 6,518,207 ha of planted oil palm. Much of this would likely have once been orangutan habitat. We overlaid the 2010 orangutan distribution with oil palm concession data to calculate that a total of 3,012,683 ha (18 per cent) of remaining orangutan habitat occurs in known

industrial oil palm concessions. Breaking this distribution down by region, we found that nearly a quarter (23 per cent) of Kalimantan's known orangutan habitat was located within oil palm concessions. This subset was distributed between Central Kalimantan (48 per cent), West Kalimantan (37 per cent) and East Kalimantan (15 per cent). For Malaysian Borneo, we found that Sarawak had 47,253 ha (six per cent) of its orangutan distribution in industrial oil palm estates, with only 19,474 ha (one per cent) for Sabah. However, these are likely to be gross underestimates since estate boundary information was out of date for all regions, and especially in Sabah, where there is a marked dearth of land title information.

The lack of publicly available information on the distribution of oil palm estates further complicates the task of developing strategies for reconciling the inherent tensions between orangutan conservation and oil palm development. Of the concessions that were researched for the inventory in Kalimantan ($n=32$), all had orangutan habitat and 56 per cent of these had significant extents of habitat (at least 75 per cent of the estate). Many of these concessions had other forms of High Conservation Values (HCV), including peatland, watersheds and customary land as well as primary, secondary and protected forest. For Sarawak, all 15 oil palm estates we examined had orangutan habitat within their boundaries, mostly ranging from 1-25 per cent of the land title. For Sabah however, of the 119 land titles we researched, only 55 of these had known orangutan habitat as methods for collecting estate level information differed from that of Kalimantan and Sarawak. Most of the inventory estates in Sabah were members of the Roundtable for Sustainable Palm Oil (RSPO) and therefore tended to have greater numbers of Impact Assessments available (Environmental Impact Assessments, Social Impact Assessments and HCV assessments). We also assessed the impact of the 2015 Indonesian fires. We found that there were 2,886 fire events in areas with known orangutan distribution on Borneo, often associated with the establishment of new oil palm plantations, threatening at least one third of the remaining wild orangutan population.

Sabah had some of the oldest known estates (some dating to before 1989), with Kalimantan having some of the newest, with most of the concessions we inventoried granted from 2000-2009. In terms of the balance of ownership, Kalimantan had fairly equal portions of 100% domestically owned and <50% domestically owned estates, yet many titles did not provide this kind of breakdown. In Sabah and Sarawak, most titles were >50% domestically owned. Typically though, there was a general lack of publicly available information on concessions. This lack of transparency did not merely make our research more difficult: it poses an important wider challenge to conservation efforts that regulatory bodies should address.

Clearly, many different aspects of oil palm development will need to be integrated in order to inform effective orangutan conservation and land use planning for this crop. The Bornean orangutan is under threat and the governments of Indonesia and Malaysia, as well as the oil palm industry, need to urgently adopt joint, progressive measures to give this species a realistic chance of long-term survival.



1 GENERAL INTRODUCTION

Indonesia and Malaysia are the only two countries with wild orangutan populations, an arboreal lowland forest-dwelling great ape found on the islands of Borneo (*Pongo pygmaeus*) and Sumatra (*Pongo abelii*) (Wich *et al.*, 2008; Wich *et al.*, 2012). Both Indonesia and Malaysia have lost significant lowland forest, largely due to oil palm (*Elaeis guineensis*) expansion. For example, 55-59 per cent of Malaysia's primary/secondary forest was converted to oil palm from 1990-2005 (Koh & Wilcove, 2009). In fact, these nations are currently the two leading palm oil producing countries globally, collectively contributing 78 per cent of the world's planted oil palm (FAO, 2012). The expansion of this crop is driven by high net revenues that have provided significant economic benefits at national and local levels in Indonesia and Malaysia, and increasingly elsewhere (Rist *et al.*, 2010; Sayer *et al.*, 2012).

Oil palm plantations have had a significant impact on orangutan habitats, which typically include tropical lowland and peatland rainforests below 500 metres above sea level (Wich *et al.*, 2012). Such areas are prime locations for oil palm due to their biophysical suitability for supporting high yields and therefore higher economic returns (Abram *et al.*, 2014). The conversion of lowland forest is almost certain to continue since both countries are relying on oil palm expansion to achieve national economic targets. Indonesia is the world's leading palm oil producing country, with more than 8.4 million ha planted (Indonesian Ministry of Agriculture, 2011) out of a total 18 million ha identified as suitable for this crop (Jakarta Post, 2009). Malaysia is the second largest producer with more than five million hectares of oil palm (MPOB, 2012), which could potentially rise to 6.6 million ha under national targets set out in the country's Economic Transformation Programme (Permandu, 2010). Although the arbitrary killing of orangutans is prohibited under Indonesian and Malaysian law, there are currently no laws that prevent the destruction and/or degradation of orangutan habitat in either country. Unless adequate solutions are implemented to protect orangutan habitat through better land use allocation, the prospects for the orangutan's long-term viability will be tenuous at best.

This study assesses the impact of large-scale land acquisitions on great ape conservation by identifying the overlap between ape habitat and areas demarcated for large-scale agri-business developments; as well as the extent of ape habitat within existing protected areas. We specifically consider the interplay between Bornean orangutan habitat (the only great ape on the island of Borneo) and large-scale land acquisitions for oil palm development. Although other industries such as logging and paper and pulp have contributed towards habitat loss, we focus on oil palm since this crop is regarded as a major threat to orangutan conservation and biodiversity in general in Borneo; and its impact on forest conservation is of growing concern elsewhere in the global tropics (Sodhi *et al.*, 2004; Koh & Wilcove, 2008). Furthermore, although there are significant areas under smallholdings and small-to-medium sized plantations, we focus on large-scale oil palm plantations (typically over 1,000 ha) in order to inform the growing conversation centred on the relationship between large-scale land deals and great ape conservation.

1.1 Other reports in this study

Additional reports in the study on *Assessing and Addressing the Impact of Large-scale Land Acquisitions on Ape Conservation in Borneo*, include: (1) an analysis of legal frameworks and political economies that interrelate with the oil palm industry and orangutan conservation (Jonas, 2017); (2) and a through-the-lens fine-scale case study of these issues in the Lower Kinabatangan region in eastern Sabah (Abram and Ancrenaz, 2017); and, (3) a synthesis of these four reports (Jonas *et al.*, 2017).



2 METHODOLOGY

2.1 Estimating orangutan populations in Borneo

To obtain population estimates for the Bornean orangutan, we consulted scientific peer-reviewed papers and grey literature. We then assessed and tabulated orangutan population numbers in order to derive recent, and where possible historic, estimates for Borneo at the island and sub-regional levels; as well as within protected areas.

2.2 Orangutan distribution in Borneo

At the time of writing, two studies – one by the University of Liverpool (UK) and the other by the University of Queensland (Australia) – were undertaking modelling that will yield more precise estimates of the distribution and population of the Bornean orangutan. However, since their findings were not yet available we based our analysis on previous studies.

For Sarawak and Kalimantan, we used the geographic distribution of the Bornean orangutan, as developed by Wich *et al.* (2012). This orangutan distribution layer was based on orangutan occurrence data from extensive surveys carried out from 1990-2011 that were integrated with a set of environmental variables (including various bioclimatic and topographic metrics, road density, carbon stock and land use and land cover data for 2010), using Maximum Entropy Modelling (MaxEnt), and a species-level workshop for post-model processing (see Wich *et al.* 2012 for details).

For Sabah, however, we used a distribution layer developed by author Nicola K. Abram for the subspecies *Pongo pygmaeus morio* (Abram *et al.* unpublished). This distribution layer was developed similarly using a MaxEnt approach, with more comprehensive and recent occurrence records (from 2000-2011) than that of Wich *et al.* (2012). These occurrence data were filtered to a minimum distance of one kilometre between each point to match the resolution of the spatial environmental data, and a bias grid was developed and included within the modelling procedure to minimise inherent sampling errors that can bias model outputs (for methods see, Phillips *et al.*, 2009). The environmental variables used included: elevation, and three least correlated climate variables (precipitation seasonality, precipitation of driest quarter and temperature annual range, from <http://worldclim.org/bioclim>), 2010 carbon stock (Baccini *et al.*, 2012), forest intactness and land cover data for 2010 (Gaveau *et al.*, 2014), population density for 2007 (Bright *et al.*, 2008), Euclidian distance to rivers, soil type and the degree of ruggedness (from '1' being flat to '7' being very rugged); and restricted initially to 2010 forest extent (Gaveau *et al.*, 2014). Within MaxEnt the 'auto features' default option was used to allow MaxEnt to prescribe the best feature options for the model, using the jackknife function, and logistic output algorithm to assign probabilities of occurrence in each cell in the model output, of which the minimum point threshold was used to determine suitable versus unsuitable habitat (for details see, Elith *et al.*, 2011). Post-model processing of the spatial output was undertaken by comparing it with the extensive known occurrence points, largely through helicopter surveys (Ancrenaz *et al.*, 2005).

2.3 Orangutan habitat in protected areas

Types of protected areas in Borneo include: national parks, nature reserves, wildlife sanctuaries and game reserves, recreational parks, virgin jungle reserves, and protection forests. To quantify the extent and location of protected orangutan habitat we compiled information on protected areas across Borneo. Protected area data for Kalimantan and Sarawak were derived from Wich *et al.* (2012). For these data, the protected area boundaries in the four Kalimantan provinces were derived from: (1) provincial spatial plans (*Rencana Tata Ruang Wilayah Propinsi*); (2) national spatial plans (*Paduserasi*) at a scale of 1:250,000; and/or (3) National Park offices at 1:50,000 scale wherever such local boundary delineation was available (Gunung Palung and Danau Sentarum National Parks). For Sarawak (and Brunei) protected area boundaries were obtained from the World Database of Protected Areas (UNEP-WCMC, 2010). For Sabah, digital protected area boundaries and protected area types were obtained from Sabah's Forestry Department, at a scale of 1:250,000, dated to July 2013. These included all protected forest under Sabah Forestry Department jurisdiction, as well as under Sabah Parks, and Sabah Wildlife Department.

2.4 Agri-buisness concessions in orangutan habitat

2.4.1 Large-scale concession inventories with orangutan habitat

Typically land use allocation for agriculture is a sensitive and sometimes controversial subject in both Malaysia and Indonesia, especially if it means forest conversion to land use types such as oil palm; or if it may mean land disputes between local communities and concession holders. As a result, no official government data on land titles/concessions were publicly available for Malaysian Borneo at the time of this report. This meant that up-to-date concession/land title data was unavailable, so we used the best available data.

For Kalimantan and Sarawak, we used data compiled from Wich *et al.* (2012). In brief, for Kalimantan, maps of oil palm concession boundaries were obtained from various provincial governments at a scale of 1:250,000. For South and East Kalimantan provinces, these maps corresponded to 2005; and for Central and West Kalimantan the maps corresponded to 2007 and 2008, respectively. For Sarawak, land title maps of oil palm concessions were obtained from AidEnvironment and the Sarawak Dayak Iban Association; and compiled from a range of different sources across different years, but largely for 2010; see Wich *et al.* (2012) for more details. All maps were georeferenced in ArcGIS and each unique concession area was digitised and its estate/company name included when known. The absence of official up-to-date government maps for Sarawak meant that it was impossible to judge the accuracy of the concession data.

For Kalimantan and Sarawak, we overlaid orangutan distribution with oil palm concession data – within a GIS – and extracted those titles that had orangutan habitat. For Sarawak, we researched an almost comprehensive list of concessions with orangutan habitat ($n=15$) since there were relatively few significant examples due to the limited orangutan distribution in the state. For Kalimantan, a number of concessions in Kapuas Hulu in West Kalimantan near the Sarawak boarder were selected since this is an important region for trans-boundary

orangutan populations. The remaining concessions in Kalimantan (totalling 32) were then selected based on the size of the orangutan habitat within their boundaries.

For Sabah, the procedure for identifying concessions (referred to as 'land titles' in Malaysia) differed. Digitised land title information was available for the Kinabatangan region (eastern Sabah) from two sources: (1) from WWF-Germany which had land titles digitised with names of estates and title holder company names/contact details, but these were restricted to areas adjacent to the river in that region; and, (2) from a previous study in eastern Sabah that had digitised land titles but did not include estate/company names (Abram *et al.*, 2014). As a result, the method for the inventory procedure differed for Sabah (discussed below). We extended the available land title data by purchasing all available cadastral maps (at a scale of 1:250,000). In total 53 cadastral maps were acquired, covering approximately 50-60 per cent of Sabah in the eastern, central and northern regions. These maps were geo-referenced in ArcGIS and all identifiable commercial titles (otherwise known as Country Lease titles) were digitised regardless of their size (as typically land titles are smaller in Sabah than in Kalimantan and Sarawak). Within the cadastral maps, however, many demarcated land titles had no associated numbers, meaning title types could not be identified.

2.4.2 Inventory procedures

The procedure for selecting oil palm estates for the inventory was different for Sabah due in part to the lack of known estate names/company details, but also due to the fact that our inventory work ran in parallel to the digitising of the cadastral maps. Initially, we overlaid orangutan distributions with existing title data from WWF-Germany and then focused on investigated those land titles with orangutan habitat. We were later able to incorporate additional titles that we found through Google searches for oil palm producer companies in Sabah. Companies that we found that could be located on a map were geo-referenced in the GIS. We still included the remaining companies we had found in the inventory despite the fact that we did not know their location. We also identified a subset of companies for which we neither knew the estates for which they held licenses, nor whether these had orangutan habitats. Nevertheless, we included all the estate data we could find for two reasons: (1) This inventory information can be built on in the future; (2) Most oil palm plantations in Sabah are within or adjacent to orangutan habitat, or within historically known orangutan distribution areas, and therefore may constitute important areas for existing/future wildlife corridors.

The specific information we compiled for this study can be seen in the associated inventory Excel spreadsheets. They include information on: estate size, date and location of land acquisition; investor details (name, country of origin, public or private and so on); stage of agricultural investment (timeline); proposed agricultural activity; land ownership; and investment amount. To find such information, we searched Google for company annual reports and any other relevant documents. For Sabah and Sarawak, we found multiple subsidiaries of companies and have included this information in the table. Where we could find neither parent companies' annual reports, nor official records from investors and government authorities, we supplemented our findings with information from articles by the media, NGOs and on popular blogs. In addition, we consulted specific websites to search

for relevant data or reports where appropriate, including for example: the Roundtable on Sustainable Palm Oil (RSPO) Annual Communications of Progress (ACOPs) for companies belonging to the RSPO (<http://www.rspo.org/members/acop>); Wilmar dashboard (Wilmar is a large oil palm actor in Sabah) (<http://www.wilmar-international.com/sustainability/dashboard/>); and online Library (<http://e-resources.perpusnas.go.id/>). In Kalimantan, we contacted various institutions to try to obtain information. These included: Land agencies (National, Kapuas Hulu, Central Kalimantan, East Kalimantan to access *Hak Guna Usaha* (HGU) or land business/exploitation information); TuKan NGO experienced with oil palm companies in West Kalimantan; Sawit Watch, Walhi, two other NGOs; BKPM, an Indonesian Investment Coordinating Board; a plantation agency in Central Kalimantan (to access information on listed companies); and the ministry of environment and forestry (for accessing Environmental Impact Assessment information). It was generally difficult to obtain official, transparent documentation concerning estates and companies, which meant there were many gaps in our data.

2.4.3 Forest fires in orangutan ranges

Indonesia's National Space and Aviation Agency (Lapan) estimates that more than two million hectares of forest have been destroyed in Indonesia; including 806,817 ha burnt in Kalimantan (Meijaard, 2015a). To identify fires in orangutan distributions, either in protected areas or oil palm estates, we extracted fire occurrence data for Borneo from the Global Forest Watch "[Southeast Asia NOAA-18 active fires](#)" dataset. This showed the locations of fire hotspots using imagery provided by the NOAA-18 satellite at around a one kilometre pixel resolution. We overlaid these fire event data with our orangutan 2010 distribution and land use information to assess the potential impact of the fires on orangutan habitat.



3 ORANGUTAN DISTRIBUTION AND POPULATION ESTIMATES IN BORNEO

Borneo has suffered a great deal of forest loss, particularly in lowland regions, over the past few decades, which has taken a heavy toll on orangutan distributions. It is estimated that in 1973, 76 per cent (558,060 km²) of Borneo's land surface was under intact forest (Gaveau *et al.*, 2014) (Figure 1A). From 1973-2010, forests had declined by a further 30 per cent (168,493 km²) largely due to industrial oil palm and timber plantation establishments (Figure 1B and Figure 2), and logged forests were found extensively throughout the island (Figure 1C and D); with much intact forest being restricted to the central highlands (Figure 1D). These significant changes in land use and land cover have affected orangutan populations (Figure 2). In the 1960s and 1970s, the Bornean orangutan was estimated to number around 156,000 (Wich *et al.*, 2008). More recent population estimates from Wich *et al.* (2008) are in the region of 45,000-69,000 individuals – across all sub-species – implying a 56-71 percent loss in population over the past few decades (Table 1).

Table 1: Orangutan population estimates and distribution estimates within protected areas (PAs), known oil palm estates, and other land use types, within the differing regions and the island as a whole.

	Species/sub-species	Orangutan population estimate	Estimate year	Orangutan distribution in 2010 (ha)	Orangutan distribution in PAs (ha)	Orangutan distribution in known oil palm estates (ha)	Orangutan distribution outside of oil palm estates and PAs (ha)
Sabah	<i>P. p. morio</i>	10,000* (11,000**, 25,000~)	2011(2005; 1987)	2,772,939	1,023,681 (37%)	19,474 (1%)	1,729,784 (62%)
Sarawak	<i>P. p. pygmaeus</i>	1,143-1,761^	2002	763,538	217,847 (29%)	47,253 (6%)	498,438 (65%)
Kalimantan	<i>P. p. pygmaeus</i> / <i>P. p. wurmbi</i> / <i>P.p.morio</i>	38,330- 40,000®	2013	12,804,830	2,793,663 (22%)	2,948,329 (23%)	7,062,838 (55%)
Borneo	-	45,000- 69,000^ (156,000^)	2008 (1960/ 1970)	16,341,307	4,035,191 (25%)	3,015,056 (18%)	9,291,060 (57%)

*Ancrenaz *et al.* 2010

**Ancrenaz *et al.* 2005

~Payne 1987

^Wich *et al.* 2008

®Singleton *et al.* 2004

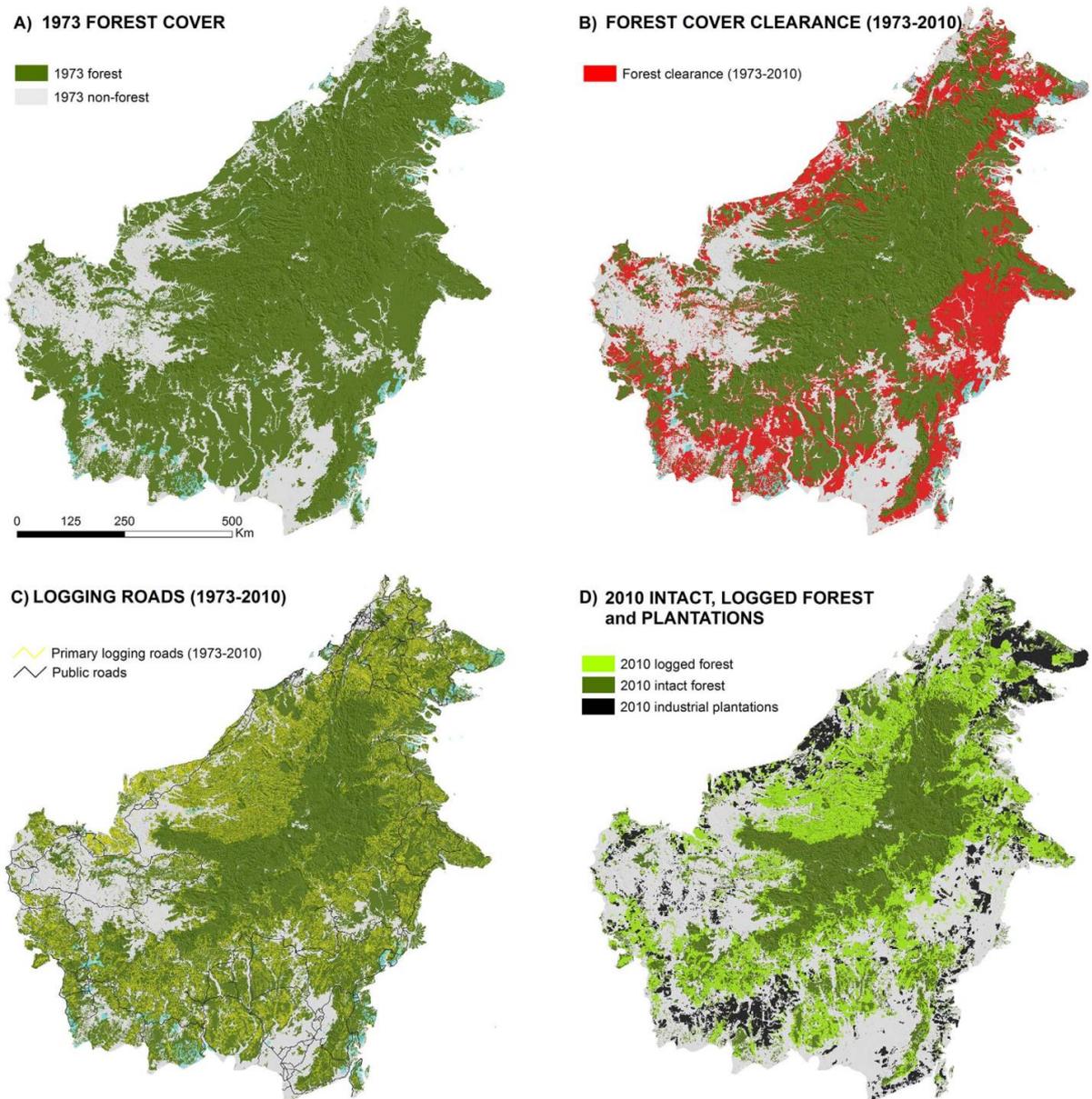


Figure 1: Four decades of forest persistence, clearance and logging on Borneo. (A) forest (dark green) and non-forest (grey) in year 1973, and residual clouds (cyan); (B) Areas of forest loss during 1973–2010 (red); (C) Primary logging roads from 1973–2010 (yellow lines); and, (D) Remaining intact forest (dark green), remaining logged forest (light green), and industrial oil palm and timber plantations (Black) in year 2010. Figure extracted from Gaveau *et al.* 2014.

In 2010, the total predicted orangutan distribution extended across 22 per cent of Borneo's land mass (16.3 million ha). This was located mainly in Kalimantan (78 per cent), with 17 per cent in Sabah, and five per cent in Sarawak (Table 1; Figure 2B). The orangutan distribution from 2010 shows that only 25 per cent of orangutan habitat lies within protected forest – which is grossly inadequate for the long-term survival of this species. The remaining orangutan distribution was found within known oil palm concessions (18 per cent), which is likely to be a gross underestimate; with the rest (57 per cent) occurring in industrial tree plantation concessions, timber concessions, and other land use types (Table 1).

Within Kalimantan, all three sub-species occur (Figure 2B) (*P.p.pygmaeus*, *P.p.wurmbii* and *P.p.morio*) within an estimated distribution of 12.8 million ha according to the 2010 data (Table 1). Population estimates for orangutan (all sub-species) in Kalimantan range from 38,330 to 40,000 (Singleton *et al.*, 2004). Within Malaysian Borneo, the sub-species *P.p.morio* occurs in Sabah, and *P.p.pygmaeus* in Sarawak (Figure 2B). Although Sabah is the stronghold of *P.p.morio*, numbers have dwindled from around 25,000 in 1987 (Payne, 1987) to 10,000 in 2011 (Ancrenaz *et al.*, 2010).

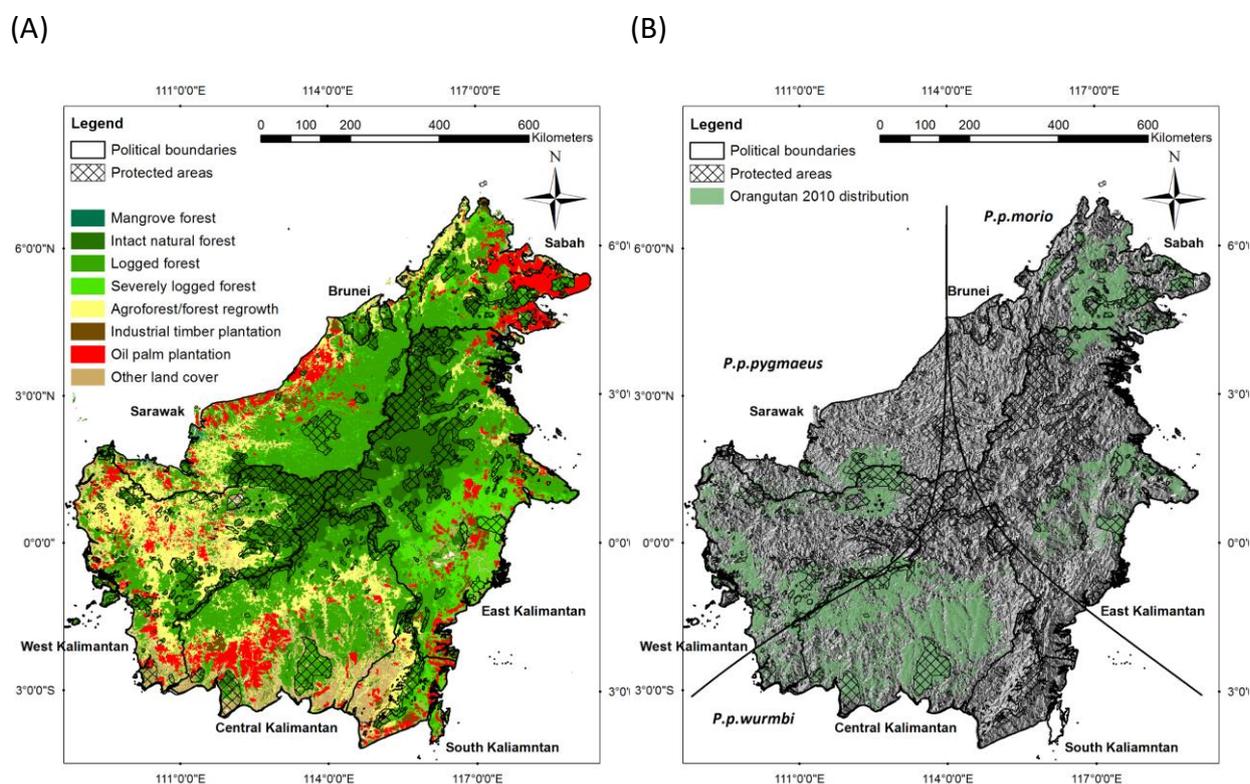


Figure 2: Land use and land cover for 2010 throughout Borneo, overlaid with the protected area network and political boundaries for: Brunei, the Malaysian States of Sabah and Sarawak and East Kalimantan, South Kalimantan, South Kalimantan and West Kalimantan in Indonesia (A) (data from Gaveau *et al.* 2014); and, Bornean orangutan 2010 distribution (green) dissected into the three sub-species *P. p. pygmaeus*; *P. p. morio*; *P. p. wurmbii* (black lines) in the four provinces of Kalimantan (West, Central, South and East), Sabah and Sarawak (B) (orangutan data for Kalimantan and Sarawak from Wich *et al.* 2012).

4 INVENTORY OF PROTECTED AREAS IN THE ORANGUTAN RANGE

No studies have quantified the efficacy of protected areas for orangutan conservation in comparison to other land use types. Nevertheless, there is a general consensus that because protected areas prohibit activities such as deforestation, logging, and hunting, these areas provide strongholds for orangutan (Wich *et al.*, 2012). In addition, protected areas are less prone to being de-gazetted than other land-uses (such as logging concessions) and may therefore provide a more stable long-term habitat.

We estimated that 25 per cent of orangutan distribution was within protected areas in Borneo according to the 2010 data (Table 1; Figure 3). Of this, Sabah had proportionally the greatest amount of protected orangutan habitat (37 per cent); Sarawak had 29 per cent, and Kalimantan 22 per cent (Table 1).

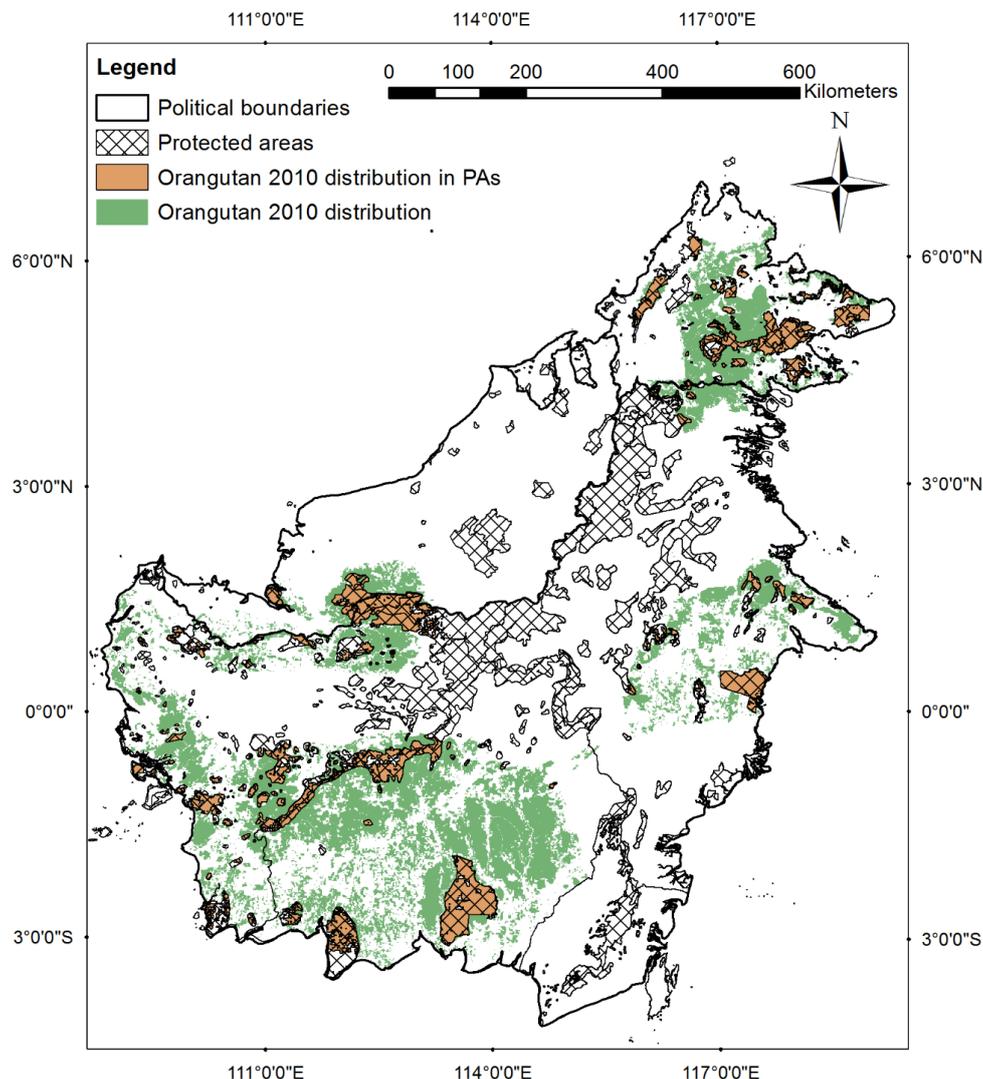


Figure 3: Orangutan distribution on Borneo in 2010 outside of protected areas (green) and within protected area boundaries (orange).

4.1 Orangutan distribution in Sabah

Of the 2,772,939 ha of predicted orangutan habitat in Sabah, 37 per cent (1,023,681 ha) was located within the 2013 protected area network (Figure 4). Sabah has a number of protected area types under differing State jurisdictions, such as Class I, VI, VII under Sabah Forestry Department; Parks, under Sabah Parks, and Wildlife Sanctuary/Conservation Areas under Sabah Wildlife Department (Table 2); all of which have full protection status and prohibit any form of use within their boundaries. Within these protected areas, Class I – Protection Forest Reserves – have the greatest area of orangutan habitat (over 624,000 ha) with 72 per cent of this type of protected area having suitable habitat for this species (Table 2). A high proportion of most of Sabah’s protected area types are suitable for orangutan (Table 2).

More than 67 protected areas in Sabah had orangutan habitat within their boundaries. Those that enumerated more than 5,000 ha of orangutan distribution in 2010 are outlined in Table 3, along with the proportion of predicted orangutan habitat, overall size, management type, and orangutan population where known. Ulu Segama Forest Reserve and Tabin Wildlife Reserve seem to be bastions of orangutan with around 100,000 ha of orangutan habitat found within their boundaries, and with estimated populations of 2,064-11,064, and 517-3,796, respectively (Ancrenaz *et al.*, 2010). Mount Magdalena, Danum Valley and Malua Forest Reserves had proportionally large extents of orangutan habitat, with Danum hosting a population of around 309-570 (Sabah Wildlife Department, 2012).

Table 2: Shows the total extent and area of orangutan (*P.p.morio*) habitat in 2010 within the various protected areas in Sabah.

Type of protected area	Sum of orangutan habitat (ha)	Sum of protected area (ha)	% of habitat
Class I Forest Reserve - Protection Forest Reserve	624,718	873,648	72
Class VI Forest Reserve - Virgin Jungle Reserve	69,498	102,904	68
Class VII Forest Reserve - Wildlife Reserve	137,460	140,360	98
Parks	167,442	250,398	67
Wildlife Sanctuary/Conservation Area	24,563	73,720	33

It should be noted that the above figures on protected distribution and populations are almost certain to be underestimates since Sabah expanded its protected area network in 2016; in particular by increasing the scope of lowland protected forests, which also have orangutan populations, though data on these were unavailable at the time of writing. Furthermore, Sabah Forestry Department aims to increase the current protected area network, which covered 22 per cent (16,300 km²) of Sabah’s land mass in 2013 (Figure 4) to 30 per cent by 2020 (Othman *et al.*, 2013).

The hope is that these additional protected areas will provide functional links between currently protected forests to ensure the viability of wildlife populations (Roever *et al.*,

2013). In doing so, they would help facilitate species movement patterns and mitigate the impact of climate change on species' ranges (Schwartz, 2012). Sabah's protected areas could also ensure that all threatened forest types that are key habitats for orangutan (such as lowland seasonal swamp forests, swamp forests, peat forests and mangrove forest types) are fully protected and that Sabah's biodiversity is better represented in its protected area network (Margules and Pressey, 2000; Sarkar *et al.*, 2006).

Table 3: Protected areas in Sabah with >5,000 ha of orangutan (*P.p.morio*) habitat within their boundaries.

Names	Protected area type	Sum of orangutan habitat (ha)	Sum of protected area (ha)	% of habitat	Population estimate
Ulu Segama FR	Class I - Protection Forest Reserve	101,983	128,851	79	2064-11064*
Tabin Wildlife Rve.	Class VII- Wildlife Reserve	95,852	113,44	84	517-
Mount Magdalena FR	Class I - Protection Forest	61,379	66,998	92	
Danum Valley FR	Class I - Protection Forest Reserve	42,515	44,555	95	309-570***
Malua FR	Class I - Protection Forest	33,997	34,389	99	
Mount Louisa FR	Class I - Protection Forest	31,085	63,479	49	
Taman Negara Banjaran	Parks	30,261	141,61	21	*
Maliau Buffer Zone FR	Class I - Protection Forest	21,849	30,166	72	
Tawai FR	Class I - Protection Forest	20,304	22,934	89	
Sungai Tiagau FR	Class I - Protection Forest	18,487	19,767	94	
Tawau Hill	Parks	16,948	28,440	60	
Ulu Kalumpang FR	Class I - Protection Forest	16,315	51,854	31	
Maliau Basin FR	Class I - Protection Forest	14,296	59,115	24	
Kinabatangan Wildlife Sanctuary	Wildlife Conservation Area/Sanctuary	14,171	27,248	52	800**
Kulamba Wildlife Rve.	Class VII - Wildlife Reserve	13,806	20,760	67	182-
Sg. Imbak FR	Class VI - Virgin Jungle Reserve	13,241	18,425	72	
Sungai Taliwas FR	Class I - Protection Forest	9,938	9,939	100	
Sg. Pinangah FR	Class I - Protection Forest	8,925	10,918	82	77-644*
Mt. Hatton FR	Class I - Protection Forest	8,835	8,835	100	
Bukit Taviu FR	Class I - Protection Forest	7,964	8,700	92	
Mt. Wullersdorf FR	Class I - Protection Forest	5,242	8,343	63	

*Ancrenaz *et al.* (2005)

**Ancrenaz *et al.* (2014)

***Sabah Wildlife Department (2012)

Despite an overall net gain in protected forests in Sabah, the conversion of native forests to industrial plantations (oil palm and monoculture tree species) continues within commercial forest reserves (mainly Class II), and within orangutan range areas, including within the UNDP-GEF project area (Othman *et al.*, 2013) and FMU 5, highlighting the need for greater conservation efforts in non-protected areas.

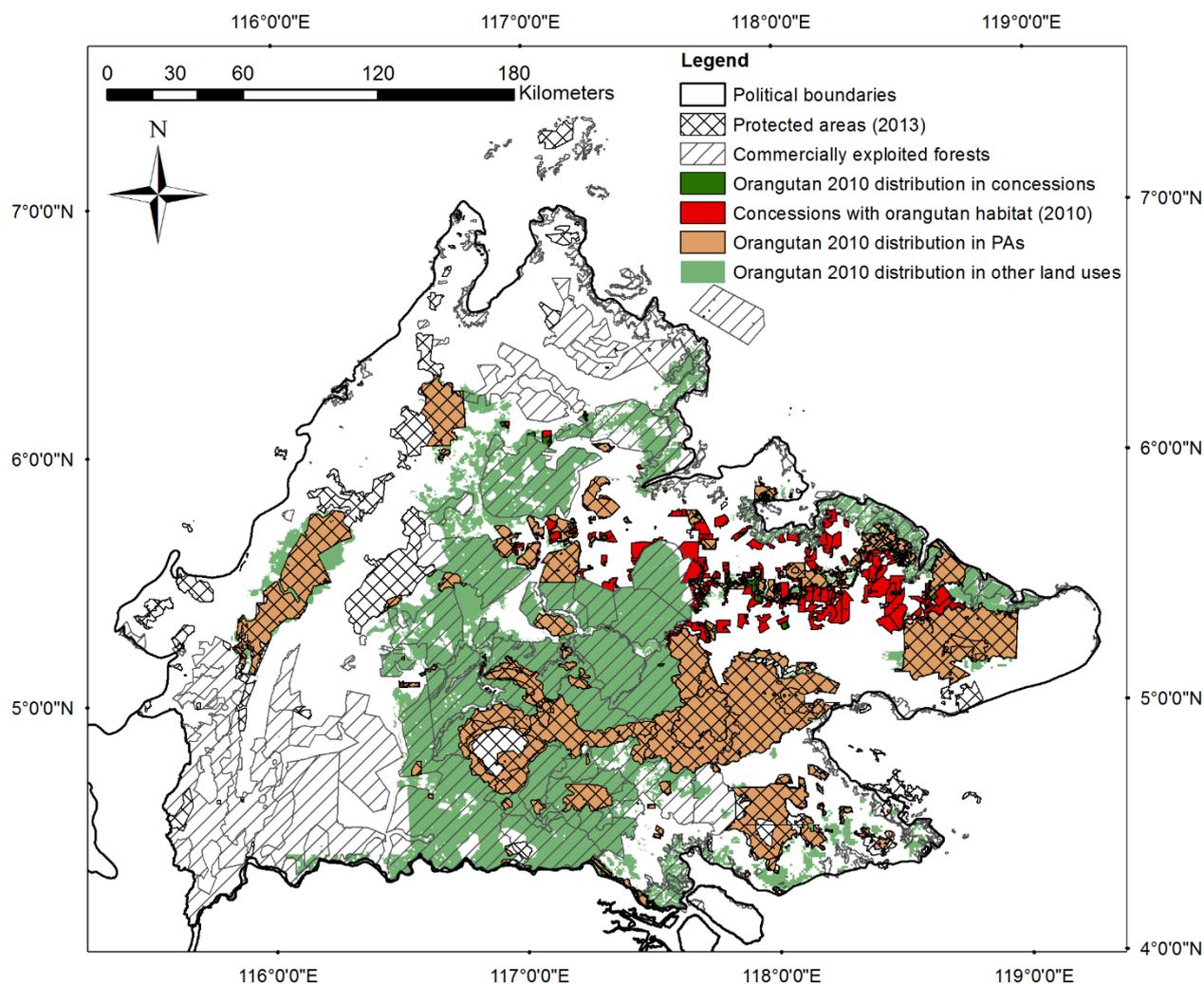


Figure 4: Orangutan distribution in Sabah in 2010 in protected areas (orange), in known oil palm estates (dark green) and commercial forest (light green); overlaid with protected area locations (cross hatch) and commercially exploited forests (diagonal lines).

4.2 Orangutan distribution in Sarawak

Sarawak had 29 per cent (217,800 ha) of its known orangutan distribution (763,538 ha) within four protected areas (Table 4; Figure 5). Population estimates are known for Laniak-Entimau National Park and Batang Ai with 1,024–1,181 and 119-580 respectively (Wich *et al.*, 2008). Although Sarawak has a relatively sparse orangutan distribution, it is imperative that the State employ better conservation measures to ensure its distribution is conserved by some form of management. This will be particularly important in areas that boarder Kalimantan, and inter-governmental cooperation over orangutan conservation will be fundamental to effectively managing trans-boundary populations.

Table 4: Protected areas with orangutan (*P.p.pygmaeus*) habitat in Sarawak.

Names	State	Sum of orangutan habitat (ha)	Sum of protected area (ha)	% of habitat	Population estimate
Lanjak-Entimau	Sarawak	163,526	171,076	96	1024-1181*
Maludam	Sarawak	39,482	43,845	90	Unknown
Medalam	Sarawak	32,469	33,698	96	Unknown
Batang Ai	Sarawak	24,124	25,169	96	119-580*

*Wich *et al.* 2008

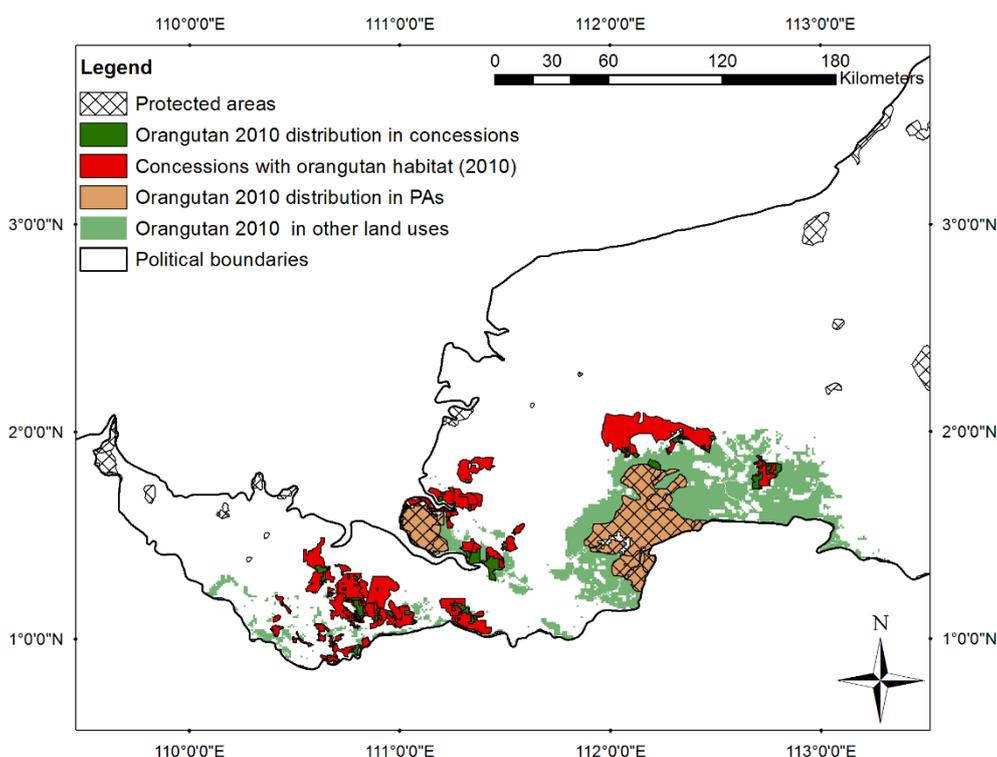


Figure 5: Orangutan distribution in Sarawak in 2010 in protected areas (orange), oil palm estates (dark green) and commercial forest (light green); overlaid with protected area locations (cross hatch) and commercially exploited forests (diagonal lines).

4.3 Orangutan distribution in Kalimantan

Of the 12,804,830 ha of orangutan habitat in Kalimantan, 22 per cent (2,793,663 ha) was located within protected areas (Figure 6). Sebangau was a stronghold with over one million hectares of orangutan habitat (Table 5); and an estimated population of 6,900 (Wich *et al.*, 2008). Tanjung Putting National Park has a population of around 6,000 orangutans (Wich *et al.*, 2008) and just over 200,000 ha of orangutan habitat. Other protected areas such as Betung Kerihun and Kutai National Park are also important strongholds (Table 5).

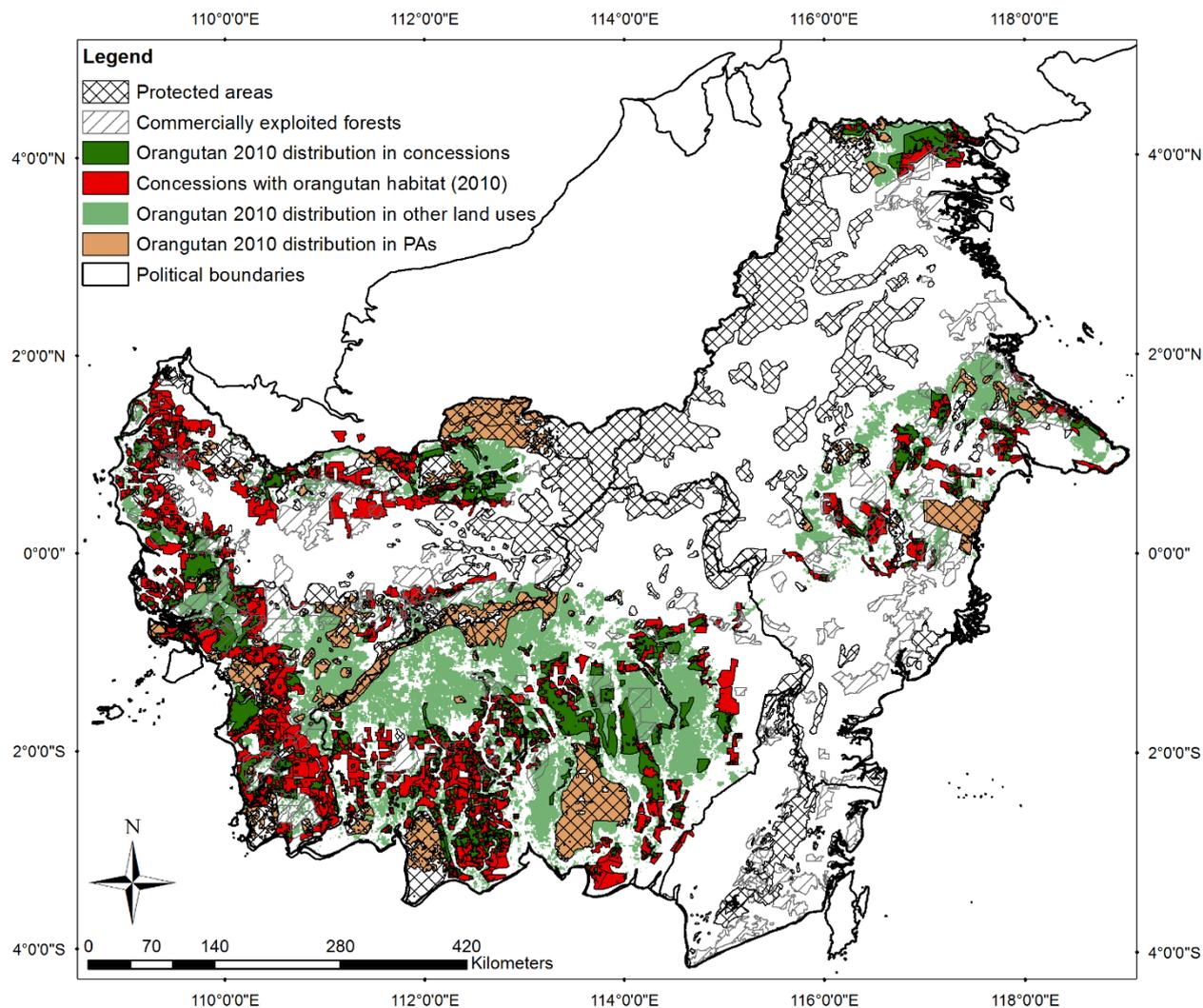


Figure 6: Orangutan distribution in Kalimantan in 2010 in protected areas (orange), in oil palm concessions (dark green) and in commercial forest (light green); overlaid with protected area locations (cross hatch) and commercially exploited forests (diagonal lines).

Protected areas (such as Kutai, Sebangau, and Tanjung Puting National Parks) continue to be affected by illegal logging, encroachments and wildfires (Soehartono and Mardiasuti, 2001; Curran, 2004); with some hosting illegal settlements, such as Sebangau (Abram *et al.*, 2015b). As a result, human-orangutan conflicts and persecutions often occur within protected areas, despite orangutan killings being illegal (Abram *et al.*, 2015a). Furthermore, in Kalimantan governments have disproportionately allocated remote, steep and rugged terrain for protected areas; and flatter, lowland forested regions – which are the preferred habitat of orangutans – for large-scale industrial plantations, transmigration programs, urban and infrastructural development (Curran, 2004; Gaveau *et al.*, 2009). As a result, the current protected area network in Kalimantan is inadequate for the long-term viability of orangutans and should be reconfigured to enhance habitat protection and connectivity.

Table 5: Protected areas with orangutan habitat in Kalimantan.

Names	Region	Sub-species	Sum of orangutan habitat (ha)	Sum of protected area (ha)	% of habitat	Population estimate
Sebangau	Kalimantan	<i>P. p.</i>	1,053,799	1,137,390	93	6,900*
Betung Kerihun	West	-	275,394	769,848	36	1,330-
Bukit Baka (Bukit Raya)	Kalimantan	<i>P. p.</i>	210,706	272,256	77	175*
Kutai National Park	East	<i>P. p.</i>	205,819	206,916	99	600*
Tanjung Putting National	Central	<i>P. p.</i>	177,922	369,370	48	6,000*
Hulu Kerian	Kalimantan		115,250	227,429	51	
Gunung Palung National	West	<i>P. p.</i>	80,324	99,771	81	2,500*
Sei Pinoh	Kalimantan		64,941	106,783	61	
Kendawangan	Kalimantan		53,030	140,547	38	
Sapathawung	Kalimantan		52,578	331,582	16	
Unknown	Kalimantan		42,984	70,884	61	
Danau Sentarum	Kalimantan		42,796	127,478	34	500-
Medang	Kalimantan		38,195	40,004	95	
Rubai Pasilan Tabah	Kalimantan		35,422	197,321	18	
Gunung Nyut Parensen	Kalimantan		33,670	101,046	33	
Gunung Ketungan Timur	Kalimantan		29,250	59,968	49	
S. Kayan S. Mentarang	Kalimantan		13,538	1,314,437	1	
Melawai	Kalimantan		12,158	668,617	2	
Batang Batu Putih	Kalimantan		11,849	107,767	11	
Muara Kaman Sedulang	Kalimantan		11,171	64,927	17	
Gunung Tarak	Kalimantan		10,351	22,225	47	
Gunung Kenebah	Kalimantan		6,871	22,448	31	
Gunung Nyut Parensen	Kalimantan		4,197	36,307	12	

*Wich et al. 2008

**Singleton et al. 2004

4.4 Summary of orangutan distribution in protected areas

Overall, protected orangutan habitat accounts for only one quarter of this species' range. Although in some regions – such as Sabah – there is hope that the amount of protected habitat may increase, the current level of protection is inadequate to curb further population loss and localised extinctions. Sabah is Malaysia's orangutan stronghold, and both Sabah and Indonesia have adopted Species Action Plans that aim to stabilize orangutan

populations by 2015 (in Sabah) and 2017 (for Indonesia). Yet without adequate habitat protection, and if forest conversion to oil palm and other non-forest land uses continues, then these action plans will fail and the orangutan will be in grave danger of disappearing from Borneo forever.



5 INVENTORY OF AGRIBUSINESS CONCESSIONS IN THE ORANGUTAN RANGE

One of the key objectives of this report and the associated inventory was to explore the overlap between apes and agri-business estates: in this case orangutan habitat and oil palm plantations. In both Malaysia and Indonesia, land use allocation is determined by laws and procedures that ultimately promote the clearing of forests for agriculture (Brockhaus *et al.*, 2012). There are significant differences in legislation in the two countries, and indeed between the Malaysian states of Sabah and Sarawak. However, it is safe to say that the legal and political framework for land use allocation in all these regions is very complex, involving overlapping policy and regulatory mandates with multiple actors at multiple levels (for details see Jonas 2017).

Land allocation for oil palm in Indonesia is subject to initial spatial planning and license granting exercises governed by legislation including Basic Agrarian Law, Basic Forestry Law and planning laws. Investors must then obtain development licences for oil palm concessions that are conditional on local government approving mandatory local impact assessments. Consultation with local communities is also obligatory at this stage, typically at the district level. Furthermore, the mandatory implementation of Indonesian Sustainable Palm Oil (ISPO) standards aims to strengthen the pre-requirements for palm oil allocations. Nevertheless, there are still major issues that plague land allocation procedures for oil palm in Indonesia. Furthermore, corruption and negative ‘rent-seeking’ behaviour is pervasive in land use allocation and decision-making, which has a negative impact on local communities and biodiversity, including orangutan habitat (Blunt *et al.* 2012; Butt 2011).

Land allocation in Malaysian Borneo is more straightforward. Spatial allocation for oil palm in Sabah is based on a 1976 “Land Capability Classification Map” that identified all land suitable for agricultural purposes. The map is still used as a yardstick to guide agricultural development. Oil palm is predominantly allocated in the eastern region due to its fertile floodplains and lowland areas (Abram *et al.*, 2014). Land title applications for large-scale commercial titles (known as Country Lease titles) for oil palm are assessed against the Land Capability Classification Map to discern whether the proposed area is suitable. Once a title is granted, oil palm development must proceed as decreed under the State Land Ordinance (Sabah Land Ordinance, 2010). As in Indonesia, bribery, corruption and the practice of making multiple and bogus applications for land is widespread (Siddiquee 2010).

In Borneo as a whole, there is a lack of adequate and detailed spatial information to guide land allocation for oil palm development. It will therefore be essential for relevant government bodies to improve their understanding of which areas are most suitable for oil palm development and the value of forests for protected species such as the orangutan.

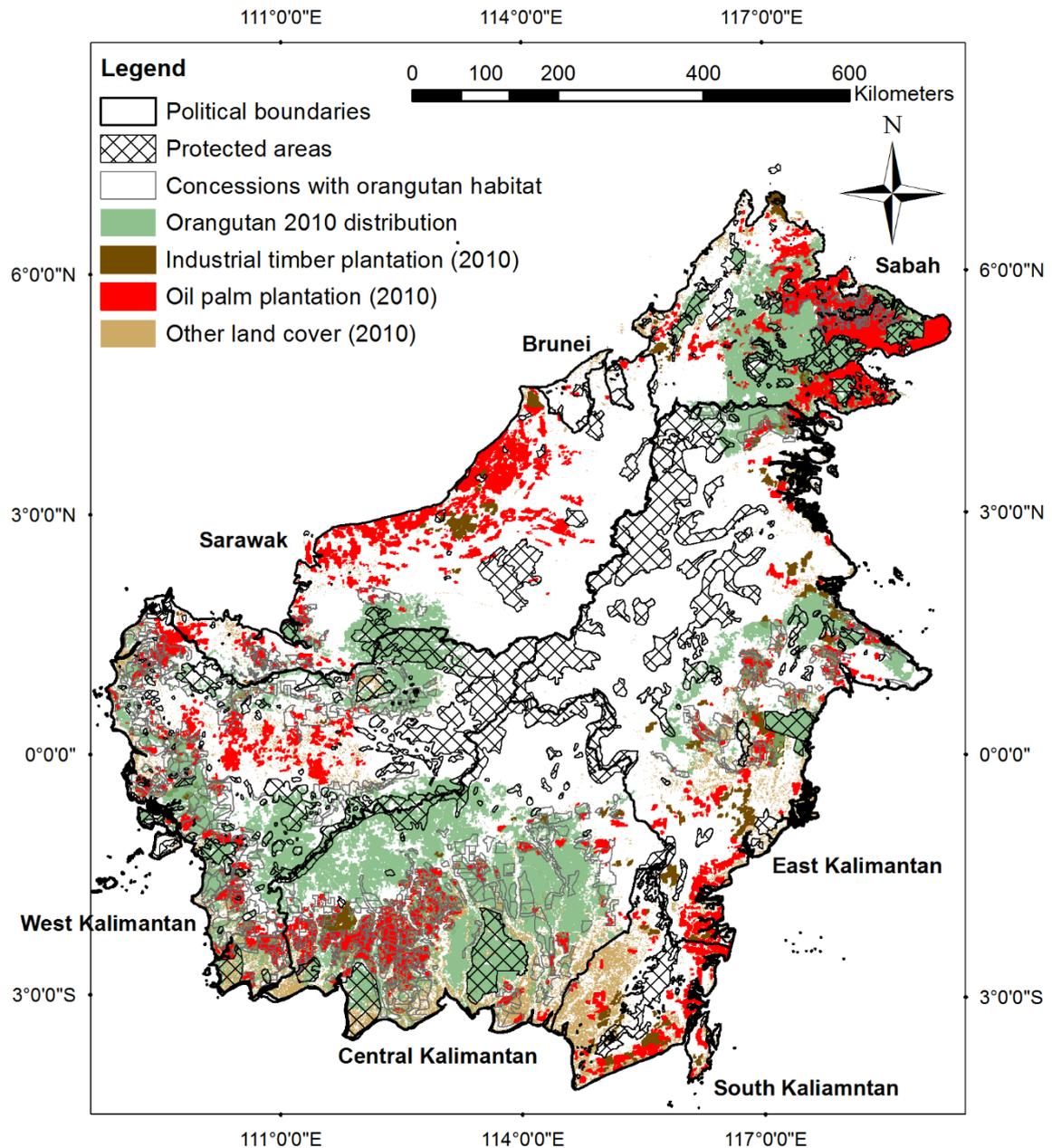


Figure 7: Orangutan distribution on Borneo in 2010 overlaid with protected area information (hatched) and oil palm concessions with orangutan habitat within them, shown on a base map of 2010 Land use/land cover classes and protected areas (cross hatch).

5.1 Orangutan habitat in oil palm estates

According to the land use and land cover data for 2010, Borneo had a total area of 6,518,207 ha of planted oil palm (Figure 7) (Gaveau *et al.*, 2014). Much of this area would likely have been orangutan habitat since both orangutan and oil palm are restricted to lowland-rainforest regions, typically less than 500 metres above-sea-level. To ascertain the likely distribution of orangutan in oil palm estates, we overlaid the 2010 orangutan data with our estate data. We concluded that a total of 3,012,683 ha (18 per cent) of remaining orangutan habitat occurred in known industrial oil palm plantations. By region, nearly a quarter (23 per cent) of known orangutan habitat in Kalimantan was in oil palm concessions; this was partitioned into 48 per cent in Central Kalimantan, 37 per cent in West Kalimantan, and 15 per cent in East Kalimantan (Wich *et al.*, 2012) (Figure 6). It is clear from these figures that there is a desperate need for conservation efforts – such as outreach to oil palm concessions – to conserve these areas, particularly in Central and West Kalimantan. For Malaysian Borneo, Sarawak had 47,253 ha (six per cent) of its orangutan distribution in industrial oil palm plantations (Figure 5); with only 19,474 (1 per cent) for Sabah (Figure 4). We note that these figures are likely to be gross underestimates since our concession/land title data was not up-to-date for any of the regions.

Although this report focuses on industrial oil palm estates, Wich *et al.* (2012) calculated that at least six per cent of the Bornean orangutan range was in industrial tree plantations (such as *Acacia* spp.); 29 per cent was in logging estates exploited for timber; with the remaining 24 per cent occurring in other land use allocations, including smallholdings for oil palm. As a result, they estimated that the total land allocated for oil palm, industrial tree plantations, oil palm smallholdings and other land uses would imply the loss of half of the current 2010 orangutan distribution in the foreseeable future.

5.2 Inventory information

There were significant differences in the amount of information available on the estates in the three regions. However, we were able to compile inventories including: estate sizes and locations; lease types and construction start dates (for clearing and planting palms); investor information; as well as information on Environmental Impact Assessments (EIA) and Social Impact Assessments (SIA). In addition, we also examined areas of High Conservation Value (HCV); along with the extent of orangutan habitat within the estates. For Sabah and Sarawak, we found multiple subsidiaries of companies and have included estate, company and parent company names where available.

5.2.1 Concession locations and sizes in the inventories

For Kalimantan, we researched 32 concessions for our inventory (Figure 8A), with a total area of 831,577 ha, of which 68 per cent (567,240 ha) was estimated to be orangutan habitat, according to the 2010 data. These concessions ranged in size from 4,519-121,651 ha, and were typically much larger than those found in Malaysian Borneo. For Sarawak, we researched 15 land titles, totalling 197,713 ha, with 13 per cent (24,937 ha) of this being

orangutan habitat (Figure 8B). Land title sizes ranged from 661-6,807 ha (though only one was under 1,000 ha). For Sabah, we researched 119 land titles, of which 55 had known orangutan habitat within them (Figure 8C). These ranged from 377-8,169 ha, and covered a total of 129,741 ha. However, only five percent of this area (6,223 ha) is orangutan habitat – far less than in Sarawak and Kalimantan.

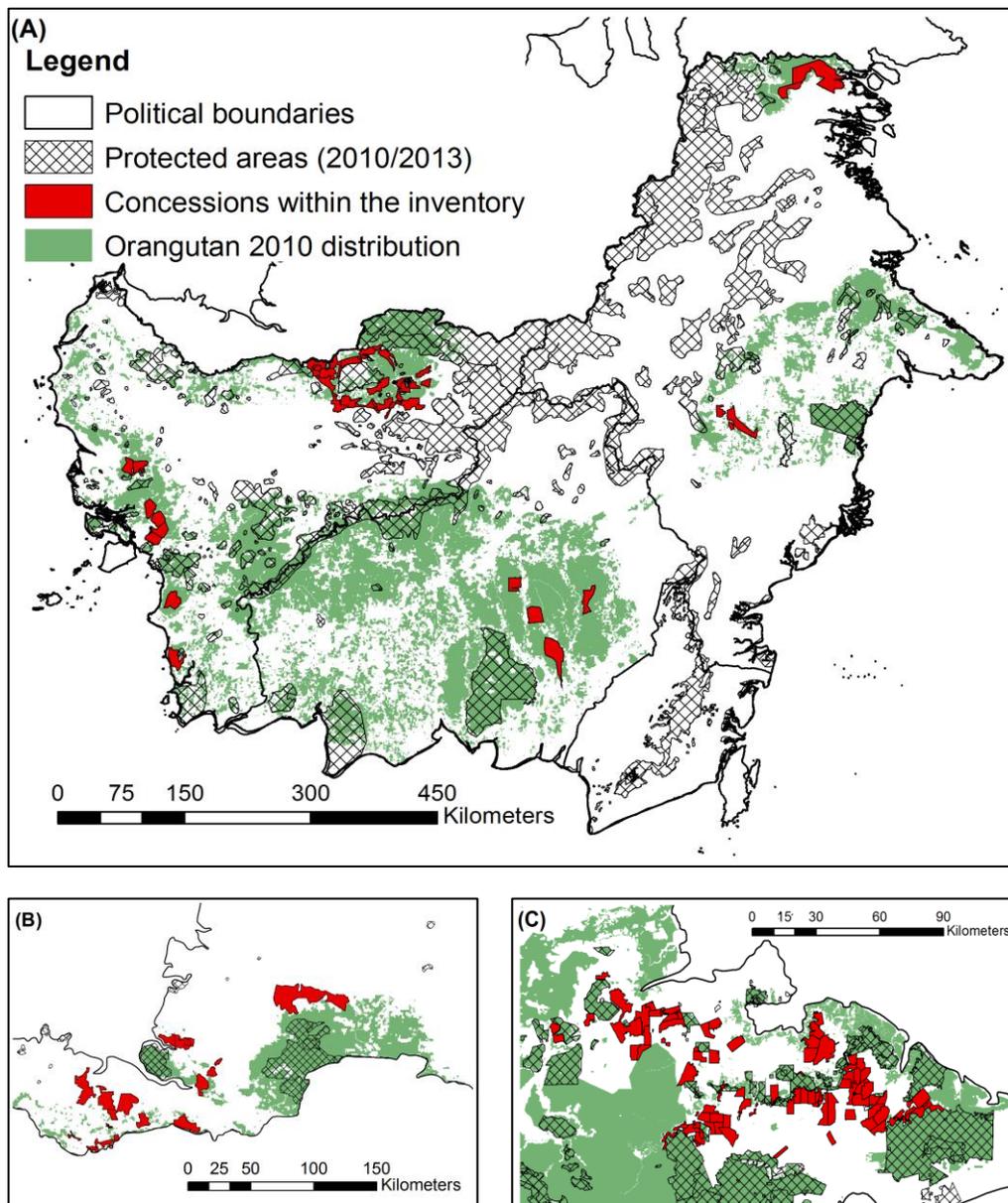


Figure 8: Location of concessions within the inventory analyses (red), along with orangutan distribution in 2010 (green) and protected areas (cross hatch) within Kalimantan (A); Sarawak (B); and, Sabah (C).



5.2.2 Land lease allocation and construction dates

Most concessions granted in Kalimantan, and all titles in Sarawak and Sabah, were allocated for oil palm as the intended commodity crop. In general, there was a dearth of information on the dates when titles were granted and when site preparation and plantings commenced (Table 6). Nevertheless, in Kalimantan, most (known) dates of land titles showed they were granted after 2000, and conversion and planting of palms starting within the same decade (Tables 6 and 7). Our research in Kalimantan was further complicated by the fact that the status of some licenses was unclear. For example, some companies appeared to have had their licences revoked because they had not complied with planting requirements within the stipulated three-year period. However, some of these companies still seemed to

be operating. For example, PT. Kahayan Agro Lestari’s permit was revoked in 2010 (by Kapuas regent decree No: 153/Disbunhut/2010), but the company continued to operate, including by engaging with local communities to initiate a plasma/out grower scheme in 2013. It was impossible to establish whether this company is still in operation, although its name remained on the statistical bureau’s list of palm oil association members in 2014.

In Sabah, our inventory of titles dates back to before the 1990s. As one of Malaysia’s first states to prioritise oil palm development, Sabah remains a palm oil stronghold, and accounts for more than 28 per cent of the country’s oil palm landscape. Space, however, is limited and many Malaysian companies have started to make new plantings in other countries (including Indonesia). Most known title types in Sabah were Country Lease titles (or provisional titles) which are meant for commercial agricultural purposes, typically spanning 99 years (Sabah Land Ordinance, 2010). However, companies have increasingly secured native titles, either through 30-year leasing agreements or other legal or more informal arrangements. Native titles (<40 ha) are intended for smallholdings (up to 999 years) and should technically only be held by native people, as per the Sabah Land Ordinance (Sabah Land Ordinance, 2010). However, we found several examples of companies holding native titles, though it was uncertain whether this was through 30-year lease agreements or the purchasing of titles. For example, the Syarimo estates of IOI Corporation Berhad had land lease lengths of both 1-3 plantings and more than 900 years (see inventory for more details).

Table 6: Percentages of concessions/land titles granted by region, with start dates of construction/preparation and planting for the commodity crop (oil palm).

	Concessions/land titles granted			Construction/planting began		
	Kalimantan	Sarawak	Sabah	Kalimantan	Sarawak	Sabah
Land titles granted	(n=32)	(n=15)	(n=119)	(n=32)	(n=15)	(n=119)
<1989	0%	0%	12%	0%	0%	8%
1990 - 1999	6%	7%	28%	6%	7%	20%
2000 - 2009	31%	27%	21%	19%	0%	6%
>2010	3%	13%	3%	6%	0%	0%
Unknown	59%	53%	37%	69%	93%	66%

For Sarawak, most estate titles were allocated from 2000 onwards, though it seems like planting dates were not well documented in the available reports (Table 6). Most oil palm titles in the Sarawak inventory were under provisional leases. These plantations were often managed under joint-venture projects between state, native customary rights (NCR) land owners and private investors, or two-way partnerships between the state and NCR land owners. However, these types of leases involving NCR land owners, state government and private investors have led to several disputes regarding land rights, and are further discussed in the social impact assessment section for Sabah and Sarawak.

Many of the land leases for Sarawak were made through two state-owned statutory bodies that leased NCR land: the Sarawak Land Consolidation and Rehabilitation Authority (SALCRA); and the Land Custody and Development Authority (LCDA). SALCRA is a rural

development project led by the state of Sarawak to forge a partnership between the state and native landowners for oil palm development. The LCDA approach is similar, however it differs in that it was meant to be a joint venture including private sector investors as well as the state and NCR landowners. Land leases with SALCRA and the LCDA were valid for 60 years (Cooke *et al.*, 2011, p.17). Eleven land titles had a lease of 60 years, while the rest of the land title leases covered only one to three plantings cycles or lasted for multiple centuries.

5.2.3 Oil palm investor information

Of the 32 total concessions researched in Kalimantan, nine were 100 per cent domestically-owned; one was 50 per cent domestically owned; eight had less than 50 per cent domestic ownership; and two concessions were 100 per cent owned by foreign investors. We could not discern the status of the remaining 12 concessions (Table 7).

In terms of ownership structure, we found that the primary investor in 11 of the concessions was 100 per cent privately owned; three concessions were more than 50 per cent privately-owned; and six were less than 50 per cent privately-owned (Table 8). (Once again, we could find no information for the 12 more opaque concessions). Of these private companies, eight were Indonesian; three were Malaysian and there was one each from Singapore, Italy and the United Kingdom. There were eleven companies where the investors' country of origin could not be identified. In some concessions, the investors came from more than one country (six concessions were joint ventures by Thai and Singaporean companies; one had investors from Singapore and Indonesia). In such cases, it was probable that the foreign investor was a subsidiary of a parent company based in a third country. For example, the concession Pt. Kartika Prima Citra in West Kalimantan is a subsidiary of PT SMART and Golden Agri Resources (GAR). Golden Agri Resources is a Singapore-based company but its main shareholder is Flambo International, which is a subsidiary of Sinar Mas Group, an Indonesian company.

For Sarawak, we only researched 15 concessions due to the fact that only a few had orangutan habitat within their boundaries. Of these, in most (80 per cent) cases the primary investor was 100 per cent domestically-owned (Table 7). Of these companies, around half were 100 per cent privately-owned (Table 8). Most of the Malaysian investors (87 per cent) were involved in agribusinesses (except for one concession we describe in the inventory).

Table 7: Breakdown in percentages of foreign or domestic primary investor information within the differing regions.

Foreign or domestic Primary Investor (PI)	Sabah titles with			
	orangutan habitat (n=55)	Sabah titles (n=64)	Sarawak titles (n=15)	Kalimantan titles (n=32)
PI is 100% domestically-owned	13	18	12	9
PI is >50% domestically-owned	35	30	1	1
PI is <50% domestically-owned	3	7	-	8
PI is 100% foreign-owned	-	-	-	2
Details unknown/mixed	4	9	2	12

For Sabah, we researched a total of 119 land titles. Tables 7 and 8 break down our findings for those titles with orangutan habitat and those without/or whose status was unknown. Taking the titles as a whole, we found that 26 per cent of primary investors were domestic, and 55 per cent were >50% domestically owned (Table 7). For 55 per cent of these 119 titles, the primary investor was <50% privately owned, with 21 per cent being >50% privately owned (Table 8). The majority (89 per cent) of investors were Malaysian in origin; and 55 per cent of investors were diversified conglomerates, with 39 per cent representing an agribusiness industry (see inventory for details).

Table 8: Breakdown in percentages of public or private primary investor within the different regions.

Public or private Primary Investor (PI)	Sabah titles			
	with orangutan habitat (n=55)	Sabah titles (n=64)	Sarawak titles (n=15)	Kalimantan titles (n=32)
PI is 100% privately-owned	-	-	6	11
PI is >50% privately-owned	15	11	1	3
PI is <50% privately-owned	31	35	1	6
PI is 100% publicly-owned	3	7	-	-
Details unknown/mixed	6	11	7	12

5.2.4 Social and Environmental Impact Assessments

Environmental Impact Assessments are the only type of impact assessment required by law in both Malaysia and Indonesia for new oil palm plantings. Typically, those concessions that won approval for their Environmental Impact Assessment (EIAs) also had their Social Impact Assessments (SIAs) approved. For Kalimantan, of the 32 concessions, 20 had received SIA and EIA approvals, while three concessions did not receive approval for either. There was no information available for the remaining estates.

For Sarawak, we could find almost no information on EIA reports despite the fact they are a legal requirement. We found only one documented example of an EIA that had been approved. EIA consultants were mostly hired to conduct studies by the title holder, raising questions over the degree of impartiality in the process. Indeed, NGOs widely question the credibility of EIAs in Sarawak (and elsewhere) since they are not subject to public scrutiny, and are only reviewed by the State Planning Unit and Sarawak Land Development Ministry (Colchester et al, 2007). A number of estates claimed to have won approval for SIAs, but there was no official documentation available to support these claims. However, local news sites and blogs carried reports of estate-community disputes that implied projects were having a negative impact on communities regardless of whether SIAs had been undertaken. The risks may be particularly high for joint venture schemes and partnerships (such as

through SALCRA and LCDA) that take advantage of native customary rights land (NCR), which can leave considerable scope for later misunderstandings and conflict between communities and oil palm estates. The lack of disclosure around EIA and SIA reports risks fuelling corruption, and these companies' level of transparency should be considered when assessing their credibility.

In Sabah, 77 of the 119 land titles we reviewed had received EIA approval (Sabah state government, 2016); and 81 had approved SIAs. In addition in Sabah, 100 estates were members of the Roundtable for Sustainable Palm Oil (RSPO) (<http://www.rspo.org/about>), which requires SIAs and High Conservation Value (HCV) assessments for all RSPO certified estates. The high proportion of RSPO members within the estates is likely explain the unusually abundance of information on EIAs and SIAs. Additionally, some annual reports stated several complaints regarding communities (who claim to have native customary rights) entering the oil palm estates, although disputes were not described in detail.

5.2.4.1 High Conservation Value Areas

In Kalimantan, there were 18 concessions that had identified High Conservation Value (HCV) areas. The other 14 concessions either did not have HCV areas or their HCV status was unknown. Types of HCV land included peatland or peat swamp forest, watersheds, customary land, and primary/secondary or protected forest. Of the 18 concessions, 11 held two or more of these types of HCV. Five concessions had either peatland or peat swamp forest and two concessions had primary, secondary, or protected forest in the concession. No HCVs were identified as approved for the inventory estates in Sarawak.

For Sabah, examples of HCV area types shown in annual reports were: buffer zones, isolated patches of forest, swamps, >25 degree slopes, water catchment areas, rehabilitation areas for wildlife, peatland and mangroves. Of the 119 land titles we reviewed in Sabah, 61 had areas with at least one type of HCV, as noted in annual reports and assessments, which generally included information on whether these HCV areas were clearly demarcated in the estate. For example, the 26 estates of the Strategic Operating Unit (SOU) and the Sentosa, Tun Tan, Tigowis, Tunku and Segaliud estates noted isolated patches of forest, swamps, mangroves and river buffer zones, and remarked on their proximity to Class VI Virgin Jungle Reserves. Estates that include HCV areas, or that share boundaries with HCV forests, can play a crucial role in orangutan conservation by providing habitat or facilitating connectivity between protected areas, for example.

The inventory concessions identified and researched in Kalimantan were proportionately larger than those found in Malaysian Borneo (see Section 5.2.1), and they also harbour higher proportions of unconverted forested areas that were deemed as orangutan habitat. In Kalimantan, 56 per cent of concessions had 76-100 per cent of the title classified as orangutan habitat (Table 9). In contrast, Sabah had 80 per cent and Sarawak 98 per cent of their inventory concessions classified as having 0.1-25 per cent orangutan habitat within their known boundaries. Nevertheless, these estates in Sabah and Sarawak are likely to be very valuable as wildlife corridors between protected areas.

Table 9: Estimated proportion (% classes) of orangutan habitat in estates within the inventory analyses in Kalimantan, Sarawak and Sabah.

	Kalimantan (n=32)	Sarawak (n=15)	Sabah (n=55)
Proportion of concession with orangutan habitat			
0.1 % - 25%	4 (13%)	12 (80%)	54 (98%)
26% - 50%	9 (28%)	1 (7%)	1 (2%)
51% - 75%	1 (3%)	2 (13%)	0
76% - 100%	18 (56%)	0	0

5.2.5 Challenges of inventory data collection

There were several challenges to collecting data for the inventory section of this study, with the most serious being access to information. Company annual reports were not always available, and the quality of information they contained was variable. Data searches through other documents, such as those relating to EIA/SIA information, RSPO documents, NGO reports and media sources were useful but typically yielded only piecemeal information for companies within the inventory. Furthermore, there were widespread inconsistencies between sources.

Other obstacles included the difficulty of accessing company and/or parent company level information, which was particularly difficult to ascertain for Sabah. It was also sometimes difficult to keep track of estates whose names had changed, perhaps because their owner had also changed its trading name. Estate names might also change in cases where licenses had been revoked, perhaps before any EIA or SIA reports had been submitted. Access to up-to-date spatial data was also difficult on all counts, for all regions.

5.3 Fires in protected areas and concessions with orangutan habitat

The 2015 fires that burned throughout Indonesia have been called “the biggest environmental crime of the 21st century” (Meijaard, 2015b). From October 2014 to December 2015, 2,886 fire events occurred within the Bornean orangutan’s distribution, with the vast majority of these being in Kalimantan (2,750) (Table 10). Of the fire events in Kalimantan, 34 percent were in unconverted orangutan habitat in oil palm concessions; and 13 per cent were in orangutan habitat in protected areas.

There were multiple causes and actors involved in the 2015 fires, with some fires started by large timber and oil palm companies clearing land within their concession boundaries. In Kalimantan however, 79 per cent of fire emissions came from small and mid-sized farmers and land-owners, mostly growing oil palm (Meijaard, 2015c). In addition, illegal clearings for land acquisition also contributed to the fires. Although the Indonesian government has faced scrutiny for its insufficient preventative and enforcement measures (Balch, 2015); responsibility for the fires also rests with the plantation owners and managers of large estates and smallholders, as well as the authorities.

Table 10: Number of recorded fire events between 22 October 2014 and 1 December 2015 within the 2010 orangutan distribution – in protected areas (PAs) and oil palm estates.

Region	Species/sub-species	Total fire events in known orangutan distribution	Fire events in orangutan distribution within PAs	Fire events in orangutan distribution within oil palm estates
Sabah	<i>P. p. morio</i>	107	15	2
Sarawak	<i>P. p. pygmaeus</i>	29	3	13
Kalimantan	<i>P. p. pygmaeus/P. p.</i>	2,750	368	939
Borneo	-	2,886	386	954

Poor land management practices, which have dried and degraded peat swamp forest, also exacerbated the fires (Lingga, 2015). Previously resilient peat forests have become highly flammable due to extensive anthropogenic changes, such as the building of canals to drain them for agricultural purposes (Meijaard, 2015a). In addition, the El Nino weather pattern, which was estimated to be the worst in 20 years, caused a prolonged drought and increased winds throughout the region (Drake, 2015). All-in-all, it is estimated that 1.5 billion tons of carbon dioxide was released into the atmosphere by these fires (Drake, 2015).

In addition, the 2015 fires affected approximately 40 million people (Meijaard, 2015b), led to 19 direct deaths, and were estimated to have caused 500,000 acute respiratory infections (Lingga, 2015) and more than 100,000 premature deaths in the region (Balch, 2015). The economic cost for these health impacts has been estimated at US\$35 billion (Meijaard,

2015b). Non-tangible costs from effects such as school closures, crop losses and bee deaths could push the economic, social and environmental costs substantially higher (Meijaard, 2015b). These enormous costs raise fundamental questions over the oil palm-driven development strategies pursued by Indonesia and Malaysia.

For orangutans, it was estimated that the fires threatened at least one-third of the remaining wild population (Vidal, 2015), posing a risk to approximately 20,000 orangutans in Indonesia (Winter, 2015). There were 358 fire “hotspots” identified inside the Sebangua Forest in Kalimantan, home to the world’s largest population of nearly 7,000 wild orangutans (Vidal, 2015). Fires were identified in Tanjung Putting national park, Katigan forest, and Mawas Reserve, affecting another 12,500 wild orangutans combined (Vidal, 2015). Furthermore, the Samboja Lestari Orangutan Reintroduction Centre in East Kalimantan saw 200 ha burn (Mattangkilang, 2015). Haze covered a far greater area and the health effects are likely to be detrimental to orangutans, given their anatomical similarity to humans (Vidal, 2015).

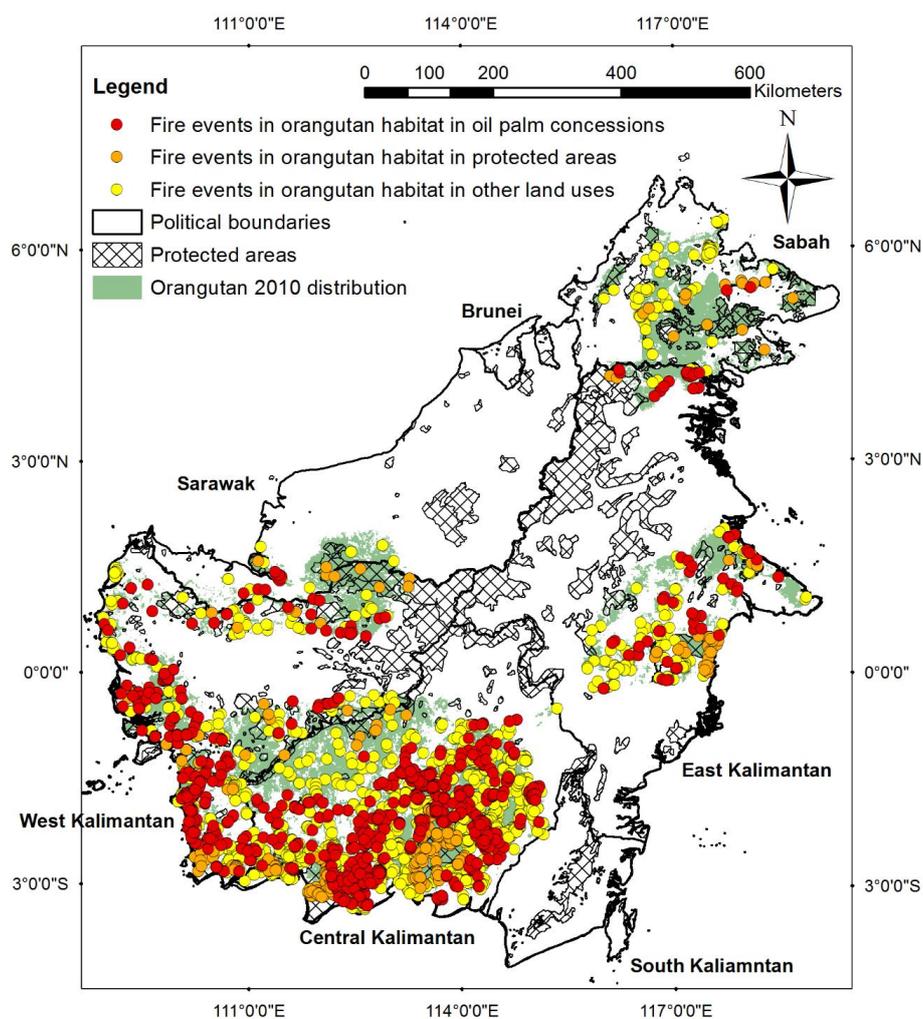


Figure 9: Location of fire events between 22 October 2014 and 1 December 2015 within the 2010 orangutan distribution – in protected areas (orange), known oil palm estates (red), and in other land uses (yellow).

6 CONCLUSION

Indonesia and Malaysia are the only countries with wild orangutan populations, yet they are also the leading producers of palm oil. While revenue from oil palm can provide economic benefits, the oil palm sector is underpinned by corruption and poor land allocation procedures, which negatively affect species such as orangutan, and biodiversity as a whole. For example, only 25 per cent of Borneo's orangutan habitat is within protected forest, which is grossly inadequate for the long-term survival of this species. The remaining orangutan distribution was found within known oil palm concessions (18 per cent), which is likely a gross underestimate, meaning many more orangutans will be at risk as plantations are developed. Furthermore, both countries plan to expand this industry to fuel their development agendas. More concessions will mean the loss of even more orangutan habitat, causing irreversible damage to resident orangutan populations.

Our study also highlighted important concerns over transparency in the oil palm industry. We found that detailed information on oil palm concessions was not readily available to the public, posing a challenge for informed planning at the intersection of orangutan conservation and oil palm development. Of those oil palm estates that we examined, many had HCV areas, including peatland, watersheds, customary land and primary, secondary and protected forest. However, the lack of transparency in many individual plantations is a red flag that should be better addressed by regulatory bodies, especially since we found so much estate land overlaps with orangutan habitat, and there may be many more cases we were unable to identify. Unless progressive solutions for better land use allocation for oil palm are implemented urgently, hopes for the long-term survival of the critically-endangered orangutan will be tenuous at best.

This report provides key findings on the geographical overlap between Bornean orangutan habitat in protected areas and estates demarcated for large-scale oil palm development. Additional reports in the series analyse legal frameworks and political economies that interrelate with the oil palm industry and orangutan conservation (Jonas 2017), and a through-the-lens fine-scale case study of these issues in the Lower Kinabatangan region in eastern Sabah (Abram & Ancrenaz 2017). A synthesis of these three reports is also available (Jonas *et al.* 2017).



7 REFERENCES

- Abram, N and Ancrenaz, M (2017) Orangutan, Oil palm and RSPO: Recognising the importance of the threatened forests of the Lower Kinabatangan, Sabah, Malaysian Borneo. Ridge to Reef, Living Landscape Alliance, Borneo Futures, Hutan, and Land Empowerment Animals People. Kota Kinabalu, Sabah, Malaysia.
- Abram, N *et al.* (2014) Synergies for Improving Oil Palm Production and Forest Conservation in Floodplain Landscapes. *PLoS ONE*, 9, e95388.
- Abram, N *et al.* (2015a) Mapping perceptions of species' threats and population trends to inform conservation efforts: the Bornean orangutan case study. *Diversity and Distributions*.
- Abram, N *et al.* (2015b) Mapping perceptions of species' threats and population trends to inform conservation efforts: the Bornean orangutan case study. *Diversity and Distributions*, 21, 487-499.
- Ancrenaz, M *et al.* (2010) Recent Surveys in the Forests of Ulu Segama Malua, Sabah, Malaysia, Show That Orang-utans (*P. p. morio*) Can Be Maintained in Slightly Logged Forests. *PLoS ONE*, 5, e11510.
- Ancrenaz, M *et al.* (2014) Of pongo, palms, and perceptions – A multidisciplinary assessment of Bornean orangutans in an oil palm context. *Oryx*, doi:10.1017/S0030605313001270.
- Ancrenaz, M *et al.* (2005) Aerial Surveys Give New Estimates for Orangutans in Sabah, Malaysia. *PLoS Biology*, 3, e3.
- Baccini, A *et al.* (2012) Estimated carbon dioxide emissions from tropical deforestation improved by carbon-density maps. *Nature Climate Change*, 2, 182-185.
- Balch, O (2015) Indonesia forest fires: everything you need to know. *The Guardian*.
- Bright, E *et al.* (2008) *LandScan 2007*. Oak Ridge National Laboratory, Oak Ridge, TN.
- Brockhaus, M *et al.* (2012) An overview of forest and land allocation policies in Indonesia: Is the current framework sufficient to meet the needs of REDD+? *Forest Policy and Economics*, 18, 30-37.
- Curran, L *et al.* (2004) Lowland forest loss in protected areas of Indonesian Borneo. *Science*, 303, 1000-1003.
- Drake, N (2015) Indonesia blazes threaten endangered orangutans. *Nature*, 527, 18.
- Elith, J *et al.* (2011) A statistical explanation of MaxEnt for ecologists. *Diversity and Distributions*, 17, 43-57.
- FAO (2012) FAOSTAT online statistical service. *Food and Agriculture Organization of the United Nations (FAO)*, Rome, Italy. <http://faostat.fao.org>. Accessed 08-02-2014.
- Gaveau, D *et al.* (2009) The future of forests and orangutans (*Pongo abelii*) in Sumatra: predicting impacts of oil palm plantations, road construction, and mechanisms for reducing carbon emissions from deforestation. *Environmental Research Letters*, 4, 034013.
- Gaveau, D *et al.* (2014) Four Decades of Forest Persistence, Clearance and Logging on Borneo. *PLoS ONE*, 9, e101654.
- Indonesian Ministry of Agriculture (2011) Tree crop estate statistics of Indonesia 2010-2012 Oil Plam. In. Directorate General of Estates, Jakarta.
- Jakarta Post (2009) Indonesia allocates 18 million of hectares of land for palm oil. In: *Jakarta Post*. Jakarta.

- Jonas, H (2017) An analysis of the legal ecosystem and political economy of large-scale oil palm and orangutan conservation in Borneo. Ridge to Reef, Living Landscape Alliance, Borneo Futures, Hutan, and Land Empowerment Animals People. Kota Kinabalu, Sabah, Malaysia.
- Jonas, H *et al.* (2017) Addressing the Impact of Large-scale Oil Palm Plantations on Orangutan Conservation in Borneo: A spatial, legal and political economy analysis. IIED, London.
- Koh, L and Wilcove, D (2008) Is oil palm agriculture really destroying tropical biodiversity? *Conservation Letters* (1) 60-64.
- Koh, L and Wilcove, D (2009) Oil palm: disinformation enables deforestation. *Trends in Ecology & Evolution* (24) 67-68.
- Lingga, V (2015) The week in review: The worst forest fires. *Jakarta Post*, Jakarta.
- Margules, C and Pressey, R (2000) Systematic conservation planning. *Nature*, 405, 243-253.
- Mattangkilang, T (2015) Fire engulfs orangutan conservation site in East Kalimantan. In: *Jakarta Globe*, Jakarta.
- Meijaard, E (2015a) Two million hectares of Indonesian forests lost to fires since June. In: *Jakarta Globe*. Jakarta.
- Meijaard, E (2015b) Indonesia fire crisis -- the biggest environmental crime of the 21st century. In: *Jakarta Globe*. Jakarta.
- Meijaard, E (2015c) Getting the facts right on Indonesia's haze problems. In: *Jakarta Globe*, Jakarta.
- MPOB (2012) Malaysian Oil Palm Statistics 2011, 31st Edition. *Malaysian Palm Oil Board, Ministry of Plantation Industries and Commodities*. Malaysia.
- Othman, N (2013) Elephant Conservation and Mitigation of Human-Elephant Conflict in Government of Malaysia-UNDP Multiple-Use Forest Landscapes Project Areas in Sabah. *Gajah*, 39, 19-23.
- Payne, J (1987) Surveying orangutan populations by counting nests from a helicopter: A pilot survey in Sabah. *Primate Conservation*, 8, 92-103.
- Permandu (2010) Economic Transformation Programme: A Roadmap For Malaysia. Kuala Lumpur.
- Phillips, S *et al.* (2009) Sample selection bias and presence-only distribution models: implications for background and pseudo-absence data. *Ecological Applications* (19) 181-197.
- Rist, L *et al.* (2010) The livelihood impacts of oil palm: smallholders in Indonesia. *Biodiversity and Conservation* (19) 1009-1024.
- Roeber, C *et al.* (2013) Functional connectivity within conservation networks: Delineating corridors for African elephants. *Biological Conservation* (157) 128-135.
- Sabah Land Ordinance (2010) State of Sabah Land Ordinance (Sabah Cap.68). Land Ordinance. Kota Kinabalu, Sabah.
- Sabah Wildlife Department (2012) Orangutan Action Plan 2012-2016. Sabah Wildlife Department. Kota Kinabalu, Sabah.
- Sarkar, S *et al.* (2006) Biodiversity conservation planning tools: Present status and challenges for the future. *Annual Review of Environment and Resources*, 31, 123-159.
- Sayer, J *et al.* (2012) Oil palm expansion transforms tropical landscapes and livelihoods. *Global Food Security* (1) 114-119.
- Schwartz, M (2012) Using niche models with climate projections to inform conservation management decisions. *Biological Conservation* (155) 149-156.

- Singleton, I *et al.* (2004) Orang-utan Population and Habitat Viability Assessment: Final Report. IUCN/SSC Conservation Breeding Specialist Group, Apple Valley, MN, USA.
- Sodhi, N *et al.* (2004) Southeast Asian biodiversity: an impending disaster. *Trends in Ecology & Evolution*, 19, 654-660.
- Soehartono, T and Mardiasuti, A. (2001) Kutai National Park: Where to go. *Tropical biodiversity* (7) 83-101.
- UNEP-WCMC (2010) The world database on protected areas (WDPA): annual release. Cambridge, UK.
- Vidal, J (2015) Indonesia's forest fires threaten a third of world's wild orangutans. *The Guardian*. London.
- Wich, S (2008) Distribution and conservation status of the orang-utan (*Pongo* spp.) on Borneo and Sumatra: how many remain? *Oryx* (42) 329-339.
- Wich, S (2012) Understanding the Impacts of Land-Use Policies on a Threatened Species: Is There a Future for the Bornean Orang-utan? *PLoS ONE*, 7, e49142.
- Winter, S (2015) Burning in their home: 20,000 orangutans on verge of being wiped out by raging forest fire. *Daily Express*. London.