Ecosystem Services Certification Document for Ratah Timber, Long Hubung sub-district, Ulu Mahakam District, East Kalimantan

Part I: Information regarding the demonstration of impact

Declaration of the ecosystem services for which a claim is being or will be made (Step 1)

Please state the ecosystem service(s) for which you are making or plan to make FSC claims for the maintenance and/or enhancement of ecosystem services. You can choose more than one option.

- ☐ Carbon sequestration and storage
- ☐ Watershed services
- ☒ Biological diversity conservation
- ☐ Soil conservation
- ☐ Recreational services

Management objectives related to maintenance and/or enhancement of each declared ecosystem service (Step 1)

Biodiversity

To maintain and protect terrestrial mammal and bird species.

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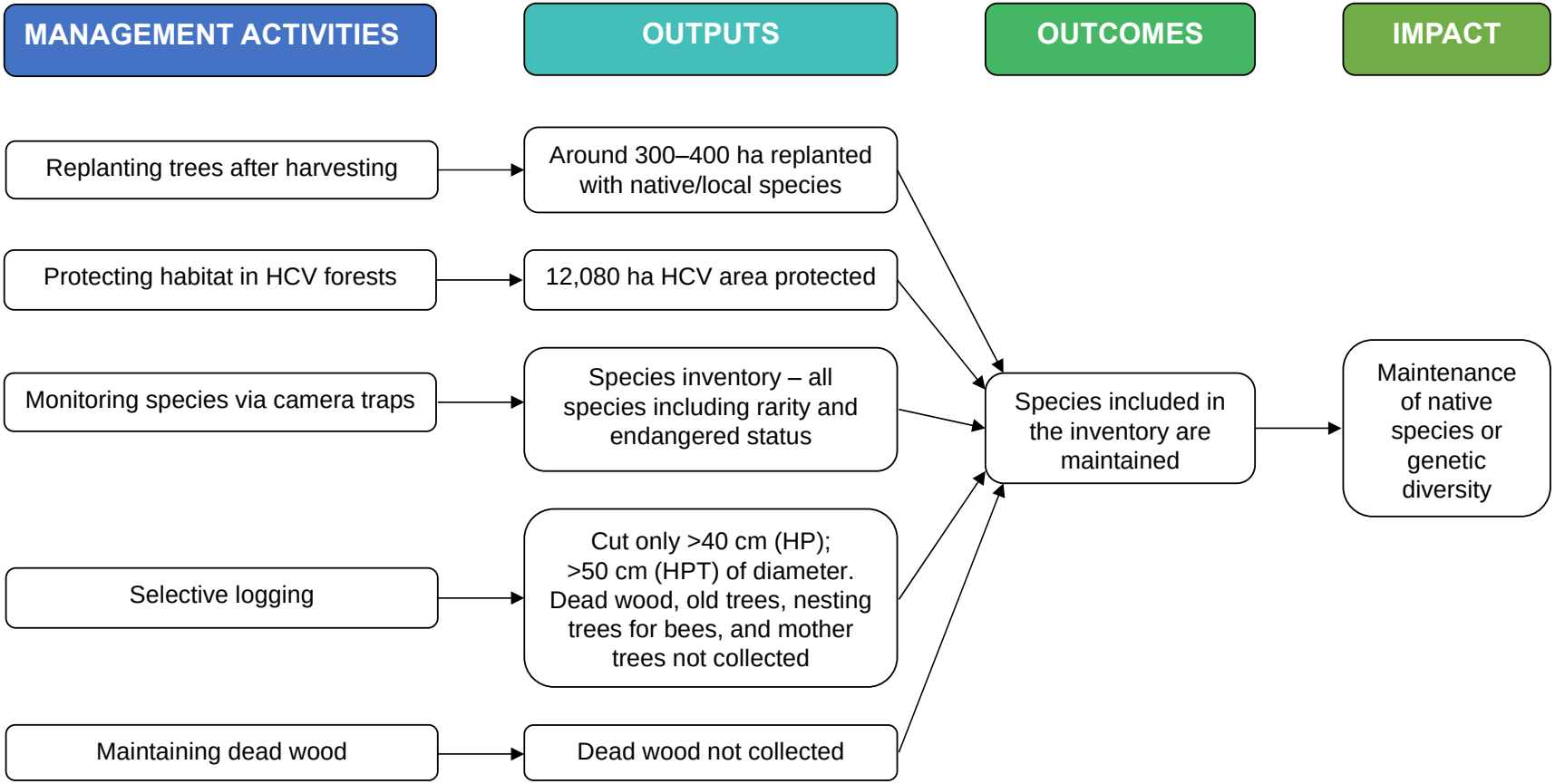
Chosen ecosystem services impact to be demonstrated[1] (Step 4)
Biodiversity: Maintenance of native species or genetic diversity

[1] Please define a theory of change for each chosen ecosystem service impact. You can use as many arrows and boxes for management activities, outputs, and outcomes as you need.

Theory of change template (Step 5)



HCV, high conservation value; HP, Hutan Produski (natural forest production); HPT, Hutan Produski Terbatas (natural forest with limited harvesting, which depends on slope, rainfall, and soil type).

List of chosen outcome indicators (from Annex D) (Step 5)

Biodiversity

Abundance of terrestrial mammal and bird species (taxa) before and after logging.

1. Description of the current condition of the declared ecosystem service(s) and the area that is being managed to maintain and/or enhance the ecosystem service(s) within the management unit (Step 2)

PT Ratah Timber manages a forest concession with an area of 93,425 hectares, of which 84,850 ha is already certified according for FSC forest management (FM) and chain of custody (CoC). An area of 8,575 ha outside of the FSC-certified area is proposed for community social activities and is not yet used for production (Table 1).

Table 1. Zonation areas in forest concession on Ratah Timber

Zonation	Forest function		Total (ha)
	Production forest (ha)	Limited production forest (ha)	
Areas for production (timber)	53,254	14,089	67,293
HCV areas	11,383	697	12,080
Buffer zone around protected area	348	2,649	2,997
River boundary	586	194	780
Social areas	8,164	411	8,575
Infrastructure	412	88	500
Permanent plot measurement	600	0	600
Nursery	600	0	600
Total area			**93,425**

PT Ratah Timber manages the concession for forest production, but it also aims to manage ecosystem services, including biological diversity conservation. Terrestrial mammal and bird species have large territories and home ranges, so it is also important to take into account areas outside of the management unit, as those species have ranges beyond the limits of the management unit.

The areas outside of the FSC-certified concession, which contribute to the claim of ecosystem services for biodiversity, are presented in Table 2.

Table 2. Classification of areas adjacent to the concession

Location	Forest ownership
North	Other land use (agriculture, plantation, etc.) Forest concession PT Seroja Unversum Narwastu Palm oil company Daya Kaltim Abadi
East	Other land use (agriculture, plantation, etc.) Forest concession PT Kedap Sayaaq
South	Government forest (not in use) Forest protection – Buring Ayok
West	Government forest (not in use) Forest concession PT Agro City Kaltim

The concession managed by PT Ratah Timber is a core habitat for wildlife, because land around the concession is used for plantation and farming. The only other sanctuary for wildlife is the protected forest in Buring Ayok, which is an important area for the watershed and biological diversity. All of the rivers that flow into the concession area pass through the protected forest area upstream.

The Ratah Timber concession is a key area for the protection of wildlife because the surrounding areas have already been converted to plantation or agriculture. Consequently, the company plans to establish wildlife corridors with partners.

Land clearing in adjacent areas impacts community members' ability to move in the area (for farming, cultivation, and hunting), restricting the area available, which will increase disturbance in the forest concession area.

2. Threats to the declared ecosystem service(s) within and outside of the management unit (Step 3)

The company has identified several threats to biodiversity.

1. Encroachment of forest concession by local people
2. Illegal logging activities by local communities
3. Forest fire
4. Illegal hunting

3. Description of the baseline for the selected outcome indicator(s) (Step 6)

Biodiversity

Abundance of terrestrial mammal and bird species before and after logging. The species abundance was compared between previously harvested plots (plots that were harvested twice in 1973–1976 and 2003–2013 and plots that were harvested only once in 1977–1997).

Data are presented in Annex 1.

4. Description of the method used to demonstrate the impact for each selected claim (Step 7)

Biodiversity

The methodology to evaluate biodiversity for the ecosystem services scheme was originally developed by a Kyoto University team. Kyoto University and WWF collaboratively installed sensor cameras in the field (Ratah Timber forest concession) to monitor medium-sized to large animals. The methodology referred here is based on Kyoto University Research Group (2016).

Fauna

A total of 10 circular plots (each with 1-km diameter) were systematically established within the management unit of PT Ratah Timber (Table 3, Figure 1). Within each circular plot, 10–18 points were randomly selected for camera-setting using statistical software R.2.10.1 (R Development Core Team, 2011). The latitudes and longitudes of the setting points were downloaded to a GPS (GPSmap60CSx, Garmin Ltd, Osath, KS) to navigate to the points.

At each camera point, a passive-infrared-sensor digital camera (Bushnell Trophy Cam Model 119437C) was installed on a nearby tree trunk 1.5 m above the ground. Each camera was set up to face open ground to avoid bushes that would intercept the field of view. The field of view from a camera was 2–7 m^2. All plots were assessed simultaneously for 25 months from June 2012 to July 2014 (Table 3). A total of 157 camera points were initially used; however, some of the cameras malfunctioned and were discarded. Data were analysed from a total of 147 camera points with 22,399 camera-days.

In the analysis of photographed mammals, redundant photos when the same species was photographed within 30 minutes were excluded. Photographs were assessed for all animal species except for rodents, tree shrews and bats because of the difficulties of identifying small mammals.

The impact of logging operations was evaluated by comparing the trapping rate of each species between areas harvested only once in 1977–1997 (plots A, B, C, D) and the areas harvested twice in 1973–1976 and 2003–2013 (plots E, F, G, H) with Wilcox rank sum test ($P < 0.05$). Plot I with volcanic soil (which is a special soil type here) and Plot J burned in 1997 were excluded from the analysis. In addition, Plot J represented an area allocated to local people under shifting cultivation (not part of the FSC-certified forest) and was not appropriate for inclusion in the evaluation.

Table 3. Coordinates of the 10 circular plots where sensor cameras were set up, number of cameras initially set up, and periods of monitoring

Plot[a]	Latitude of centre (North)	Longitude of centre (East)	Total no. camera-setting points	First date	Last date	Total camera working days	Year(s) forest plot harvested
A	–0.00050	115.053625	14	6 June 2012	7 July 2014	2,609	1997
B	0.09418	115.060661	12	12 June 2012	13 September 2013	1,758	1983
C	0.08535	115.177511	15	11 June 2012	8 July 2014	2,084	1977
D	0.14866	115.168622	10	13 June 2012	12 January 2014	2,011	1978
E	0.10298	115.231194	15	10 June 2012	11 July 2014	3,055	1976 (RIL 2003)
F	0.13960	115.275803	17	15 June 2012	13 July 2014	2,001	1975 (RIL 2008)
G	0.08497	115.311847	18	9 June 2012	12 July 2014	2,098	1974 (RIL 2010)
H	0.13045	115.356953	18	16 June 2012	10 July 2014	1,736	1973 (RIL 2003)
I	0.06704	115.411258	15	8 June 2012	16 July 2014	2,803	1973 (volcanic soil)
J	0.16652	115.446758	15	17 June 2012	14 July 2014	2,244	1971 (and burned in 1997)

[a] See Figure 1.

RIL, reduced impact logging.

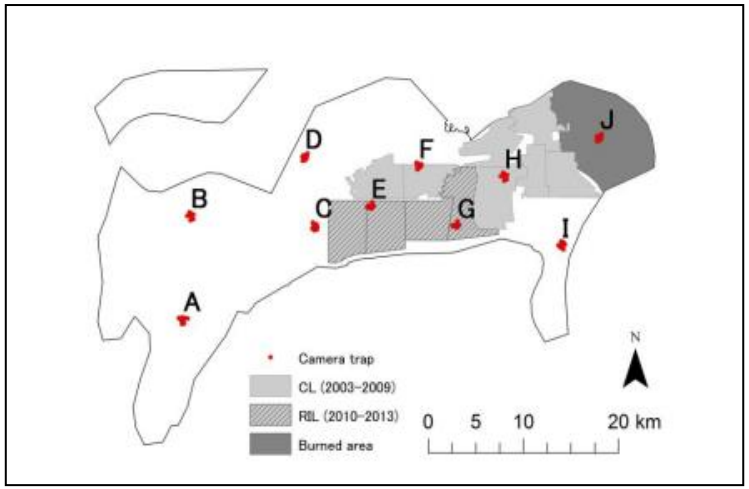


Figure 1. Location of camera-trap plots

5. Description of the verifiable targets related to maintenance and/or enhancement of declared ecosystem service(s) (Step 5)

Biodiversity

Maintain population of terrestrial mammal and bird species in the forest concession.

6. Detailed results of impact evaluation (to supplement statement of results) and monitoring (Step 8)

Biodiversity

Inventory of medium-sized to large mammal species was conducted with sensor cameras in the entire management unit (except for the north detached section) for two years from early June 2012 until early July 2014. A total of 29 mammal species were recorded during the 22,399 camera-days (Table 3), including two endangered (EN) species and 11 vulnerable (VU) species according to the IUCN Red List (IUCN, 2016). Sensor cameras also photographed five ground-dwelling bird species, including one endangered (EN) species and one vulnerable (VU) species. Table 4 gives the number of photographs for

each species. Southern pig-tailed macaque was the most frequently recorded species (615 times) followed by lesser mouse-deer (574 times) and greater mouse-deer (296 times).

Table 4. List of terrestrial mammals and birds recorded, with the frequency of photographs (number of images), in PT Ratah Timber, 2012–2014

English name	Scientific name	IUCN status[a]	Number of images (camera trap)
Mammals			
Southern pig-tailed macaque	*Macaca nemestrina*	VU	615
Crab-eating macaque	*Macaca fascicularis*	–	9
White-fronted langur	*Presbytis frontata*	VU	3
Malayan porcupine	*Hystrix brachyura*	–	250
Moonrat	*Echinosorex gymnura*	–	88
Sunda pangolin	*Manis javanica*	EN	8
Banded linsang	*Prionodon linsang*	–	2
Sunda clouded leopard	*Neofelis diardi*	VU	6
Marbled cat	*Paradofelis marmorata*	VU	15
Bay cat	*Catopuma badia*	EN	9
Leopard cat	*Prionailurus bengalensis*	–	18
Banded palm civet	*Hemagalus derbyanus*	VU	2
Binturong	*Arctictis binturong*	VU	4
Masked palm civet	*Paguma larvata*	–	6

Asian palm civet	*Paradoxurus hermaphroditus*	–	43
Malayan civet	*Viverra tangalunga*	–	86
Short-tailed mongoose	*Herpestes brachyurus*	–	28
Collared mongoose	*Herpestes semotorquatus*	–	11
Sun bear	*Helarctos malayanus*	VU	28
Oriental small-clawed otter	*Aonyx cinerea*	VU	1
Malayan weasel	*Mustela nudipes*	–	1
Yellow-throated marten	*Martes flavigula*	–	7
Bearded pig	*Sus barbatus*	VU	245
Lesser mouse-deer	*Tragulus kanchil*	–	574
Greater mouse-deer	*Tragulus napu*	–	296
Bornean red muntjac	*Muntiacus muntjak*	–	73
Bornean yellow muntjac	*Muntiacus atherodes*	–	276
Sambar deer	*Rusa unicolor*	VU	53
Birds			
Crested partridge	*Rollulus rouloul*	–	49
Great argus	*Argusianus argus*	–	284
Bornean peacock-pheasant	*Polyplectron schleiermacheri*	EN	5
Malay crestless fireback	*Lophura erythrophthalma*	–	28
Bornean crested fireback	*Lophura ignita*	VU	174

[a] EN, endangered; VU, vulnerable; – not rated.

The presence of rich species diversity of animals indicates that Ratah forests are of high conservation value. Moreover, the density (i.e. the number of photographs) per species was not significantly different between the old logged area and the recently logged area for most species, suggesting effective biodiversity safeguards.

Impacts of recent operations were evaluated by comparing the trapping rate (number of photographs) of each animal species between the area (4 plots) harvested only once during 1977–1997 and the area (also 4 plots) harvested twice in 1973–1976 and 2003–2013. Trapping rate can be regarded as an index of density of ground-dwelling animals (O'Brien et al., 2003).

The trapping rate was significantly different between the two areas for only four of the 34 species photographed (Wilcox rank sum test, $P < 0.05$), while it was not significantly different for the rest (i.e. 30 species). Of these 30 species, the trapping rate of sun bear was only marginally higher in the old logged forest ($P = 0.0571$), so its trapping rate was not considered statistically different from recently logged forests (Annex 1).

Trapping rates of Malayan civet and great argus were higher in the old logged forest; however, these two species are neither endangered nor vulnerable. On the contrary, the trapping rate of southern pig-tailed macaque and leopard cat were higher in the recently logged forests; this seems quite positive as southern pig-tailed macaque is a vulnerable species. It can be concluded that the management of Ratah maintains biodiversity, as 88% of the species (n = 30) identified were maintained and 6% enhanced (n = 2), while only two species (6%) were decreased in the recently logged forests. In addition, none of the endangered and vulnerable species identified were decreasing, demonstrating the good management of biodiversity in the site.

From this data, we deduce that implementation of reduced impact logging (RIL) has had a positive impact on the distribution of animals. This is because the regeneration process of after harvesting is relatively quick, compared with conventional logging. Thus, the formerly RIL harvested areas bring in a high density and distribution of wildlife. A number of endangered species (e.g. bay cat) were caught by camera-trap in the Ratah Timber areas that had experienced RIL (Table 3 and Annex 1).

Part II: Management information

1. Name of the forest management organization
PT Ratah Timber

2. Location of the management unit

Long Hubung sub-district, Ulu Mahakam District, East Kalimantan, Indonesia.

See Annex 2 for a map of the management area.

3. Type of certification

Please tick all the options that apply to the management unit:

Size:

☐ Large scale ☒ Conventional ☐ SLIMF (small and low-intensity managed forest)

Type of organization certified:

☐ Individual ☒ Private company ☐ Public organization ☐ Indigenous Peoples ☐ Local communities ☐ Management group

4. Characteristics of the certificate

Please give the following information:

Management unit area (in hectares): 93,425 ha

Number of members (if applicable): –

FSC Certificate Code: FSC*A000322

First issue date: 15 March 2013

Last issue date: 15 March 2013

Expiry date: 14 March 2018

5. Organization contact information

Please provide relevant contact information:

Email: rizal2368@yahoo.com and sri.wahyudi16@yahoo.co.id

Postal address: Ratu Plaza Office 6th, Jalan Jenderal Sudirman No. 9, Jakarta Selatan

Telephone number: 0811118005

Contact name: Ir. Bakhrizal Bakri, M.Si (Direktur Utama)

6. Legal tenure to manage and/or use the forest, or other legal right to receive payments for declared ecosystem services

PT Ratah Timber first obtained permission for forest concessions in 1970 with areas of approximately 125,000 ha in Kutai Barat District, East Kalimantan province. This licence lasted for 20 years and expired on 7 November 1990 (Decree of the Minister of Agriculture No : 526 / Kpts / Um / XI / 1970).

PT Ratah Timber's forest concession was renewed by the Minister of Forestry through Decree No: 95 / Kpts-II / 2000 dated 22 December 2010 for an area of 97,690 ha.

PT Ratah Timber forest concession was granted a second licence by the Minister of Forestry No. SK.359 / Menhut-II / 2008 dated 18 June 2008 for an area of 93,425 ha. IUPHHK PT Ratah Timber extension is valid for 45 years from 8 November 2010 to 7 November 2055.

The administration of Ratah Timber is located in Long Laham and Long Hubung sub-districts, Mahakam Ulu District, East Kalimantan province (Annex 2).

A new law on ecosystem services is under development by the Government of Indonesia. However, the forest company can already identify and/or develop methods to evaluate ecosystem services and market them.

The scheme for ecosystem services trading on natural forest concessions is underway, with the supporting regulation already in place. However, the forest company needs to identify and/or develop some method to show that it is developing the ecosystem service product. The challenge related to ecosystem services is to clarify demand (identify a buyer) and identify the market potential at national and global levels. At this time, the only real market is ecotourism/recreation. Eventually, the scheme must be clear: the seller or operator–developer of the ecosystem services can sell the product to anyone anywhere. Both provincial and national governments are aware that timber production is going to be limited, so we need other strategies to conserve and preserve the forest beyond timber alone, and the solution is non-timber forest products (NTFPs) and ecosystem services.

7. List of communities and other organizations involved in activities related to the declared ecosystem service(s)

- Subnational government and/or local government: forestry agency and environmental agency are strategic partners to implement regional policy and help encourage implementation by other forest management units interested in FSC and management of ecosystem services.
- University of Kyoto technical experts developing the methodology and providing technical support.
- Universitas Mulawarman (local NGO) is helping in monitoring biodiversity and carbon monitoring, and assisting with data analysis in East Kalimantan.
- APHI (Association of Indonesia Forest Concession Holders) East Kalimantan region is a collaboration and strategic partner for implementation of sustainable forest management for APHI participants.
- Dewan Perubahan Iklim Daerah (DPID) Board of Climate Change in East Kalimantan province is a strategic partner for implementation of sustainable forest management in the forest concession and KPH. It also provides support and assistance related to subnational regulation such as incentives, support, development of the method (SNI), and other issues.
- Ministry of Forestry (MoF): Indirectly, the MoF has a function in and contributes to the release of national regulations to back up subnational regulations related to ecosystem services (forest carbon and biodiversity, in particular).
- WWF Indonesia is pushing for regulations related to ecosystem services – e.g. Government regulation No. 46/2017 Instrument Ekonomi Lingkungan Hidup (economic instrumental for environmental). One of the main regulations driven is PP Economic Instruments for which evidence was brought from PT Ratah Timber for developing ecosystem services (forest carbon and biodiversity).

8. Summary of culturally appropriate engagement with Indigenous Peoples and local communities, related to the declared ecosystem service(s) – including ecosystem services access and use, and benefit sharing – consistent with FSC Principles 3 and 4

In managing forest production, PT Ratah Timber has implemented a sustainable forest management system in accordance with the principles, criteria, and indicators of the FSC system. In addition, the company has carried out various activities to support the implementation of sustainable forests for public welfare. The managed areas of Ratah Timber are close to 12 villages: Mamahaq Teboq, Sirau, Lutan, Data Bilang Ilir, Data Bilang Ulu, Data Bilang baru, Long Hubung, Long Hulung Ulu, Muara Ratah, Danum paroy, Long gelawang, and Nyarubungan. All these villages are located outside the forest concession, yet the company provides compensation and benefit to them all. Ratah Timber has six villages which have land tenure and/or indigenous forest land within the forest concession, the ethnic groups involved are Dayak Bahau in Mamahaq Teboq, Sirau, Long Hubung, and Long Gelawang; Poenan in Danum Dayak paroy; and Bakumpai Dayak tribe in Nyarubungan (Annex 2).

The company provides assistance to and engages directly with all these communities. The company cooperates with the local communities to conduct reforestation in the degraded areas by planting fast-growing tree species, multi-purpose timber species (MPTS), and NTFP species with economic value.

The company distributes some funds to the local communities from the timber sold and also provides basic infrastructure for rural development. It also implemented participatory rural appraisal (PRA) and social impact assessment based on free, prior, and informed consent (FPIC) guidance, for all forest management activities.

The FPIC process for ecosystem services activities is not yet completed, because there are no clear benefits at this time. However, the company will develop and implement a benefit-sharing mechanism if (when) there are profits from the management of ecosystem services. This may occur in the future and increase social investments in the communities. There have not been any discussions about benefit sharing as yet, to avoid creating false or misleading expectations.

Activities for ecosystem services are being prepared and set up by PT Ratah Timber, and therefore the company does not yet know the level of compensation to be offered to the communities. So far, the compensation given to the local communities has come from corporate social responsibility (CSR) activities of the forest concession, associated with rural development in education, health, and infrastructure.

The communities are aware of the activities related to forest carbon accounting and biodiversity monitoring. In the future, the communities should be actively involved in managing the ecosystem services in Ratah forest areas, so as to build collaboration between communities and the forest concession.

9. A description of management activities to reduce the threats to declared ecosystem service(s) within and outside of the management unit

- Encroachment of forest concession by local people

  Activities to mitigate threat:

  - Conduct patrolling and monitoring in the forest concession
  - Prohibit forest conversion and install information boards, focusing on protected areas
  - Raise awareness about the prohibition of forest conversion, including the fines for converting forest
  - Collaborate with local communities to conduct reforestation activities in open areas
  - Monitor forest cover in the concession, both by patrolling and by using satellite images.

- Illegal logging activities by local communities

  Activities to mitigate threat:

  - Same as for encroachment.

- Forest fire

  Activities to mitigate threat:

  - Conduct patrolling and monitoring in the forest areas at greatest risk of fire
  - Prohibit forest fires and install information boards on the risks of forest fires, focusing on areas at greatest risk
  - Raise awareness of local communities about the hazards of forest fires
  - Monitor forest cover through patrolling and satellite images to identify forest fires early
  - Establish an early warning system for forest fires.

- Illegal hunting

  Activities to mitigate threat:

  - Conduct patrolling and monitoring in the forest concession
  - Prohibit illegal hunting in the concession
  - Raise awareness about the regulation that prohibits illegal hunting and install information boards about the regulation and associated fines
  - Cooperate with the police to enforce the regulation and share information about wildlife status (rare, endangered, critically endangered, etc.).

References

IUCN (2016) The IUCN Red List of threatened species. Cambridge, UK: IUCN. http://www.iucnredlist.org/ (accessed 2016).

Kyoto University Research Group (2016) Technical report: Evaluation of ecosystem services provided by the PT Ratah Timber, East Kalimantan, Indonesia. Kyoto, Japan: Kyoto University (in press).

O'Brien, T.G., Kinnaird, M.F., and Wibisono, H.T. (2003) Crouching tigers, hidden prey: Sumatran tiger and prey populations in a tropical forest landscape. *Animal Conservation* 6: 131–139.

R Development Core Team (2011) R: A Language and Environment for Statistical Computing. Vienna: the R Foundation for Statistical Computing. Available online at http://www.R-project.org/.

The following referenced documents are relevant for the application of this document. For references with specific version, only the edition cited applies. For other references, the latest edition of the referenced document (including any amendments) applies.

FSC-STD-01-001 V5-2 *FSC Principles and Criteria for Forest Stewardship*

FSC-STD-01-002 *Glossary of Terms*

FSC-STD-50-001 *Requirements for use of the FSC Trademarks by Certificate Holders*

FSC-STD-60-004 *International Generic Indicators* (IGI)

FSC-PRO-30-002 *Demonstrating the Impact of Forest Stewardship on Ecosystem Services* (field testing draft)

FSC-PRO-60-006 *Development and Transfer of National Forest Stewardship Standards to the FSC Principles and Criteria Version 5-1*

Terms and definitions

For the purposes of this template, the terms and definitions given in FSC-STD-01-002 *Glossary of Terms*, FSC-STD-01-001 *FSC Principles and Criteria for Forest Stewardship*, and FSC-STD-60-004 *International Generic Indicators* are used.

Annex 1. Data on mammals and ground birds recorded in the areas harvested

Trap-rates of mammals and ground birds recorded in the areas harvested once and twice in the management unit of PT Ratah Timber

English name	Scientific name	Harvested once (old-growth forests)	Harvested twice (recently logged forests)	Remark
Birds				
Crested partridge	*Rollulus rouloul*	6.617 820 846	1.349 831 271	
Great argus	***Argusianus argus***	**20.326 164 03**	**11.698 537 68**	***** Significantly different
Bornean peacock-pheasant	*Polyplectron schleiermacheri*	0.709 052 234	0	
Malay crestless fireback	*Lophura erythrophthalma*	3.308 910 423	0	
Bornean crested fireback	*Lophura ignita*	13.8265 185 5	10.461 192 35	
Mammals				
Southern pig-tailed macaque	***Macaca nemestrina***	**24.107 775 94**	**56.242 969 63**	*** Significantly different**
Crab-eating macaque	*Macaca fascicularis*	0.236 350 745	0.224 971 879	
White-fronted langur	*Presbytis frontata*	0	1.237 345 332	
Malayan porcupine	*Hystrix brachyura*	12.526 589 46	21.934 758 16	
Long-tailed porcupine	*Trichys fasciculata*	1.890 805 956	10.461 192 35	
Moonrat	*Echinosorex gymnura*	1.654 455 212	7.649 043 87	
Sunda pangolin	*Manis javanica*	0.354 526 117	0.337 457 818	
Banded linsang	*Prionodon linsang*	0.118 175 372	0.112 485 939	
Sunda clouded leopard	*Neofelis diardi*	0.236 350 745	0.449 943 757	

Marbled cat	*Pardofelis marmorata*	1.181 753 723	0.899 887 514	
Bay cat	*Catopuma badia*	0.236 350 745	0.449 943 757	
Leopard cat	***Prionailurus bengalensis***	**0.118 175 372**	**1.574 803 15**	*** Significantly different**
Banded palm civet	*Hemigalus derbyanus*	5.317 891 751	6.974 128 234	
Binturong	*Arctictis binturong*	0	0.337 457 818	
Masked palm civet	*Paguma larvata*	0	0.449 943 757	
Asian palm civet	*Paradoxurus hermaphroditus*	3.308 910 423	1.574 803 15	
Malayan civet	***Viverra tangalunga***	**7.917 749 941**	**1.912 260 967**	***Significantly different**
Short-tailed mongoose	*Herpestes brachyurus*	1.063 578 35	2.137 232 846	
Collared mongoose	*Herpestes semitorquatus*	0	1.012 373 453	
Sun bear	*Helarctos malayanus*	3.308 910 423	0.787 401 575	
Oriental small-clawed otter	*Aonyx cinerea*	0	0.112 485 939	
Malayan weasel	*Mustela nudipes*	0.118 175 372	0	
Yellow-throated marten	*Martes flavigula*	0.472 701 489	0.337 457 818	
Bearded pig	*Sus barbatus*	24.344 126 68	10.123 734 53	
Lesser mouse-deer	*Tragulus kanchil*	50.460 883 95	26.096 737 91	
Greater mouse-deer	*Tragulus napu*	21.035 216 26	21.372 328 46	
Bornean yellow muntjac	*Muntiacus atherodes*	37.579 768 38	16.085 489 31	
Bornean red muntjac	*Muntiacus muntjak*	0.118 175 372	1.124 859 393	
Sambar deer	*Rusa unicolor*	7.326 873 08	4.611 923 51	

Annex 2. Biodiversity and carbon plot in PT Ratah Timber forest concession