



Darwin Initiative: Final Report

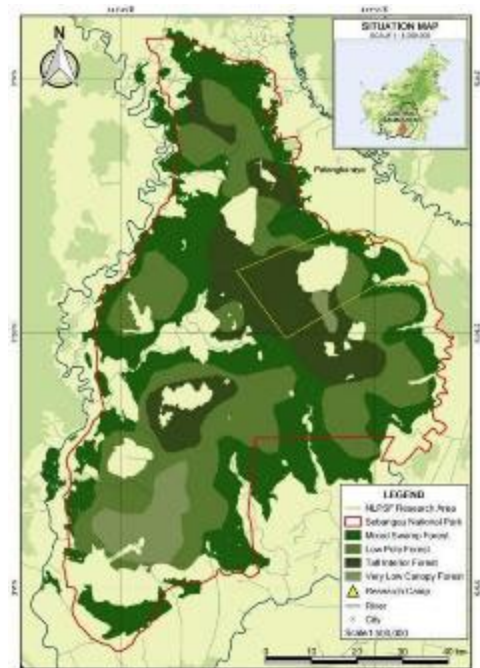
Darwin Project Information

Project reference	25-001
Project title	Preventing Borneo's peatland fires to protect health, livelihoods and biodiversity
Country(ies)	Indonesia
Lead organisation	University of Exeter
Partner institution(s)	Borneo Nature Foundation
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Project leader's name	Dr Frank Van Veen
Project website/blog/social media	BNF Website ; BNF Facebook ; BNF Twitter
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1 Project Summary

The 600,000 ha Sebangau National Park is the largest lowland rainforest remaining in Borneo, with globally important populations of many endangered species and numerous social and economic functions for local communities. The main threat to this forest is Indonesia's worsening annual peatland fire crisis. In their natural state, peat-swamp forests are permanently waterlogged and fire-resistant. Drainage channels dug illegally in the past to remove timber and to develop plantations dry out the peat, leading to annual dry season forest fires which increase during El Niño drought years.

In 2015 massive peatland fires raged for months, burning over 2.2Mha of peatland in Kalimantan and creating a toxic smoke haze to which 69 million people were exposed, causing the premature death of up to 17,000 people. The fires and haze resulted in a \$16.1 billion loss to the Indonesian economy (1.9% of GDP) and carbon emission rate that exceeded that from fossil fuels in the entire EU. Carbon leaching poisoned fish stocks, the major source of protein for local communities. In Sebangau the forested proportion of the Park declined from 80.4% to 68.5%, a loss of 833 km², an area equivalent to twice the size of the Danum Valley Conservation Area in North Borneo.



The peatland fire crisis requires major interventions at all levels, from national policy down to local *in situ* actions. This proposal is aimed at the latter, addressing the root causes of fires in Sebangau including those that are driven by poverty (illegal logging, illegal burning) and those that impact on poverty (local fire-prevention capacity, health impacts), with the long-term aim to develop an integrated, community-based fire-prevention model for this region. The peatland fire crisis requires major interventions at all levels, from national policy down to local *in situ* actions. BNF aims to address the root causes of fires in Sebangau including those that are driven by poverty (illegal logging, illegal burning) and those that impact on poverty (local fire-prevention capacity, health impacts), with the long-term aim to develop an integrated, community-based fire-prevention model for this region.

2 Project Partnerships

During the course of this project, the University of Exeter (UoE) and Borneo Nature Foundation (BNF) developed and strengthened our partnership by working together to implement this project, expanding research collaborations, providing opportunities for student research and planning future activities to continue our partnership, now five years old. Our core partnership has facilitated additional collaborations with institutions in Central Kalimantan to implement research and conservation initiatives, including governmental agencies, universities, community groups and NGOs amongst more than 25 stakeholders engaged in this project. The support received from the Darwin Initiative boosted our ability to form new conservation partnerships, strengthening our local capacity to implement effective conservation activities and providing a long-term legacy to benefit people and biodiversity in Central Kalimantan.

Specifically, BNF has formalised partnerships by signing new or renewed Memorandums of Understanding (MoUs) with UPT-CIMTROP, University of Palangkaraya, the Sebangau National Park (BTNS), the Palangkaraya City District Government and the Pulang Pisau District Government. BNF and the Sebangau National Park have agreed a five-year work plan, ratified by the Ministry of Forestry and Environment, to continue and upscale activities undertaken in the recently concluded project, ensuring long-term sustainability of impacts. These agreements have facilitated the development of collaborative networks, including the Sebangau community fire-fighting coordination network, the drone technology centre based at CIMTROP-University of Palangkaraya, the network of community seedling nurseries to support reforestation initiatives, and the Ecosystem Essential Area working group established in partnership with the Pulang Pisau District Government. The effectiveness of our partnerships was witnessed during the intense period of fire-fighting during the 2019 dry season, with effective coordination achieved between five community fire-fighting teams, two government agencies (Sebangau National Park and the Central Kalimantan Disaster Management Agency) and academic/research institutions.

BNF has formed two new academic partnerships with biodiversity and conservation research groups at two highly-regarded Indonesian universities, the National University (UNAS) and Gadjah Mada University (UGM), each on the island of Java, adding to existing partnerships with the University of Palangkaraya (UPR), Muhammadiyah Palangkaraya University (UMP) and the Christian University of Palangkaraya (UNKRIP), each in Kalimantan. Likewise UoE maintains partnerships with UGM, UPR and UMP.

Building on the Darwin Project partnerships, UoE has led the development of a GCRF-funded interdisciplinary research consortium with the aim of providing the evidence base to support resilience-building efforts in the heavily degraded ex-Mega Rice Project to the east of Sebangau. This consortium includes and funds Indonesian academic partners at three universities (Universitas Palangka Raya, Universitas Gadjah Mada, Universitas Indonesia), working in collaboration with counterparts at five UK universities, and with BNF and the Indonesian government's peatland and mangrove restoration agency (BRGM) as main non-academic partners.

Data compilation for the final report has been a collaborative effort led by BNF and the University of Exeter with input from stakeholders involved in implementation, monitoring and evaluation, particularly from UPT-CIMTROP, community seedling nurseries, community fire-fighting and patrol teams and Sebangau National Park staff.

3 Project Achievements

3.1 Outputs

Output 1. Ex-illegal logging canals blocked and areas burned in the 2015 fires replanted in the Sebangau National Park to re-wet the swamp thus reducing fire risk, preventing further forest losses and reverse fire damage.

1.1 Number of canals closed increased to 24 (baseline 10) and up to 200 new dams built by end yr 3

We identified and surveyed 27 canals in our target area, 10 of which were blocked prior to the project starting. Twelve drainage canals were blocked during the project period by constructing 145 double-walled dams along their lengths. Three further canals did not require damming owing to natural infilling and, in one case, the gradient of the canal which caused water to flow into the forest. The two remaining canals will remain open based on the specific request of local communities. All drainage canals in the target region have been addressed, achieving Output 1.1. Evidence is compiled in Section D, including maps of the canals and dam locations, and annual summaries of canal-blocking activities.

1.2 Reduction in water flow-rates and discharge rates (by up to 80% - or 20% of baseline values) within canals, and raising groundwater levels (>10 cm in each dammed canal in comparison to pre-dammed state and control studies).

Hydrology monitoring surveys were undertaken monthly in six canals to measure water discharge-rates and groundwater tables, with 71 locations in total along both blocked and unblocked (control) canals used to assess the impacts of canal blocking on ecosystem hydrological recovery. Water discharge rate reduced by 70% in the largest dammed canal, from 0.191 m³/s to 0.052 m³/s. Short-term data collected from recently blocked canals provide similar findings, with reductions between 49% and 81%, concluding that canal blocking achieves a consistent slowing of water-discharge rates as water is retained for longer in the peatland ecosystem at the onset of the dry season (Figures 15-19, Annex 7). This in turn raises the water-table, keeping the peat wet and reducing oxidation and subsidence, with average annual groundwater tables in the vicinity of the largest canal 8cm higher post-blocking compared to baseline values (comparing years with similar rainfall profiles); with groundwater-tables raised by up to 11cm near other blocked canals (Figures 23-27).

1.3 50,000 seedlings planted / over 150 ha of previously burnt forest. Average of 80% survival rates for different species / planting conditions identified

A total of 48,902 native seedlings have been planted during this project in burned peatland areas in the Sebangau National Park. These comprise 22,372 seedlings donated by the governmental Watershed Management Agency with the remaining 26,530 grown by the community nurseries established under this project. Following socialisation and initial training, nursery members have collected and grown seedlings from target species for the reforestation project, with a project-end stock of over 55,000 seedlings to be planted during the coming year. (Figure 29, Annex 7.)

Fifty hectares have been reforested to date with a further 100 ha to be reforested with the current seedling stock during 2021, working towards an initial target of 1000 ha over the next five years at a planting density of 1,000 seedlings/ha. The restoration site has been prepared with access boardwalk constructed, planting transects laid out and in situ nurseries built to hold seedlings for pre-planting monitoring and acclimation purposes (Figures 36 – 39, Annex 7). In 2020, we began research trials for aerial seed dispersal; packing *Syzygium* seeds into seed balls. 71% of the seeds germinated in initial trials. Trials were suspended during the covid19 pandemic but will be resumed.

Monitoring of seedling survival and growth rates for the four primary species in the reforestation project has determined a first-year mean survival rate of 72%, varying from 70% for *Shorea balangeran* to 86% for *Elaeocarpus mastersii*.

1.4 Forty (40) families involved in 8 community nurseries. 5 community nurseries operational by end yr 2 and 3 community nurseries established by end yr 3. Twenty (20) women working in Community groups crafting organic-bags/pots to plant seedlings for reforestation purposes.

By the end of this project, 54 people from two villages have been successfully engaged in the community seedling nursery initiative. Ten nurseries have been established and eight remain active, with two merging and one closing. 18 of the 54 community members have been fully involved in all stages of the project, including building nurseries, transporting, planting and monitoring seedlings. The proportion of women has increased over the course of the project, from 11% in year 1 to 30% in year 3.

The nursery output has increased from year to year, with 5,000 – 6,500 seedlings produced per nursery in the first year of operation, increasing to 7,000 – 9,500 seedlings in the second year, with an eventual target of 10,000-15,000 seedlings per nursery. A cooperative group comprising 19 women and 4 men produced organic seedling bags for the project, with 3,000 bags crafted before this initiative was halted owing to Covid-19 concerns, as the main participants are older women.

This initiative has proven to be very successful and we are continuing to scale it up, with plans to increase the number of nurseries in order to meet our future reforestation targets.

Output 2. Improved local fire-fighting capacity for rapid response to peatland fires in Sebangau NP and Palangkaraya district.

2.1 Four community fire-fighting teams operational (current baseline = two); up to 20 local people recruited and two training sessions / yr held in peat-fire extinguishing methods and use of equipment.

Establishing community fire-fighting teams as the primary defence against forest fires was a major activity in the first year of the project. Following strategic discussions with community leaders and government agencies, two community fire-fighting teams (MPA: Masyarakat Peduli Api) were fully established, equipped and trained, and eight new members were added to the existing CIMTROP Patrol Team. A total of four independent fire-fighting teams have been supported during the course of this project, with 105 individual fire-fighters trained to patrol and extinguish peat and forest fires.

Nine capacity building and training workshops were undertaken (Figure 59, Section D, Annex 7), covering the following topics: Forest and peatland fire prevention; Navigation and GPS training; Fire-fighting team coordination; Using Drones for detection of peat fires using thermal infrared sensors ; SMART Patrol techniques and reporting; Application of Forest Fire Control Information System (SIKAT) in Sebangau National Park

In the final year of the project, building on the successful implementation of the community fire-fighting initiative and development of a regional fire-fighting network, BNF began discussions with three additional

communities bordering the Sebangau National park, namely Habaring Hurung, Sei Bangah and Tumbang Nusa villages, with the objective to establish two new MPA teams and bring 8 existing teams into the Sebangau regional fire-fighting network (Figure 58).

2.2 Fire-response teams effectively mobilised during each dry season

During the project period a major fire-fighting response was required during the 2019 dry season, which was longer and drier than normal owing to an El Nino climate event. Severe fires burned throughout Central Kalimantan's peatland areas, and recorded peat- and forest loss was the worst since 2015. Each of the four community fire-fighting teams was successfully mobilised, with 313 fire patrol or fire-fighting activities recorded and a total of 154 team-days spent fighting fires (Figures 61-62, Annex 7). A minor fire-fighting response was required in 2018, whereas no fires were detected in 2020, a wetter-than-average year.

2.3 100% of identified fires attended and extinguished in target areas

A total of 123 fires were detected during the project period (2018-2021) within the target area in the north-east Sebangau National Park. Each detected fire was attended and extinguished (as necessary) by the community fire-fighting teams, with a total of 345 interventions and 251 fire-fighters mobilised. All the major fires were located and extinguished within the sedge areas bordering the forest, thanks to the quick response of the community teams. Aerial support was provided in 2019 using thermal cameras attached to quadcopter drones which detected peat fires burning below the surface and greatly aided the fire-fighting efforts of the on-ground teams.

To quantify the total forest loss in the target area; Annual Difference Normalised Burn Ratio models (imagery source: Landsat 8) were prepared annually and validated using existing spatial datasets i.e. NASA Firms - MODIS collection and forest loss by year (Hansen et al.) These revealed that only 132 ha of forest was lost to fire within the target area during this period, a significantly smaller area than lost during previous climatologically comparable years (baseline). This is particularly notable considering that major peatland fires burned in Kalimantan during 2019, with 16,465 hotspots detected by MODIS satellites in Central Kalimantan alone and major forest loss occurring elsewhere. Data are presented in Figures 69 - 73).

2.4 Network of community fire-fighting teams established and coordinating with government agencies in Palangkaraya district and with each other with multi-stakeholder workshops held in yr 2 and 3

BNF facilitated the effective coordination of fire fighting teams operating in Kereng Bangkirai and Sabaru villages, in partnership with the Disaster Management Agency and the Sebangau National Park, during the 2019 fire season. Despite the many challenges arising from the need for a rapid emergency fire response, the teams cooperated as they have never done before, implementing joint patrols, holding coordination meetings and sharing resources and data as needed. This was the start of the new regional fire-fighting network, a grouping of grassroots and community teams designed to share resources and knowledge and access training and equipment. With local government agencies we co-hosted 11 multi-stakeholder workshops and coordination meetings which aimed to empower fire-fighting teams, land managers and communities to better manage and understand fire risks and impacts, and to develop standardised operational procedures, culminating in developing the network of community fire-fighting teams.

In the final year of the project we expanded this network to involve 12 teams with 155 active members who wish to collaborate within this network and coordinate with the local government. Actions to strengthen this network are continuing, including establishing a management framework to ensure long-term sustainability.

Output 3. Local communities adopt more “peat-friendly” farming and fishing practices that avoid peat drainage and use of fire; and families better understand how to mitigate the harmful effects of fire.

3.1 240 education modules/sessions held with 20 schools, 3 community forums and special interest groups (fishermen; farmers cooperatives), including three large-scale forums per year with aim to reach 90% of people in these target groups by end yr 3.

A total of 125 modules/sessions were held in 22 schools, which were largely completed in years 1 and 2. Since the start of the Covid-19 pandemic in March 2020 schools in Indonesia have remained closed and thus these sessions have been suspended. To replace them we began running webinars for schools and education professionals in December 2020, attempting to overcome issues of ensuring equal access to all, and adjusted education and community awareness activities by developing new protocols, delivery methods, resources and alternative participatory approaches. Over the entire period of the project we have reached 1,021 students and 57 teachers (Figure 80, Annex 7). Awareness activities have been re-designed in the context of the global epidemic, identifying the potential impacts of COVID-19 in the context of tropical conservation and implementing a series of online workshops and seminars to address this. BNF also launched an online podcast titled *Conservation Outlook 2021: Towards a New Equilibrium for Forests in Central Kalimantan*, to increase awareness and knowledge of the relationship between environmental health and well-being.

Parallel to this we began engaging with local fishermen and farmer's cooperatives from Kereng Bangkirai and Sabaru villages, but the COVID-19 pandemic interrupted these activities. Therefore this output has only been partially achieved and remains an important activity to implement when conditions allow.

3.2 1,000 people reached with education and awareness activities by end yr 3.

During the project period we recorded a total of 4,915 people participating in education and awareness-related activities, including both formal and non-formal activities and yearly festivals (3,108 children, 266 teachers and 1,541 parents/family members) as detailed in the summary table, with participation exceeding our expectations (Figure 88).

3.3 Number of people demonstrating positive response to these activities (70% increase in knowledge / awareness on environmental issues)

The BNF education team undertook evaluation assessments in order to quantify the impact of education activities on knowledge, behaviour and attitude concerning habitat conservation. Assessments were implemented in twelve participating schools, collecting data from 141 respondents both pre-and post activities, a total of 282 completed questionnaires. All questionnaires were completed prior to the Covid-19 pandemic. (Figures 91 - 94).

The assessments identified a consistent self-reported increase in knowledge and attitudes towards conservation after education sessions, including the following results:

Forest and wildlife knowledge:	65% post-intervention increase
Understanding of peat-swamp forest:	108% post-intervention increase
Understanding and willingness to mitigate threats:	59% post-intervention increase
Understanding and willingness to work on solutions:	97% post-intervention increase

We also analysed participant's understanding of our key conservation initiatives and solutions; with Forest Protection (40% of answers), Habitat Restoration (31%) and Fire-Fighting (13%) the best-known initiatives before implementing education sessions. Post-session analyses indicate that participants not only gained understanding about conservation initiatives and solutions but also increased the number of initiatives they were aware of, including waste management, forest management, wildlife management, wildlife protection, pollution mitigation, research and outreach.

Away from school education, BNF has experienced exponential growth in website visitors, social media followers and responses to posts

3.4 (50% increase in willingness for) adoption of alternative farming and fishing practices, in particular use of non-burning/drainage methods, among local community members.

In 2020 BNF initiated a series of training sessions for the adoption of sustainable farming and fishing practices, (i) demonstrating effective permaculture and aquaculture activities on peatland which do not require land burning or drainage and (ii) encouraging crop diversification in the community nurseries to complement villagers income and promote sustainable livelihood development. These initiatives have been implemented in partnership with researchers from the Forestry and Fisheries Faculties at the University of Palangkaraya.

Training on techniques for developing, maintaining and harvesting fish-ponds (aquaculture) in peat soils, permaculture practices on peat soils and introducing 25 new plant crops that are effective in peat soils have been carried out, with at least 59 people involved in these initiatives. Three community nurseries have adopted these practices to date, with one large fish pond constructed and in use.

Notably, interviews in 2019 indicate a shift in livelihoods is currently ongoing. While in the past (as reported in the 2016 interviews), people turned from logging to fishing (once logging was stopped in the Sebangau Forest), now people report turning from fishing to the tourism industry or to 'swift houses' that produce nests for the edible-nest industry.

Output 4. Foundations established to create a long-term legacy for fire prevention and mitigation in and around the Sebangau National Park.

4.1 Effective fire-prevention system adopted by National Park managers and stakeholders resulting from 1 multi-stakeholder workshop in yr 2 and follow-up in yr 3

During 2019 and 2020 BNF facilitated several coordination meetings, capacity building workshops and evaluations to contribute towards this output. Two multi-stakeholder workshops implemented in the second year with 63 participants from fire-fighting teams, land managers and government agencies discussed fire-prevention systems and protocols, capacity building needs and opportunities and created partnerships between community teams and land management agencies. A complementary Integrated Fire-fighting Workshop was hosted by the Regional Development Planning Agency in 2019 and attended by BNF and the network of Fire-fighting teams. In year 3 a Multi-stakeholder Coordination Meeting for Fire Prevention around the Sebangau National Park was organised by the National Park and the Ministry of Forestry and Environment (KLHK). Following this workshop BNF organised an Evaluation and Coordination Meeting for the Management of Emergency Status Forest and Land Fire, attended by 60 participants. These initiatives have strengthened the establishment of an integrated

and coordinated network of teams working to prevent fires in the Sebangau landscape, achieving coordinated patrols, bore-drilling and re-wetting actions, multiple training sessions, improved health and safety protocols and a coordinated emergency response. Further work (in partnership with national authorities) is ongoing to achieve the successful implementation of prevention and intervention protocols.

4.2 Twenty (20) National Park staff receive training in restoration and biodiversity monitoring techniques (70% increase in knowledge) and involved in field activities during 3 training workshops in yr 2 and 3, including field sessions.

In 2019 BNF and the Sebangau National Park (BTNS) signed an *MoU* and agreed a Programme Implementation Plan for the next 5 years (RPP), with specific commitments from BNF to provide research capacity building opportunities to BTNS staff. In the third year of this project, two days of training and capacity building workshops were provided to 19 National Park staff on biodiversity survey and monitoring techniques, including orangutan surveys and camera-trapping, and the use of biological indicators to assess habitat quality assessment, data management and basic analysis.

At the end of the sessions the Park staff were able to understand how to conduct biodiversity surveys and use the results to support conservation actions. Pre- and post-training questionnaires were conducted to assess the degree of knowledge gain. A significant increase in knowledge was recorded, which varied depending on the initial base-line. Staff with an initial low-level of understanding demonstrated a large-gain increase of 44%, whereas staff with a previously high level of understanding achieved a smaller knowledge-gain of 18%, as expected. There was a significant increase between the pre- and post-test scores for all participants (paired sample t-test, $t=-7.315$, $p<0.05$).

BTNS provided positive feedback and have requested further training sessions, particularly on the following topics: Forestry monitoring, Carbon stock estimation, data analysis and scientific report writing. A number of training sessions were postponed owing to the COVID-19 pandemic, but the positive feedback and working agreement will ensure that these activities will be continued during 2021 and in the future.

4.3 Three (3) meetings to promote coordination with provincial and national strategies for peatland conservation and fire prevention achieved by end yr 3.

National strategies for peatland conservation and peat fire prevention are led by the Peat and Mangrove Restoration Agency (BRGM) and relevant provincial strategies are led by the Central Kalimantan Departments for the Environment (DLH), Watershed Management (BAPPEDAS), Conservation of Natural Resources (BKSDA) and Disaster and Fire-fighting Management (BPBPK), amongst others. We have coordinated with all of these agencies, providing data and reports and presenting results, and have hosted several large provincial seminars and workshops attended by representatives of these agencies to align strategies on peatland conservation and fire prevention, with special focus on the Sebangau peat-swamp forest landscape.

Six large multi-stakeholder workshops in total were implemented with representatives from the above agencies as well as the Sebangau National Park, universities, NGOs, community leaders, private sector and conservation platforms/forums. A total of 71 institutions and 2,212 people participated in one or more of the workshops; achieving strengthened cooperation and collaboration and contributing to national and regional strategies for peatland conservation and fire prevention. We have achieved the proposed Output and continue to develop these positive impacts. The Darwin Initiative supported workshops / seminars were as follows:

- BNF Sebangau Programme Profile and Conservation Workshop: presenting BNF's Research, Conservation, Outreach and Integrated fire management programmes in the Sebangau National Park and inviting collaboration (Y1)
- Coordination Workshop on Forest Fire Prevention (Y1)
- Sebangau Conservation Programme Socialisation and Coordination Workshop (Y2)
- Fire-prevention in Sebangau – Strategy and Coordination Workshop (Y2)
- 2020 Dialogue - New Directions for Peatland Restoration in Central Kalimantan (Y3)
- Preparation and Coordination for the Management of Emergency Fire-fighting Response in 2020 (Y3)

3.2 Outcome

The occurrence and intensity of fires in and around Sebangau National Park in Central Kalimantan is significantly reduced, thus benefiting biodiversity conservation and human health.

The project achieved its intended outcome, by demonstrably reducing both the number of fires (Indicator 1) and the area of forest impacted by fires (Indicator 2). Monitoring of biodiversity (Indicator 3) revealed both larger populations of key fauna species and increased forest biomass at the end of the project period compared to the baseline, thus indicating that the project benefited biodiversity. Human health indicators were harder to monitor owing to incomplete datasets and impacts arising from outside our project area. The number of respiratory tract infections was reduced in 2018 and 2019 compared to previous years, but was higher in 2020, presumably linked to Covid19 infections and not air quality. However indirect measures of air

quality, which is the main cause of fire-related health impacts, demonstrate a 54% reduction in airborne particles (PM₁₀) in 2019 compared to pre-project years with a comparable ENSO Index (an indication of the strength of the El Niño Southern Oscillation, which causes increasingly severe droughts). Owing to the clear link between haze from peat fires and human health we are confident that reduced fires has led to improved health.

In the short time-frame of the project period, we conclude that this Outcome was achieved based on the success of the Community Fire-fighting teams at locating and extinguishing peat and forest fires, as evidenced, combined with positive outputs from community awareness and education activities to reduce the number of fires started. Longer-term we expect this Outcome to be achieved based on the legacy of habitat restoration and other fire prevention outputs that we have completed during the project period.

Indicator 1: Number of fires in target area reduced to 25% of baseline value by yr 3, compared to comparable pre-project years

Data Source: Baseline figures for the number of hotspots (MODIS hotspots VIIRS Catalog) in the target area were established for pre-project years (2001-2017) and compiled annually during the project, alongside the ENSO index for each year.

Means of verification/adequacy of indicators: The number of hotspots detected is a reliable and adequate indicator as it correlates with burned area size, but should take into account that one fire can include many hotspots and hotspots can be undetected when smoke haze is very thick..

Evidence presented:

- Spatio-temporal analysis of MODIS hotspot distribution in Sebangau Sub-district and Northern Sebangau Forest compared to previous years with similar ENSO index
- Hotspot maps for target area using MODIS VIIRS Catalog pre- and during project period (Figure 113, Annex 7)
- Annual hotspots frequency for the target area (Sebangau Sub-district and Forested Area within the Natural Laboratory of Peat-swamp Forest) (Figures 114 and 117 in Annex 7)
- Historical analysis of the frequency of hotspots, using El Niño Index as a grouping factor and comparing pre-project years (baseline) with the Darwin project period. (Figure 115 in Annex 7)
- Fire periods and ENSO events from 2000- 2020 (Figure 118 in Annex 7)
- Map of patrols and local community fire-fighting teams' reports during the 2019 drought and fire season. (Figure 63 in Annex 7)

Progress: This Indicator has been achieved with a substantial reduction in fires in the forested portion of the target area. In 2019, the sole drought year during the project period, the number of fire hotspots recorded in forested areas was 80% fewer in our intervention area compared to 2014, a year with a similar ENSO index. The impact can be contrasted with a 141% increase for the whole National Park over the same period, clearly demonstrating the effectiveness of our project at creating and mobilising a successful emergency fire response.

Indicator 2: Area of peatland burned in target area reduced to 10% of baseline value compared to comparable pre-project years.

Data Source: Spatial data-sets of burned areas for the pre-project years (2000-2017) and the project period (2018, 2019 and 2020) were compiled and processed using a dNBR (difference Normalised Burn Ratio) to identify forest loss due to fire for the northern Sebangau landscape, contrasting areas with differing levels of interventions.

Means of verification/adequacy of indicators: We consider the indicator has been reliable and adequate. We performed an analysis of annual pre/post-fire seasons using LandSat imagery and running dNBR models. We also used forest loss spatial data for the period 2000–2020, and on-the-ground monitoring of burned areas using drones and patrol reports; the data have been compared to previous years with similar El Niño indices.

Evidence presented:

- Maps of the burned areas pre (baseline data) and during the project period on a yearly basis difference Normalized Burn Ratio models (dNBR) (Figure 119 in Annex 7)
- Forest loss assessment yearly for the Northern Sebangau landscape, using ENSO Index as a grouping factor and comparing pre-project years (baseline) with the project period (Figure 120 in Annex 7)

Progress: The indicator has been achieved and the size of burned areas in the target area has been reduced to 6% of the area burned in comparable pre-project years. The means of verification, using LandSat imagery and Forest loss spatial data, successfully detected burned areas.

Indicator 3: Improving (or at minimum stable) forest condition and populations of key forest fauna, compared to pre-project baselines.

Data Sources: Baseline data for indicators that demonstrate forest condition improvement were collated and compared to annual monitoring data collected during the project period. These include monthly monitoring of groundwater levels (40 locations); tree growth and mortality rates in 2.4 ha of permanent forest plots; orangutan population surveys using line transects of nests; organic matter litter-fall and monthly monitoring of animal species presence and abundance using fixed location camera-traps.

- Ground-water levels: from BNF Monthly monitoring of the 40 locations for Ground Water Tables (GWT) measurements found across the study area, covering a total of 122 ha including forest sedge, interior forest,

non-blocked canals and blocked canals. Complementary short-term hydrological monitoring datasets have been used to estimate the hydrological recovery.

- Yearly tree size increase: from BNF Forestry plots (2.4 ha; trees >20 cm DBH) found in the Sebangau Forest (2003-2019). Post-project intervention monitoring data has been collected during the 2019 dry season and is planned for the 2021 dry season (i.e. after submission of this report, in July-August 2021).
- Orangutan population density estimates: from BNF monthly nest surveys across 7 transects, dataset available from 1997 to 2020
- Forest organic matter/ litter-fall: from litterfall traps (16 x 1 m² traps, data collected monthly along two transects) from 2017-2021
- Fauna species presence and abundance: from BNF Camera traps monthly surveys (Baseline 2015-2017: 31 camera traps; Project monitoring 2018-2021: 23 camera traps)

Means of verification/adequacy of indicators: The indicators are considered to be reliable to verify the forest condition and populations of key fauna. The hydrological recovery, forest structure changes and biodiversity variables provided evidence of responses to improved conservation management.

Evidence presented:

- Monthly monitoring of peat-water levels for the 40 GWT locations, including location maps and processed data to support the hydrology recovery. El Niño events have been considered and GWT has been contrasted against areas with no hydrological restoration implemented. (Figures 21, 22 and 121 in Annex 7)
- Tree size increase in BNF historical Forestry plots (2003 – 2019, monitoring implemented every 2 years): including the following variables as indicators: stem density /ha, Basal area (m²/ha), AGB t/ha, BGB t/ha and total Biomass (t/ha). (Figure 122 in Annex 7)
- Orangutan population density: number of nests found every month (from 1997 to 2020) and population density analysis yearly for each habitat type (Mixed Swamp Forest, Tall interior Forest and Low-pole Forest), the total number of orang-utans in Sebangau in a 13 x 10 Km sample area. (Figures 124 and 125)
- Fauna species presence and abundance: camera trap results for the period 2015-2020 presented yearly, including camera trap effort, camera trapping days, the total amount of species caught on camera, the total amount of photos and occupancy index for key species. (Figures 126 - 129 in Annex 7)
- Forest organic matter/ litter-fall: 2017-2020 data set, processed analysis for litterfall leaves (kg/ha). (Figure 123 in Annex 7)

Progress: The indicator has been met, with increasing tree biomass over the project period (2017: 477.89 t/ha // 2019: 557.20 t/ha); an increase in orangutan density (**MSF** - 2017: 1.89-2.15 ind/km² // 2020: 2.42-2.88 ind/km² // **LPF** - 2017: 0.80 ind/km² // 2020: 0.98 ind/km²) and abundance (2017: 187 ind. // 2020: 222 ind.) in the target area, and raised groundwater levels (minimum annual GWL 2016: -20.38 cm // 2020: -15.78 cm). The means of verification were useful to prove the improvement of forest condition and populations of key forest fauna. Specific details on the results and analysis interpretation on this outcome are available in Section 3.4 *Impact: achievement*

Indicator 4: Reduction in negative health impacts amongst local community members, compared to comparable pre-project years.

Data Sources: A pre-project baseline was obtained and monitoring data collected annually. Health impacts were either direct measures, i.e. number of acute respiratory infections (2014-2020) or indirect measures of air pollution, i.e. Air Quality Index (PM₁₀; 2005-2020) and visibility index (2005-2020)

- PM₁₀ - Air Quality data: Meteorology Climatology and Geophysics Agency (Station Jl. Tjilik Riwut, Palangkaraya)
- Visibility data: Meteorology Climatology and Geophysics Agency (Station Jl. Tjilik Riwut, Palangkaraya)
- Figures for acute respiratory infections: Palangka Raya District Government reports, years 2015, 2016, 2017, 2018, 2019 and 2020

Means of verification/adequacy of indicators: The measurable indicators chosen were adequate in theory; however these data are not always publicly available in Central Kalimantan and the data sets are incomplete or unreliable in the most part. PM₁₀ (inhalable particles, with diameters that are generally 10 micrometers and smaller) are considered the most reliable indicator from the Air Quality Index relating to smoke haze, but the dataset is incomplete due to sensor malfunction, with most data missing for 2020. We identified visibility records from the airport as a proxy for haze, however these sensors also malfunctioned, and no data were collected after 2018. Haze can be blown large distances, affecting the air quality of areas with no fires, as seen in 2019 when haze from Pulang Pisau District to the south affected Palangkaraya city and the project area. Data on the number of respiratory infections are compromised by the onset of Covid19 infections in 2020, these data are also only available for the city as a whole and not for selected rural communities near to our intervention area.

Evidence presented:

- Summary table for acute respiratory infections yearly (baseline and project period) (Figure 131 in Annex 7)
- Historical PM₁₀ (µgram/m³) compared with MODIS hotspots in the landscape (Figure 132 in Annex 7)
- PM₁₀ and Visibility raw data (Figure 133 in Annex 7)

Progress: Indicator potentially met, however the data sets proposed to validate this are largely incomplete or unreliable. The number of respiratory tract infections was reduced in 2018 and 2019 compared to previous years, but was higher in 2020, this rise presumably linked to Covid-19 infections and not necessarily air quality. Air pollution from smoke haze, as measured through PM₁₀ levels, a measure of poisonous and dangerous breathable

materials in the air, was 54% reduced during the 2019 fire season compared to 2014, a year with a comparable ENSO Index. This indicates that there was less haze at this time, which correlates with the reduced number of fires in our target area compared to 2014. Poisonous haze from peat-forest fires have been directly linked to negative health impacts, therefore we are confident that by reducing fire prevalence we have directly contributed to an improvement in air quality in the target area and hence improved human health in nearby communities.

3.3 Monitoring of assumptions

OUTCOME ASSUMPTIONS

Assumption 1: Fire incidence is directly linked to peat drainage (i.e. peat water levels and water discharge), the effect of which can be distinguished from that of rainfall alone.

Fires do not occur when water levels are high and are known to occur more frequently in drained peatlands. Fire incidence was regularly monitored using several sources of data, and groundwater levels were monitored every month. Fire incidence was lower in 2019 (compared against climatologically comparable years), which could be linked to reduction in peat drainage, but is also attributable to the efforts of the fire-fighting teams. Reduced fire incidence owing to reduced drainage should be measurable over the long-term.

Assumption 2: Fire hotspots and burn scars can be effectively detected by remote imagery and on-the-ground observations.

Fire hotspots data from MODIS and VIIRS sensors are reliable when identifying burned area locations, although the number of hotspots does not always correlate with the number of peat-fires as MODIS obtain many recurrent hotspots for one fire, whilst the detection ability of both VIIRS and MODIS is reduced in thick haze conditions. This has not been a factor during the project period but we have included field observations within the target area and drone-based thermal imagery as additional data-sources. Drones are particularly good at detecting fires in haze conditions. We have obtained good satellite cloud-free imagery for each year to detect burn scars.

Assumption 3: Hydrological, forest structure and biodiversity variables show detectable responses within the project period to proposed changes in conservation management interventions.

The assumption has held true, particularly for hydrological variables for which we detected measurable changes in groundwater tables and flow-rates in response to conservation management interventions (dam-building). Forest structure and biodiversity variables showed increases in biomass and fauna population sizes, as desired. Several are the continuation of long-term positive trends since the formal protection of the National Park and as such may not be directly attributable to interventions as part of this project, nevertheless these positive trends would not be reported if forest habitat had been lost to fire.

Assumption 4: Trends in number of reported cases of medical submissions/treatments for potential haze-related ailments can be reliably linked to haze, numbers of cases are accurately reported by authorities/media and data remain available.

Haze-related ailments are primarily respiratory illnesses, and there is evidence from external studies demonstrating a clear link between smoke haze and illness. Provided non-haze related respiratory illnesses remain constant, and assuming consistent levels of hospitalisation, data from hospital records supplied by the Indonesian Statistics Agency should be a reliable indicator. It is certain, however, that acute respiratory infection reports from 2020 onwards will include Covid-19 patients. Hopefully this indicator will once again be reliable in the not-to-distant future.

OUTPUT 1. ASSUMPTIONS

Assumption 1: River/canal water levels are appropriate for dam construction.

Fluctuating water levels provided a logistical challenge but all planned dam construction was completed.

Assumption 2: Dam construction materials remain available (or suitable alternatives can be found).

Dam construction materials have remained available throughout from verified sources, certified with the Indonesian Timber Legality Verification System (SVLK) standard.

Assumption 3: Local communities and government remain supportive of dam building.

Although we aimed to block all drainage canals in the National Park, community perceptions and historical ownership claims should be taken into account before proceeding with canal blocking activities. We always contacted the person who claimed ownership of the canal (who had previously invested resources in its construction) in advance to socialise the project and prevent any negative reaction. For the same reason we also determine if any of the canals are still regularly used (e.g. by fishermen or people collecting forest products). As a result of this two of the 27 identified canals have not yet been blocked whilst we resolve these issues.

Overall communities and government have remained supportive of dam-building, evidenced by semi-structured interviews carried out in two villages to identify perceptions of current conservation practices. We

discovered that some people consider canal-blocking to damage fish populations, so have undertaken research into this and socialised the results. (Output 3.4 and Figure 98 in Annex 7).

Assumption 4: Replanted seedlings are not killed or damaged by fire or extreme flooding. Seedling tags are not lost.

Seedling mortality post-planting is in the range of 20-30%, acceptable for a project of this nature in an environment with many stresses for young seedlings. Approximately 5% of seedling tags could not be located when monitoring. Fire is an ongoing risk, as fires are more likely to arise in previously burned areas than natural forest, therefore patrolling by fire-fighting teams and the construction of deep wells enables a quick response to protect the reforestation areas. Overall we have applied our prior experience to prevent failures of this kind, including the selection of resilient native species and application of good practice guidelines.

OUTPUT 2. ASSUMPTIONS

Assumption 1: Village residents and authorities support community fire-fighting team establishment, and willing new team members can be found.

This assumption has held true. Both village residents and local authorities supported the establishment of community fire-fighting teams, being willing participants in the project development and remaining committed throughout.

Assumption 2: Community members promptly and accurately report fires to TSA teams; fires can be effectively detected through a combination of river patrols, drones and MODIS hotspot images.

This assumption has held true. Community information-sharing and a good network of firefighters patrolling daily in the fire-prone areas proved successful methods to detect smoke columns and tackle fires before they became too large. Evidence to support this assumption in Output 2.3 Annex 7.

Assumption 3: TSA teams keep accurate records of fires reported and extinguished.

The TSA teams kept accurate records, although there was variation in consistency and level of detail between members, and some members lack basic skills. BNF introduced training on SMART reporting, GPS and record-keeping which improved the quality and consistency of reports. Evidence of SMART patrol and reporting sheets are provided in Output 2.2 Annex 7.

Assumption 4: The different community fire fighting teams agree to form a network, collaborate effectively within this network and show initiative to coordinate with local government.

The teams collaborated well together. The challenging 2019 fire season increased effective collaboration between and amongst teams and with government agencies. These are good indicators for the successful implementation of a sustainable integrated fire-fighting network. Evidence for the increased effort on joint patrols is available in Output 2.2 Annex 7.

OUTPUT 3. ASSUMPTIONS

Assumption 1: Education team keep accurate records of session participant numbers, plus participant and teacher feedback.

This assumption has held true. The education team developed a detailed database to record activities implemented (Figure 88, Annex 7) and effective methods for quantifying activity impacts (Output 3.2 Annex 7).

Assumption 2: Education/outreach session participants are willing to participate in pre-/post-session assessments and respond truthfully to these.

The participants were willing to participate in the assessments. Questionnaires pre- and post-session have been effective tools to assess the participant's knowledge, understanding and willingness towards behavioural change, although some questions did not provide valuable data and will be rephrased. The assumption hasn't been valid in the context of Covid-19 online sessions. Schools have been closed since the start of Covid-19 restrictions, which has required replacing in-person education sessions with online weekly modules, podcasts and webinars. The participants were given a questionnaire to be completed before and after the sessions, but hardly any students returned the second questionnaire. This made it difficult to monitor impacts or revise sessions based on feedback.

Assumption 3: Trends/responses revealed through analysis of website/social media data accurately reflect those of the wider local community.

It is difficult to test this assumption, but trends of increasing engagement with our website and social media appears to support increasing interest in peatland conservation by the Indonesian media at large.

Assumption 4: Community members are receptive to changing farming, fishing and land management practices, and do not perceive/encounter insurmountable resistance from local government to this.

This varies from person to person as the “community” concept is heterogeneous and subject to many factors and conflicts of interests. Some individuals are very receptive to change and others less so, as some of the traditional farming and fishing methods are deep-rooted or driven by immediate economic benefit. We truly believe that our long-term presence increases community trust and reduces resistance to behavioural change, and as we do so we will bring more people along with us.

Assumption 5: Community members respond truthfully during discussions / questionnaires / forums on the above topics.

As far as we can determine, participants responded truthfully. Some community members expect small financial compensation for information sharing; this practice has been widely implemented by other conservation organisations in Indonesia. BNF prefers to rely on reciprocity and trust.

OUTPUT 4. ASSUMPTIONS

Assumption 1: National Park staff and management are receptive to training and willing to implement lessons learned.

Yes, the National Park staff and management are enthusiastic to collaborate. In 2019 we signed a *Memorandum of Understanding* with the Sebangau National Park and developed a detailed and holistic work plan for the next five years. Many coordination activities, training sessions and workshops have been implemented in partnership with the National Park. Evidence of these collaborations and willingness to receive training and implement lessons learned is provided in Output 4.1 and Figure 111.

3.4 Impact: achievement of positive impact on biodiversity and poverty alleviation

The Impact our project worked towards, as stated in our application form, is “Effective local conservation leadership and management of peat-swamp forests, for the benefit of biodiversity, human health and local economies.”

We contributed towards effective local conservation leadership by helping local communities form fire-fighting teams to protect their environment and health; by facilitating the construction of community nurseries to generate income and sustainable livelihood opportunities; by providing training to develop the capacity of the Sebangau National Park agency and its staff to effectively manage the Park; and by promoting coordination and collaboration between agencies and community teams all working to achieve the same outcomes, namely reducing peat-forest fires and improving health and livelihoods.

We contributed towards effective management of peat-swamp forests by introducing an integrated fire prevention strategy to the Sebangau National Park and encouraging its adoption by all stakeholders; by demonstrating an impactful restoration strategy to rewet peat and replant burnt peat-forests; by delivering education and awareness to communities and young people; by encouraging shifts to more sustainable livelihoods; and by demonstrating a long-term commitment to our partners to help fulfil the project legacy.

In the short term, we have delivered an improved emergency fire response; slowed peatland drainage; increased local awareness of fire impacts and causes, resulting in the beginnings of behaviour change that reduces fire risk; and introduced enhanced reforestation techniques and community-driven reforestation initiatives. To enable benefits to continue over the long-term we have increased local management capacity and coordination, aimed to prevent peat degradation and peatland fires in the region surrounding the Sebangau National Park in Central Kalimantan.

Positive impacts on Biodiversity

The proposed project has delivered positive impacts for biodiversity conservation by strengthening protection and restoration of the Sebangau National Park: the largest contiguous lowland rainforest remaining on Borneo, which is home to the world’s largest protected population of the Critically Endangered Bornean orangutan (~6,080 individuals; Husson et al., 2015), and a rich faunal and floral biodiversity including 46 globally-threatened and 60 nationally-protected species (Husson et al., 2018).

We measured these positive impacts by monitoring populations of key fauna species and forest structure during the project period. The orangutan population has continued to grow, with surveyed densities increasing from 2.3 individuals per km² (ind/km²) in the mixed-swamp habitat sub-type at the start of the project to 2.9 ind/km² by project end (Figure 125 of Annex 7.) indicating a healthy and viable population of apes that continues to recover from previous logging disturbance. Camera traps were used to monitor large mammal diversity and abundance, with consistent results suggesting stable populations throughout the project period. We recorded 49 mammal species in total, with between 30 and 35 species recorded each year, including 1 Critically Endangered, 3 Endangered, 1 Vulnerable and 3 Near Threatened species and 15 protected under Indonesian law (Figure 128 of Annex 7). The occupancy index for selected key species, a measure of abundance, was stable with a few fluctuations (Figure 129 in Annex 7). Forest structure monitoring in 2.4 ha of permanent plots demonstrated increasing growth and recovery post-logging to develop a taller, increasingly mature forest, with fewer but larger trees and increasing biomass (477 t/ha pre-project to 557 t/ha in 2019, (Figure 122 in Annex 7) demonstrating

continuing sustained forest growth (Harrison et al., 2021). This conclusion is further supported by an increase in forest litterfall over the same period, a proxy for forest productivity (Figure 123 in Annex 7).

Positive impacts on poverty alleviation

The primary benefits for poverty alleviation arising from our project are positive impacts for human health. It is well established that peat fires and the resulting toxic haze pollution have major negative impacts on health by increasing respiratory ailments, leading to increased mortality especially among the elderly and children, long-term impacts such as cancer, chronic health conditions and even stunted growth. We have been unable to directly demonstrate short-term health benefits owing to a respiratory disease pandemic confounding these data, but we have indirectly demonstrated these by quantifying an improvement in air quality relative to pre-project years with similar climatic conditions and fire prevalence. Fires and haze also lead to wider socio-economic disruptions, including school and business closures, disruption of trade, lower crop yields and even reduced fish captures resulting from river acidification. In reducing the risk of fire in Sebangau National Park and hence reducing haze exposure in surrounding communities, our project is playing an important role in combating these negative poverty impacts associated with peat fires and haze.

Financial benefits which contribute to poverty alleviation at the local level have been compiled and quantified for this project, including direct benefits from the community nurseries (42,267 seedlings sold), canal blocking activities, community fire-fighting teams, women's groups and other green job opportunities. Approximately 85 people (54 people from community nurseries, 8 people from dam-building teams, and 23 people from cooperative women's groups) received direct benefits from BNF's integrated restoration initiatives. The community nurseries have the potential to increase family income by 25-30%, as well as helping to diversify their income by providing permaculture and aquaculture training opportunities. The total income for each Community Nursery and annual Income per Family are presented in Figure 51 of Annex 7.

Fire-fighting and patrol team members received a complimentary monthly income by protecting and fighting fires in the Sebangau forest and its surroundings. Around 50 community members received direct benefits from these activities (numbers oscillate through the yearly cycle, depending on predicted fire-risk and the length of the dry season). During the 2019 fire season, BNF provided fire-fighting related jobs to an extra 70 people (porters, boat drivers, cooks, logistics support and community volunteers). We estimate that approximately 200 people and their families received direct conservation-related job benefits during the length of this project.

Overall, we believe that the conservation approach adopted and implemented during this project is a good sustainable and scalable model that brings green-job opportunities, environmental awareness and wellbeing for future generations.

4 Contribution to Darwin Initiative Programme Objectives

4.1 Contribution to Global Goals for Sustainable Development (SDGs)

The main aim of this project has been to mitigate the effects of peat and forest fires for the benefit of biodiversity conservation and human health. This work contributed to the following SDG goals.

Goal 3: Good health and well-being – by reducing the frequency and intensity of peat forest fires, nearby communities will benefit from a reduction in associated toxic haze, thus reducing incidences of respiratory and other illnesses and potentially deaths from air pollution. We achieved our fire prevention goals by creating and preparing an emergency fire response; by rewetting and revegetating degraded peatland to reduce fire risk, and through education, awareness and promotion of sustainable peat-friendly livelihood alternatives. Notably in 2019, over 150 local community members joined teams to fight the fires; working non-stop for three months and thanks to their commitment, extraordinary efforts and dedication, all fires were extinguished and none of them reached the Sebangau forest. These efforts resulted in fewer forest fires in the Sebangau landscape and consequently less smoke and pollution, thus producing positive impacts for people's health and wellbeing.

Goal 5: Gender equality – by adopting and implementing Equal Opportunities policies, including promoting the role of women in leadership positions and encouraging equal input from women in project implementation and strategy; and by breaking down gender barriers and pre-conceptions about women's involvement in previously male-dominated activities.

We have increased the participation of women in the community seedling nurseries initiative from 11% at the start of the project to 30% by the end of the project and have engaged 23 women from cooperative women's groups to make organic polybags for the restoration project. We have succeeded in integrating the first two women into the community fire-fighting teams, previously 100% male, thus contributing towards breaking gender barriers and altering pre-conceptions. BNF Indonesia is also delighted to promote two Dayak women to their Board of Directors, demonstrating an internal commitment to gender equality and female empowerment.

Goal 12: Responsible consumption – by promoting sustainable management of natural peatland resources; promoting increased responsibility for better waste management and recycling; and encouraging shifts to more peat-friendly agriculture and fishing livelihoods that reduce dependence on burning and drainage. Our education sessions with local schools, young adults and cooperative groups, development of peat-friendly alternative fishing

and farming plans with local cooperatives, and public outreach via media and public events all contribute to this objective.

Goal 15: Life on land – by improving protection, restoration and management of the peat-swamp forest ecosystem thus improving biodiversity protection. Most of our activities contribute to this, including capacity building for National Park staff, development of an integrated fire prevention strategy, habitat restoration, coordination networks for fire-fighting teams, education and outreach, and monitoring research. We have reduced forest loss, and hence biodiversity loss, by reducing the number of fires during the project period and reducing future fire risk. Biodiversity monitoring has confirmed positive impacts for key species and SOPs and training materials have been prepared to develop long-term monitoring capacity by local partners.

4.2 Project support to the Conventions or Treaties

This project supports the CBD's Forest Biodiversity Programme and Targets 1 (conservation and biodiversity) and 2 (sustainable use of its components), through enhanced protection and condition of the Sebangau forest, improved governance and local capacity and raised local awareness. The regional Department of Forestry, representing the Indonesian focal point for the CBD, has been involved throughout including participating in multi-stakeholder workshops to improve forest management.

We contributed to the following Elements of the CBD's Expanded Programme of Work on Forest Biological Diversity: *Element 1: Conservation, sustainable use and benefit-sharing* by protecting and restoring biodiversity, promoting sustainable resource-use and implementing fire prevention actions; *Element 2: Institutional and socio-economic enabling environment* by developing local capacity to improve forest governance and increasing public education and awareness in Kalimantan; and *Element 3: Knowledge, assessment and monitoring* by undertaking biodiversity monitoring, providing training on this, publishing results and improving field station infrastructure for monitoring biodiversity

BNF has supported the preparation and submission of a proposal by the National Park authority for the designation of Sebangau National Park as a Ramsar site, which is presently being reviewed by the Indonesian Ramsar Focal point.

4.3 Project support to poverty alleviation

By achieving our project outcome, reducing the occurrence and intensity of fires in and around Sebangau National Park, we contributed to poverty alleviation in the following ways.

- Reduction of short- and long-term negative public health impacts, primarily respiratory and cancer impacts owing to haze and toxic smoke pollution linked to peat fires. Reduced respiratory-health impacts may be particularly beneficial as this may have compounded risks from Covid-19 infections, with links between air pollution and severity of Covid-19 illness demonstrated by studies elsewhere.
- Reduction of economic losses associated with forest fires, land degradation and river acidification, and enhanced income potential from recreation and tourism.
- Preservation of ecosystem services through fire prevention, including safeguarding forest resources, clean water, flood control, local climate regulation, as well as social benefits including preservation of cultural heritage, recreation and tourism, scientific and educational initiatives; and wider-reaching functions including carbon storage and sequestration, nutrient cycling, pollination and preventing salinisation.

Although these benefits were either partially measured or not directly measured as part of this project, this link between peatland fires and poverty in Indonesia has been well-established by previous studies.

Direct economic benefits for disadvantaged rural communities through direct employment or supplementing income, achieved through community nurseries, women's groups, fire-fighting teams, dam-building, supply of transport, materials and other resources, and research and monitoring, all of which benefited people from these local communities and many of which are long-term sustainable 'green job' opportunities; and by promoting livelihood diversification and sustainability through introduction of permaculture and aquaculture initiatives; and alternative means of land management.

4.4 Gender equality

UoE and BNF have strong commitments to promote gender equality. We collected gender disaggregated data on all team members and the composition of community groups and individuals participating in this project. Indonesia is typically a male-dominated society, especially at the village level, and this is reflected through the composition of fire-fighting teams and field monitoring teams. As part of this project BNF encouraged women to join these activities and achieved the first permanent female recruits into the fire-fighting teams, since they first came into existence 15 years ago. We increased the number of women participating in the seedling nursery project from 11% at project start to 30% at the end, and directly involved women's groups by purchasing organic polybags from these cooperatives.

BNF provided environmental education and university scholarships to many girls and young women from deprived backgrounds and delivered gender-equality education as part of this programme, discussing alternative ways to understand male-female roles and empowering young women.

BNF has continually provided strong female leadership models, leading by example and inspiring women to purchase professional careers, especially women from Kalimantan. Two of the four members of BNF's Board of Directors are Dayak women (the indigenous people of Kalimantan), 37% of all employees are women, including 6 of 9 senior managers/coordinators. BNF's female staff led capacity-building activities, met with senior government officials, coordinated fire-fighting teams, presented at scientific conferences and appeared on radio talk-shows.

4.5 Programme indicators

Did the project lead to greater representation of local poor people in management structures of biodiversity?

Yes, by supporting the creation and operation of independent community fire-fighting teams in rural villages, and establishing networks for these together with responsible government agencies, these teams contribute to multi-stakeholder forums, workshops and dialogues, as well as direct habitat protection activities, and can liaise between communities and officials.

Were any management plans for biodiversity developed and were these formally accepted?

Not directly, however the National Park management and zoning plans were updated during the project period, with contributions from project participants and the Sebangau National Park Ecosystem Recovery plan 2018-2022 is in process of review for extension, with substantial input from BNF. A proposal for designating RAMSAR status for Sebangau national park was prepared and is being considered.

Were they participatory in nature or were they 'top-down'? How well represented are the local poor, including women, in any proposed management structures?

The management plan updates were generally created "top-down" but involved socialisation and participatory events in which community leaders could provide feedback. The role of local communities in management structures is consultative via multi-stakeholder forums, but through the work of our project the National Park are developing more formal partnerships with the community teams in order to increase cooperation and effectiveness in protecting this vast landscape.

How did the project positively influence household (HH) income and how many HHs saw an increase?

The project directly increased household income in an estimated 215 households in 2 rural villages through participation in project activities, notably in 42 households engaged through the community seedling nurseries initiative which saw a substantial increase in their income.

How much did their HH income increase (e.g. x% above baseline, x% above national average)? How was this measured?

We quantified the increase in household income for the 42 families engaged in the seedling nursery project. On average, each family increased their monthly income by the equivalent of 20% of the District's average minimum wage for 2020 (Palangkaraya City District) by collecting, growing and selling seedlings, investing a few hours a week on seedling maintenance. This is in addition to income some of them received through employment in other aspects of the restoration project (see Figure 51 in Annex 7 for the specific details on household income increase).

4.6 Transfer of knowledge

Knowledge transfer took place in the following ways

- Multi-stakeholder workshops which discussed strategy and shared knowledge and resources between participants, to develop and implement the integrated fire prevention strategy and fire-fighting networks.
- Training workshops, either for single or multiple beneficiaries, in many aspects of the project including fire-fighting techniques, canal-blocking, nursery establishment and management, reforestation, use of drones, SMART patrolling and reporting, biodiversity surveys and sustainable livelihoods.
- Education and awareness for young people, targeted community groups and the wider public delivered via one-on-one and group sessions, webinars, radio, and social media.
- Published information in print media and peer-reviewed journals, including a collaborative manuscript in preparation aimed at peat-swamp reforestation practitioners combining a systematic literature review with data obtained during this project.
- Discussions and contribution of data and reports to Indonesian policymakers and implementers, including our local partners as listed and the Indonesian Peat and Mangrove Restoration Agency (BRGM).
- Via regional, national and international networks for forest and biodiversity conservation, including the Indonesian Forum for Orangutan Conservation (FORINA), Central Kalimantan Orangutan Conservation Forum (FORKAH), Multi-Stakeholder Forum Palangka Raya (MSF), Heart of Borneo Working Group (POKJA HoB), Pulang Pisau Essential Ecosystems Working Group (POKJA KEE PP), Asian Species Action

Partnership (ASAP), Great Apes Survival Partnership (GRASP) and IUCN SSC Specialist Groups for Cats, Freshwater Fish and Primates (Great Apes and Small Apes sections)

- Via various Restoration platforms and initiatives to support the UN Decade on Ecosystem Restoration. During this project BNF has been selected as one of the founding 50 members of the UN Decade and as a winner of the World Economic Forum/Uplink/1t.org Trillion Trees Challenge

Several Indonesian and international students and staff of BNF received formal qualifications in fields related to the project, or support towards future qualifications. A member of BNF's field team received an undergraduate degree in Forestry at the University of Palangkaraya. Two drone pilots obtained their pilot certification from the Indonesian Drone Pilot Association., completing a Drone Safety and Ethics Training Course in Surabaya (Java). BNF awarded an 'Orangutan caring scholarship' to 15 selected students from the University of Palangkaraya, who joined activities including workshops, seminars, field trips and outreach activities to gain experience.

International students conducted dissertation research on related subjects towards the following qualifications: PhD (University of Leicester) freshwater fish and fisheries; PhD (University of Dresden) impacts of fire on orangutan behaviour; MRes (University of Exeter) impacts of fire on orangutan communication; MRes (University of Exeter) impacts of fire on butterfly abundance; MSc (University of Plymouth) forest bioacoustics and changes post-fire; MSc (University of Plymouth) long-term trends in forest structure and orangutan populations; and MSc (University of Exeter) socio-economic impacts of community nurseries. Forty-five students from the University of Exeter visited the Sebangau research site for an undergraduate field course, participating in research and conservation activities; and 10 students from various US universities took part in an 'introduction to primate behaviour research' field course.

4.7 Capacity building

BNF has joined the Pulang Pisau Essential Ecosystems Working group (POKJA KEE PP) and the Heart of Borneo Working Group (POKJA HoB). Agnes Ferisa (BNF Vice Director of Partnerships, female) appointed Secretary of the Central Kalimantan Orangutan Conservation Forum (FORKAH). Darmae Nasir (CIMTROP Head, male) appointed as technical advisor to the Indonesian Peat and Mangrove Restoration Agency (BRGM).

5 Sustainability and Legacy

Project achievements which will endure include the establishment of grassroots peatland-fire prevention activities as a business-as-usual conservation strategy in this region and connecting these with regional and national strategies. The development of strategic partnerships and collaborations with government agencies and strengthening partner organisational capacity will continue the legacy of this project. In coming years we expect the restoration, education, outreach and capacity building initiatives to scale up across the landscape; with improved technical methods and volume of outputs leading to reduced fire impacts in the landscape. Specific outcomes which benefit project sustainability and create a legacy include:

- Establishing a good project reputation within Palangkaraya and Central Kalimantan and strong stakeholder support with and within communities.
- BNF has undergone substantial structural development, becoming more integrated in regional conservation activities and networks and gaining trust from key stakeholders.
- Community habitat protection and fire-fighting teams are integrated with National and regional development plans; thus enabling access to centralised funds to maintain these initiatives.
- Community development opportunities have been diversified to reduce dependence of beneficiaries on a single funding source; achieved by aligning participation in fire-fighting teams, seedling nurseries and livelihood development activities.
- The launch of BNF's 1 Million tree campaign, to continue the reforestation legacy of this project. BNF has set a target to plant one million trees over the next five years in the Sebangau National Park, growing the seedlings in an expanded network of community nurseries.
- The development of a Community Fire-fighting network and integrated fire-management approach in the Sebangau National Park region, with 12 fire-fighting teams joined to date.
- The launching of a drone centre by UPT LLG CIMTROP and BNF, to promote the use of drones to support the mitigation and monitoring of peat fires in Central Kalimantan.
- The launching of BNF's *Natura* magazine, a conservation communication and outreach tool to raise awareness of conservation projects locally.
- The establishment of *Memorandums of Understanding* (MoU) and annual work-plans between BNF and the Sebangau National Park authority; Palangkaraya City Government and Pulang Pisau District Government to continue this work over the next 3-5 years; and between BNF and University of Palangkaraya (UPR), Gadjah Mada University (UGM) and National University of Indonesia (UNAS), to develop research partnerships and training in the context of peatland management and biodiversity conservation.

6 Lessons learned

- The inception phase took longer than anticipated, to coordinate with local partners, conduct risk analysis, and develop a work-plan with monitoring and evaluation components. The substantial amount of time spent building these partnerships and work-plans, and socialising activities with stakeholders, was one of the most important factors for the ultimate success of the project; but it also reduced the time available to deliver all milestones or produce all deliverables as planned within the time-frame of the project.
- Replicating and expanding the scope and location of activities which had previously been piloted or carried out at a small-scale resulted in some upscaling challenges in administration, human resources and team coordination. Many staff and teams were added, particularly during the second year, which required additional support to achieve milestones on time. A more realistic development plan and assessment of team capacity may have helped smooth this process.
- Working with people requires patience and flexibility, to consider and embrace the many different hopes, fears and perceptions that exist within a community; so that a solid foundation can be built, and goals agreed by all. Community conflicts are not always predictable but will always occur, these can be minimised with open dialogue and sensible resolution of differing views.
- To achieve our goal of empowering communities to lead conservation activities, such as fire-fighting patrols and seedling nurseries, it is essential to acknowledge the principle of independence and self-management, whilst providing the necessary level of support and capacity-building they require. This can be a difficult balancing act, as too hands-off an approach can allow conflicts to arise within teams thus leading to failure, in the case of two seedling nursery groups which were dissolved in the second year. Understanding our role and limitations is important, so we do not interfere in key dynamics or micro-manage local partners whilst ensuring group cohesion and focus on outputs.
- As a result of COVID-19 some education sessions were moved online, but this created monitoring and evaluation problems. Participants were provided questionnaires to complete and return after the session, but very few were returned. In future we will anticipate this issue and use online evaluation tools (e.g. Slido) within an evaluation session scheduled as part of the seminar/workshop itself.
- We found difficulty in obtaining good indicators of health and wellbeing owing to lack of access to reliable datasets, or an inability to analyse these datasets in detail. We have begun conversations with the health agency for future analyses but this would have been more beneficial to complete in the inception phase.
- Instigating a dedicated Monitoring and Evaluation team within BNF has been a great benefit to manage the large volume of data provided by the field teams and enhanced the quality of our reporting and research outputs and ability to evaluate the project as it proceeded.

6.1 Monitoring and evaluation

There were no changes to the logframe. Our M&E system was practical and helpful and supported capacity-building within local partners BNF, by demonstrating the success of projects on the ground, providing analysed results to support their external communication and outreach, training them to do the same and helping teams overcome and learn from difficulties. Establishing a dedicated M&E team was a key factor in ensuring monitoring was effective and meaningful.

UoE and BNF conducted an annual internal evaluation of the project, using the annual report reviews as part of this process, to review the project logframe and work plans for the following year. BNF's programme teams carried out a performance assessment every year as part of the annual project cycles, to assess the effectiveness of certain initiatives such as the community seedling nurseries. Frequent evaluations were conducted between BNF and implementation partners, for example evaluation workshops are held at the end of the dry season with each fire-fighting team separately. Ongoing review and evaluation to obtain feedback from all project participants in each activity, to address issues arising and plan the next stage, has been an important and integral component of this project.

6.2 Actions taken in response to annual report reviews

Report reviews were detailed, helpful and received positively, and proved essential to amend specific (and non-internally identified) issues. They formed part of the annual project evaluation by the lead partners to shape the direction of the project in each year, and as were therefore shared with the lead implementing partner with feedback passed on to other partners

BNF is currently planning a major multi-stakeholder workshop in partnership with the Sebangau National Park, to discuss and wrap up this project and discuss the next phase, including upscaling and capacity-building plans for the conservation initiatives implemented during this project, including the 1 million tree reforestation campaign and continuing establishment of a fire-fighting network and peat-friendly livelihoods as the basis of a fire-free alliance in Central Kalimantan. This workshop will be held as soon as Covid-19 restrictions allow.

7 Darwin identity

BNF displayed the Darwin Initiative logo prominently on its website, on posters and banners at workshops and meetings in Kalimantan that we organised. Support from the Darwin Initiative is part of a larger programme, with other supporters acknowledged alongside. Support was also acknowledged on several of BNF’s online stories and social media concerning activities undertaken as part of this project, as well as communicated to journalists covering our work including in social media. Figures 137 and 138 of [Annex 7](#) summarises BNF’s communication and increasing trends in numbers of followers. UoE have also covered this project in its online media. The Darwin Initiative is still little known in Kalimantan but the involvement of policy-makers and academics as project partners has raised its profile, and all partners are aware this is UK Government funding supporting their efforts.

8 Impact of COVID-19 on project delivery

Indonesia’s forests have been under an increased threat owing to COVID-19’s impacts on law enforcement, protected area management and monitoring. The rate of forest loss in Indonesia is estimated to have increased by 50% during the first half of 2020 (Greenpeace analysis; based on forest loss GLAD data analysed by University of Maryland) and forest clearance in Indonesia was up 130% compared to the three-year average for March 2017 to 2019 ([WWF 2020; Forest loss in times of corona pandemic](#)). Reports also indicate alarming new health impacts in Indonesia linking forest-fire haze to COVID-19 ([Greenpeace 2020; Burning up report](#)) and livelihood shifts due to impacts on travel and tourism ([D.Helm 2020; The Environmental Impacts of the Coronavirus](#)) resulting in increased hunting and logging in rural areas, with higher forest-use increasing the risk of peat-forest fires. Each of these factors had the potential to work against the project Impact, and forest patrols were stepped up to make sure that illegal activities did not increase whilst the authorities’ focus was elsewhere. Thankfully we didn’t identify any increase in illegal activities or fires in the project area during this period.

Local travel, social-distancing, and gathering size restrictions impacted our delivery of education, awareness, training, and community development activities, but BNF and partners increased forest patrols, fire-fighting preparedness and socially-distanced community outreach in response to potential increased threats. Through this crisis BNF committed to supporting all existing staff members to ensure their financial security, to retain skills and knowledge, and to continue essential conservation and monitoring activities within the parameters of local restrictions. To help facilitate a wider understanding of the impacts and challenges of COVID-19 in Central Kalimantan, BNF implemented a series of online workshops and webinars for stakeholders to address the consequences of COVID-19 on habitat conservation and land management in the region, with the aim to identify additional support that may be needed and to promote coordination.

Schools have been closed since the start of the pandemic and training sessions and events with large numbers of people are not permitted. We delivered activities online where possible, attempting to overcome issues of ensuring equal access to all, and meetings and workshops were scaled down or postponed in most cases. We adjusted education and community development activities by developing new protocols, delivery methods, resources and alternative participatory approaches. Our teams responded quickly to the emerging barriers and proactively developed new ideas, such as online modules for schools, weekly resource packs, webinars, podcasts and information brochures, as well as introducing awareness of ecosystem health, zoonotic diseases, and information about Covid-19 itself into outreach events. Understandably, the number of participants across all outreach activities reduced substantially and several targets in these areas could not be reached.

UoE were unable to conduct direct field evaluations of activities, but frequent online coordination and good communication ensured that UoE’s project role continued satisfactorily and feedback was acted upon. A budget change request was approved which enabled unused funds from travel, workshop and education costs to be reallocated for in-country partner training and development of fire-fighting strategy.

All partners followed their respective national directives for social-distancing and home-working, with all partner offices closed for substantial periods. The city of Palangkaraya was a regional hotspot for Covid-19 infection, so visits to the forest were curtailed to reduce risks of transmission to endangered primate species. All staff conducting activities with communities were tested frequently, mask-wearing was adopted as standard and other regulations such as health-checks and isolation protocols were implemented by BNF. Masks and sanitiser were also distributed to community groups, family members of staff and project partners. In future we will make greater use of virtual meetings, and in particular continue the series of webinars which have proved successful and reached a wide audience in Indonesia and overseas.

9 Finance and administration

9.1 Project expenditure

Project spend (indicative) since last annual report	2020/21 Grant (£)	2020/21 Total actual Darwin Costs (£)	Variance %	Comments (please explain significant variances)

Staff costs (see below)				
Consultancy costs				
Overhead Costs				
Travel and subsistence				
Operating Costs				
Capital items (see below)				
Others (see below)				
TOTAL				

Staff employed (Name and position)	Cost (£)
Professor Frank Van Veen PI	
Dr Helen Morrogh-Bernard, Research Fellow	
Berni Ripoll - Project Management	
Juliarta Ottay - Government Liaison	
Koesmyadi - Community Liaison	
Dwi Riyan - Education Manager	
Desi Natalia - Communications Officer	
Siti Muaquifah - Finance Officer	
Santiano - Research Team Leader	
TOTAL	

Capital items – description	Capital items – cost (£)
N/A	
TOTAL	

Other items – description	Other items – cost (£)
Nursery consumables and monitoring Dam-building materials	

TOTAL	
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9.2 Additional funds or in-kind contributions secured

Source of funding for project lifetime	Total (£)
University of Exeter	
The Orangutan Project	
Arcus Foundation	
Re:Wild (Global Wildlife Conservation)	
Franklinia Foundation	
TOTAL	

Source of funding for additional work after project lifetime	Total (£)
University of Exeter	
The Orangutan Project	
Arcus Foundation	
Re:Wild (Global Wildlife Conservation)	
Franklinia Foundation	
TOTAL	

9.3 Value for Money

This project delivered value for money by achieving measurable conservation outputs for relatively-small expenditure, owing to long-term commitment by partners and strong integration with the target communities. Our local partners applied rigorous financial controls to keep costs in line with budget and ensure accurate reporting. Activities were primarily led by Indonesian staff with lower salary components compared to UK employees, which also benefited capacity building and empowerment of Indonesian nationals. Partners contributed in-kind support, including office space, meeting rooms, vehicles and equipment; existing research infrastructure, data management systems and trained personnel supported the monitoring objectives, with freely available supporting data such as MODIS fire data, Indonesian Meteorology Agency air quality data and Provincial Health Service health data used for certain indicators. Field activities, including restoration, sustainable livelihood and social forestry initiatives, did not require land purchase, expensive equipment or substantial infrastructure: all materials and services were sourced locally and benefits channelled to low-income communities. Local communities participated willingly and contributed time and resources owing to their motivation to prevent fire. Finally, the project prioritised capacity- building to deliver the clear upscaling and replication potential of the project, ensuring that project expenditures will continue to provide benefits in the future.

10 OPTIONAL: Outstanding achievements of your project during the (300-400 words maximum). This section may be used for publicity purposes

I agree for the Darwin Secretariat to publish the content of this section.

The University of Exeter / Borneo Nature Foundation partnership completed an ambitious project by developing an integrated fire management strategy to address the devastating impacts of forest fires in southern Borneo's vast peat-swamps. Huge peatland fires have destroyed large areas of forest in the past three decades, damaging

the health and livelihoods of people living nearby, releasing huge amounts of carbon dioxide into the atmosphere and threatening biodiversity, including the largest protected populations of orangutans in the world.

The project partners have worked with the Sebangau National Park agency and surrounding rural communities to restore, reforest and protect this ecosystem, by blocking drainage channels to keep the peat wet, establishing a network of community seedling nurseries to grow trees for reforesting burnt land, and by helping farmers and fishers adopt more peat-friendly techniques that reduce reliance on drainage and burning. Crucially, the project partners initiated a regional fire-fighting network, composed of community fire-fighting teams who patrol for and extinguish dry-season fires before they reach the forest. Putting their lives at risk, these volunteer fire-fighters are on the front-line in the global fight to combat climate change, motivated to prevent the poisonous smoke haze that afflicted so many people during the disastrous 2015 fires. When fires returned in 2019, with our support they extinguished over 100 hotspots in the project area and prevented any forest-loss – whereas elsewhere in Borneo large areas were destroyed.

By blocking 25 drainage channels, planting over 50,000 trees and delivering environmental education to thousands of children and young adults, this project has already delivered substantive change – gaining recognition as the winner of the Keeling Curve Prize 2020, chosen as one of the winners of the UpLink Trillion Trees Challenge 2020 at the World Economic Forum's Sustainable Development Impact Summit, and showcased as one of the Founding 50 members of the UN Decade on Ecosystem Restoration's Digital Hub. The impacts will continue long-term, however, as our focus on capacity-building and training, integrating community initiatives with government policy, facilitating coordination networks and introducing advanced technologies to the region, will enable the scaling-up of peatland restoration and fire prevention activities that are essential to consign Kalimantan's fire crisis to history.

Annex 1 Project's original (or most recently approved) logframe, including indicators, means of verification and assumptions.

Note: Insert your full logframe. If your logframe was changed since your Stage 2 application and was approved by a Change Request the newest approved version should be inserted here, otherwise insert the Stage 2 logframe.

Project summary	Measurable Indicators	Means of verification	Important Assumptions
<p>Impact: Effective local conservation leadership and management of peat-swamp forests, for the benefit of biodiversity, human health and local economies.</p>			
<p>Outcome: The occurrence and intensity of fires in and around Sebangau National Park in Central Kalimantan is significantly reduced, thus benefiting biodiversity conservation and human health</p>	<p>Indicator 1 Number of fires in target area reduced to 25% of baseline value by yr 3 , compared to comparable pre-project years</p> <p>Indicator 2 Area of peatland burned in target area reduced to 10% of baseline value compared to comparable pre-project years.</p> <p>Indicator 3 Improving (or at minimum stable) forest condition and populations of key forest fauna, compared to pre-project baselines.</p>	<p>Indicator 1 Spatio-temporal analysis of MODIS hotspot distribution in Sebangau Sub-district; TSA patrol and local community reports. Data compared to previous years with a similar El Niño index.</p> <p>Indicator 2 Analysis of annual pre/post-fire season LandSat imagery; on-the-ground monitoring of burned areas. Data compared to previous years with a similar El Niño index.</p> <p>Indicator 3 Regular monitoring of peat water levels at 40 locations; tree size and mortality in 2.4 ha of long-term forest plots; orangutan population density through line transects of nests; fauna species presence and abundance through 24 camera traps. Data collected during the project compared to pre-project 2017 baseline.</p>	<p>Fire incidence is directly linked to peat drainage (i.e. peat water levels and water discharge), the effect of which can be distinguished from that of rainfall alone.</p> <p>Fire hotspots and burn scars can be effectively detected by remote imagery and on-the-ground observations.</p> <p>Hydrological, forest structure and biodiversity variables show detectable responses within the project period to proposed changes in conservation management interventions.</p>

	Indicator 4 Reduction in negative health impacts amongst local community members, compared to comparable pre-project years.	Indicator 4 Local air quality monitoring; local medical authority reports; local media reports; reports received by TSA teams from local community members. Data compared to previous years with a similar El Niño index.	Trends in number of reported cases of medical submissions/treatments for potential haze-related ailments can be reliably linked to haze, number of cases are accurately reported by authorities/media and data remain available.
<p>Outputs:</p> <p>1. Ex-illegal logging canals blocked and areas burned in the 2015 fires replanted in the Sebangau National Park to re-wet the swamp thus reducing fire risk, prevent further forest losses and reverse fire damage.</p>	<p>1.1 Number of canals closed increased to 24 (baseline 10) and up to 200 new dams built by end yr 3</p> <p>1.2 Reduction in water flow-rates and discharge rates (by up to 500%) within canals, and slowing of dry season water-table drawdown (>10 cm in each dammed canal in comparison to pre-dammed state and control studies</p> <p>1.3 50,000 seedlings planted / over 150 ha of previously burnt forest. Average of 80% survival rates for different species / planting conditions identified.</p> <p>1.4 Forty (40) families involved in 8 community nurseries. 5 Community nurseries operational by end yr 2 and 3 Community nurseries established by end yr 3.</p>	<p>1.1 Hydrology Restoration team reports, including photographic and GPS evidence; field inspections by project leaders.</p> <p>1.2 Monthly measurements of peat water table at 40 locations, plus water depth and flow rates in canals at 50 locations (5 in each canal; including in dammed and undammed canals) using hand-held and automated data loggers. Comparison of data collected during project period to pre-project years with similar rainfall levels.</p> <p>1.3 Monitoring of the number of seedlings of different species planted under different conditions (tagged on planting); subsequent monitoring of tagged seedling survival 1, 6 and 12 months post planting.</p> <p>1.4 Number of local men and women actively engaged in community nursery programme in nearby villages, established through field inspections.</p>	<p>River/canal water levels are appropriate for dam construction.</p> <p>Dam construction materials remain available (or suitable alternatives can be found).</p> <p>Local communities and government remain supportive of dam building.</p> <p>Hydrological monitoring locations remain accessible and equipment functional.</p> <p>Replanted seedlings are not killed or damaged by fire or extreme flooding. Seedling tags are not lost.</p> <p>Local community members are willing to engage with community nursery programme.</p>

	Twenty (20) women working in Community groups crafting organic-bags/pots to plant seedlings for reforestation purposes.		
2. Improved local fire-fighting capacity for rapid response to peatland fires in Sebangau NP and Palangkaraya district.	<p>2.1 Four community fire-fighting teams operational (current baseline = two); up to 20 local people recruited and two training sessions / yr held in peat-fire extinguishing methods and use of equipment</p> <p>2.2 Fire-response teams effectively mobilised during each dry season</p> <p>2.3 100% of identified fires attended and extinguished in target areas</p> <p>2.4 Network of community fire-fighting teams established and coordinating with government agencies in Palangkaraya district and with each other with two multi-stakeholder workshops held in yr 2 and 3</p>	<p>2.1 Records of the number of teams created, plus members recruited and retained for each team. Training levels assessed against set criteria at minimum annual intervals.</p> <p>2.2 Records of number and percentage of known fires (established through direct reports to TSA teams, river patrol, drone and MODIS hotspot monitoring) responded to; length of time between report receipt and response launch.</p> <p>2.3 TSA team records, community reports and field inspections by project leaders.</p> <p>2.4 Establishment and composition of the network at annual intervals; continuous assessment of network member contributions based on peer reports and project leader inspections; number of coordination meetings with relevant government agencies and government responses to these.</p>	<p>Village residents and authorities support community fire-fighting team establishment, and willing new team members can be found.</p> <p>Community members promptly and accurately report fires to TSA teams; fires can be effectively detected through a combination of river patrols, drones and MODIS hotspot images.</p> <p>TSA teams keep accurate records of fires reported and extinguished.</p> <p>The different community fire fighting teams agree to form a network, collaborate effectively within this network and show initiative to coordinate with local government.</p> <p>Local government are receptive to coordination with the community fire-fighting network.</p>

<p>3. Local community adopt more “peat-friendly” farming and fishing practices that avoid peat drainage and use of fire; and families better understand how to mitigate the harmful effects of fire.</p>	<p>3.1 240 education modules/sessions held with 20 schools, 3 community forums and special interest groups (fishermen; farmers cooperatives), including three large-scale forums per year with aim to reach 90% of people in these target groups by end yr 3.</p> <p>3.2 1,000 people reached with education and awareness activities by end yr 3.</p> <p>3.3 Number of people demonstrating positive response to these activities (70% increase in knowledge / awareness on environmental issues)</p> <p>3.4 (50% increase in willingness for) adoption of alternative farming and fishing practices, in particular use of non-burning/drainage methods, among local community members.</p>	<p>3.1 The Education team records the number of sessions held, plus participant numbers and composition. Field inspections by project leaders.</p> <p>3.2 Records from Education team (see 3.1); records from Outreach team on number of people attending events; data on number of website/social media hits.</p> <p>3.3 Pre- and post-session assessments (questionnaires, tasks, games) of education session participant understanding of and position in relation to issues addressed during sessions; informal feedback from session participants and school teachers; and growth in website/social media follower numbers and responses to posts (comments/shares/likes).</p> <p>3.4 Community member responses during informal discussions, formal workshops/forums and to questionnaires in relation to current and intended farming, fishing and land management strategies.</p>	<p>Education team keeps accurate records of session participant numbers, plus participant and teacher feedback.</p> <p>Education/outreach session participants are willing to participate in pre-/post-session assessments and respond truthfully to these.</p> <p>Trends/responses revealed through analysis of website/social media data accurately reflect those of the wider local community.</p> <p>Community members are receptive to changing farming, fishing and land management practices, and do not perceive/encounter insurmountable resistance from local government to this.</p> <p>Community members respond truthfully during discussions / questionnaires / for a on the above topics.</p>
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<p>4. Foundations established to create a long-term legacy for fire prevention and mitigation in and around the Sebangau National Park.</p>	<p>4.1 Effective fire-prevention system adopted by National Park managers and stakeholders resulting from 1 multi-stakeholder workshop in yr 2 and follow-up in yr 3.</p> <p>4.2 Twenty (20) National Park staff receive training in restoration and biodiversity monitoring techniques (70% increase in knowledge) and involved in field activities during 3 training workshops in yr 2 and 3, including field sessions</p> <p>4.3 Three (3) meetings to promote coordination with provincial and national strategies for peatland conservation and fire prevention achieved by end yr 3.</p>	<p>4.1 Above recommendations adopted within NP management plan, stakeholder forum established and regularly meeting to ensure coordination and knowledge-share between organisations</p> <p>4.2 Number of training sessions held, number of people involved, pre- and post-training delivery assessment of participant skill levels against set criteria.</p> <p>4.3 Number and composition of coordination meetings and other communications with relevant government departments; responses during these meetings and less formal correspondence; requests for input by government into strategy development; representation of project findings/recommendations within government strategies.</p>	<p>National Park staff and management are receptive to training and willing to implement lessons learned.</p> <p>Stakeholder forum members remain committed to objectives and willing to engage with government</p> <p>Provincial and national government remain committed to peat and biodiversity protection, and are willing to engage with and receive input from project proponents.</p>
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Annex 2 Report of progress and achievements against final project logframe for the life of the project

Project summary	Measurable Indicators	Progress and Achievements
<p>Impact</p> <p>Effective local conservation leadership and management of peat-swamp forests, for the benefit of biodiversity, human health and local economies.</p>		
<p>Outcome</p> <p>The occurrence and intensity of fires in and around Sebangau National Park in Central Kalimantan is significantly reduced, thus benefiting biodiversity conservation and human health.</p>	<p>Indicator 1 Number of fires in target area reduced to 25% of baseline value by yr 3, compared to comparable pre-project years</p> <p>Indicator 2 Area of peatland burned in target area reduced to 10% of baseline value compared to comparable pre-project years.</p> <p>Indicator 3 Improving (or at minimum stable) forest condition and populations of key forest fauna, compared to pre-project baselines.</p>	<p>Indicator 1 Baseline figures for the number of hotspots (MODIS hotspots VIIRS Catalog) in the target area were established for pre-project years (2001-2017) and compiled annually during the project, alongside the ENSO index for each year.</p> <p>This Indicator has been achieved with a substantial reduction in fires in the forested portion of the target area. In 2019, the sole drought year during the project period, the number of fire hotspots recorded in forested areas was 80% fewer in our intervention area compared to 2014, a year with a similar ENSO index. The impact can be contrasted with a 141% increase for the whole National Park over the same period, clearly demonstrating the effectiveness of our project at creating and mobilising a successful emergency fire response.</p> <p>Indicator 2 Spatial data-sets of burned areas for the pre-project years (2000-2017) and the project period (2018, 2019 and 2020) were compiled and processed using a dNBR (difference Normalised Burn Ratio) to identify forest loss due to fire for the northern Sebangau landscape, contrasting areas with differing levels of interventions.</p> <p>The indicator has been achieved and the size of burned areas in the target area has been reduced to 6% of the area burned in comparable pre-project years. The means of verification, using LandSat imagery and Forest loss spatial data, successfully detected burned areas.</p> <p>Indicator 3 Baseline data for indicators that demonstrate forest condition improvement were collated and compared to annual monitoring data collected during the project period. These include monthly monitoring of groundwater levels (40 locations); tree growth and mortality rates in 2.4 ha of permanent forest plots; orangutan population surveys using line transects of nests; organic matter litter-fall and monthly monitoring of fauna species presence and abundance using fixed location camera-traps.</p>

	<p>Indicator 4 Reduction in negative health impacts amongst local community members, compared to comparable pre-project years</p>	<p>The indicator has been met, with increasing tree biomass over the project period (2017: 477.89 t/ha // 2019: 557.20 t/ha); an increase in orangutan density (MSF - 2017: 1.89-2.15 ind/km² // 2020: 2.42-2.88 ind/km² // LPF - 2017: 0.80 ind/km² // 2020: 0.98 ind/km²) and abundance (2017: 187 ind. // 2020: 222 ind.) in the target area, and raised groundwater levels (minimum annual GWL 2016: -20.38 cm // 2020: -15.78 cm). Specific details on the results and analysis interpretation on this outcome are available in Section 3.4 <i>Impact: achievement of positive impact on biodiversity.</i></p> <p>Indicator 4 A pre-project baseline was obtained and monitoring data collected annually. Health impacts were either direct measures, i.e. number of acute respiratory infections (2014-2020) or indirect measures of air pollution, i.e. Air Quality Index (PM10; 2005-2020) and visibility index (2005-2020)</p> <p>Indicator potentially met, however the data sets proposed to validate this are largely incomplete or unreliable. The number of respiratory tract infections was reduced in 2018 and 2019 compared to previous years, but was higher in 2020, this rise presumably linked to Covid19 infections and not air quality. Air pollution from smoke haze, as measured through PM₁₀ levels, was 54% reduced during the 2019 fire season compared to 2014, a year with a comparable ENSO Index. This indicates that there was less haze at this time, which correlates with the reduced number of fires in our target area compared to 2014. Poisonous haze from peat and forest fires have been directly linked to negative health impacts in rural communities, therefore we are confident that by reducing the number and intensity of forest fires we have directly contributed to an improvement in air quality in the target area and hence improved human health in nearby communities</p>
<p>Output 1. Ex-illegal logging canals blocked and areas burned in the 2015 fires replanted in the Sebangau National Park to re-wet the swamp thus reducing fire risk, prevent further forest losses and reverse fire damage.</p>	<p>1.1 Number of canals closed increased to 24 (baseline 10) and up to 200 new dams built by end yr 3</p> <p>1.2 Reduction in water flow-rates and discharge rates (by up to 500%) within canals, and slowing of dry season water-table drawdown (>10 cm in each dammed canal in comparison to pre-dammed state and control studies</p>	<p>1.1 We identified and surveyed 27 canals in our target area, 10 of which were closed prior to the project starting. Twelve drainage canals were blocked during the project period by constructing 145 double-walled dams along their length. Three further canals did not require damming owing to natural infilling and in one case, the gradient of the canal which caused water to flow into the forest. The two remaining canals will remain open based on the specific request of local communities.</p> <p>1.2 Hydrology monitoring surveys were undertaken monthly in six canals to measure water discharge-rates and groundwater tables, with 71 locations in total along both blocked and unblocked (control) canals. Water discharge rate reduced by 70% in the largest dammed canal, from 0.191 m³/s to 0.052 m³/s. Short-term data collected from recently blocked canals provide similar findings, with reductions between 49% and 81%. This in turn raises the water-table, keeping the peat wet and reducing oxidation and subsidence, with average annual groundwater tables in the vicinity of the largest canal 8cm higher post-blocking</p>

	<p>1.3 50,000 seedlings planted / over 150 ha of previously burnt forest. Average of 80% survival rates for different species / planting conditions identified.</p> <p>1.4 Forty (40) families involved in 8 community nurseries. 5 community nurseries operational by end yr 2 and 3 community nurseries established by end yr 3.</p> <p>1.5 Twenty (20) women working in Community groups crafting organic-bags/pots to plant seedlings for reforestation purposes.</p>	<p>compared to baseline values, with groundwater-tables raised by up to 11cm near other blocked canals.</p> <p>1.3 A total of 48,902 native seedlings have been planted over the last three years in the 2015 burned area. The first planting (25,666 seedlings planted in 25 ha, December 2019) was sourced with seedlings donated by the Watershed Management Centre for Protected Forest (BPDAS HL), with a total of 22,372 seedlings; the remaining 3,294 seedlings were grown in BNF in-situ nursery. A total of 50ha have been reforested by April 2021, and another 100ha will be reforested during the 2021 dry season as water levels were too high before April 2021, reaching a total of 150 ha.</p> <p>Survival and growth rates were monitored. We have recorded a first-year mean survival rate of 72%, varying from 70% for <i>Shorea balangeran</i> to 86% for <i>Elaeocarpus mastersii</i>.</p> <p>1.4 At the end of this project, a total of 54 families (8 groups) from Kereng Bangkirai and Sabaru villages are fully involved in the community seedling nursery initiative. From the initial five community nurseries established in year 1, three remained active until the end of this grant period. During the second half of 2020 three new nurseries were established and in early-2021 two more groups joined the scheme.</p> <p>Since year 1, 18 community members were involved in the whole reforestation process, taking part in the seedlings transportation, building new nurseries, preparing the reforestation transects, planting seedlings and supporting monitoring activities</p> <p>1.5 A total of 19 women and 4 men established cooperative groups working on organic pot crafting. 3,000 organic pots were crafted by the women's groups during the project period. COVID-19 pandemic has forced us to completely stop this initiative since early 2020. The main participants in these groups are old women who gather in interior spaces to socialise and weave the organic pots. As this population sector is at risk due to COVID, we decided to pause it for health and safety reasons.</p>
<p>Activity 1.1 Canals surveyed beforehand to identify priority locations for blocking using dams and develop dam building schedule in each target canal. Dams built on canals in target area by local workforce using sustainable natural materials and a pre-trialled design. Pre-construction socialisation of damming plans with local community to create awareness, allow opportunity for discussion and help ensure community support for damming. Post-construction, dam condition monitored and repaired throughout the year as necessary.</p>		<p>Activity 1.1 Canals in the target area have been identified and surveyed, and a hydrology restoration strategy defined, which was shared with local communities during a series of socialisation meetings. 12 canals have been blocked with 145 dams, turning into over 10,000 meters of blocked drainage canals. Dams constructed were revisited to assess condition and improved / repaired when necessary.</p>

<p>Activity 1.2 Seedlings grown in the <i>in-situ</i> Sebangau nursery transplanted into burnt peatland areas of the Sebangau National Park. Species that have previously shown ability to survive and grow in these conditions, through BNF own research and studies elsewhere, will be selected for this purpose. Seedling growth and survival monitored post planting. Additionally the use of drones to disperse seeds in burned and degraded areas will be trialled. Drones will distribute seedlings aerially over larger areas that are difficult to reach on the ground. Sample plots will be established to assess the success of this method.</p>	<p>Activity 1.2 During the grant period, a total of 48,902 seedlings have been transplanted into burned areas. All seedlings planted were transported and stored in the reforestation nurseries built in the burned area, for acclimation and to reduce stress.</p> <p>First trials for aerial seed dispersal have been conducted using a selection of species with high-potential for stock collection, storage and germination. Although trials were made under controlled conditions, initial results show a promising 71% seed germination.</p>
<p>Activity 1.3 Establishment of community nurseries in villages adjacent to the National Park, initially established through connections with fire-fighting teams and their families. Community nursery scheme members will be provided with start-up resources and seedlings, trained in seedling growth techniques and will then grow seedlings for replanting burned and degraded areas of the park. Once suitable size is reached (confirmed through spot-checks), BNF will buy seedlings from nursery owners for planting. This is more staff and cost effective, requires no land purchase and offers more economic opportunities to local community members compared to establishing a large, project-owned nursery. Socialisations and training sessions will be conducted, and contracts detailing management and monitoring signed before set-up resources are provided. In addition to growing seedlings, families will be encouraged to diversify into additional crops to provide additional benefits.</p>	<p>Activity 1.3 54 community members are part of the community seedling nursery scheme in 8 groups. They have sold 65,503 seedlings to us for our reforestation activities: 23,236 seedlings in year 2 and 42,267 seedlings in yr 3. Series of training sessions have been delivered, including (i) nursery management (stock management, seedling collection and care, pests), (ii) reforestation techniques (BGP on planting, seedling monitoring, ect); and (iii) alternative livelihoods (permaculture and aquaculture).</p>
<p>Output 2. Improved local fire-fighting capacity for rapid response to peatland fires in Sebangau NP and Palangkaraya district.</p>	<p>2.1 Four community fire-fighting teams operational (current baseline = two); up to 20 local people recruited and two training sessions / yr held in peat-fire extinguishing methods and use of equipment</p> <p>2.2 Fire-response teams effectively mobilised during each dry season</p> <p>2.1 Following strategic discussions with community leaders and government agencies, two community fire-fighting teams were fully established, equipped and trained, and eight new members were added to the existing CIMTROP Patrol Team. A total of four independent fire-fighting teams have been supported during the course of this project, with 105 individual fire-fighters trained to patrol and extinguish peat and forest fires.</p> <p>During the length of the project, nine capacity building and training workshops were undertaken. In the final year of the project, building on the successful implementation of the community fire-fighting initiative and development of a regional fire-fighting network, BNF began discussions with three additional communities bordering the Sebangau National Park with the objective to establish two new MPA teams and bring 8 existing teams into the Sebangau regional fire-fighting network</p> <p>2.2. During the project period a major fire-fighting response was required during the 2019 dry season, which was longer and drier than normal owing to an El Nino climate event. Each of the four community fire-fighting teams was successfully mobilised, with 313 fire patrol or fire-fighting activities recorded and a total of 154 team-days spent fighting fires, with 24 major fires identified and extinguished by the teams and additional equipment and coordination support provided by BNF. Minimal forest loss due to fire was identified within the target area, in contrast to unprotected peatlands elsewhere in Kalimantan.</p>

<p>Activity 2.1 New community fire-fighting teams will be created through recruiting team members during socialisation events in the local villages, which will also be used to promote the importance of peat rewetting and revegetation in preventing fire to the community. Training sessions, led by experienced local fire-fighters, will be held to familiarise new team members and refresh existing team members with equipment, teach fire patrolling and fire-fighting techniques, plus establish management structures, accounting and reporting systems.</p>	<p>Activity 2.1 At the end of the project period BNF is supporting 4 patrol and fire-fighting teams with a total of 88 active and permanent members. All teams are operational in the northern Sebangau landscape, with capacity building provided and fully equipped.</p> <p>A total of nine fire-fighting capacity building sessions were delivered to these four teams and also to other fire-fighting teams, NGOs and governmental agencies.</p>
<p>Activity 2.2 Fire-fighting team members will be provided with cameras, GPS units, logbook and laptop to facilitate accurate patrolling and fire-fighting records, with the potential for implementing SMART monitoring systems investigated. Training progress of new team members and team readiness will be monitored during the bi-annual training sessions, and through monthly meetings and reports. These reports will include records on where fires were detected/recorded and tackled, fire size, number of fire-fighters deployed, time to extinguish fire and area burned. During risk periods, fire incidence will also be monitored through drone surveys across target areas and remotely through daily checks of MODIS satellite fire hotspot data.</p>	<p>Activity 2.2 BNF provided fire-fighting equipment to the fire-fighting teams, ensuring (i) teams have all the essential equipment to tackle fires, (ii) effective communication, and (iii) use of new technologies will support the fire-fighting strategy. After the 5-days workshop <i>SMART: Patrol techniques and reporting</i> held in year 2, both MPAs and CIMTROP Patrol and Fire-fighting teams started a pilot project to implement SMART monitoring in their patrols and reports.</p>
<p>Activity 2.3 A network of fire-fighting teams created at an initial multi-stakeholder workshop, to which all community fire-fighting teams, including those affiliated to this project will be invited to join the network and introduced to each other, recognising these teams as the front-line of the fire-fighting response. Guidelines for methods and training, coordination between groups and with government agencies, access to resources and other issues arising will be developed at this, and follow-up annual workshops. Communication channels, such as a newly created WhatsApp group, and summary email reports will serve to keep teams connected and serve as a platform for sharing alerts, ideas, advances and problems encountered, plus to facilitate coordinated government liaisons and access to financial support.</p>	<p>Activity 2.3 During the 2018 and 2019 dry season, BNF facilitated the effective coordination of fire fighting teams operating in Kereng Bangkirai and Sabaru villages, in partnership with the Disaster Management Agency and the Sebangau National Park. The two existing community fire-fighting teams, the CIMTROP Patrol team and community groups cooperated, implementing joint patrols, holding coordination meetings and sharing resources and data when needed. In 2020 BNF initiated a series of coordination meetings with existing teams that support the Fire-fighting activities in the northern Sebangau landscape. A total of 12 teams with 155 members have been identified and added to the contact list for future coordination.</p> <p>During the grant period, teams joined 11 fire-fighting and fire integrated management multi-stakeholder workshops. Out of these, three multi-stakeholder workshops implemented in 2020 and 2021 supported the initiative of developing a network of community fire-fighting teams. These were led by BNF and local governmental agencies.</p>
<p>Activity 2.4 Fire-fighting teams will conduct regular patrols (min. 15 days/month) in the forest and along waterways to check for fire hotspots and prevent illegal activities, meet with forest users in their homes and coordinate with local authorities as necessary. Upon detecting or receiving reports of a fire, a rapid-response team will be quickly mobilized to extinguish the fire, using water bores to obtain water from beneath the peat if necessary and creating fire breaks to protect forest and property.</p>	<p>Activity 2.4 During the grant period, the CIMTROP Patrol and Fire-fighting Team increased the amount of patrols to an average of 38 patrols per month.</p> <p>The two community fire-fighting teams also contributed to patrolling activities in periods when fire risk was high. In the 2018 and 2019 dry season, they carried out an average of 18 patrols per month. They worked under the integrated fire-fighting activities, led by the Central Kalimantan Disaster Management Agency (BPBPK).</p>

<p>Output 3.</p> <p>Local community adopt more “peat-friendly” farming and fishing practices that avoid peat drainage and use of fire; and families better understand how to mitigate the harmful effects of fire.</p>	<p>3.1 240 education modules/sessions held with 20 schools, 3 community forums and special interest groups (fishermen; farmers cooperatives), including three large-scale forums per year with aim to reach 90% of people in these target groups by end yr 3.</p> <p>3.2 1,000 people reached with education and awareness activities by end yr 3.</p> <p>3.3 Number of people demonstrating positive response to these activities (70% increase in knowledge / awareness on environmental issues)</p> <p>3.4 (50% increase in willingness for) adoption of alternative farming and fishing practices, in particular use of non-burning/draining methods, among local community members.</p>	<p>3.1 A total of 125 modules/sessions held with 22 schools have been implemented during the project period, consisting of 69 formal environmental education modules with 8 local schools in year 1 and 53 formal environmental education modules with 7 local schools in year 2. Since March 2020 and due to the COVID-19 pandemic, the environmental education modules with schools were cancelled (since the beginning of the pandemic and until today, schools remain closed in Indonesia) and only 3 modules (virtual sessions) could be implemented. Since December 2020, the BNF Education team conducted 3 online webinars for Primary Schools from Yogyakarta. During the whole length of the project, a total of 1,021 students and 57 teachers received the direct benefits of the education modules implemented in 22 schools</p> <p>3.2 During the project period we quantified that a total of 4,915 people has been reached with education and awareness-related activities, including formal, non-formal activities and yearly festivals (3,108 children, 266 teachers and 1,541 parents/family members).</p> <p>3.3 Knowledge increase assessments implemented (282 questionnaires) in participating schools (12 schools) indicate an average 75% increase in knowledge and awareness on environmental issues. We also analysed participant’s understanding of our key conservation initiatives and solutions; with Forest Protection (40% of answers), Habitat Restoration (31%) and Fire-Fighting (13%) the best-known initiatives before implementing education sessions. Post-session analyses indicate that participants not only gained understanding about conservation initiatives and solutions but also increased the number of initiatives they were aware of, including waste management, forest management, wildlife management, wildlife protection, pollution mitigation, research and outreach.</p> <p>3.4 In 2020 BNF initiated a series of training sessions for the adoption of alternative farming and fishing practices, to increase community awareness on non-burning/draining methods in peatland areas. The training sessions have been conducted in the BNF land in Kereng Bangkirai and in the <i>Permakulture Kalimantan</i> project’s land, where permaculture and aquaculture demonstration plots have been established for this purpose. Two key trainings were implemented: (i) Freshwater and fishpond cultivation in peat soils, led by Dr Yulintine and Dr Edison (32 attendants) and (ii) Permaculture practices in peatland soils, led by <i>Permakultur Kalimantan</i> (17 attendants).</p>
<p>Activity 3.1 Fact-finding research with local fishing and farming groups to identify current practices, including use of fire and peat drainage, and holding workshops and discussion sessions to identify impacts of current activities and potentially suitable alternatives, evaluate willingness for changing practices to more peat-friendly alternatives and identifying resources needed for this and applying for additional funding to secure these resources.</p>	<p>Activity 3.1 Collected data on fish populations over 22 months, or 660 trap nights. During this period, we have trapped and measured 5,910 fish from 22 different species. Surveys with 36 traps were set in 5 canals and one river, surveyed 3 days per month. From June 2019 until December 2020, we have trapped and measured 5,767 fish. No significant difference between fish stocks in blocked and unblocked canals was identified. In April 2019, 20 gender-balanced semi-structured interviews were conducted in two villages to identify perceptions of current practices and fire.</p>	

<p>Activity 3.2. Bespoke education sessions conducted in schools, clubs, community forums, and fishing and farmers cooperatives to raise awareness of the impacts of peat drainage and fire use, of potential alternatives and the impacts of behaviour change. This will include speakers, use of video and other props, provision of written materials and games for children.</p>	<p>Activity 3.2 During the first two years of the project, BNF implemented weekly education sessions and quarterly awareness events in schools in the two Sebangau villages and Palangkaraya city. The COVID-19 pandemic disrupted plans for year 3. Schools closed and all activities were affected by local restrictions. We redesigned our methodological approach and some activities were moved online.</p>
<p>Output 4. Foundations established to create a long-term legacy for fire prevention and mitigation in and around the Sebangau National Park.</p>	<p>4.1 Effective fire-prevention system adopted by National Park managers and stakeholders resulting from 1 multi-stakeholder workshop in yr 2 and follow-up in yr 3.</p> <p>4.2 Twenty (20) National Park staff receive training in restoration and biodiversity monitoring techniques (70% increase in knowledge) and involved in field activities during 3 training workshops in yr 2 and 3, including field sessions</p> <p>4.3 Three (3) meetings to promote coordination with provincial and national strategies for peatland conservation and fire prevention achieved by end of yr 3.</p> <p>4.1 During 2019 and 2020 BNF facilitated several coordination meetings, capacity building workshops and evaluations that contributed towards this output achievement. BNF conceptualised and began implementing an integrated fire-fighting management system. This involves implementing a suite of interventions focusing on reducing both short-term fire impacts and long-term fire risk. This follows the annual seasonal cycle, with four main work areas included within our integrated approach: fire prevention, preparedness, response and recovery.</p> <p>Two multi-stakeholder workshops on capacity building opportunities to firefighting members were implemented by BNF in year two. A complementary Integrated Fire-fighting workshop was hosted by the Regional Development Planning Agency in 2019. These workshops also presented and offered the opportunity to discuss fire-prevention systems and protocols in partnership with site managers and governmental agencies In year 3 a Multi-stakeholder Coordination Meeting in Fire Prevention Around the Sebangau National Park Area was organised by the Sebangau National Park and the Ministry of Forestry and Environment (KLHK). Following this workshop BNF organised an Evaluation and Coordination Meeting for the Management Of Emergency Status Forest And Land Fire.</p> <p>4.2 In year 3, a 2-day training session on biodiversity monitoring techniques and wildlife survey protocols was conducted. The training sessions were attended by 19 field staff from the Sebangau National Park responsible for biodiversity and forest monitoring and included theory and practical sessions in the field. Pre- and post-training questionnaires were conducted and a 32% increase in knowledge was observed. Knowledge increase was variable, depending on the initial knowledge of the participants.</p> <p>4.3. A total of 6 large multi-stakeholder workshops were implemented during the grant period, including: (i) BNF Sebangau Conservation Workshop: Research, conservation, outreach and integrated fire management in Sebangau Forest (Y1); (ii) Coordination and discussion on Forest fires Prevention (Y1); (iii) Sebangau Conservation Programme socialisation and coordination (Y2); (iv) Fire-fighting coordination and prevention (Y2); (v) 2020 Dialogue - New Directions for Peatland Restoration (Y3); (vi) Coordination for the management of emergencies and land-fires in 2020 (Y3).</p> <p>Workshops involved a total of 71 institutions and a total of 2,212 people benefited from the coordination meetings, workshops and events organised in Central Kalimantan, working</p>

		towards the effective coordination and development of national and regional strategies for peatland conservation and fire prevention.
<p>Activity 4.1 Multi-stakeholder workshops in years 2 and 3 to discuss and agree on effective and realisable long-term strategies for peatland restoration and fire prevention in the Sebangau National Park, which will be formalised in summary document/s endorsed by the project proponents and park management. This will include strategies and SOPs for identifying at-risk areas, early fire warning systems, peat rewetting and revegetation, plus fire preparedness (addressing underlying causes of fire, such as fire starting, through awareness, education and community development) and fire-fighting team readiness (equipment, training, management structures, procedures, etc.).</p>		<p>Activity 4.1 A total of 6 large multi-stakeholder workshops have been implemented during the grant period with key governmental agencies, institutions, stakeholders and relevant actors. It was quantified that 2,212 people from 71 institutions benefited from these sessions, working towards the effective coordination and development of national and regional strategies for peatland conservation and fire prevention</p>
<p>Activity 4.2 Training of National Park staff through 3 workshops conducted during years 2 and 3. These workshops will include theoretical and technical class-room components, plus field training on peat rewetting (damming strategies, dam construction, hydrological monitoring), revegetation (suitable tree species, replanting and monitoring techniques), plus biodiversity monitoring (including habitat condition and ape populations).</p>		<p>Activity 4.2 A 2-days training session on biodiversity monitoring techniques and wildlife survey protocols was conducted in year 3. The training sessions were attended by the 19 field staff from the Sebangau National Park responsible for biodiversity and forest monitoring and included theory and practical sessions in the field.</p>
<p>Activity 4.3 Coordination with the Sebangau National Park, Environment Agency (DLH), the Disaster Management Agency (BNPB) and Peat Restoration Agency (BRG) to ensure alignment of restoration and fire-fighting activities in the National Park with these agencies' strategies, effective coordination of efforts and data/information sharing. This will include employing Indonesian Fire Management and Habitat Restoration Officers within BNF with specific responsibility for coordinating our activities and network management, plus sharing data and information, across local government agencies through regular one-to-one and multi-stakeholder meetings and workshops; distributing and socialising reports, proposals, images and data; and creating a cloud platform to facilitate information sharing.</p>		<p>Activity 4.3 BNF led more than 41 coordination meetings/events, seven fire-fighting multi-stakeholder workshops, one habitat restoration workshop and a specific and targeted habitat restoration socialisation event for governmental agencies, held in collaboration with CIMTROP.</p> <p>BNF coordinated and reported activities implemented with key Governmental agencies including the Sebangau National Park, Environment Department (DLH), the Disaster Management Agency (BNPB) and the Peat and Mangrove Restoration Agency (BRGM).</p>

Annex 3 Standard Measures

Code	Description	Total	Nationality	Gender	Title or Focus	Language	Comments
4a	Number of undergraduate students receiving training	11	Indonesian	M/F	Scholarships	Indonesian	University of Palangkaraya
4b	Number of training weeks provided to undergraduate students	2 weeks approx.	Indonesian	M/F	Scholarships	Indonesian	University of Palangkaraya
6a	Number of people receiving other forms of short-term education/training (e.g., not categories 1-5 above)	40	Indonesian	M/F	Environmental Education	Indonesian	Children of Sebangau (Figure 88)
6a		16	Indonesian	M/F	Environmental education and Sustainable livelihoods A	Indonesian	Sebangau Rangers (Figure 88)
6a		451	Indonesian	M/F	Conservation Modules	Indonesian	Formal Modules with Schools (Figure 80)
6a		87	Indonesian	M/F	Community Awareness about covid-19	Indonesian	(Figure 88)
6a		49	Indonesian	M/F	Permaculture & aquaculture	Indonesian	Training workshops (Figure 102)
6a		247	Indonesian	M/F	Patrol and Fire fighting	Indonesian	Training workshops (Figure 59)
6a		19	Indonesian	M/F	Biodiversity Monitoring	Indonesian	BTNS Training workshops
6a		52	Indonesian	M/F	Drone piloting	Indonesian	Training workshops (Figure 59)
6a		54	Indonesian	M/F	Seedling nurseries management	Indonesian	Training and sessions (Figure 55)

Code	Description	Total	Nationality	Gender	Title or Focus	Language	Comments
6b	Number of training weeks not leading to formal qualification	4	Indonesian	M/F	Conservation related trainings	Indonesian	Training sessions (Figures 55, 59 and 102)
6b		97	Indonesian	M/F	Environmental education	Indonesian	Education sessions and activities (Figure 88)
9	Number of species/habitat management plans (or action plans) produced for Governments, public authorities or other implementing agencies in the host country (ies)	1	Indonesian	M/F	RAMSAR proposal submitted	English	Led by BNF and BTNS
11a	Number of papers published or accepted for publication in peer reviewed journals	8	Indonesian/UK /others	M/F	Many	English	See publication's list
11b	Number of papers published or accepted for publication elsewhere	3 Conference Proceedings	Indonesian/UK /others	M/F	Many	English	See publication's list
12a	Number of computer-based databases established (containing species/generic information) and handed over to host country	> 10	Indonesian	M/F	Fire-fighting teams / Community patrols Community Seedling Nurseries New reforestation plots New spatial datasets Dam/Fisheries dataset	Indonesian/ English	All databases managed in host country and shared with partners
12b	Number of computer-based databases enhanced (containing species/genetic information) and handed over to host country	>15	Indonesian	M/F	Forestry datasets (phenology, litterfall, etc) Hydrology restoration Reforestation plots GIS / Spatial datasets Workshops/ activities and events database Education impacts database	Indonesian/ English	All databases managed in host country and shared with partners
13a	Number of species reference collections established and handed over to host country(s)						

Code	Description	Total	Nationality	Gender	Title or Focus	Language	Comments
13b	Number of species reference collections enhanced and handed over to host country(s)	3	Indonesian	M/F	Mammals' species list Fish species list Forestry datasets	Indonesian/ English	All databases managed in host country and shared with partners

Dissemination Measures		Total	Nationality	Gender	Theme	Language	Comments
14a	Number of conferences/seminars/workshops organised to present/disseminate findings from Darwin project work	1	Indonesian	M/F	Peatland protection and restoration: reducing fires to protect health, livelihoods & biodiversity	Indonesian/ English	During 2021
14b	Number of conferences/seminars/ workshops attended at which findings from Darwin project work will be presented/ disseminated.	5-10	Indonesian/UK /etc.	M/F	Peatland restoration; tropical forest conservation; Community development & fire-management	Indonesian/ English	During 2021 and 2022




Physical Measures		Total	Comments
20	Estimated value (£s) of physical assets handed over to host country(s)		Fire-fighting equipment (See extended list in Figure 65) 1 Vehicle - Hilux Double cabin Three Cameras for Firefighting teams Three Garmin GPS Units 64Sc for Firefighting teams 2 Computers Hydrology data-logging equipment
21	Number of permanent educational, training, research facilities or organisation established	8 1	Community Seedling Nurseries in local villages Education hub in BNF land

		2	Field Nurseries for stock management
		2	Boardwalks in research and reforestation area
		1	Wooden hut in Bakung River for hydrology restoration purposes
		1	Drone centre
22	Number of permanent field plots established	2	Reforestation plots (>50 ha)

Financial Measures		Total	Nationality	Gender	Theme	Language	Comments
23	Value of additional resources raised from other sources (e.g., in addition to Darwin funding) for project work		N/A	N/A	Research, conservation and outreach	N/A	

Annex 4 Aichi Targets

	Aichi Target	Tick if applicable to your project
1	People are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.	<input checked="" type="checkbox"/>
2	Biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems.	<input checked="" type="checkbox"/>
3	Incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socio economic conditions.	<input checked="" type="checkbox"/>
4	Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits.	<input type="checkbox"/>
5	The rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.	<input checked="" type="checkbox"/>
6	All fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.	<input checked="" type="checkbox"/>
7	Areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.	<input checked="" type="checkbox"/>
8	Pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.	<input type="checkbox"/>
9	Invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment.	<input type="checkbox"/>
10	The multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning.	<input type="checkbox"/>
11	At least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.	<input type="checkbox"/>
12	The extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.	<input checked="" type="checkbox"/>
13	The genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.	<input type="checkbox"/>
14	Ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.	<input checked="" type="checkbox"/>

15	Ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.	
16	The Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is in force and operational, consistent with national legislation.	
17	Each Party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy and action plan.	
18	The traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels.	
19	Knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss, are improved, widely shared and transferred, and applied.	
20	The mobilization of financial resources for effectively implementing the Strategic Plan for Biodiversity 2011-2020 from all sources, and in accordance with the consolidated and agreed process in the Strategy for Resource Mobilization should increase substantially from the current levels. This target will be subject to changes contingent to resource needs assessments to be developed and reported by Parties.	

Annex 5 Publications

Type *	Detail	Nationality of lead author	Nationality of institution of lead author	Gender of lead author	Publishers	Available from
Journal	Husson, S.J. and 30 others. (2018): Biodiversity of the Sebangau tropical peat swamp forest, Indonesian Borneo. Mires and Peat, 22(05), 1-50.	UK	UK	Male	Mires and Peat	map_22_05.pdf (mires-and-peat.net)
Journal	Bersacola E, Juwita Sastramidjaja W, Rayadin Y, Macdonald DW, Cheyne SM (2019) Occupancy patterns of ungulates and pig-tailed macaques across regenerating and anthropogenic forests on Borneo. Hystrix, Ital J Mammal 30	Swiss	UK	Female	Hystrix, the Italian Journal of Mammalogy	http://www.italian-journal-of-mammalogy.it/Occupancy-patterns-of-ungulates-and-pig-tailed-macaques-across-regenerating-and-anthropogenic.113023,0,2.html
Journal	Cheyne SM, Capilla BR, K A, Supiansyah, Adul, Cahyaningrum E, Smith DE (2019) Home Range Variation and Site Fidelity of Bornean Southern Gibbons (<i>Hylobates albibarbis</i>) from 2010-2018. PLoS One	UK	UK/Indonesia	Female	PLoS ONE	https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0217784
Report	M.E. Harrison, S.J. Husson, B. Ripoll Capilla and H. C. Morrogh-Bernard (2018) Trends in habitat condition and orangutan populations in relation to anthropogenic activities in northern Sebangau. BNF reports	UK	UK	Male	BNF publications	BNF website
Journal	Harrison, M. E., J. B. Ottay, F. van Veen and 28 other (2020). Tropical forest and peatland conservation in Indonesia: Challenges and directions. People and Nature 2: 4-28. DOI: 10.1002/pan3.10060	UK	UK/Indonesia	Male	People and nature	https://www.scienceopen.com/document?vid=e728de6b-4908-459e-b4fa-c9cdd782a2b2
Journal	Claire Burke et al.(2019) Thermal-Drones as a Safe and Reliable Method for detecting Subterranean Peat Fires. Drones, 3, 23.	UK	UK/Indonesia	Female	Drones	https://www.mdpi.com/2504-446X/3/1/23

Type *	Detail	Nationality of lead author	Nationality of institution of lead author	Gender of lead author	Publishers	Available from
Journal	Brooks, D. M., Adul and S. M. Cheyne (2018). A camera-trap survey of avifauna in a Bornean peat-swamp forest. Wilson Journal of Ornithology 130(4): 969-980.	UK	UK/Indonesia	Male	Wilson Journal of Ornithology	https://www.semanticscholar.org/paper/A-camera-trap-survey-of-avifauna-in-a-Bornean-Brooks-Adul/67983b6844769db73264aff66179947a83742676
Journal	Cheyne, S. M. and J. Bramansa Ottay (2020). Managing staff and health in wildlife conservation: a perspective from the Borneo Nature Foundation. Biodiversity. DOI: 10.1080/14888386.2020.177615	UK	UK/Indonesia	Female	Biodiversity	https://www.tandfonline.com/doi/abs/10.1080/14888386.2020.1776154
Journal	Jeffers, K., Adul and S. Cheyne (2019). Small cat surveys: 10 years of data from Central Kalimantan, Indonesian Borneo. Journal of Threatened Taxa 11(4): 13478-13491. DOI: 10.11609/jott.4466.11.4.13478-13491.	UK	UK/Indonesia	Female	Journal of Threatened Taxa	https://threatenedtaxa.org/index.php/JoTT/article/view/4466
Journal	Thornton, S. A., E. Setiana, K. Yoyo, Dudin, Yulintine, M. E. Harrison, S. E. Page and C. Upton (2020). Towards biocultural approaches to peatland conservation: The case for fish and livelihoods in Indonesia. Environmental Science & Policy 114: 341-351. DOI: 10.1016/j.envsci.2020.08.018	UK	UK/Indonesia	Female	Environmental Science & Policy	https://www.sciencedirect.com/science/article/abs/pii/S1462901120302719?dgcid=author
Journal	Thornton, S. A., Dudin, S. E. Page, C. Upton and M. E. Harrison (2018). Peatland fish of Sebangau, Borneo: Diversity, monitoring and conservation. Mires and Peat 22(04): 1-25. DOI: 10.19189/MaP.2017.OMB.313	UK	UK/Indonesia	Female	Mires and Peat	http://mires-and-peat.net/pages/volumes/map22/map2204.php
Proceedings	Harrison M. E., Green H., Hendri, Boyd N., Erb W., Imron M. A. and Collins S. (2020) Use of passive acoustic monitoring to assess impacts of fire and regeneration in a Borneo peat forest. British Ecological Society Tropical & Conservation Ecology Twitter Conference: Advances in Technology and Innovative Methods, 5-6 November 2020	UK	UK/Indonesia	Male	Conference: Advances in Technology and Innovative Methods	https://twitter.com/BESConservation/status/1324689063769759744?s=20

Type *	Detail	Nationality of lead author	Nationality of institution of lead author	Gender of lead author	Publishers	Available from
Proceedings	Harrison, M. E., D. Nasir, W. Healy, I. P. Kulu, S. J. Husson, Santiano, A. Purwanto, Iwan, S. E. Page, F. van Veen and M. A. Imron (2021). The importance of monitoring research in assessing impacts of anthropogenic activities on tropical peatland biodiversity: examples from Central Kalimantan, Indonesia. In: (Eds.). Peatlands and Peat – Source of Ecosystem Services. Abstract Book: Oral Presentations. Proceedings of the 16th International Peatland Congress. Tallinn, Estonia, International Peat Society: 44-50	UK	UK/Indonesia	Male	Abstract Book: Oral Presentations. Proceedings of the 16th International Peatland Congress	https://www.peatlandcongress2021.com/wp-content/uploads/2021/05/IPC2021-Oral-presentations.pdf
Proceedings	Ottay, J. B., M. E. Harrison, D. Nasir, Y. Ermiasi, P. Bruges Sintes, K. Kusin, H. C. Morrogh-Bernard, B. Ripoll Capilla, D. R. Katoppo, Salahuddin, S. W. Smith, F. van Veen and S. J. Husson (2021). Tropical peatland biodiversity conservation and revegetation: towards 1 million trees replanted in Sebangau National Park, Indonesian Borneo. In: (Eds.). Peatlands and Peat – Source of Ecosystem Services. Abstract Book: Poster Presentations. Proceedings of the 16th International Peatland Congress. Tallinn, Estonia, International Peat Society	Indonesian	Indonesia/UK	Male	Abstract Book: Poster Presentations. Proceedings of the 16th International Peatland Congress	https://www.peatlandcongress2021.com/wp-content/uploads/2021/05/IPC2021-poster-presentations.pdf
Proceedings	Smith S. Wand 30 others (2021) Peatswamp forest revegetation: lessons learnt from a systematic review. In: Peatlands and Peat – Source of Ecosystem Services. Abstract Book: Poster Presentations. Proceedings of the 16th International Peatland Congress. International Peat Society, Tallinn, Estonia. pp 141-142.	UK	Indonesia/UK	Male	Abstract Book: Poster Presentations. Proceedings of the 16th International Peatland Congress.	https://www.peatlandcongress2021.com/wp-content/uploads/2021/05/IPC2021-poster-presentations.pdf

Type *	Detail	Nationality of lead author	Nationality of institution of lead author	Gender of lead author	Publishers	Available from
Journal	Petricia Andini Hutasoit, Risti Angelina Saragih, Dwi Riyan, Ina Christina, Riethma Yustiningtyas, Joana Aragay Soler and Susan M. Cheyne (in prep) Communicating Conservation: Evidence of Knowledge Gains through a Children's Conservation Club in Central Kalimantan, Indonesia	Indonesian	Indonesia/UK	Female	In prep	NA
Journal	Many authors, including BNF, CIMTROP, UPR, etc. Tree species that survive and grow: a systematic review of tropical peat swamp reforestation	TBC	many	TBC	In prep	N/A

Annex 6 Darwin Contacts

Ref No	25-001
Project Title	Preventing Borneo's peatland fires to protect health, livelihoods and biodiversity
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Partner 2	
Name	Darmae Nasir – Head of CIMTROP since 2020 / Pak Jagau (deceased in 2019)
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Partner 3	
Name	Andi Muhammad Kadhafi
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Checklist for submission

	Check
Is the report less than 10MB? If so, please email to Darwin-Projects@ltsi.co.uk putting the project number in the Subject line.	
Is your report more than 10MB? If so, please discuss with Darwin-Projects@ltsi.co.uk about the best way to deliver the report, putting the project number in the Subject line.	✓
Have you included means of verification? You need not submit every project document, but the main outputs and a selection of the others would strengthen the report.	✓
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Have you involved your partners in preparation of the report and named the main contributors	✓
Have you completed the Project Expenditure table fully?	✓
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