

An impact analysis of RSPO certification on Borneo forest cover and orangutan populations

A Borneo Futures report for the Orangutan Land Trust and Wilmar International

Borneo Futures, Bandar Seri Begawan, Brunei Darussalam

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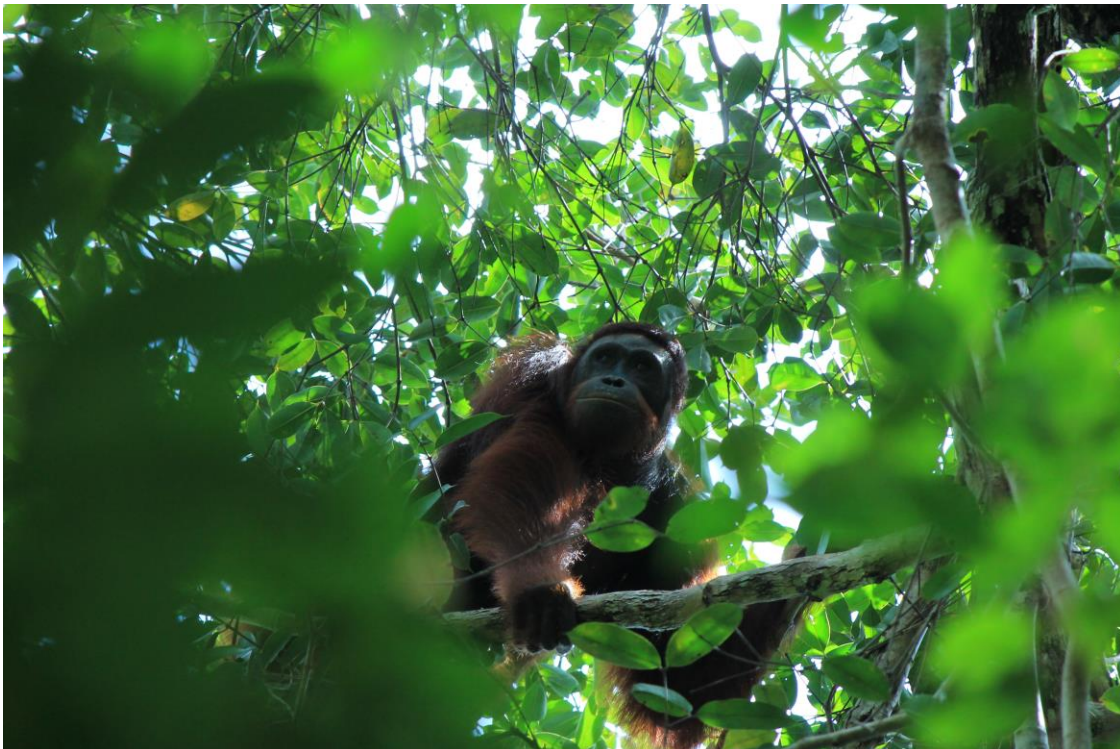
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Executive summary

This report compares deforestation rates between RSPO and non-RSPO oil-palm estates within 2,771 palm-oil estates across the island of Borneo, and the implications of this for orangutan conservation. Out of these 2,717 estates, 20% were inactive in 2016 (i.e., no palm had been planted within the boundaries of the estates and concessions; 8.1% were RSPO members).

In 2015, more than 13.3 million ha had been allocated to the mapped oil-palm estates and concessions across the island (or 17.1% of the total land mass), but only 36.2% of the mapped concessions and estates had been planted with oil-palm (4.8 million ha). 2.8 million ha (or 21.2% of the total) was still forest in 2015. We note that at this stage in the study, a significant number of estates in Sabah have not yet been reliably mapped and that the total area allocated to oil-palm is higher than the 13.3 million ha mentioned in this study.

Our results show that:

- Total loss of intact and logged forest between 2000 and 2015 in RSPO-certified concessions and estates (815,592 ha) was **73,559 ha** (i.e., **9.0%** of total concession area).
- Total loss of intact and logged forest between 2000 and 2015 in concessions and estates that were active and non-RSPO-certified in 2016 was **1,748,123 ha of forest loss** (in 10,152,756 ha of concessions and estates, i.e., **17.2%** of total concessions and estates area).
- Annual forest loss rates in RSPO-certified areas have consistently declined after 2005 (the RSPO cut-off date for deforestation avoidance), **from 13,417 ha per year between November 2005 and November 2007 to 1,839 ha per year after May 2014**, whereas those in non-RSPO areas have stayed consistently higher.
- Overall average planted area for active non-RSPO concessions and estates (41%) is much lower than that for RSPO-certified areas (82%), probably indicating better and more efficient land management and also potentially better resolution of land conflicts.
- Active RSPO-certified concessions and estates retain less forest on average (**4.5% in 2015**) than active non-RSPO areas (**10.9% in 2015**), but forest loss rates between 2000 and 2015 are much higher in non-RSPO areas.

Our analysis also reveals that there is still extensive overlap between oil-palm concessions and estates and orangutan habitats, especially in West and Central Kalimantan, to a lesser extent in East Kalimantan, few in Sabah and apparently none in Sarawak. In 2014, we estimate that **275 orangutans were occurring in 32 RSPO-certified estates, while 9,300 individuals were found in non-RSPO estates**. Between 1999 and 2014, orangutan populations in areas that are now RSPO-certified declined by **34%** from 419 to 275, or about **2.2%** population loss per year. In the same period, orangutan populations in non-certified concessions and estates declined by **31.0%** from 13,480 to 9,302, or about **2.1%** population loss per year. This suggests that the absolute loss of orangutans is significantly lower in RSPO areas on Borneo than in non-RSPO-certified areas, but that relative loss rates are about the same. Nevertheless, RSPO-certified concessions and estates are not yet meeting the target stipulated in P&C 5.2 as orangutan

populations continue to decline in certified plantation areas and improvements need to be made in this regard.

The key challenge to be addressed through the PONGO Alliance is to prevent **the loss of nearly 10,000 orangutans** that currently still occur in Bornean oil-palm areas. There is one sector that is best positioned to do this and that is the palm-oil sector itself. But a number of fundamental changes need to occur for the oil-palm sector to take a more proactive in protecting rather than killing orangutans. RSPO-certified growers remain a minority and most threatened orangutans are in concessions certified by compulsory Indonesian Sustainable Palm Oil (ISPO) and Malaysian Sustainable Palm Oil (MSPO) criteria. Either these criteria are insufficient to prevent deforestation and loss of orangutan habitat or the implementation of certified practices under ISPO and MSPO remains insufficiently audited and corrected. The onus is on **ISPO and MSPO to ensure their certified members adhere to similar practices that reduce environmental impacts as RSPO-certified members.**

Our recommendations are:

- At least 10% of natural forest must be retained and properly managed within oil-palm estate with orangutans. Forests are essential to sustain orangutans and to make the oil-palm cultivation more profitable;
- Land-use planning must avoid high-priority orangutan habitats if the species is to survive in Borneo and Sumatra. Large areas of oil palm concessions in Kalimantan are unplanted. Rather than giving out new licenses, the government should focus on increasing management efficiency;
- Positive outcomes for orangutan conservation will be achieved through careful management of remaining orangutan habitats: companies need to hire qualified environmental staff that can influence decision-making at the plantation level;
- Peat swamp areas, mangroves and floodplains must not be developed for oil-palm production
- For the PONGO Alliance to spearhead this initiative to manage orangutans within an oil-palm landscape via dialogue, practical recommendations and adequate training.

Background

The loss of tropical forest over the past four decades has been mostly attributed to large scale land conversion for industrial agriculture. Within South East Asia, the rapid expansion of oil-palm (*Elaeis guineensis*) crops, particularly in Indonesia and Malaysia, has been correlated with significant declines in tropical forests and biodiversity and has become a major concern for conservation. In Borneo, industrial oil-palm concessions were responsible for 37,000–40,000 km² of forest loss between 1973 and 2015, or between 20 and 22% of total deforestation on the island (Gaveau et al. 2016b). Indonesia and Malaysia are the largest global producers of palm-oil, contributing 53% and 34% respectively to global trade, and governments in these countries consider the industry to be central to development. Having the highest yield of any vegetable oil, palm-oil is a cost effective crop to fulfil rapidly growing global demand for vegetable oils. Given this demand for oils, and the lack of financially viable synthetic alternatives, a shift away from palm-oil would mean the development of larger areas of oil crops and concomitant environmental and social costs elsewhere.

Despite economic benefits, the oil-palm industry is frequently criticized for an array of negative impacts including human labor rights violations, land use conflicts and environmental degradation. Such criticism tends to become especially emotional when oil-palm expansion occurs at the expense of orangutans, the Critically Endangered great ape species of Asia. This negative association with orangutan survival has harmed the public perception of the oil-palm industry, much more so than other industries engaged in vegetable oil production (e.g., maize, rapeseed, coconut or soy). Despite this severe criticism that has been maintained for at least two decades, there is surprisingly limited information available on the overlap between orangutan distribution and palm-oil concessions, and thus the relative contribution that oil-palm plantations make to the decline of orangutans compared to other threats (e.g., hunting, deforestation for small-holder agriculture, fire).

In response to concerns over the industry's sustainability standards, the Roundtable on Sustainable Palm-oil (RSPO) was formed in 2004 by a collective of industry representatives and civil society groups. The RSPO broadly aims to “promote the growth and use of sustainable Palm-oil products through credible global standards and engagement of stakeholders.” Although any interested party can become a RSPO member, RSPO certification can only be achieved by adhering to the 8 operating Principles covering 39 criteria that form the scheme's guidelines. These principles and Criteria (P&C) relate to economic, social and environmental aspects of oil-palm plantation development, management and production. In addition to the P&C, recently launched New Planting Procedures require that all RSPO grower members comply regardless of whether they are currently seeking certification for an estate or concession or not.

Since its initial establishment in 2004, RSPO has grown to represent nearly 3,000 members, certifying 2.83 million hectares of oil-palm plantations, 157,115 ha High Conservation Value forest, and nearly 16 million tons of sustainable palm-oil and palm kernel oil (RSPO 2016), equating to over 20% of global trade. However, despite the initial promise of the certification scheme, RSPO is frequently criticized as a ‘slow bus’ lacking the authority to uphold and regulate standards in the palm-oil industry. As a sign of

this criticism, a well-known orangutan conservation NGO, PanEco, recently resigned from RSPO, citing “sheer level of inaction”.

In 2015, in an attempt to speed up improved management of oil-palm in orangutan habitat, a number of conservation NGOs and palm-oil companies came together and formed the Palm-Oil and NGO (PONGO) Alliance. Its mission is to serve as a collaborative platform that supports managing orangutans within an oil-palm landscape. The PONGO Alliance recognizes that orangutans are increasingly found in oil-palm landscapes, but that they cannot survive in oil-palm alone and need secure forest areas within the oil-palm landscapes. On-the-ground experiments have shown that orangutan populations can survive within such mix landscapes, but it requires commitments from oil-palm estate owners and managers to keep forest set asides and corridors, and ban hunting. It also requires an understanding of the costs and benefits of setting aside and managing forest areas within oil-palm estates. Within RSPO’s compensation procedures there are opportunities for funding such orangutan conservation initiatives.

To start implementing the PONGO Alliance mission, a first necessary step is to clearly delineate where remaining orangutan habitats overlap with oil-palm plantation and specifically with RSPO-certified palm-oil. At the moment such data are not available, further fueling the polarized debate on palm-oil and orangutans that is often fed by disinformation. In addition to understanding where orangutans and responsible palm-oil overlap, there is a need to quantify what RSPO certification means on the ground in terms of protection of High Conservation Value forests and reduction in deforestation levels, compared to non-certified concessions.

This report intends to firstly, evaluate whether RSPO certification is beneficial to orangutans, at a macro level (throughout Borneo) and a micro level through a fine-scale analysis within a well-renowned region for orangutan (in the Kinabatangan, eastern Sabah); and, secondly, share recommendations with the industry to improve the chance of long-term survival of this highly iconic species in oil-palm landscapes.

Methods

Mapping concession boundaries

For Kalimantan, we created a concessions and estates map in ArcGIS 10.0 through the compilation of multiple data sets. First, we obtained a layer of oil-palm concessions developed by the Indonesian Ministry of Agriculture (Kalimantan oil-palm concession shape file 2014) through the World Resources Institute (WRI). Next we obtained shape files for several RSPO-certified concessions and estates from the Sustainable Palm-oil Transparency Toolkit (SPOTT; Zoological Society of London Sustainable Palm-oil Platform (ZSL SPOM)) and from Global Forest Watch (GFW). Additional shape files were obtained from RSPO ACOP reports where available. Names, parent companies and provinces of all 535 oil-palm plantations in Indonesian Borneo were compiled from the Oil-palm Plantation Company directory produced by the Indonesian Bureau of Statistics (2014). From here, we cross-referenced concession and estate names with data included in RSPO ACOP reports, company annual reports and sustainability dashboards hosted by The Forest Trust (TFT). As supply chain certificates are given to Palm-oil Mills (POM), RSPO-certified mills were also mapped along with the estates from which they are supplied.

For Sarawak, we obtained a map of all oil-palm estates through GFW. As with Kalimantan, RSPO-certified estates were identified through RSPO certification certificates and ACOP reports.

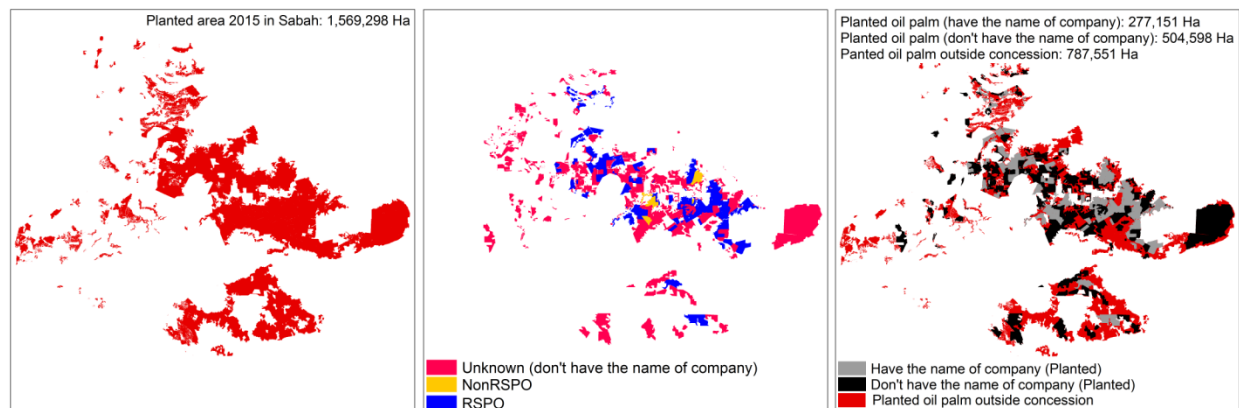


Figure 1. Estate boundary data set for Sabah used in the current study and its relationship to planted oil-palm (Gaveau et al. 2016b)

For Sabah, official government land title/estate data are not publicly available, although some information became viewable online very recently, but remains still not accessible for download. As a result, we used existing digitized cadastral data developed in previous studies, from georeferenced cadastral maps (Abram 2016; Abram et al. 2014). These data covered approximately 50-60% of Sabah. We extracted the commercial land titles (known as Country Lease titles) for oil-palm from these datasets. Some of the digitized estates (but not all) had details such as estate names, company and parent company names, and whether they were certified or members of the RSPO. To identify all RSPO-certified oil-palm estates, we cross-checked and updated with those RSPO-certified estates identified in the ZSL online SPOTT database; and with available RSPO-certified Mill locations downloaded from GFW

(although some of these mills had location errors). If such RSPO estates were missing, we digitized the boundaries and assigned the relevant information into the oil-palm estate dataset. Due to difficulty in acquiring cadastral maps for the remaining areas of Sabah, the oil-palm estate data is incomplete (Figure 1). As a result, our estate data covers around 50% of planted oil-palm in Sabah, although a relatively large proportion of planted oil-palm is under smallholder titles, which we excluded from this study. Of this 50%, 17.7% estates had estate boundaries, estate names/company and parent company names; and 32.2% had estate boundaries but no estate or company details.

Errors and omission in boundaries maps

Because official spatial data on Indonesian and Malaysian concession and estate boundaries are currently not available, we used a range of different sources to generate these datasets. These data introduce error, although we don't know the magnitude of the error nor do we know whether we over- or under-estimate the areas given out for oil-palm development. For Kalimantan, online government data indicate that we may over-estimate the area (Figure 2), but then again it is unclear how accurate the government data are. For example, some of the Indonesian concession boundaries in our dataset may refer to the original *izin prinsip* or *izin lokasi*, rather than the ultimate HGU (Right to Exploit; *Hak Guna Usaha*) or licensed area. We are currently unable to rectify these boundary errors, which would require for the government to make correctly registered cadastral data publicly available. Such errors are also likely to exist in the Sarawak dataset that has been put together from a variety of data sources (see Runting et al. 2015). For Sabah, we attempted to refine estate boundary locations by cross-referencing digitised cadastral data with satellite images, although accuracy can be further improved in this dataset where there was obscurity in either the cadastral maps that were digitised or in the satellite images. Nevertheless, errors on boundary locations are likely relatively small, enabling good spatial and statistical analyses of our deforestation rates and orangutan population trends.

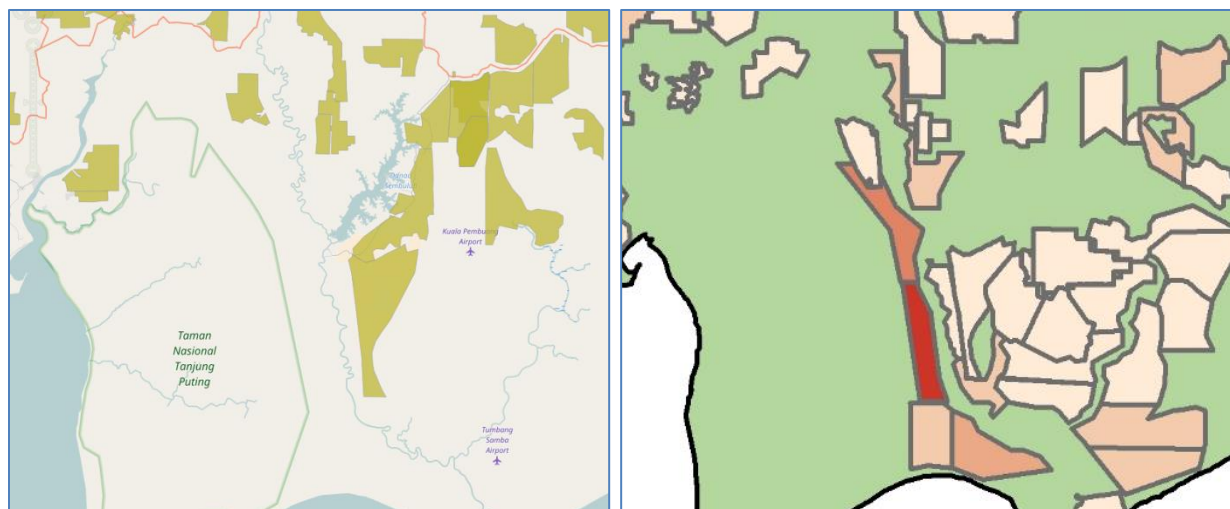


Figure 2. Online concession data made public in graphic format by the Indonesian Ministry of Land and Spatial Planning (peta.bpn.go.id) compared to our concession data set for the same area. The left map shows HGU areas only

Forest cover and deforestation analyses

We determined the decline in forest area for the period 2000 – 2015 combining two published LANDSAT-based datasets: 1) a forest map revealing the area of remaining natural forest in Borneo in year 2000 (Margono et al. 2014) with a Tree Loss map revealing annual losses of trees from January 2001 to December 2015 (Hansen et al. 2013; Hansen et al. 2016). This Tree Loss map does not distinguish between removal of natural and planted trees (Margono et al. 2014). To reduce any error resulting from this ambiguity, we excluded Tree Loss pixels outside of the area occupied by natural forests according to the 2000 Forest map, to only determine losses in natural forest area rather than losses in planted trees. The definition of Forest includes any natural closed-canopy evergreen forest that has remained in sufficiently good condition to be classified as intact or nearly intact forest in the near-infrared, mid-infrared, and red bands of LANDSAT imagery. This definition includes old-growth forest (Dipterocarps and Kerangas on dry mineral soils, on fresh-water and peat swamps as well as mangrove forests), selectively logged forest, and some forest only mildly impacted by ground fires (Gaveau et al. 2014). It excludes young forest regrowth, scrublands, tree plantations, agricultural land, and non-vegetated areas.

Orangutan population trends

We determined orangutan population numbers and population trends in RSPO and non-RSPO oil-palm concessions and estates by using a data set prepared by Santika et al. (in review). This dataset is based on analyses in a Bayesian framework of orangutan nest counts and presence-absence data. The nest count data were obtained from aerial and ground line transect surveys (while the presence-absence data were derived from two survey approaches: 1) recce transects and targeted surveys of nest observations, and 2) interview surveys of direct orangutan sightings. We divided the data into three time periods: 1) 1997-2002, 2) 2003-2008, and 3) 2009-2014, thus providing an analysis of the change in orangutan abundance every six years. This time interval conforms to the minimum inter-birth intervals (the time between consecutive offspring) of female Bornean orangutan (Knott et al. 2009). It also conforms roughly to the time frames of orangutan conservation plan at a national level for Indonesia (Soehartono et al. 2007) and a state level for Malaysia (Sabah Wildlife Department 2012).

We adapted a dynamic population model for integrating count data and presence-absence data of the species. Our model generalizes the negative binomial model for open populations and assumes that abundance patterns are determined by an initial territory establishment process followed by gains and losses resulting from births, mortalities and dispersal. It also accounts for varying detection errors inherited from the different nature of survey data. We assessed orangutan population trends by measuring the change in the total number of individuals. For this, we assessed the relative importance of drivers of orangutan population declines by region relating environmental covariates explaining survival rates in areas where orangutans are predicted to occur with known actual threats observed on Borneo, which includes: 1) habitat fragmentation, i.e. breaking up intact forest habitats into small forest patches, 2) habitat loss, i.e. the loss of natural forest of orangutan habitats due to conversion of forest to agriculture and other types of land-uses, 3) human-orangutan conflicts, and 4) anthropogenic human activities, such as hunting and poaching. For further details of the analysis, refer to Santika et al. (in

review). This model provided 1 x 1 km² density estimates for Borneo across three time periods (1997 – 2002, 2003 – 2008, 2009 – 2014). This data was then overlaid with oil-palm concession data and a spatial correlation performed in Arc GIS (v10).

Fine-scale analysis on RSPO/Non-RSPO oil-palm estates, in Sabah

To get a more detailed picture of whether RSPO estates are meeting environmental/biodiversity related standards of specific RSPOs Principles and Criteria (RSPO 2013), we undertook fine-scale analyses of RSPO, Non-RSPO and estates of unknown status in the Lower Kinabatangan region of eastern Sabah (Figure 3), an area well-regarded for its orangutan population (Ancrenaz et al. 2004; Ancrenaz et al. 2015). For this part of the study, we refined the accuracy of the estate boundaries within the Lower Kinabatangan, to ensure more accurate results, and we similarly excluded titles that were for smallholdings (Native Titles) or State lands (see Figure 3).

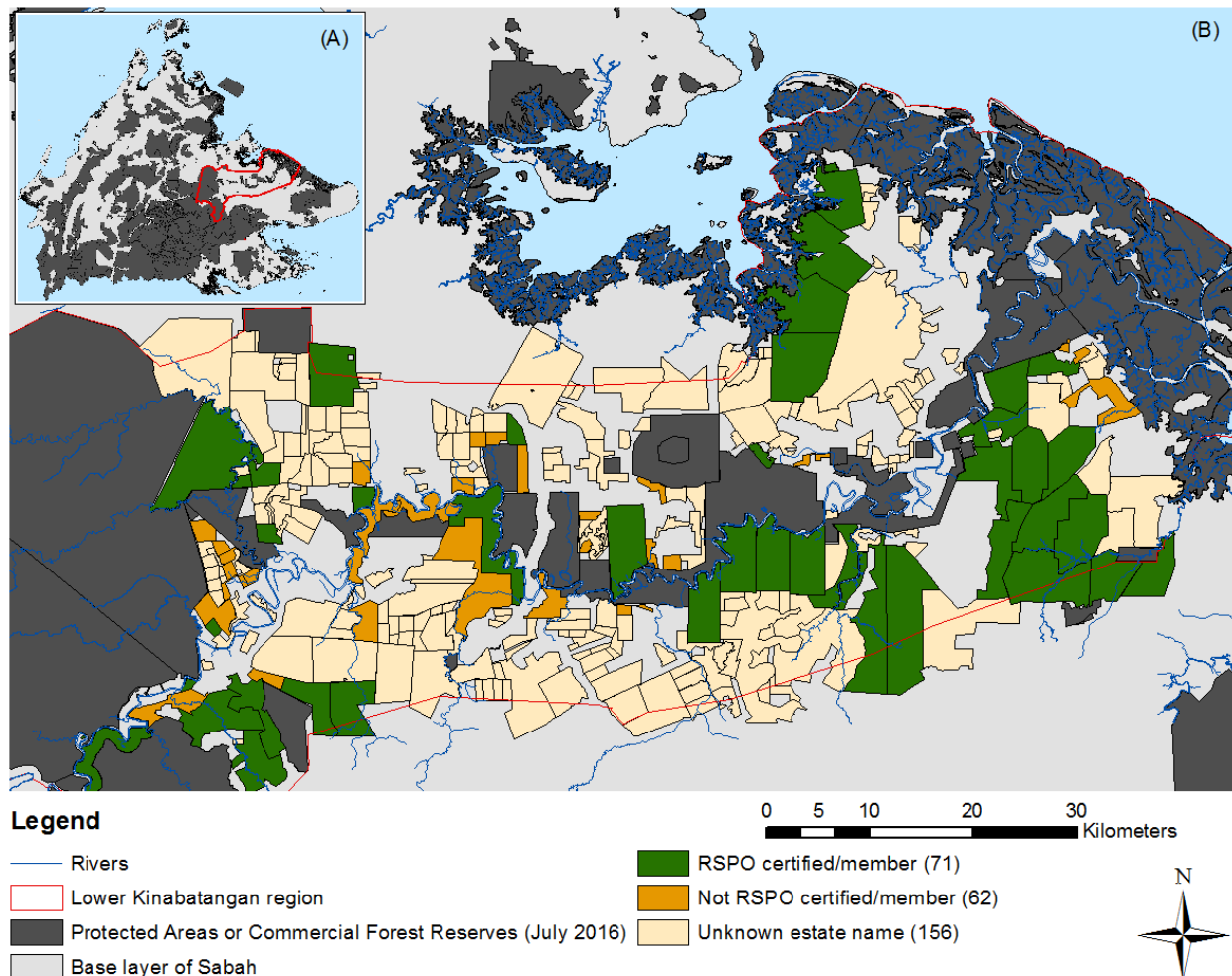


Figure 3. (A) Lower Kinabatangan region in eastern Sabah; (B) Oil-palm estate selected in the Lower Kinabatangan region that have been identified as RSPO certified estates or parent companies of those estates are RSPO members (green), or non-RSPO estates (orange), or estates with unknown information on estate and company names (beige).

Forest loss from 2005 and 2014

To calculate the extent of forest and forest loss for the lower Kinabatangan area, we used forest extent data digitized from satellite images for the years 2005 (Landsat 30 m resolution), and 2014 (SPOT 1.5 m resolution), within ArcGIS 10.3. Forest extent for these years was digitized for the entire region, regardless of whether forested areas were in commercial oil-palm estates; or indeed on other land title types or on state land. For the selected estates, forest for 2005 and 2014 were extracted and forest loss from 2005 was calculated.

High Conservation Values

Orangutan habitat (HCV 1): To identify selected oil-palm estates that had orangutan habitat, we used existing orangutan distribution data developed for the Kinabatangan region, at 1 hectare resolution, for 2010/11 (see Abram 2016). We updated this 2010/11 distribution by extracting overlapping areas with the 2014 forest extent data, and then overlaid the updated 2014 orangutan distribution with the selected oil-palm estate boundaries and calculated the area of orangutan habitat per estate.

Fire: To look at fires in oil-palm estates, we used fire occurrence data for the selected estates in the Kinabatangan from the Global Forest Watch “Southeast Asia NOAA-18 active fires” dataset. These data demonstrated locations of fire hotspots using imagery provided by the NOAA-18 satellite at around a 1km pixel resolution between the dates of 22-10-2014 to 22-12-2016. We overlaid these fire hotspot data with our estate boundaries and calculated the number of estates that had fires.

Protected Areas: We identified which of the selected oil-palm estates border protected areas (PAs), whether fully protected or adjacent to a Forest Reserve that has natural forest management. A simple positive or negative value was assigned to estates, regardless of extent of borders with PAs.

Riparian Reserves: To identify which of the selected estates comply with riparian reserve legislation in the State, we first identified those estates that have rivers running through their boundaries, or rivers that are directly proximal to their boundary. Of these estates, we manually looked at each estate to identify whether there was compliance with State legislation fully in regards to the minimum requirement for width or riparian reserves. We categorized those estates as: Yes, fully complying; partially complying; or, noncompliance.

Slopes, peat and unsuitable areas for oil-palm: To understand the extent of remaining forest on slopes, we used digitized topographic map data at 10 m intervals for Sabah. Using ArcGIS tools, we converted these contour data to slope data (at 90 m resolution) and identified all areas with slopes of 25 degrees and above, and calculated the extent within the selected estates. We then overlaid slope with 2014 forest data to identify the remaining forest on slopes within estates. To identify the extent of soil associations with peat, and how much forest remaining on these areas, we used digitised soil association data developed in the 1970s (Land Resource Division, 1974). Within these data we selected those soil associations with parent material that included peat (i.e., Klias, Sapi, Sipitang, and Weston) and overlaid these with the selected estate boundaries, and 2014 forest extent. Extensive areas of oil-palm failure in the region due to unsuitable conditions have been mapped previously (Abram et al. 2014). We updated these data, originally mapped for 2010/11, using 2014 images to identify failed oil-palm that had

approximately 25% palm capacity or less, typically in seasonal or tidal flood prone areas (see Abram et al. 2014), and overlaid these with the estate boundaries.

High Carbon Stock (HCS) forest

We used an existing carbon stock spatial data developed by Abram et al. (2016). These data were classified into six categories (using metric tons of carbon per hectare i.e. tC/ha): Class 1='<50 tC/ha'; Class 2='50-100 tC/ha'; Class 3='100-200 tC/ha'; Class 4='200-300 tC/ha'; Class 5='300-400 tC/ha'; Class 6='>400 tC/ha. The High Carbon Stock (HCS) threshold proposed to the RSPO is 75 metric tons of carbon per ha (tCha) and above, for above-ground carbon. To identify High Carbon Stock (HCS) in the unprotected forests, we reclassified these six categories to map out areas that are: (1) below, and (2) above the proposed HSC carbon stock value. To determine this we took the mid-point range in Class 2, which is 75 tCha, meaning Classes 1 and 2 were classified as non-HCS forest, and Classes 3 – 6 were classified as HCS forest. We calculated the extent (in ha) and mapped the location of HCS and non-HSC forests in the Kinabatangan region.

Results

Summary data

We mapped a total of 2,771 oil-palm concessions and estates on Borneo, divided across the geographical units of the island as follows: Sabah (1285); North Kalimantan (57); East Kalimantan (211); South Kalimantan (93); Central Kalimantan (414); West Kalimantan (463); and Sarawak (248) (see Figure 4 and Figure 5). We note that this data set is incomplete, as we were unable to map all estates.

Of the 2,771 oil-palm concessions and estates on Borneo, 2,168 were active in 2016 as judged from the presence of planted oil-palm as identified by Gaveau et al. (2016b). The remainder (603; 22% of all mapped) were inactive and had no planted oil-palm in their license area. Inactive concessions and estates are primarily located towards the center of Borneo (Figure 4). Of the 2,771 oil-palm concessions and estates on Borneo, 220 (8%) were RSPO-certified at the time of our study, divided as shown in Table 1 across the geographic units.

Table 1. Number of RSPO and non-RSPO estates on Borneo. Note that Sabah data are incomplete.

Geographic unit	Number of RSPO estates mapped (percentage of total estates mapped in that geographic unit)	Number of active non- RSPO estates (percentage of total estates mapped in that geographic unit)	Number of inactive non- RSPO estates (percentage of total estates mapped in that geographic unit)
Sabah	134 (10.4%)	907 (70.6%)	244 (18.9%)
North Kalimantan	0 (0%)	34 (59.6%)	23 (40.4%)
East Kalimantan	9 (4.2%)	146 (69.2%)	56 (26.5%)
South Kalimantan	23 (24.7%)	41 (44.1%)	29 (32.9%)
Central Kalimantan	35 (8.5%)	285 (68.8%)	94 (22.7%)
West Kalimantan	11 (2.4%)	326 (70.4%)	126 (27.2%)
Sarawak	8 (3.2%)	217 (87.5%)	23 (9.2%)
TOTAL	220 (7.9%)	1956 (70.6%)	595 (21.5%)

The total area of mapped oil-palm concessions and estates on Borneo was 13,327,233 ha in 2015, with an average estate/concession area of 7,778 ha. This equals about 18.1% of the total land area of Borneo.

The total area of planted oil-palm within these concessions and estates was 4,826,296 ha in 2015, which indicates that only about 36.2% of the totally available license areas on Borneo is actually planted with oil-palm. Of the remaining areas of unplanted oil-palm concessions and estates, 2,827,143 ha (21.2 of total) was still forest in 2015. We note that the total area of planted industrial-scale oil-palm on Borneo is 7.9 Mha (Gaveau et al. 2016a), which suggests that 3.07 Mha of industrial-scale oil-palm occurs outside of the estate boundaries that we had available in this study, much of this in Sabah, for which our data set remains incomplete (Figure 5).

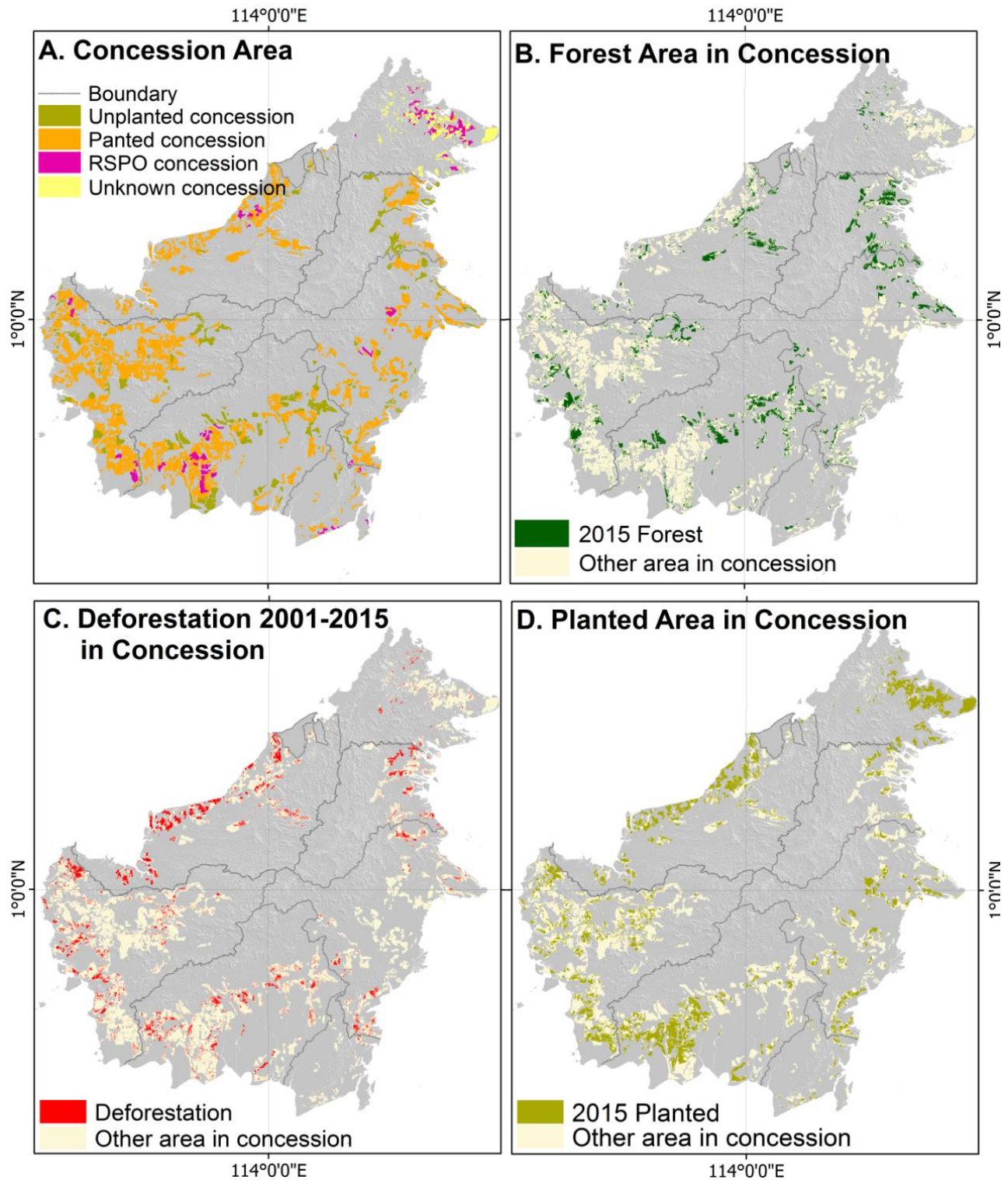


Figure 4. 2015 Land cover in Borneo's oil-palm estates and concessions

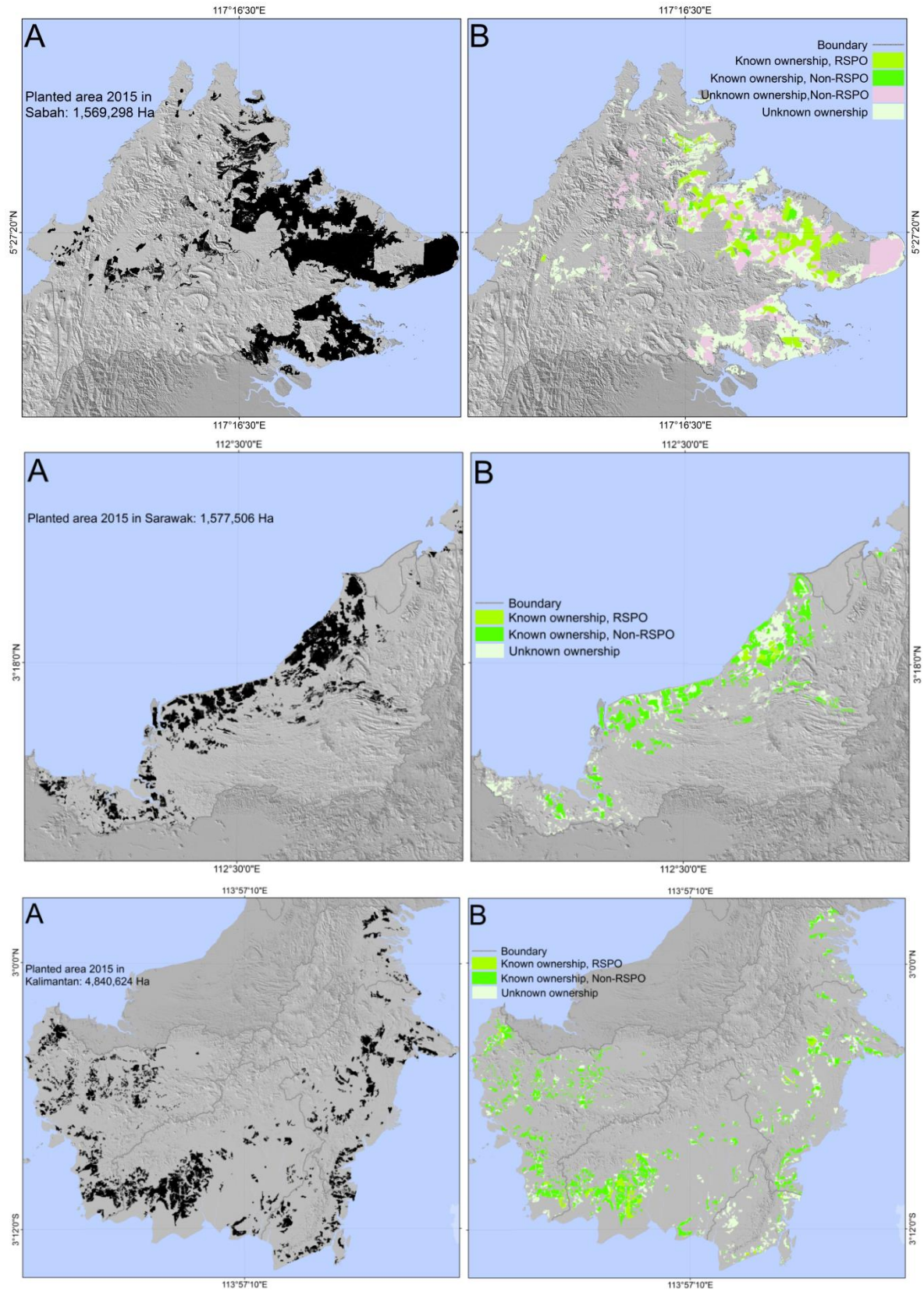


Figure 5. Planted area of oil-palm in Sabah, Kalimantan, and Sarawak (after Gaveau et al. 2016), and the extent to which we could assign ownership.

Of the total area of mapped oil-palm concessions and estates on Borneo (13,327,233 ha), 815,592 ha (6.1% of total) was RSPO-certified in 2016. The area of active, non-RSPO concessions and estates was 10,152,756 ha (76.2% of total). The remainder (2,358,885 ha, or 17.7% of total) were non-active, non-RSPO concessions and estates.

Total loss of intact and logged forest area between 2000 and 2015 in all concessions and estates (13,327,233 ha) was 1,952,537 ha. The deforestation and forest protection rates differ between the RSPO and non-RSPO areas and between active (planted) and inactive (unplanted) areas (Tables 2, 3, and 4).

Table 2. Average percentage forest cover per estate/concession for 2000 and 2015, and total deforestation for RSPO certified concessions in different parts of Borneo for time periods relevant to the RSPO Compensation Mechanism.

Regional units (number of estates or concessions)	Average % Forest 2000	Average % Forest 2015	Average % planted	Total forest loss Nov '05 – Nov'07 (ha)	Total forest loss Nov'07 – Dec '09 (ha)	Total forest loss Jan '10 to May '14 (ha)	Total forest loss after May 9, 2014 (ha)
Sabah (134)	14.30	5.63	92.42	1,203.35	983.92	1,130.26	48.27
North Kalimantan (0)	-	-	-	-	-	-	-
East Kalimantan (9)	0.47	0.19	60.40	19.89	5.85	45.33	3.74
South Kalimantan (23)	2.58	1.07	54.44	250.23	185.55	119.63	322.29
Central Kalimantan (35)	14.14	1.70	78.87	20,788.90	5,684.60	2,862.08	278.99
West Kalimantan (11)	19.34	4.63	50.00	3,850.27	4,950.82	3,984.98	1178.95
Sarawak (8)	6.10	2.22	87.76	722.31	323.50	79.74	7.03
TOTAL	12.64	4.52	82.69	26,834.95	12,134.24	8,222.02	1,839.27
FOREST LOSS PER YEAR				13,417	6,067	2,530	1,839

Total loss of intact and logged forest between 2000 and 2015 in RSPO-certified concessions and estates (815,592 ha) was **73,559 ha** (i.e., **9.0%** of total oil-palm license area). Of this, **49,030 ha** were lost after November 2005, or **about 0.6%** of the total oil-palm license area per year. There is a declining trend in annual forest loss from RSPO concessions and estates after November 2005 from 13,417 ha per year between November 2005 and November 2007 to 1,839 ha per year for the same total oil-palm license area after May 2014.

Table 3. Average percentage forest cover per estate/concession for 2000 and 2015, and total deforestation for active (planted) non-RSPO certified concessions in different parts of Borneo for time periods relevant to the RSPO Compensation Mechanism.

Regional units (number of estates or concessions)	Average % Forest 2000	Average % Forest 2015	Average % planted	Total forest loss Nov '05 – Nov'07 (ha)	Total forest loss Nov'07 – Dec '09 (ha)	Total forest loss Jan '10 to May '14 (ha)	Total forest loss after May 9, 2014 (ha)
Sabah (907)	17.22	7.82	87.48	7,299.09	5,851.14	10,492.77	1,055.65
North Kalimantan (34)	77.42	38.59	36.78	11,734.23	33,769.04	61,702.29	13,377.44
East Kalimantan (146)	36.04	19.98	39.67	25,214.66	25,908.88	82,612.25	18,330.39
South Kalimantan (41)	9.31	6.77	35.87	1,615.07	537.03	1,223.63	637.00
Central Kalimantan (326)	25.45	10.78	52.87	74,377.78	77,541.89	99,435.59	20,386.78
West Kalimantan (326)	25.16	12.03	31.17	52,471.05	105,208.68	229,196.38	65,566.19
Sarawak (217)	52.53	15.16	67.01	91,106.54	175,745.14	171,987.22	13,689.16
TOTAL	25.23	10.86	65.60	263,818.47	424,561.88	656,650.59	133,042.68
FOREST LOSS PER YEAR				131,909.24	212,280.94	202,046.15	133,042

Sabah and Sarawak stand out for having much higher percentages of their estates actually planted with oil-palm (averaging 92.42% and 87.76% respectively). This tends to be much lower in the Kalimantan provinces (varying from 50% to 78.9%). At the same time, Sabah had the highest average percentage of forest set aside within estates (5.63%), whereas this was much lower in most of Kalimantan. This indicates that great parts of Kalimantan's RSPO-certified concessions and estates are neither used for oil-palm development nor forest protection, and instead presumably for small-holder agricultural uses, contested land claims in non-forest areas, burnt areas etc.

Total loss of intact and logged forest between 2000 and 2015 in concessions and estates that were active and non-RSPO certified in 2016 was **1,748,123 ha of forest loss** (in 10,152,756 ha of concession areas, i.e., **17.2%** of total concession area). Of this, **1,478,073 ha** were lost after November 2005, or **about 14.56%** of the total concession area per year. We note the very high rates of forest loss in the recently (2012) established province of North Kalimantan, and also in Sarawak. The trend in annual forest loss from active non-RSPO concessions and estates is not clearly going up or down, with high losses from November 2007 to May 2014 and reduced losses after May 2014.

Similar to the RSPO-certified concessions and estates, Sabah and Sarawak have higher averages for planted areas (87.48% and 67.0% respectively), compared to Kalimantan (between 31.2% and 52.87%). It is noteworthy that the overall averages planted area for active non-RSPO concessions and estates (65.6%) is much lower than that for RSPO certified areas (82.7%), probably indicating better and more efficient land management and also potentially better resolution of land conflicts. On the other hands, RSPO-certified concessions and estates retain less forest on average (4.52% in 2015) than active non-RSPO concession (10.7% in 2015). Then again forest loss rates between 2000 and 2015 are much higher in non-RSPO concession as pointed out above.

Table 4. Average percentage forest cover per estate/concession for 2000 and 2015, and total deforestation for non-active (unplanted) non-RSPO certified concessions in different parts of Borneo for time periods relevant to the RSPO Compensation Mechanism.

Regional units (number of estates or concessions)	Average % Forest 2000	Average % Forest 2015	Average % planted	Total forest loss Nov '05 – Nov'07 (ha)	Total forest loss Nov'07 – Dec '09 (ha)	Total forest loss Jan '10 to May '14 (ha)	Total forest loss after May , 2014 (ha)
Sabah (244)	62.45	55.61	-	394.01	898.13	2697.35	667.90
North Kalimantan (23)	61.37	53.96	-	2,168.61	3,339.93	8,853.97	2,886.86
East Kalimantan (56)	48.71	43.56	-	1,479.71	1,368.66	6,135.28	3,015.30
South Kalimantan (29)	15.35	12.27	-	89.06	178.80	103.35	180.67
Central Kalimantan (94)	46.19	39.01	-	11,637.95	6,479.21	14,984.08	11,949.23
West Kalimantan (126)	19.94	17.44	-	2,124.11	2,974.78	4,566.14	4,544.03
Sarawak (23)	35.64	29.38	-	399.23	689.67	4,145.88	1,242.14
TOTAL	45.72	40.18	-	18,292.70	15,929.18	41,485.98	24,486.13
FOREST LOSS PER YEAR				9,146.35	7,964.59	12,764.92	24,486.13

Total loss of intact and logged forest between 2000 and 2015 in concessions and estates that were inactive and non-RSPO certified in 2016 was **130,854 ha of forest loss** (in 2,358,885 ha, or **6%** of total oil-palm license area). Of this, **100,194 ha** were lost after November 2005. We reiterate that these losses

were not caused by the planting of industrial-type oil-palm, but by other causes like fires and small-scale agriculture.

Forest cover in these non-active plantations is still high (40.2% on average for all of Borneo in 2015), and nearly 1 million ha of forest could potentially be lost if these concessions become active.

Orangutan populations and trends in RSPO and non-RSPO concessions

Our analysis revealed that there is still extensive overlap between oil-palm concessions and orangutan habitats, especially in West and Central Kalimantan, to a lesser extent in East Kalimantan, few in Sabah and apparently none in Sarawak (Figure 6). Some concessions have over 300 orangutans on their land. RSPO-certified concessions make up a small subset of the concessions with orangutans (Figure 7).

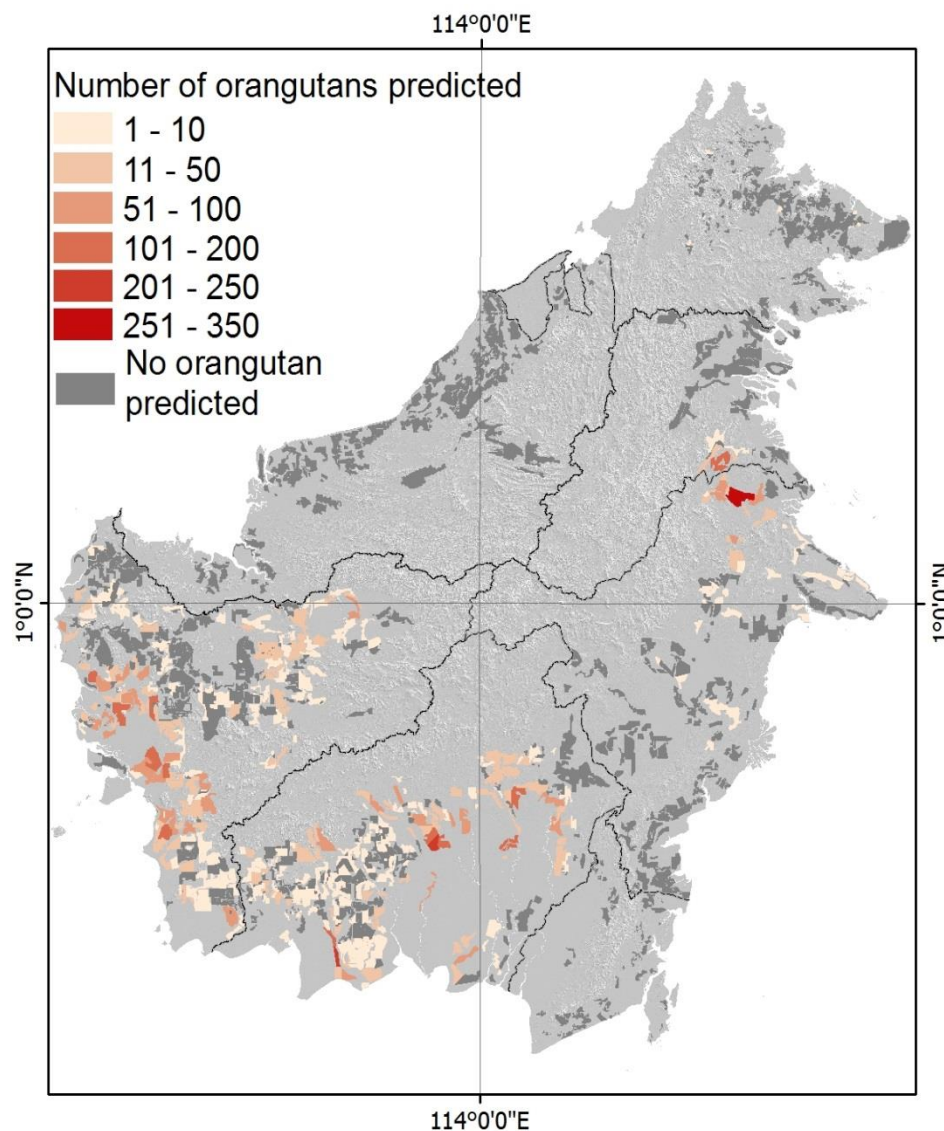


Figure 6. All oil-palm concessions (RSPO and non-RSPO) on Borneo with orangutans. Predicted population numbers per concession as in the legend.

In 2014, an estimated 275 orangutans occurred in 32 RSPO-certified oil-palm concessions and estates (Table 5), and an estimated 9,302 orangutans in the non-RSPO areas. Between 1999 and 2014, orangutan populations in areas that are now RSPO-certified declined by **34%** from 419 to 275, or about **2.2%** population loss per year. In the same period, orangutan populations in non-certified areas declined by **31.0%** from 13,480 to 9,302, or about **2.1%** population loss per year (Figure 8 and Figure 9). This suggests that the absolute loss of orangutans is significantly lower in RSPO concessions and estates on Borneo than in non-RSPO certified areas, but that relative loss rates are about the same.

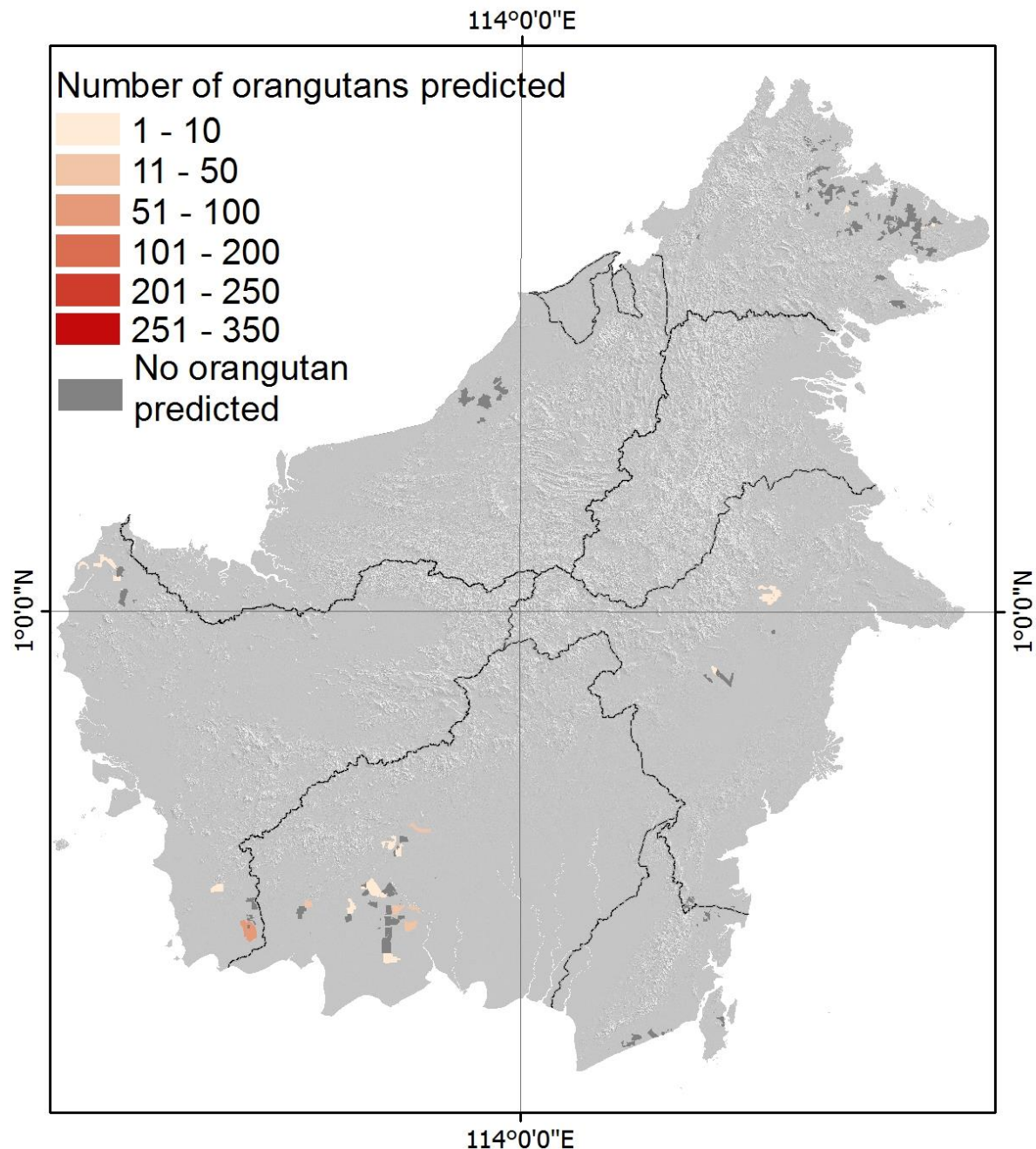


Figure 7. RSPO certified concessions that had orangutans within their boundaries in 2014. Predicted population numbers per concession as in the legend.

Table 5. RSPO concessions and estates where our analysis indicates the presence of orangutans. Population estimates per concession provided for 2003, 2009, and 2014.

Estate Name	# in 2003	# in 2009	# in 2014
Tagas Estate	7	5	5
Litang Estate	6	6	6
Tabin Estate	6	5	4
Tabin Estate 2	3	4	0
Sungai Segama II	3	2	0
Unknown estate	3	0	0
Mayvin Grouping	2	0	0
Sg. Pin Estate	2	0	0
Linbar 1 and 2 Estates	1	1	1
Unknown ?	1	0	0
Rimmer	0	2	0
Dharma Inti Sawit Nugraha	1	2	1
Dewata Sawit Nusantara	1	0	0
Agro Bukit	86	62	50
Globalindo Alam Perkasa	29	34	27
Unggul Lestari	4	0	0
Sukajadi Sawit Mekar	39	45	29
Sawit Sumber Mas Sarana	46	38	29
Bumi Sawit Kencana	1	0	0
Teguh Sempurna	1	0	0
Tapian Nadenggan	2	1	3
Kridatama Lancar	7	2	2
Karya Makmur Bahagia	2	4	7
Bina Sawit Abadi Pratama	35	34	22
Wilmar Sambas Plantation	2	0	0
Agronusa Investama	2	1	0
Kencana Graha Permai	18	10	3
Harapan Sawit Lestari	104	102	82
Indo Sawit	5	0	0
Swakarsa Sinar Sentosa	0	1	1
Rea Kaltim Plantation	0	1	1
Sarana Titian Permata	0	0	2

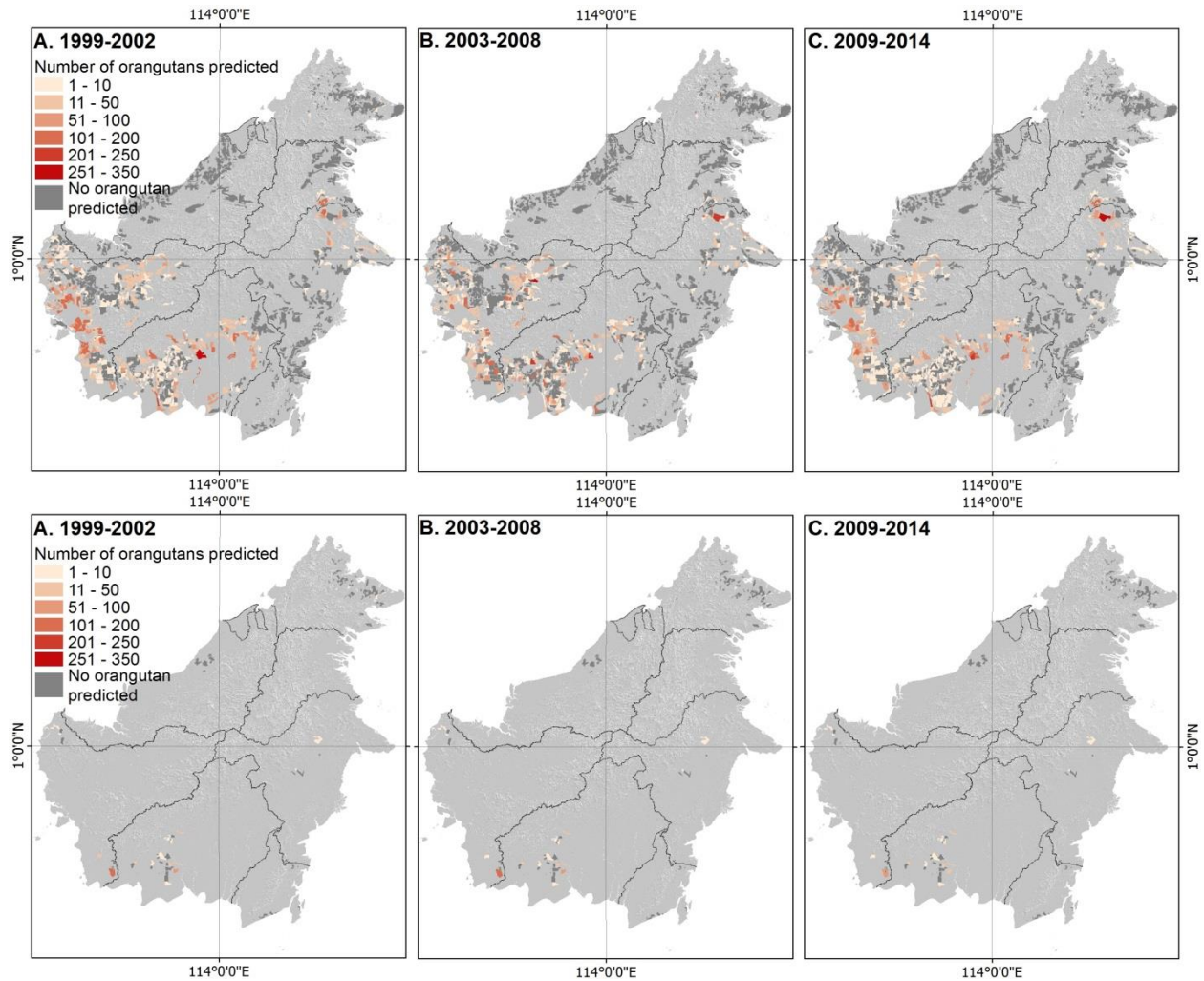


Figure 8. Population trends from 1999 to 2014 for all oil-palm concessions on Borneo (top) and RSPO-certified concessions (bottom).

The predicted orangutan population sizes are based on Bayesian modelling that takes into consideration a various input data (helicopter nest counts, transect nest counts, and interview data) and predictors. Unlike forest cover change which can be directly measured and has small errors, the error in the orangutan populations estimates is less clear. We do know however that these predictions contain some error. For example, we know that the list of RSPO concessions with orangutans misses out some concessions that certainly do have orangutans, such as the Mentaya Sawit Mas concession in Central Kalimantan belonging to the Wilmar group, which has a population of some 30 orangutans (Meijaard et al. 2016a). Also, several RSPO-certified plantations in the Kinabatangan area in Sabah are known to have small numbers of resident or transient orangutans. These populations were however not identified in the current analysis and further more detailed analysis would be required to ensure all RSPO concessions with orangutans are correctly recorded, allowing for targeted management interventions that ensure no further declines in orangutans.

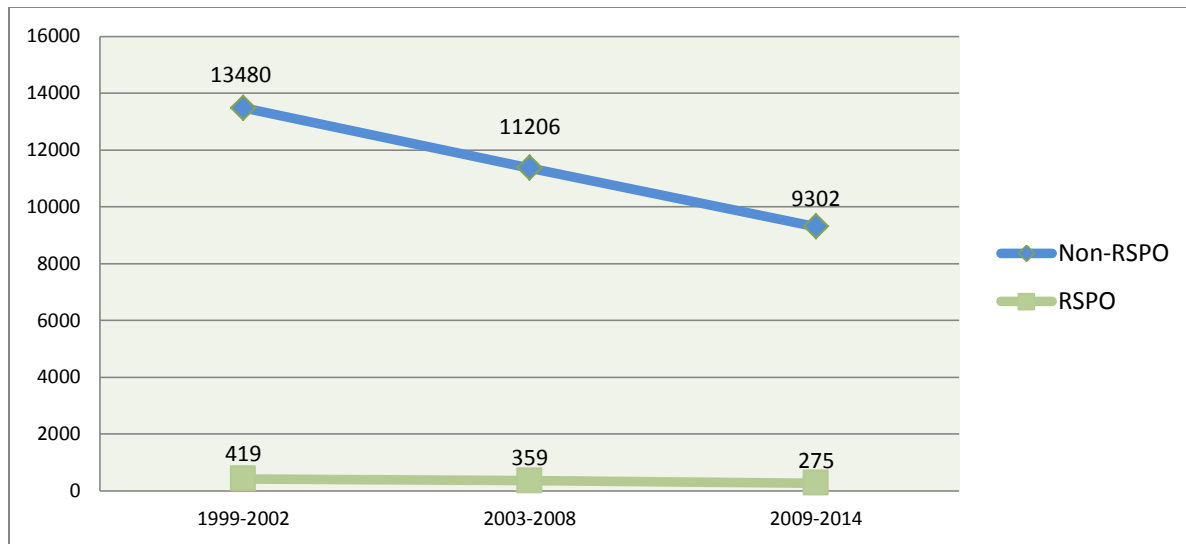


Figure 9. Orangutan population trends in Borneo oil-palm concessions between 1999 and 2014. The top line shows trends for concessions that were not RSPO certified in 2015 and the bottom line RSPO concession.

In Kalimantan, RSPO certified concessions were found to have lower predicted orangutan population sizes than non-certified concessions prior to the implementation of RSPO (i.e., 1999 – 2002). This is not surprising as RSPO certification criteria stipulates that endangered species presence must be “identified and operations managed to best ensure that they are maintained and/or enhanced” (RSPO P&C 5.2). High densities of Orangutan within oil-palm concessions are likely correlated with large portions of intact Forest, the conversion of which would make a concession ineligible for RSPO certification. When controlling for concession size and percent forest loss between 2000 and 2014, **RSPO-certified concessions experience a slower rate of orangutan population decline than non-certified concessions** (Figure 10). Despite this comparative success, RSPO-certified concessions are not meeting the criteria stipulated in P&C 5.2 as orangutan populations continue to decline in certified concessions and improvements need to be made in this regard. Nevertheless, this data suggests that RSPO-certified concessions are better at working towards this outcome than non-certified concessions (Figure 10).

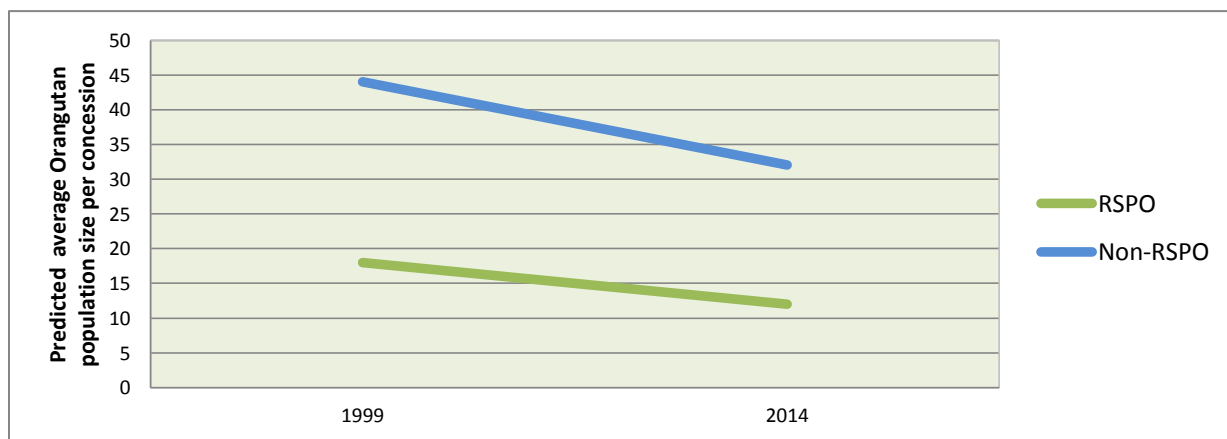


Figure 10. Average change in orangutan population size over time in RSPO certified concessions and non-certified concessions in Kalimantan when controlling for concession size and percent forest loss since 2000.

Fine-scale analysis in the Lower Kinabatangan, Sabah

For the Lower Kinabatangan region, we identified 71 RSPO estates, 62 non-RSPO estates and a further 156 estates with unknown information regarding estate names. In general, RSPO estates were larger than non-RSPO, averaging at 1,443 ha compared with 577 ha (or 489 ha for unknown titles) (Table 6).

The RSPO estates performed better regarding preventing forest loss. We found 14% (689 ha) forest loss from 2005 to 2014 in RSPO estates, compared to 24% (674 ha) in non-RSPO estates, and 26% (1,133 ha) in unknown estates (Figure 11). In a number of non-RSPO estates, forest regeneration had occurred from 2005-2014, contributing 466 ha of secondary forest.

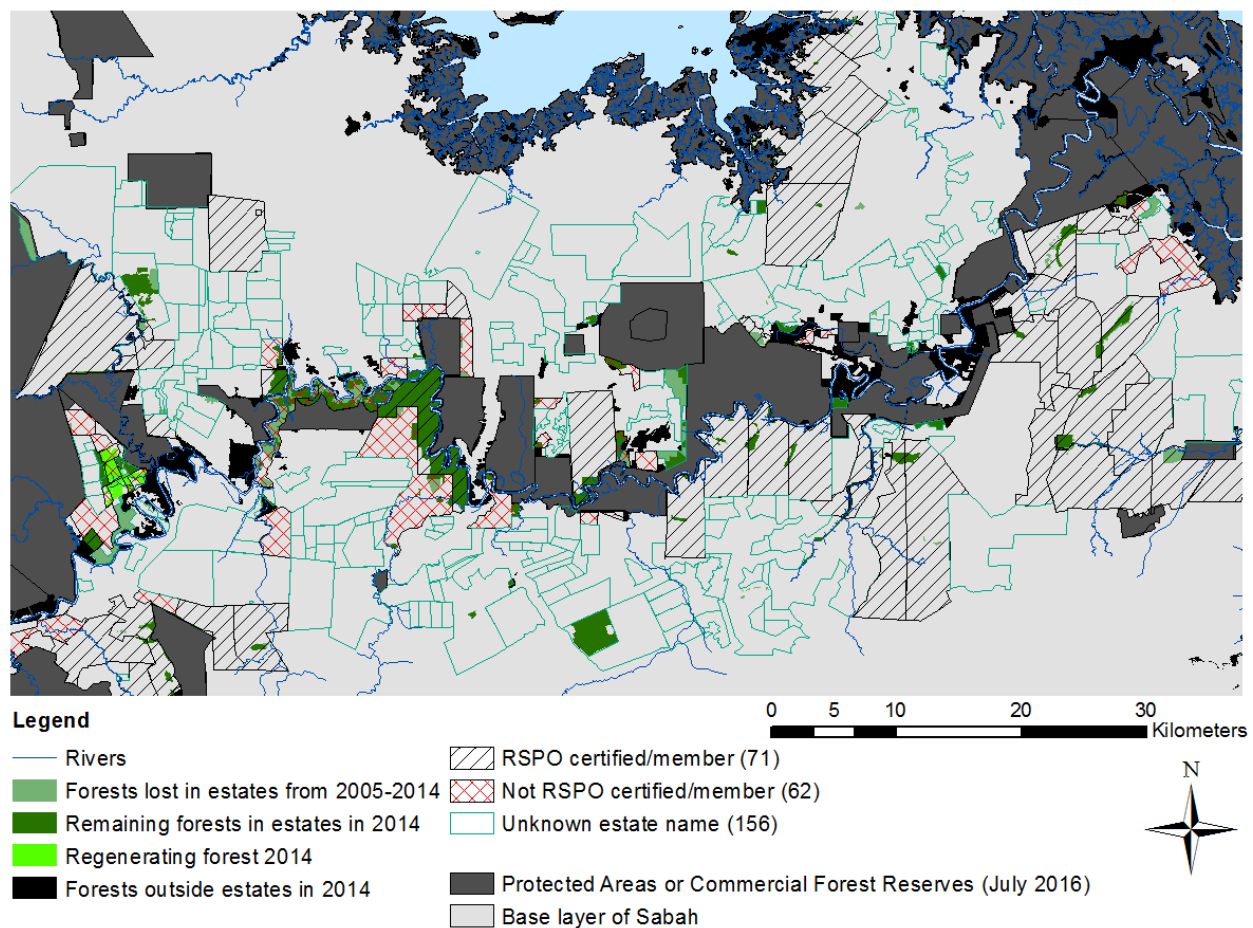


Figure 11. Area of forest loss from 2005-2014 (medium green), and remaining forest (dark green) and regenerating forest (light green) in 2014, within RSPO certified/member estates, non-RSPO estates and other unknown estates; and other forested areas outside of these estates (black).

Within the RSPO estates, we calculated a total of 4,326 ha of forest in 2014, of which 90% was identified as orangutan habitat (Figure 12), and 65% was estimated to have HCS (i.e., above-ground carbon of ≥ 75 tCha) (Table 6). For non-RSPO estates, we identified 1,633 ha of 2014 forest within the estate boundaries, 84% of this was orangutan habitat and 68% was HCS forest. Unknown estates had collectively 3,142 ha of forest in 2014, of which, 57% was orangutan habitat and 37% was classified as HCS forest.

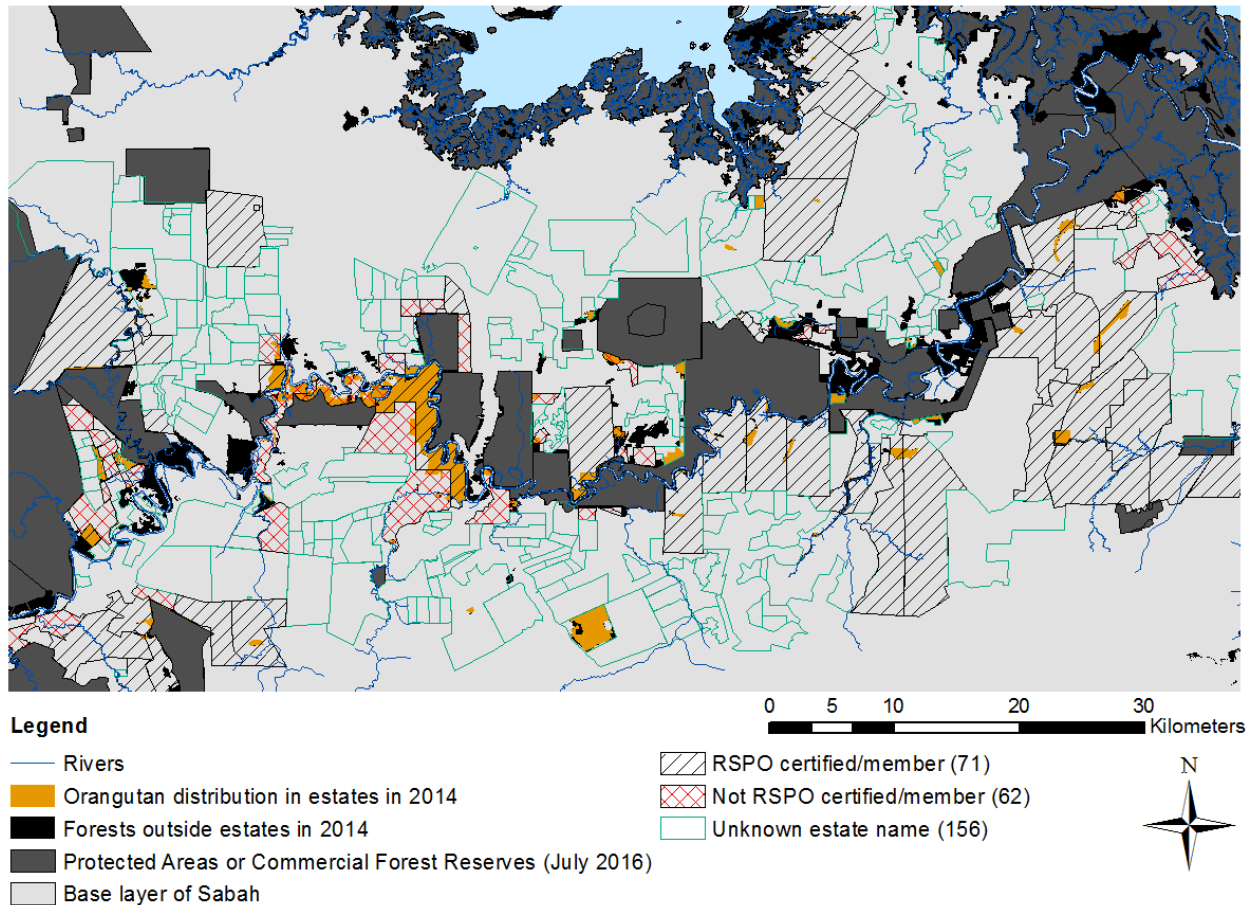


Figure 12. Orangutan habitat (orange) identified in 2014 within RSPO certified/member estates, non-RSPO estates and other unknown estates, additionally with 2014 remaining forest in other areas (black).

Only 10% of forest on slopes ≥ 25 degrees had been converted in RSPO estates by 2014. Generally, however, there were few slopes found in estates in the region, especially in non-RSPO and unknown estate boundaries. For forests associated with peat soils, most had already been lost prior to 2005. Post 2005, however, still saw the conversion of forest on peat with 59% of peat forest removed in RSPO estates from 2005-2014, 26% removed in non-RSPO estates, and 46% in unknown estates. In general, there were few fire events in estates in the region from 2014-2016; two in RSPO and two non-RSPO estates respectively, and four in unknown estates.

For RSPO estates, 46% were adjacent to one or more protected area, whereas for non-RSPO estates 42% bordered a protected area, and 19% for unknown estates. **This demonstrates the need for pro-conservation practices within estates that take into consideration impacts on adjacent protected forests.** Despite legal State requirements, for those RSPO estates that had rivers within or adjacent to them, only 41% had sufficient riparian reserves, 31% had partial riparian areas, and 28% had no riparian areas at all. **Non-RSPO estates seemed to perform better than those associated with RSPO, with 30% of those estates with rivers having riparian reserves and the remaining 70% having partial riparian areas.** For unknown estates, 47% had full riparian areas, 24% had partial, and 29% had none.

For RSPO estates, 38 (of 71) had failed oil-palm within their boundaries totaling 1,827 ha. Using Net Present Value (NPV) estimates from Abram et al. (2014), we estimate annual NPV in the area of failed oil-palm of over US\$ 118,755 (based on values of US\$ 65/ha/year over 25 years). In the non-RSPO estates 1,454 ha in 27 estates, and 1,186 ha in the unknown estates, were identified.

Table 6. Fine-scale summary data of: forest loss, and selected environmental/biodiversity related standards within RSPO P&Cs for RSPO estates, non-RSPO estates, and estates with unknown names.

	RSPO (n = 71)	Non-RSPO (n = 62)	Unknown (n = 156)
Average estate size	1,443 ha	577 ha	489 ha
Total extent of estates	102,433 ha	35,749 ha	76,234 ha
Total forest extent in 2005 (no. estates)	5,015 ha (44)	2,773 ha (33)	4,299 ha (57)
Total forest extent in 2014 (no. estates)	4,326 ha (39)	1,633 ha (27)	3,142 ha (42)
Regenerating forest extent from 2005-2014	0 ha	466 ha (4)	24 ha (3)
> Forest lost in estates from 2005-2014 (% lost)	689 ha (14%)	674 ha (24%)	1,133 ha (26%)
Extent of High Carbon Stock forest (>75 metric tons C/ha) (% of 2014 forest)	2,810 ha (65%)	1,116 ha (68%, excl. regen. forest)	1,182 ha (38%, excl. regen. forest)
Extent of orangutan habitat (% of 2014 forest, excluding regenerating forest)	3,904 ha (90%)	1,367 ha (84%)	1,778 ha (57%)
Extent of slopes of ≥25 degrees (no. estates)	114 ha	2 ha	41 ha
> Forest on slopes ≥25 degrees in 2014 (% lost)	103 ha (10%)	0 ha (100%)	1 ha (98%)
Extent of peat soil association	6,654 ha	3,400 ha	4,751 ha
> Extent of peat forest in 2005	186 ha	275 ha	923 ha
> Extent of peat forest in 2014 (% lost since 2005)	76 ha (59%)	200 ha (26%)	501 ha (46%)
No. estates next to a protected area (% of estates)	33 (46%)	26 (42%)	29 (19%)
Occurrence of fires from 2014 - 2016 (%)	2 (3%)	2 (3%)	4 (3%)
No. of estates adjacent to river (% of estates)	29 (41%)	10 (16%)	17 (11%)
> Estates adjacent to river with riparian reserves (% of estates)	Yes 12 (41%); Partially 9 (31%); Non 8 (28%)	Yes 3 (30%); Partially 7 (70%); Non 0	Yes 8 (47%); Partially 4 (24%); Non 5 (29%)
Extent of failed oil-palm (% of total area in estates; no. of estates)	1,827 (2%; 38)	1,454 (4%; 27)	1,186 (2%; 51)
> Total of NPV based on US \$-65 /ha-yr25)	-\$118,755	-\$94,510	-\$77,090
> Total of NPV based on US \$-299 /ha-yr25)	-\$546,273	-\$434,746	-\$354,614

Discussion

The oil-palm industry on Borneo has been criticized for years for its major environmental impacts, especially by environmental NGOs and conservation advocacy groups. There has been limited nuance in this critique (Meijaard & Sheil 2011), and especially through social media unsupported claims about impacts have done much to damage the reputation of the industry (for example a recent unsupported claim by the Orangutan Foundation International that 5000 orangutans claim annually because of oil palm). Much of this critique is justified: the oil-palm industry on Borneo has been a major driver of deforestation and wildlife losses, especially in Malaysian Borneo, and more recently also in Indonesian Borneo (Gaveau et al. 2016b). Whether or not these impacts are the same for all companies operating in the industry remains a matter of debate, however. There has been a strong push from within the industry to improve environmental practices, especially through RSPO certification, but many of the industry's opponents maintain that there is no such thing as responsible palm-oil and that all palm-oil is associated with high environmental impacts. Our current study is the first to shed some objective light on this issue.

We find that RSPO-certified companies are not free from deforestation, **with 49,030 ha of forest being lost after November 2005 from a total concession area of 815,592 ha**. We cannot determine the extent to which these forests were identified by the company as High Conservation Value forest, for which RSPO requires protection. We can only determine that these forest areas were either old-growth or selectively logged, as determined from medium-resolution satellite imagery, and quite likely contained conservation values. **Forest loss in RSPO concessions declined from 13,417 ha per year between November 2005 and November 2007 to 1,839 ha per year after May 2014**. In 2015, the average percentage forest cover in these RSPO concessions was 4.21%, so the potential for further forest loss was there but seemingly responsible companies have improved their management and forest loss in RSPO concessions appears to increasingly be avoided now.

As opposed to RSPO-certified companies, non-RSPO companies have a far greater impact on forest loss, both in absolute and relative terms. Just looking at active concessions, we identified **a total forest loss of 1,795,408 ha between 2000 and 2015, which is 25 times as much as in RSPO-certified concessions**. Importantly, annual forest loss rates show no clear declining trend, indicating that the non-RSPO certified part of the industry is not attempting to reduce deforestation rates, and has little incentive to do so.

Our preliminary analyses found that, **in 2014, an estimated 275 orangutans occurred in 32 RSPO-certified oil-palm concessions, and an estimated 9,302 orangutans in the non-RSPO concessions**. Between 1999 and 2014, orangutan populations in areas that are now RSPO-certified declined from 419 to 275. In the same period, orangutan populations in non-certified concessions declined from 13,480 to 9,302. This suggests that the absolute loss of orangutans is significantly lower in RSPO concessions on Borneo than in non-RSPO certified concessions, but that relative loss rates are about the same.

The key challenge to be addressed through the current program is to prevent **the loss of nearly 10,000 orangutans** that currently still occur in Bornean oil-palm concessions. There is one sector that is best

positioned to do this and that is the palm-oil sector itself. But a number of fundamental changes need to occur for the oil-palm sector to take a more proactive in protecting rather than killing orangutans.

Fine-scale analysis of RSPO vs non-RSPO estates

In a similar vein to the findings at the Borneo wide level, the fine-scale analyses in the Lower Kinabatangan region, in Sabah, found that forest was lost in RSPO estates from 2005-2014, despite this being prohibited for new plantings of oil-palm (see, RSPO Criteria 7.3). Nevertheless, there was less forest loss in RSPO estates (14%) than non-RSPO (24%) or unknown estates (26%). Many of these forests were identified as being orangutan habitat, and having high carbon stock. These findings further support the notion that although compliance to RSPO standards are not fully met by companies, and improvements are required, in general estates under RSPO seem to have better practices regarding forest conservation and the conservation of orangutan habitat. Although the identified orangutan habitat was very fragmented, ground and aerial surveys in the region have demonstrated the use of these fragments by orangutans, marking these areas critical for facilitating orangutan movement in this highly transformed and mosaic landscape (Ancrenaz et al. 2004; Ancrenaz et al. 2016; Ancrenaz et al. 2015).

According to the Malaysian National Interpretation of RSPO's Principles and Criteria (4.3), oil-palm should not be planted on slopes of 25 degrees and over. Indeed, it seems that RSPO estates are complying, for the most part, with restrictions on planting on slopes, with most slopes still harbouring forest within the identified RSPO estates. For forests associated with peat soils, the majority of peat forest has been lost with only 17% remaining in total from historical extents in the selected estates. We note that estates under RSPO certification may have existing plantings on peat (see, Criteria 4.3) but must manage these areas at least to the standard set out in the '*RSPO Manual on Best management Practices (BMPs) for existing oil-palm cultivation on peat*'. For new plantings however, RSPO prohibits planting on marginal and fragile soil which includes deep peat (Criteria 7.4). Similarly, if there are existing areas of plantings on unsuitable soil with drainage issues, RSPOs P&C guidance suggests ceasing planting after two cycles of crop and rehabilitate the area. Nonetheless, from 2005 to 2014, peat forest continued to be converted with 59% being lost in RSPO estates, with further conversions in non-RSPO estates (26%) and in unknown estates (46%).

Similarly, if there are existing areas of plantings on unsuitable soil with drainage issues, RSPOs P&C guidance suggests ceasing planting after two cycles of crop and rehabilitate the area. On top of this, the Malaysian National Interpretation of RSPO's P&C also stipulates that soil suitability information should be used for planning planting within estates and that unsuitable areas should be zoned, and forest retained for conservation purposes (see Criteria 7.4). Nevertheless, extensive areas of failed oil-palm occur in RSPO certified estates (1,826 ha) with little evidence of these areas being rehabilitated back to forest. Such failed areas were also found in non-RSPO and unknown estates, and these are extensive throughout much of the Kinabatangan landscape according to a previous study (circa 16,000 ha, see Abram et al. 2014). Costs of these areas can be very high, making planting in these areas not only a failure for ensuring biodiversity conservation within these agri-forest mosaic landscapes, but financially costly for all planters.

In regards to mixed agri-forest landscapes, 46% of RSPO estates were adjacent to one or more protected areas, whereas for non-RSPO estates 42% bordered a protected area, and 19% for unknown estates, highlighting the need for pro-conservation practices within estates whether they are RSPO-certified or not. For those estates that had rivers bordering their boundaries or within them, only 41% of RSPO estates had sufficient riparian reserves, 31% of RSPO estates had partial riparian areas, and 28% had no riparian areas at all – despite being legal State requirement under the Sabah Water Resources Enactment (1998). Non-RSPO estates seemed to perform better, with 30% of those estates with rivers having riparian reserves, and the remaining 70% having partial riparian areas. For unknown estates, 47% had full riparian areas, 24% had partial, and 29% had none. Although riparian reserves can and do facilitate wildlife movement through oil-palm plantations, this is not the principal function for riparian reserves. Nevertheless, in regions whereby plantations stretch hundreds of kilometers, narrow riparian areas can serve as a life-line to numerous threatened species (Ancrenaz et al. 2015). Yet, noncompliance of riparian reserves is found throughout much of Sabah's waterways, with little prosecution of companies by the State.

Conclusions and Recommendations

Overall, this analysis reinforces the fact that (except for a few notable exceptions), oil-palm companies largely do not retain enough forest within their estate. Our data show that forest conversion is greater in non-RSPO than in RSPO companies. The debate about retaining forest patches within an agro-industrial landscape is not new: this idea has been discussed at length in many meetings and conferences, and a significant literature exists that show what would be the socio-economic and environmental benefits to do so (see for example Ancrenaz et al. 2016).

What are largely missing though, are practical recommendations to guide field practitioners and managers about what to retain or to restore, where and how. It is beyond the scope of this first report to present detailed practical recommendations to design a more environmentally-friendly landscape within an oil-palm context. However, this report should be seen as a first step toward achieving this goal. Subsequent work should use the results of this report and apply the recommendations given below in a practical oil-palm context.

With RSPO-certified oil-palm areas performing better in terms of avoiding loss of forest and of orangutan habitats than non-RSPO concessions there is a need to either a) expand the number of RSPO-certified concessions and estates, b) ensure that non-RSPO certified companies adhere to principles and criteria that are similar to those required by RSPO; or c) ensure that the currently inactive concessions where most forest remains are not developed for oil-palm. It is unclear which of these three options has a greater chance to avoid near-future destruction of the habitat of some 10,000 orangutans, as much will depend on the political and industry support that would be given to these different options and thus their likelihood of succeeding.

Two sets of recommendations are given below. General recommendations present the overall decision framework that would be necessary to retain viable orangutan populations across oil-palm areas in

Indonesia and Malaysia. More specific recommendations follow, which target what PONGO Alliance could do to move forward.

General Recommendations

1. Retaining forest patches (as set-asides or corridors) within a palm-oil estate should become a priority for the industry. Areas that are planted purely with oil-palm are not suitable for orangutan survival. Only few generalist (and often invasive) species will maintain or increase their number in such a poor landscape. In the contrary, orangutans need forest areas within oil-palm estates to survive. While there are exceptions (Meijaard et al. 2016b), most companies have set aside only small areas of forest, and these are mostly too small for viable populations of orangutans to survive. Forests in oil-palm plantations must be maintained according to HCV (High Conservation Value) and HCS (High Carbon Stock) assessments. As a rule of thumb, the forest cover should represent at least 10% of any plantation (in cases where HCV/HCS areas are less than 10%) (Ancrenaz et al. 2016); forests should be ecologically connected through forested corridors; and they must be protected and managed properly to ensure that: 1) these ecosystems are not encroached; 2) a no-kill policy is enforced and thus orangutans and other wildlife are safe; 3) the forest ecosystem itself is maintained and restored and its overall conditions are improved.
2. Land-use planning must avoid high-priority orangutan habitats if the species is to survive in Borneo and Sumatra. Local, regional and national governments have played and still play today a major role in the demise of orangutans by allocating lands for oil-palm development that overlap with significant existing orangutan habitat. Avoiding forest areas and peatlands that contain viable populations of orangutans is the best way to avoid destroying these populations and impacting the species negatively. More broadly, both governments and the industry must avoid oil-palm developments in sites where the social and environmental costs outweigh the economic, environmental, and societal benefits.
3. Ecological expertise is required to manage orangutan populations in oil-palm areas. Where orangutans and oil-palm overlap, companies can achieve positive outcomes for orangutan conservation through careful management of remaining orangutan habitats. Experience shows that this can only be effective if the companies take on qualified environmental staff that can influence decision-making at plantation level regarding land clearance, spatial planning, and management practices.
4. Peat swamp areas, steep slopes, mangroves and floodplains must not be developed for oil-palm production. Oil-palm needs water to thrive and is often developed in relatively wet areas such as floodplains, mangroves, and peat swamps. However, conversion of forests in such areas leads to increased floods, sub-optimal or negative revenues for oil-palm producers, and negative impacts for local communities living near rivers or floodplains (such as water pollution or collapse of fisheries). Industrial-scale oil-palm should be allocated in areas where flooding risks are limited. Keeping oil-palm out of peat areas is also necessary for reducing carbon emissions and fire and haze problems that are a global and very costly issue.

Recommendations for PONGO Alliance

1. A series of meetings/workshops needs to be conducted to discuss the implications of this analysis with 1) all PONGO Alliance members; 2) RSPO; 3) other partners (including both government of Malaysia and Indonesia; industry players that are not RSPO members; NGOs). These discussions should lead to the development of a series of practical follow-up activities. These could include:
 - a. Determine the best ways to communicate the findings of the current study to national and international media.
 - b. Develop a list of all concessions (RSPO and non-RSPO) that have orangutans on their land, and share this list with authorities in Malaysia and Indonesia providing recommendations about management.
 - c. Work on the ground with a few selected/volunteer companies to identify practical ways to implement the general recommendations to manage an orangutan sub-population at the scale of an estate.
 - d. Develop training videos and toolboxes that can be shared with and used by all companies that have orangutans on their land.
 - e. Send management recommendations to all companies with orangutans. Instruct these companies that they need to manage and that rescue/translocation is only a final resort or emergency measure (or for genetic distribution such as moving a male from time to time).
 - f. Enhance capacities of oil-palm estates to manage orangutans (trainings and capacity building).
2. Communicate progress, innovations and impacts in order to demonstrate benefits of these measures both in terms of protecting forests and orangutans as well as making a business case for more efficient and sustainable management of oil-palm areas.

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Appendix. Estimated land cover change trajectory of RSPO concessions on Borneo

Name	Province	Concession area	Forest area in 2000	Forest area in 2015	Planted oil-palm	Forest Loss Nov '05 – Nov'07 (Ha)	Forest Loss Nov'07 – Dec '09 (Ha)	Forest Loss Jan '10 – May '14 (Ha)	Forest Loss After May 9, 2014 (Ha)
Agro Bukit	C Kal	15,390.25	10,180.26	35.13	14,805.48	9,394.64	127.88	136.87	7.67
Agronusa Investama	W Kal	9,661.16	6,651.82	1,306.11	7,336.70	1,742.34	1,142.87	336.99	32.20
Agronusa Investama	W Kal	5,664.26	797.10	297.46	3,990.58	249.71	141.81	40.75	6.25
Mentaya Sawit Mas	C Kal	17,324.38	1,219.32	994.50	8,700.12	54.28	45.54	38.86	14.46
Swakarsa Sinar Sentosa	E Kal	16,881.21	0.00	0.00	15,077.83	0.00	0.00	0.00	0.00
Dharma Inti Sawit Nugraha	E Kal	9,809.58	0.00	0.00	8,915.58	0.00	0.00	0.00	0.00
Rea Kaltim Plantation	E Kal	4,537.20	0.00	0.00	2,395.52	0.00	0.00	0.00	0.00
Rea Kaltim Plantation	E Kal	13,612.53	21.94	20.14	5,653.08	0.00	0.00	0.00	0.00
Rea Kaltim Plantation	E Kal	2,952.15	0.00	0.00	2,158.31	0.00	0.00	0.00	0.00
Rea Kaltim Plantation	E Kal	4,520.84	157.69	45.36	1,026.34	19.89	5.85	45.33	3.74
Sawit Sumber Mas Sarana	C Kal	194.12	51.93	8.18	167.61	0.04	0.00	0.56	0.00
Maju Aneka Sawit	C Kal	1,497.31	1.98	1.98	972.71	0.00	0.00	0.00	0.00
Maju Aneka Sawit	C Kal	3,089.49	693.01	101.92	2,151.37	459.68	36.54	61.87	32.93
Maju Aneka Sawit	C Kal	6,255.74	931.16	70.27	4,779.18	753.41	30.50	60.02	9.67
Sukajadi Sawit Mekar	C Kal	697.84	0.00	0.00	688.72	0.00	0.00	0.00	0.00
Unggul Lestari	C Kal	14,655.37	3,813.93	399.22	11,021.00	801.07	1,432.19	1,069.36	5.01
Agro Indomas	C Kal	225.31	0.00	0.00	218.33	0.00	0.00	0.00	0.00
Agro Indomas	C Kal	46.11	0.00	0.00	39.79	0.00	0.00	0.00	0.00
Agro Indomas	C Kal	408.49	0.00	0.00	397.14	0.00	0.00	0.00	0.00
Kerisawit Indonesia	C Kal	18,957.43	2,198.96	74.05	17,777.53	236.31	100.34	50.19	9.23
Sukajadi Sawit Mekar	C Kal	12,349.19	3,929.65	149.10	10,118.86	3,096.08	436.26	136.53	63.79
Sawit Sumber Mas Sarana	C Kal	7,516.89	1,462.85	113.68	6,879.33	75.36	277.85	25.90	0.05
Indotruba Tengah	C Kal	5,878.43	1.49	0.00	5,660.97	0.69	0.01	0.00	0.00
Indotruba Tengah	C Kal	712.25	0.00	0.00	540.46	0.00	0.00	0.00	0.00
Sawit Sumber Mas Sarana	C Kal	12,822.99	6,771.46	110.62	12,535.93	474.49	2,012.36	269.46	1.90
Teguh Sempurna	C Kal	12,029.13	0.00	0.00	10,329.39	0.00	0.00	0.00	0.00

Agro Indomas	C Kal	299.73	0.00	0.00	299.74	0.00	0.00	0.00	0.00
Sarana Titian Permata	C Kal	19,056.23	911.23	24.80	18,137.06	736.93	104.79	36.78	0.00
Mustika Sembuluh	C Kal	4,735.89	1,054.55	30.30	4,705.60	158.78	8.10	29.39	2.39
Mustika Sembuluh	C Kal	7,251.78	1,202.56	29.01	6,836.69	97.47	1.09	6.74	0.54
Mustika Sembuluh	C Kal	8,433.99	138.76	51.01	5,588.42	33.61	0.00	29.24	24.90
Karya Makmur Bahagia	C Kal	10,574.46	1,662.61	74.40	2,656.91	1,127.65	88.27	312.08	5.72
Teguh Sempurna	C Kal	4,544.20	248.03	0.00	4,522.94	204.14	0.00	0.00	0.00
Kridatama Lancar	C Kal	2,410.42	740.18	24.88	1,429.84	385.19	206.82	101.34	0.36
Tapian Nadenggan	C Kal	12,728.64	1,169.65	202.32	11,797.89	200.56	246.16	120.24	18.27
Kridatama Lancar	C Kal	16,993.44	1,247.25	20.42	16,427.14	1,001.15	162.72	59.36	0.00
Karya Makmur Bahagia	C Kal	9,038.78	35.20	0.00	6,596.47	0.00	8.19	20.54	0.00
Bina Sawit Abadi Pratama	C Kal	11,126.04	8,088.76	3,283.35	6,404.48	1,479.64	349.63	291.76	82.12
Sukajadi Sawit Mekar	C Kal	2,406.20	0.00	0.00	2,211.12	0.00	0.00	0.00	0.00
Sukajadi Sawit Mekar	C Kal	7,245.75	51.22	5.62	6,512.18	11.97	9.36	5.01	0.00
Buana Artha Sejahtera	C Kal	6,568.73	10.80	0.00	6,478.01	5.76	0.00	0.00	0.00
Swadaya Andika	S Kal	493.45	0.00	0.00	116.10	0.00	0.00	0.00	0.00
Smart Corporation	S Kal	7,555.52	1.54	0.94	4,352.18	0.00	0.00	0.60	0.00
Smart Corporation	S Kal	7,003.29	129.37	80.76	1,248.35	21.51	12.25	6.57	1.35
Sajang Heulang	S Kal	1,624.80	26.66	24.95	1,528.92	0.00	0.00	1.53	0.18
Sajang Heulang	S Kal	56.89	0.00	0.00	31.18	0.00	0.00	0.00	0.00
Sajang Heulang	S Kal	150.48	0.00	0.00	114.67	0.00	0.00	0.00	0.00
Laguna Mandiri	S Kal	88.72	0.00	0.00	76.04	0.00	0.00	0.00	0.00
Laguna Mandiri	S Kal	89.19	0.00	0.00	78.33	0.00	0.00	0.00	0.00
Laguna Mandiri	S Kal	266.03	0.57	0.57	184.34	0.00	0.00	0.00	0.00
Laguna Mandiri	S Kal	93.74	0.00	0.00	79.54	0.00	0.00	0.00	0.00
Bersama Sejahtera Sakti	S Kal	110.59	0.00	0.00	109.04	0.00	0.00	0.00	0.00
Bersama Sejahtera Sakti	S Kal	1,070.12	77.62	25.44	466.26	16.68	7.27	6.71	0.23
Bersama Sejahtera Sakti	S Kal	3,849.17	243.64	198.91	1,366.14	9.36	1.95	4.23	24.02
Gawi Makmur Kalimantan	S Kal	7,296.54	351.13	245.85	4,171.16	2.98	0.00	15.63	16.20
Kencana Graha Permai	W Kal	14,396.42	1,228.33	65.06	9,157.37	83.39	918.25	97.00	5.32

Harapan Sawit Lestari	W Kal	35,071.24	9,664.93	3,020.82	23,487.81	1,432.99	915.52	2,671.61	1,067.14
Harapan Sawit Lestari	W Kal	1,356.38	523.85	148.59	882.98	188.83	123.69	16.48	10.93
Harapan Sawit Lestari	W Kal	9,766.73	2.61	2.61	3,154.51	0.00	0.00	0.00	0.00
Harapan Sawit Lestari	W Kal	448.51	0.00	0.00	245.93	0.00	0.00	0.00	0.00
Harapan Sawit Lestari	W Kal	4,537.76	7.16	6.46	2,795.31	0.00	0.70	0.00	0.00
Langgeng Muara Makmur	E Kal	832.66	0.00	0.00	165.48	0.00	0.00	0.00	0.00
Langgeng Muara Makmur	S Kal	4,149.31	119.67	69.07	2,585.51	25.56	17.74	3.24	0.82
Langgeng Muara Makmur	S Kal	1,935.09	329.04	27.18	1,315.15	124.70	89.30	44.10	16.50
Dewata Sawit Nusantara	E Kal	9,248.94	54.25	54.25	8,326.97	0.00	0.00	0.00	0.00
Tapian Nadenggan	E Kal	2,488.72	0.00	0.00	1,575.96	0.00	0.00	0.00	0.00
Sajang Heulang	S Kal	200.67	12.32	5.74	166.46	0.00	0.00	5.24	1.35
Sajang Heulang	S Kal	328.99	0.57	0.00	320.49	0.57	0.00	0.00	0.00
Sajang Heulang	S Kal	217.44	1.60	1.42	119.45	0.00	0.00	0.09	0.09
Mitra Inti Sejati Plantation	W Kal	15,329.44	2,490.58	412.12	9,069.46	138.16	1,007.08	792.95	48.83
Suai	Sarawak	5,360.41	36.37	6.40	4,975.55	1.36	14.51	1.02	0.00
Rajawali	Sarawak	3,384.92	115.85	73.08	1,492.05	0.00	0.00	38.51	1.86
Derawan	Sarawak	19,340.65	365.01	82.29	17,126.49	31.31	219.41	5.66	0.09
Saremas I	Sarawak	9,630.35	1,700.58	409.44	8,967.44	304.24	18.92	20.80	5.07
Keresia Plantation	Sarawak	4,411.92	486.05	37.11	4,329.61	287.64	0.00	0.28	0.01
Layang Estate	Sarawak	21,646.96	1,046.54	926.55	20,403.92	46.68	6.92	10.86	0.00
Saremas Ii (Kaminsky)	Sarawak	4,733.81	197.52	24.55	4,703.24	51.08	63.74	2.61	0.00
Segarmas	Sarawak	4,500.23	230.95	230.95	4,129.84	0.00	0.00	0.00	0.00
Sime Darby	Sabah	2,200.18	0.00	0.00	2,200.18	0.00	0.00	0.00	0.00
Sime Darby	Sabah	413.97	0.00	0.00	413.90	0.00	0.00	0.00	0.00
Ioi Corporation Bhd.	Sabah	4,942.42	34.84	34.83	4,869.14	0.00	0.00	0.00	0.00
Ioi Corporation Bhd.	Sabah	2,621.36	0.00	0.00	2,619.65	0.00	0.00	0.00	0.00
Ioi Ladang Sabah Grouping	Sabah	2,317.60	8.21	6.51	2,311.00	0.00	0.00	0.00	0.00
Ppb Oil-palm Berhad	Sabah	8,482.43	261.86	1.88	8,237.67	108.18	44.74	35.56	1.13
Ioi Corporation Bhd.	Sabah	201.31	0.00	0.00	201.31	0.00	0.00	0.00	0.00
Very Good Estate Sdn Bhd	Sabah	89.35	0.00	0.00	43.98	0.00	0.00	0.00	0.00

Very Good Estate Sdn Bhd	Sabah	2,515.96	0.00	0.00	2,515.95	0.00	0.00	0.00	0.00
Carotino Sdn. Bhd. - Asia Pom	Sabah	2,346.23	0.00	0.00	2,346.24	0.00	0.00	0.00	0.00
Melewar Pom	Sabah	324.45	0.00	0.00	324.46	0.00	0.00	0.00	0.00
Felda Global Ventures	Sabah	2,559.87	15.32	15.30	2,535.54	0.00	0.00	0.02	0.00
Felda Global Ventures	Sabah	1,958.72	8.27	8.23	1,942.65	0.00	0.00	0.00	0.00
Felda Global Ventures	Sabah	2,066.00	11.87	11.87	2,046.43	0.00	0.00	0.00	0.00
Felda Global Ventures	Sabah	2,185.98	0.55	0.55	2,183.02	0.00	0.00	0.00	0.00
Felda Global Ventures	Sabah	2,001.70	3.67	2.80	1,994.52	0.00	0.00	0.00	0.00
Genting Plantations Bhd.	Sabah	1,627.97	0.33	0.33	1,625.74	0.00	0.00	0.00	0.00
Melewar Pom	Sabah	3,990.14	0.00	0.00	3,990.14	0.00	0.00	0.00	0.00
Melewar Pom	Sabah	207.22	0.00	0.00	207.22	0.00	0.00	0.00	0.00
Melewar Pom	Sabah	1,904.32	0.00	0.00	1,904.32	0.00	0.00	0.00	0.00
Unknown	Sabah	192.28	0.00	0.00	192.27	0.00	0.00	0.00	0.00
Melewar Pom	Sabah	94.70	0.00	0.00	94.70	0.00	0.00	0.00	0.00
Melewar Pom	Sabah	205.81	0.00	0.00	205.81	0.00	0.00	0.00	0.00
Carotino Sdn. Bhd. - Asia Pom	Sabah	2,886.30	0.00	0.00	2,886.29	0.00	0.00	0.00	0.00
Genting Plantations Bhd	Sabah	4,765.68	6.43	0.00	4,765.67	4.76	0.00	0.00	0.00
Morisem Plantations Sdn Bhd	Sabah	2,026.91	0.00	0.00	2,021.52	0.00	0.00	0.00	0.00
Hap Seng Plantations Holdings Berhad	Sabah	3,154.28	0.00	0.00	3,110.46	0.00	0.00	0.00	0.00
Hap Seng Plantations Holdings Berhad	Sabah	3,245.45	4.19	3.83	3,196.28	0.00	0.00	0.36	0.00
Ladang Asas Sdn Bhd	Sabah	1,221.90	0.00	0.00	1,221.89	0.00	0.00	0.00	0.00
Hap Seng Plantations Holdings Berhad	Sabah	2,762.24	0.00	0.00	2,762.24	0.00	0.00	0.00	0.00
Ba Plantations Sdn Bhd	Sabah	1,763.71	0.00	0.00	1,763.71	0.00	0.00	0.00	0.00
Malbumi Group	Sabah	1,597.74	0.00	0.00	1,597.73	0.00	0.00	0.00	0.00
Sime Darby	Sabah	3,548.94	0.00	0.00	3,548.96	0.00	0.00	0.00	0.00
Sime Darby	Sabah	2,089.94	36.38	36.38	2,030.56	0.00	0.00	0.00	0.00
Kuala Lumpur-Kepong (Sabah) Sdn Berhad	Sabah	2,023.17	0.00	0.00	2,023.16	0.00	0.00	0.00	0.00
Unknown	Sabah	652.18	1.42	0.00	651.24	0.04	1.26	0.12	0.00
loi Ladang Sabah Grouping	Sabah	366.85	0.00	0.00	366.86	0.00	0.00	0.00	0.00

Ioi Ladang Sabah Grouping	Sabah	258.03	0.78	0.12	255.99	0.00	0.00	0.33	0.33
Ppb Oil-palm Berhad	Sabah	4,600.95	0.72	0.00	4,573.16	0.00	0.00	0.00	0.00
Ioi Corporation Bhd - Mayvin Pom	Sabah	582.13	0.00	0.00	582.13	0.00	0.00	0.00	0.00
Kwantas Plantation Sdn Bhd	Sabah	1,485.42	114.55	76.92	1,315.66	27.91	0.00	0.00	0.00
Unknown	Sabah	157.67	150.71	143.03	3.04	2.77	0.00	0.00	0.00
Hap Seng Plantations Holdings Berhad	Sabah	2,597.04	0.00	0.00	2,597.04	0.00	0.00	0.00	0.00
Ioi Corporation Bhd - Mayvin Pom	Sabah	2,299.46	0.00	0.00	2,299.45	0.00	0.00	0.00	0.00
Kuala Lumpur-Kepong (Sabah) Sdn Berhad	Sabah	2,606.71	0.00	0.00	2,606.70	0.00	0.00	0.00	0.00
Very Good Estate Sdn Bhd	Sabah	1,959.60	443.91	79.54	1,875.56	0.00	4.34	11.69	0.00
Genting Plantations Bhd	Sabah	3,421.07	0.00	0.00	3,408.14	0.00	0.00	0.00	0.00
Sime Darby	Sabah	2,391.33	0.00	0.00	2,391.34	0.00	0.00	0.00	0.00
Pine Capital Sdn Bhd	Sabah	1,355.83	161.69	6.13	1,347.40	0.00	0.00	0.00	0.00
Pr Enterprise Sdn Bhd	Sabah	1,998.89	163.20	160.95	1,712.19	0.00	0.00	2.25	0.00
Ba Plantations Sdn Bhd	Sabah	2,131.36	0.00	0.00	2,001.06	0.00	0.00	0.00	0.00
Morisem (Sabah) Sdn Bhd	Sabah	1,952.97	0.00	0.00	1,952.97	0.00	0.00	0.00	0.00
Sime Darby	Sabah	3,185.18	9.60	7.65	3,165.94	1.95	0.00	0.00	0.00
Unknown	Sabah	169.51	0.00	0.00	169.51	0.00	0.00	0.00	0.00
Kwantas Plantation Sdn. Bhd.	Sabah	87.18	0.00	0.00	87.19	0.00	0.00	0.00	0.00
Very Good Estate Sdn Bhd	Sabah	2,145.21	436.86	163.11	1,970.80	0.00	0.00	0.27	0.27
Very Good Estate Sdn Bhd	Sabah	2,020.80	0.00	0.00	2,020.80	0.00	0.00	0.00	0.00
Very Good Estate Sdn Bhd	Sabah	1,930.96	0.00	0.00	1,930.97	0.00	0.00	0.00	0.00
Very Good Estate Sdn Bhd	Sabah	1,803.30	0.00	0.00	1,803.29	0.00	0.00	0.00	0.00
Melewar Pom	Sabah	190.96	0.00	0.00	190.96	0.00	0.00	0.00	0.00
Carotino Sdn. Bhd. - Asia Pom	Sabah	220.52	0.00	0.00	220.52	0.00	0.00	0.00	0.00
Priceland Sdn Bhd	Sabah	2,087.18	0.00	0.00	2,087.19	0.00	0.00	0.00	0.00
Carotino Sdn. Bhd. - Asia Pom	Sabah	3,883.30	0.00	0.00	3,883.29	0.00	0.00	0.00	0.00
Very Good Estate Sdn Bhd	Sabah	1,950.14	0.00	0.00	1,950.14	0.00	0.00	0.00	0.00
Ioi Ladang Sabah Grouping	Sabah	1,910.31	0.00	0.00	1,910.32	0.00	0.00	0.00	0.00
Ioi Ladang Sabah Grouping	Sabah	3,576.34	0.00	0.00	3,533.01	0.00	0.00	0.00	0.00

Ioi Ladang Sabah Grouping	Sabah	1,203.46	0.99	0.99	1,190.70	0.00	0.00	0.00	0.00
Unknown	Sabah	117.88	0.00	0.00	117.88	0.00	0.00	0.00	0.00
Unknown	Sabah	59.27	0.00	0.00	59.27	0.00	0.00	0.00	0.00
Unknown	Sabah	73.52	0.00	0.00	73.52	0.00	0.00	0.00	0.00
Ioi Corporation Bhd - Mayvin Pom	Sabah	3,133.24	27.71	27.71	3,100.43	0.00	0.00	0.00	0.00
Ppb Oil-palm Berhad	Sabah	1,752.18	133.53	4.91	1,709.79	0.00	0.00	4.06	0.00
Ppb Oil-palm Berhad	Sabah	3,233.88	2,455.11	1,499.82	1,584.20	1.26	0.83	0.23	0.02
Ioi Corporation Bhd - Sakilan Pom	Sabah	1,137.70	1.06	1.06	1,136.64	0.00	0.00	0.00	0.00
Ioi Corporation Bhd - Sakilan Pom	Sabah	1,253.66	0.00	0.00	1,253.66	0.00	0.00	0.00	0.00
Pamol Group	Sabah	543.92	5.66	5.66	534.09	0.00	0.00	0.00	0.00
Pamol Group	Sabah	4,907.73	130.83	123.62	4,738.43	0.00	0.00	0.18	0.18
Ppb - Sri Kamusan Pom	Sabah	1,218.47	1,211.90	456.45	761.21	7.87	23.97	0.00	0.00
Ppb - Sri Kamusan Pom	Sabah	222.19	214.40	28.67	193.53	0.62	1.60	0.60	0.21
Ppb - Sri Kamusan Pom	Sabah	1,704.64	1,398.64	1,191.96	379.74	0.76	205.65	0.14	0.14
Ppb - Sri Kamusan Pom	Sabah	1,382.01	1,318.60	318.59	1,053.69	112.21	16.57	24.42	1.56
Ppb - Sri Kamusan Pom	Sabah	406.99	406.97	146.99	259.98	0.00	0.00	0.00	0.00
Ppb - Sri Kamusan Pom	Sabah	882.84	811.28	174.15	618.01	461.37	22.99	32.76	0.32
Ppb - Sri Kamusan Pom	Sabah	278.46	258.58	158.04	119.06	18.67	2.80	0.00	0.00
Ppb - Sri Kamusan Pom	Sabah	1,664.02	936.71	428.72	1,039.44	77.72	329.19	26.12	0.86
Haranky Sdn Bhd	Sabah	1,124.55	3.91	2.46	1,113.52	0.00	0.00	1.22	0.05
Carotino Sdn. Bhd. - Asia Pom	Sabah	1,174.07	0.00	0.00	1,173.27	0.00	0.00	0.00	0.00
Ppb - Sri Kamusan Pom	Sabah	2,775.99	2,199.60	497.18	2,263.76	12.17	5.91	13.71	0.14
Ppb - Sri Kamusan Pom	Sabah	244.31	214.56	28.07	198.16	2.14	0.00	0.00	0.00
Ppb Oil-palm Berhad	Sabah	1,269.88	0.00	0.00	1,269.89	0.00	0.00	0.00	0.00
Pamol Group	Sabah	4,305.07	71.58	1.46	4,299.76	50.80	15.24	2.63	1.13
Ppb - Sri Kamusan Pom	Sabah	637.80	58.66	38.79	594.78	3.10	0.00	0.00	0.00
Hap Seng Plantations Holdings Berhad	Sabah	562.35	528.38	33.44	527.06	1.53	206.09	278.77	0.00
Hap Seng Plantations Holdings Berhad	Sabah	4,428.63	463.00	135.07	4,163.22	0.00	0.00	326.04	1.89

	Sabah	195.73	0.00	0.00	194.98	0.00	0.00	0.00	0.00
Hap Seng Plantations Holdings Berhad	Sabah	1,001.23	0.00	0.00	1,001.23	0.00	0.00	0.00	0.00
Unknown	Sabah	181.55	78.02	26.36	142.82	0.12	0.00	49.07	0.05
Unknown	Sabah	193.17	154.54	12.68	177.63	79.91	11.25	31.65	0.00
Hap Seng Plantations Holdings Berhad	Sabah	2,238.42	87.54	72.51	2,131.19	0.00	0.00	0.00	0.00
Hap Seng Plantations Holdings Berhad	Sabah	1,552.65	8.88	8.88	1,523.43	0.00	0.00	0.00	0.00
Sime Darby	Sabah	3,085.17	46.17	45.33	3,016.80	0.00	0.00	0.84	0.00
Very Good Estate Sdn Bhd	Sabah	1,622.47	18.61	18.61	1,595.72	0.00	0.00	0.00	0.00
Very Good Estate Sdn Bhd	Sabah	1,539.47	945.52	302.47	1,208.09	0.00	0.00	0.00	0.00
Sawit Kinabalu Bhd	Sabah	244.35	78.84	77.87	147.91	0.00	0.00	0.97	0.00
Sawit Kinabalu Bhd	Sabah	2,482.91	2,326.53	2,066.15	19.08	51.68	18.62	55.89	0.27
Hap Seng Plantations Holdings Berhad	Sabah	1,988.58	0.00	0.00	1,973.71	0.00	0.00	0.00	0.00
Hap Seng Plantations Holdings Berhad	Sabah	3,432.05	0.00	0.00	3,432.05	0.00	0.00	0.00	0.00
Hap Seng Plantations Holdings Berhad	Sabah	2,420.33	49.05	31.59	2,385.66	6.54	3.99	6.59	0.34
Ioi Ladang Sabah Grouping	Sabah	1,738.97	68.59	68.44	1,649.30	0.00	0.00	0.00	0.00
Ioi Ladang Sabah Grouping	Sabah	2,137.40	0.00	0.00	2,129.78	0.00	0.00	0.00	0.00
Ioi Ladang Sabah Grouping	Sabah	2,094.24	0.00	0.00	2,095.97	0.00	0.00	0.00	0.00
Hap Seng Plantations Holdings Berhad	Sabah	2,149.69	8.97	0.79	2,125.33	0.00	0.00	0.00	0.00
Hap Seng Plantations Holdings Berhad	Sabah	4,834.32	46.39	27.74	4,802.89	0.00	0.00	2.16	0.30
Ppb Oil-palm Berhad	Sabah	6,382.70	15.57	3.07	6,349.91	0.12	2.05	2.91	0.16
Pamol Group	Sabah	4,429.64	654.26	134.76	3,815.85	105.39	1.17	41.97	9.53
Ppb - Sri Kamusan Pom	Sabah	93.23	0.00	0.00	93.23	0.00	0.00	0.00	0.00
Ppb - Sri Kamusan Pom	Sabah	129.59	60.86	19.46	110.14	0.00	0.27	0.00	0.00
Ppb - Sri Kamusan Pom	Sabah	772.45	195.29	82.61	677.45	49.95	58.32	1.16	0.17
Ppb - Sri Kamusan Pom	Sabah	235.39	29.16	20.19	200.77	1.15	1.16	5.67	0.99
Ppb - Sri Kamusan Pom	Sabah	242.94	231.06	22.33	207.88	7.50	5.83	0.00	0.00
Ppb - Sri Kamusan Pom	Sabah	180.28	97.14	16.75	162.40	4.53	0.08	0.00	0.00

Unknown	Sabah	136.45	0.00	0.00	136.45	0.00	0.00	0.00	0.00
Bornion Pom	Sabah	1,808.79	2.33	2.33	1,800.84	0.00	0.00	0.00	0.00
Bornion Pom	Sabah	5,717.64	14.19	14.15	5,696.18	0.00	0.00	0.04	0.00
Bornion Pom	Sabah	3,240.06	7.91	7.91	3,232.17	0.00	0.00	0.00	0.00
Bornion Pom	Sabah	1,329.75	0.00	0.00	1,329.75	0.00	0.00	0.00	0.00
Ioi Corporation Bhd - Baturong Pom	Sabah	1,766.49	0.00	0.00	1,766.50	0.00	0.00	0.00	0.00
Bornion Pom	Sabah	1,298.93	0.00	0.00	1,298.94	0.00	0.00	0.00	0.00
Ppb-Sabahmas Pom	Sabah	11,272.41	686.60	503.37	9,753.93	0.00	0.00	161.91	21.32
Bornion Pom	Sabah	372.06	0.00	0.00	372.06	0.00	0.00	0.00	0.00
Ioi Corporation Bhd	Sabah	7,858.43	38.80	37.81	7,790.87	0.00	0.00	0.50	0.50
Sime Darby Plantation Sdn Bhd	Sabah	43.59	27.48	6.98	23.52	0.63	0.00	0.00	0.00
Sime Darby Plantation Sdn Bhd	Sabah	2,042.76	213.27	190.15	1,645.47	0.00	0.00	2.83	2.24
Klk	Sabah	14,300.46	132.60	123.23	14,140.27	0.00	0.00	4.69	4.69