2020

YEARLY ACTIVITY REPORT

CARDIFF UNIVERSITY
PRIFYSGOL CAERDYDD

WILDLIFE DEPARTMENT SABAH

Report prepared by Prof. Benoît Goossens
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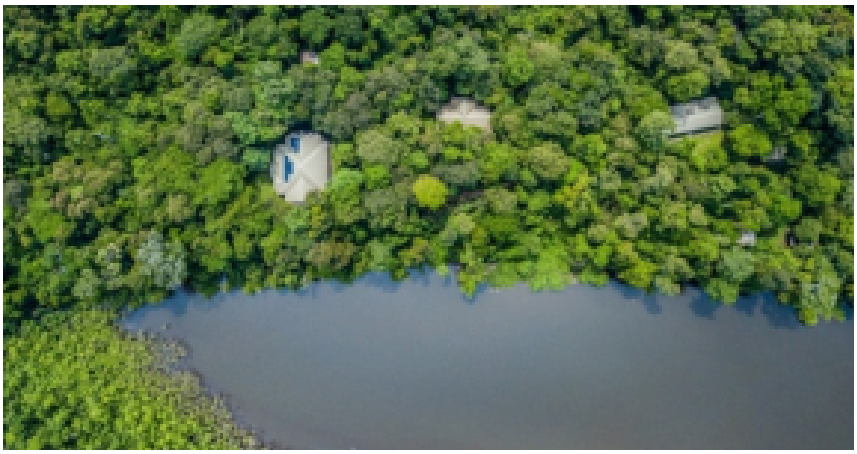
goossensbr@cardiff.ac.uk
www.dgfc.life

INTRODUCTION

The Danau Girang Field Centre (DGFC) was established in 2008 through a formal partnership between Sabah Wildlife Department (SWD) and Cardiff University (UK). The Centre continually contributes and supports the long-term conservation strategies in Sabah, undertaking scientific research to develop a better understanding of how wildlife survives in a degraded, fragmented landscape which is also impacted by human pressures such as hunting, agriculture, and climate change.



This ground-based targeted data informs and shapes Sabah's conservation strategies, such as species action plans, and continues to support the establishment of new forest reserves and wildlife corridors.

We provide higher education opportunities to Malaysian and international students (up to PhD level) and support an in-house Education Team which actively promotes the conservation of our wildlife and their habitats in our schools, communities, learned societies, and at public events throughout Sabah.

This year, however, the local and global impact of the COVID-19 pandemic meant that the Centre's external activities were greatly affected and, as such, we, unfortunately, witnessed the downturn of many of our regular and predicted income streams.

Despite this, we continued to support our conservation projects and this report presents the different activities undertaken at DGFC from January to December 2020.

VISITORS TO DGFC 2020

Field Courses

As 2020 saw the arrival of COVID-19 DGFC was significantly affected by imposed travel restrictions at home and overseas, which resulted in us only being able to host one field course and witnessing a critical reduction to the number of usual visitors.

February: Leiden University, Netherlands

- 6 Student Visitors: Universiti Malaysia Sabah (Malaysia), University of Nottingham (Malaysia Campus), University of Birmingham (UK), University of Veterinary Medicine, Hannover (GER), Oregon State University (USA), London School of Hygiene and Tropical Medicine, London (UK)

- 11 Other Visitors: Australia, United Kingdom, USA, Malaysia, Mexico

- 1 Media: Photojournalist (Belgium)

EVENTS, CONFERENCES AND WORKSHOPS

US Bureau of International Narcotics and Law Enforcement Affairs (INL): Wildlife trafficking.

As a vital component of the ongoing protection of Sabah's wildlife, this two-day workshop, on illegal wildlife trade and counteracting measures in Sabah, was held in Kota Kinabalu and was officiated by Dr Jamili Nais, the Permanent Secretary to the Ministry of Tourism, Culture and Environment.

Government officers from many departments met to discuss how to improve communications between the relevant agencies and how their collaboration can further support the State's Anti-Poaching and Wildlife Trade Task Force. Funding for this project was awarded to DGFC by the US Bureau of International Narcotics and Law Enforcement Affairs with the aim to establish an inter-agency Working Group on Wildlife Crime Intelligence to support the efforts of the existing State Wildlife Task Force.

FEBRUARY

- **DGFC Annual general Meeting**

This month the team based at DGFC hosted the Kota Kinabalu Office staff for its AGM. This is an opportunity for everyone who is part of the DGFC family to get together for reflection and discussions regarding future projects and planning. This year the DGFC Team wore Regrow Borneo T-shirts to celebrate its launch.

MARCH

- **Sun bear sign survey**

Staff from the Bornean Sun Bear Conservation Centre (BSBCC) based at Sepilok, invited DGFC personnel to learn more about the components of a sun bear sign survey. After a day of learning at the sanctuary they all came back to DGFC to carry out an initial sun bear sign survey of the surrounding forest.

Using the information gathered, the next step is to run a camera trap project to identify potential live trap sites with the aim to collar a wild resident sun bear to gain a better understanding of its spatial ecology.

Professional Training Year Students Return Home

Unfortunately, due to the COVID-19 outbreak and the subsequent international guidelines regarding students studying abroad, our Professional Training Year Students were called home by their respective universities (Cardiff and Swansea, Wales, UK). We wish them well in their respective studies and sincerely hope they can visit us again in the future.

From left to right: Tyler Cuddy (Swansea), Emma Remotti and Harriet Miles (Cardiff), Kirsty Leach (Swansea), Katie Webb and Olivia Fitzpatrick (Cardiff).

SEPTEMBER

- **HUTAN-Kinabatangan Orangutan Conservation Project**

It was good to welcome staff from HUTAN (a local conservation NGO), in September. Along with some of our research assistants they had the opportunity to carry out hornbill river and nest surveys in Lot 6. Although it was a short visit, it provided many insights regarding the future protocols for the planned survey of hornbills in Sabah.

- **Health at the Edge –Project Update**

This project is funded by Panthera Small Cat Action Fund and Danau Girang Field Centre. One of the main goals of DGFC's Health at the Edge project, is to understand the potential interactions among domestic cats and other wild carnivores inhabiting both oil palm plantations and forested areas, and to assess the risk of pathogen transmission to susceptible species.

During the year we attached GPS trackers to some of the "kucingrumah" (domestic cat in Malay) to better understand how and where they moved within plantations and the neighbouring forest. In collaboration with Felda Global Ventures Holdings, and its plantation managers in the Kinabatangan, the aim is to develop a strategic plan for the promotion of healthy animal communities, both wild and domestic, as well as improve health awareness for the local communities and plantation workers.

DGFC EDUCATION TEAM ACTIVITIES

Based at our DGFC Office in Kota Kinabalu, the Education Team's usually full programme of activities was greatly affected by the pandemic. Instead of the usual public engagement programmes, the Education Team utilised the internet and intensified their online education/outreach activities, organizing art contests and creating informative videos such as 'Otters of Sabah', 'Wildcats of Sabah' and 'The Gentle Giant of Borneo" all accessible on our YouTube channel:
(https://www.youtube.com/channel/UCkfmuw6B4PLSSJdAerHcv2w.)

The Team also actively participated in webinars, including the Borneo Eco Film Festival (proboscis monkeys), ADEX - Asia Dive Expo and Blu Hope's Big Blue Day.

When still permissible, in the first few months of 2020, the Team supported Elisa Panjang's work promoting conservation associated with her research on the Sunda Pangolin. These and other pangolin events are highlighted below.

Kota Kinabalu International Airport (KKIA) Wildlife Awareness Program and Pangolin Sculpture Launch, 21 January 2020.

DGFC organised the event at Kota Kinabalu International Airport (KKIA). The sculpture, previously located at the Sandakan International Airport, was relocated. The event was officiated by Datuk Christina Liew, Deputy Chief Minister and Minister of Tourism, Culture and Environment, supported by a short presentation, documentaries and an exhibition.

Ms. Panjang gives a short speech about pangolin in front of the sculpture.

Pangolin Awareness Talk - organised by Sukau Rainforest Lodge, Kinabatangan.

Ms. Panjang was invited to give a presentation about her pangolin research to the staff and guests of the lodge in February to mark World Pangolin Day.

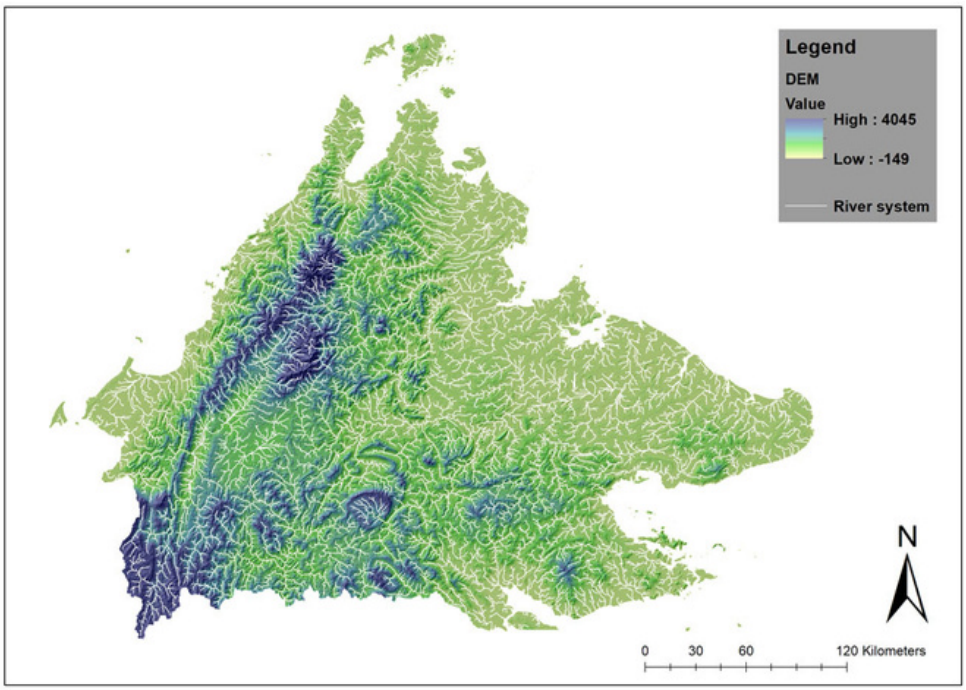
Pangolin Awareness Talk for KeTAMU event - organised by Land Empowerment Animals People (LEAP)

KeTAMU means "going to the market" in Bahasa Melayu, and this event was attended by local communities and local artists to promote their arts, crafts, and products. The event was organised with Land Empowerment Animals People (LEAP) in collaboration with Sabah Wildlife Department, Sabah Art Gallery, DGFC, Sabah Parks, and Sabah Tourism Board.

Ms. Panjang presenting to the public during the KeTAMU event.

GEOGRAPHIC INFORMATION SYSTEMS (GIS)

The DGFC Geographic Information System Facility supports many aspects of the work undertaken by the Centre, creating habitat maps and plotting home ranges of focal species using drone images and Light Detection and Ranging (LiDAR) technologies. Using aerial images and LiDAR technology, it is possible to digitize forest boundaries (including delineating between protected and unprotected forest) as well as features which potentially restrict or facilitate animal movement. This data can also be used to calculate indices of habitat quality based on characteristics such as canopy gaps, texture, height, etc.



River systems from digital elevation model (DEM) raster extraction refinement.

In May, in support of DGFC's pending forensic project, Ms. Liew undertook a course entitled, "Crime analysis solution and tracking crime patterns to aid law enforcement training". This course provided a framework for the use of the Crime Analysis toolkit, at an organisational level, to understand the benefits and complimentary science of spatial data approaches which assist in enforcement initiatives.

MAIN RESEARCH PROJECTS

Bearded pig (*Sus barbatus*)

The "Conservation Ecology of the Bearded Pig" project is a collaborative project undertaken between University of California, Berkeley (USA) and DGFC. This year, the trapping sites were maintained, and new potential sites were identified. Active live trapping could not begin until July 2020, as the arrival of tranquilizer-tracking darts had been delayed in transit due to COVID19.

Our genetics team at Berkeley completed some initial bioinformatics on the bearded pig RAD genetic dataset but found a significant amount of bacterial contamination. This was not surprising given that the bearded pig hair samples collected were from hot, muddy conditions in the rainforest. Even given other issues, there is still potential for three valuable contributions to emerge from this genetic study.

First, the high-quality tissue samples hold a wealth of data about bearded pig nuclear DNA, which has not been studied before, could infer changes in effective population size thousands of years into the past. These breakthroughs allow for a suite of compelling questions to be answered without the need for whole genome sequencing and can be useful for understanding patterns in the bearded pig population over time, and the implications of these patterns may have for modern-day conservation.
Second, we plan to use the program STRUCTURE to see if there are patterns of genetic distance between some of the higher-quality samples, and what those patterns may suggest about bearded pig gene flow in the fragmented Kinabatangan landscape.

Finally, we will report the procedure we followed with the hair sample collection, DNA extraction, and sequencing process, to help others modify their approach for future genetic studies of threatened species that prove to be challenging to capture and sample.

Bornean elephant (*Elephas maximus borneensis*)

2020 saw the publication of two key documents regarding the Bornean elephant by Danau Girang scientists and our collaborators: 1) "Natural and anthropogenic drivers of Bornean elephant movement strategies" in the peer-reviewed journal, Global Ecology and Conservation and 2) The Bornean Elephant Action Plan 2020-2029 for Sabah, which was approved by the State Cabinet on 12 February.

DGFC also began collaborating with colleagues from Peninsular Malaysia to combine our satellite data to evaluate Asian elephant habitat suitability across Peninsular Malaysia and Sabah and to identify habitat suitability across a range of land uses (protected areas, forest reserves, state lands, agriculture, etc).

In November, five months after being collared, an adult female elephant was found dead on an oil palm plantation, most probably due to poisoning. As part of the investigation, samples were shipped to the National Poison Centre in Peninsular Malaysia for analysis.

In December, a male elephant (Lokan) was rescued from a plantation estate and fitted with a satellite collar before being translocated by SWD/WRU to Segaliud - Lokan FR in central Sabah.

Civet species (*Viverridae sp.)*

The final GPS unit for this study was deployed on an adult male Malay civet in Lot 5, Lower Kinabatangan Wildlife Sanctuary in March, 2020. Successful tracking and data collection has been ongoing, and all GPS Units continued to provide high quality data throughout the year.

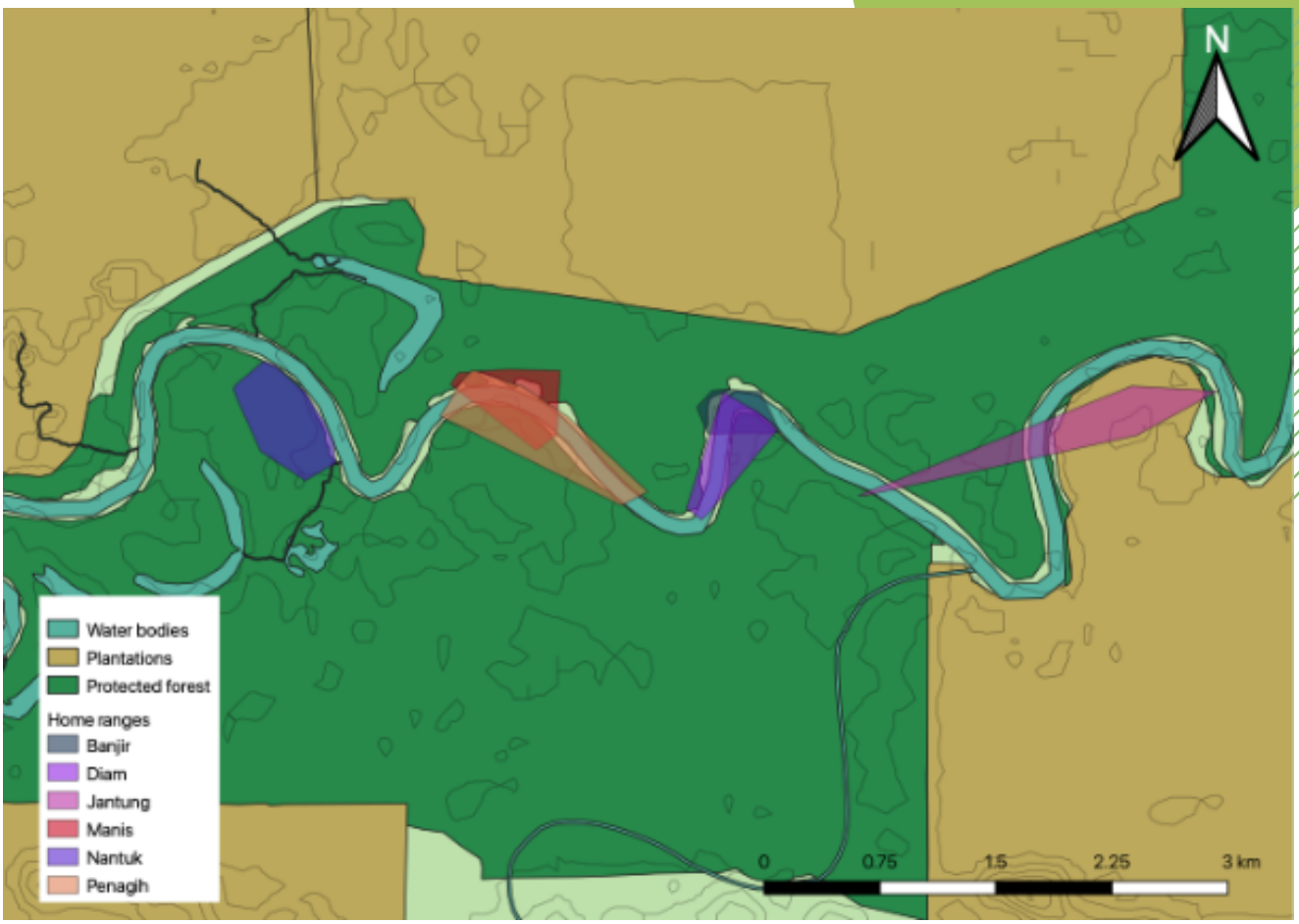
The GPS collar fitted to a male Malay civet (pictured right) also provided high-quality data from March-August and, by the end of the year, all collars were retrieved marking the completion of seven years of rigorous research on Bornean small carnivores. These data have been analysed and will be included in the first publication on the spatial ecology of Malay civets.

Reticulated python (*Malayopython reticulatus*)

For the period November 2019-December 2020, a total of 25 wild individuals were caught and sampled within the Lower Kinabatangan Wildlife Sanctuary and an additional 16 individuals were sampled after being rescued by the Sabah Wildlife Rescue Unit. This takes the total number of sampled individuals to 158 since the start of the project.

Two male pythons, implanted with new smaller VHF transmitters, were tracked daily from their release in February. After initially losing VHF contact, one male was rediscovered nearly 2 km from its last location in a riparian buffer zone bordering an oil palm plantation. Whilst another male (measuring 2.86 m in length and weighing 4.3 kg prior to release) only moved a relatively short distance within a 4.5 ha area close to the riverbank.

After many attempts to design an unobtrusive and low invasive tagging system, it appears that the new VHF subcutaneous implants are a viable tool for tracking pythons and all tagged animals continue to be regularly assessed by the field veterinarian.



Reticulated python minimum convex polygon home ranges from animals VHF tracked in 2020.

Small cats

Flat-headed cat (*Prionailurus planiceps*)

The flat-headed cat camera trap survey, focusing on the oxbows in the Lower Kinabatangan Wildlife Sanctuary continued, and experiences gained were shared at a meeting with our collaborators from Panthera (New York).

The male flat-headed cat caught in December 2019, on an oil palm plantation, was too small to be fitted with a GPS collar but the team took measurements, photographs, and various tissue samples. As this is the first flat-headed cat scientifically captured, the veterinarian and project leader submitted an article for publication detailing the procedure and health status of the animal.

The male flat-headed cat recovering from the anaesthesia prior to release.

Leopard cat (*Prionailurus bengalensis*)

In February, the team was pleased to welcome a new Malaysian Master's student, Amanda Wilson, from Universiti Malaysia Sabah, to begin work on a project entitled, "Home ranging, movement and activity patterns of leopard cats in the Kinabatangan Floodplain". During the year, five suitably sized leopard cats (2.0-2.6 kg) were captured and fitted with GPS collars which all produced high-quality data.

A male leopard cat LCM03) receiving a satellite collar.

Sunda clouded leopard (*Neofelis diardi*)

As part of the Carnivore Programme, the live trapping of clouded leopards commenced at the end of January 2020 and all the location fixes are continuing to provide us with a good understanding of the potential home ranges. On the 9th of February, an adult male clouded leopard (CLM07) was captured and fitted with a Vertex Lite Iridium Collar (pictured below).

The picture above shows the Field Veterinarian performing vital sign check prior to collar deployment. The unit is a new brand and has a cotton-belt drop off which will eventually disintegrate and allow the unit to fall from the animal.

Following a short delay in tracking, due to the continued elephant presence in the area, the collar sent 30 GPS locations during the first two months of deployment. It was interesting to note that the individual crossed major roads within the Lower Kinabatangan floodplain. In June, CLM07 was detected on a camera trap near his original capture site without the GPS collar. The animal looked to be in good health, however.

Camera trap image of CLM07 near his original capture site four months after the collaring procedure. Note the absence of the GPS collar.

Further attempts to capture another individual were unsuccessful but camera trap images confirmed CLM07 had returned to the capture site on two occasions and a newly identified male was photographed near the same trapping site in November.

Camera trap image of newly identified male clouded leopard. A clouded leopard can be identified by an individual's unique markings.

Malayan sun bear (*Helarctos malayanus*)

One of the Sabah-wide actions identified during the sun bear symposium, was the need to develop a robust sun bear population surveying method. The DGFC team initiated a collaboration with the Bornean Sun Bear Conservation Centre (BSBCC) to develop questionnaires and sign survey methods to implement across Sabah.

Throughout the year, DGFC and its collaborators continued to develop a Sabah-wide sun bear action plan, which will guide sun bear conservation in Sabah for 10 years. The action plan is still under review with main stakeholders (Sabah Wildlife Department, Sabah Forestry Department, Sabah Parks and NGOs) and has a target publication date for 2023.

The sun bear surveying team interviewing local community members from Batu Puteh Kampung.

As a result of the rainy season, live trapping could not resume until May-June 2020, but was unsuccessful. One site was selected near a hornbill nest where a sun bear had been previously recorded predating on the hornbill female and chicks. As this bear appeared to be attracted to the hornbill nest, we used audio bait from hornbill chick sounds to lure the bear near the trap site. Unfortunately, the trap was destroyed by elephants in late June and with the elephants in the vicinity, further sun bear trapping was postponed.

Sun bear breaking into a hornbill nest cavity on the 13th of March 2020.

It was decided to continue to monitor the area with camera traps and aim to deploy our traps again in 2021.

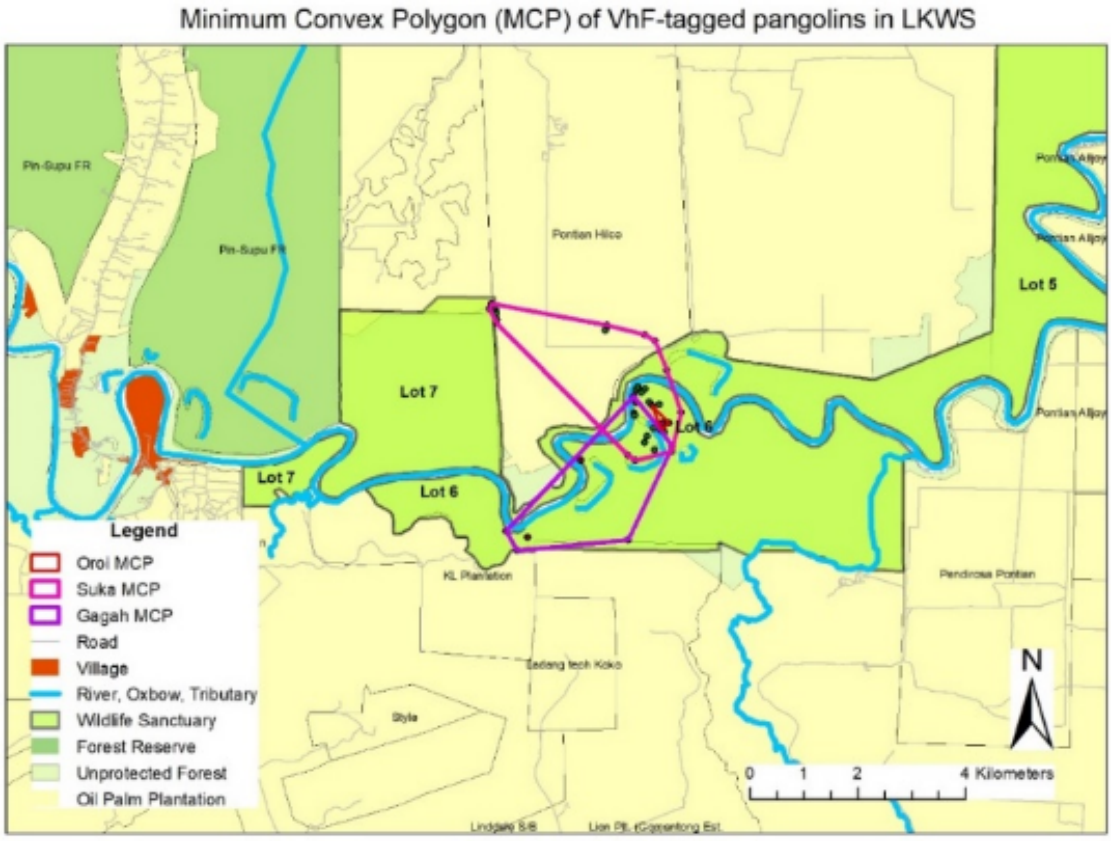
Sunda pangolin (*Manis javanica*)

A 5 kg female pangolin was rescued by the Sabah Wildlife Department and later translocated to our study area. Prior to its release in February, the female was fitted with a VHF tag and was successfully tracked for 12 days before the team recovered her dropped transmitter. Excitingly, on the 11th day of the female's release, camera traps captured images of a wild male pangolin entering her sleeping site where they remained together for two nights. It is believed that the pangolins mated during this time and suspected this may have led to the breaking of the VHF tag which was fitted on the hind leg of the female. This finding is very useful to improve future transmitter attachment designs as well as understanding the survival behaviour of reintroduced pangolin.

Ms. Panjang deployed 17 camera traps between March and July 2020, with units located at previously recorded pangolin sleeping sites. Camera traps were set up outside tree hollows to detect both pangolin and non-target species use of tree hollows. A total of 14 unique tree hollows were monitored, and four pangolin individuals (including one pup) were photographed (pictured below). Data collection and analysis is ongoing, with plans to monitor more sleeping sites in the future.

A female pangolin and her baby photographed in one of the monitored tree hollows

During March to July, three wild pangolins rescued from within the Kinabatangan area were sampled, fitted with VHF tags, and translocated into the Sanctuary. We tracked the three males for 20 and 86 days, respectively, before VHF signals were lost. In August, a female pangolin was fitted with a tag and the preliminary home ranges were analysed.



Example of home ranges derived from recently tagged Sunda pangolins.

Between September and November, a wild pangolin rescued from an oil palm plantation within the Kinabatangan area was sampled and fitted with a VHF tag. A previously tagged female pangolin has now been tracked for over 129 days. Ms. Panjang has been collecting critical information from this individual, including her sleeping sites, behaviours, and movement paths for future analyses.

Planned interview surveys for this year, involving an estimated 100 respondents from villages and plantations, were once again postponed due to COVID-19 restrictions.

Ms. Panjang tracking the VHF tagged pangolin

REGROW BORNEO

An exciting journey of ecological restoration and sustainable tropical reforestation in the forests of Borneo.

A message from the Chairs of Regrow Borneo: Dr TC Hales and Prof Benoit Goossens:

It has been a little over a year since we launched our project in October 2019, and none of us could have predicted the challenges of developing a reforestation programme during a global pandemic. We hope that you and your loved ones have made it through this difficult period safely and thank you for supporting us through this journey. A year on, as the rainy season and another movement control order close in on our team in the Kinabatangan, Borneo, the pause in planting allows us some time for reflection on what can only be described as a successful 12 months. We have planted 3 ha of forest, with a further 2 ha in preparation, and have been able to help support the economic challenges of the COVID pandemic for our Malaysian partners.

Regrow Borneo was launched with the aim of restoring tropical forests logged for timber or oil palm agriculture in an ethical, transparent, and research-led manner. The project draws on the longstanding collaboration between Cardiff University's Sustainable Places Research Institute and DGFC in Borneo, to support research into the role of active restoration of tropical forests for the improvement of people and the environment.

Regrow Borneo is a tropical reforestation project that offers a more holistic approach than simply growing forests to store carbon. Our project seeks to understand how community-based tropical forest restoration can address the following outcomes:

- Sequester carbon
- Improve biodiversity and support conservation of local ecologies
- Sustain local livelihoods and culture

- Improve scientific understanding of the environmental, economic, social and cultural impacts of tropical reforestation
- Provide opportunities for institutions and individuals to mitigate their own unavoidable carbon emissions through support for tree-planting

We launched our pilot year in October 2019 to demonstrate that we could address these goals within our project. Our initial target was to raise £15,000 to launch the reforestation program.

We began by encouraging Cardiff University staff, visitors to DGFC and the wider community to donate if they had to fly, to mitigate emissions on essential travel. By February we had reached our target. However, planting plans for the dry season beginning in March were halted by COVID. Despite this setback, donations continued to arrive and by June 2020, we had reached an impressive £20,000. Plans were agreed with our local partners to plant 5 hectares as soon as conditions allowed. This would translate to approximately 12,500 trees.

Once local COVID-19 lockdown rules were relaxed, our teams made incredible efforts to make up for lost time. Three hectares were cleared of grass and vines in what was often searing heat. There was pressure to complete as much as possible, knowing that the rainy season was fast approaching and that some areas would soon be under water. An incredible 4,100 saplings were planted within three weeks, working around any existing trees. While we were disappointed that the rainy season cut our already short planting season shorter, we have a further 8,400 healthy saplings ready to be planted as soon as the seasonally flooded areas dry out.

It is hard to know the impact of the pandemic over the coming months or years, particularly on our lives, our livelihoods, and how we will do business in the future. However, the pandemic has highlighted the important role that forests play in buffering us from disease. Also, it has shown that a near global lockdown has very little effect on the emission of carbon dioxide.

The urgency of the climate and ecological emergency is as real as ever. Projects such as Regrow Borneo offer practical, long term responses to help address this emergency. From carbon sequestration, restoring degraded land into a vibrant and functioning ecosystems, to preventing future pandemics by restoring the buffers between people and wildlife; we take our role in restoring these lands, for nature, for wildlife, for local communities - and for all futures, very seriously.

With the success of our pilot year, we are looking forward to taking our exciting project into its next phase.

Tree planting

Between July and September 2020, 4,100 trees were planted on 3 hectares of land. These were in 2 hectares of degraded forest in the Pin Supu Forest Reserve (Kaboi Lake) that sits adjacent to the Kinabatangan River and 1 hectare at the Ladang Riparian Reserve.

In total, 4 separate areas have been identified for these first waves of planting. These are:

(a) Kaboi Stumping Site - 2 hectares of riparian forest
(b) Kaboi Lake Site - 2 hectares of seasonally flooded freshwater swamp forest
(c) Laab Swamp Site - 1 hectare of seasonally flooded permanently waterlogged freshwater forest
(d) Ladang Riparian Reserve - 1 hectare of riparian reserve

Tree density

In areas that were completely deforested, planting was at a density of 2,500 trees per hectare, to achieve optimum canopy cover in the long term. In areas which had been partially deforested, planting was at a lower density, ensuring existing trees were preserved. Planting density may also vary by terrain.

A further 8,400 trees are ready to be planted in the next dry season, in March/April 2021, although clearing work may continue.

The planting sites are protected by the Sabah Forestry Department (Pin Supu Forest Reserve) and the Sabah Department of Irrigation and Drainage (Ladang Riparian Reserve).

Carbon sequestration

Tropical forests are extremely efficient at removing carbon dioxide from the atmosphere and storing it as wood or in soil. In order to measure the impact and carbon sequestration at the site over time, measurements have been taken at all sites.

Four separate sites were identified for planting; selected as they represent some of the important differences in soil type, hydrology, and potential to store carbon that are found in the area.

As a first step, a monitoring plot was set up in each location. The wood mass of dead branches and stems were measured, as well as the mass of grass and vines removed during the clearing. Existing trees have been tagged and measured to calculate their carbon content and will be identified at species level in the coming weeks.

As was referenced in the introduction, although funds to plant 12,500 saplings were raised during our pilot year, the challenges of working around the COVID-19 pandemic hindered our ability to complete the planting this season. Planting during the rainy season, where some sites will be flooded, is not recommended, however, our intention is to complete this work as soon as conditions allow, at the two other sites, Kaboi Stumping Site (2ha) and Laab Swamp Site (1ha). The full report can be found https://www.cardiff.ac.uk/documents/2484428-regrow-borneo-pilot-year-impact-report.

SABAH WILDLIFE HEALTH, GENETIC AND FORENSIC LABORATORY

Established in 2013 by SWD, Ecohealth Alliance and DGFC, researchers use the laboratory facilities to provide valuable genetic information collected from a variety of DGFC projects as well as supporting the work of government departments and forensic agencies including, Sabah Wildlife Department, Wildlife Rescue Unit, Environmental Health Agency, Universiti Malaysia Sabah, TRACE Wildlife Forensic Network and Marine Wildlife Foundation.

Since October 2019, this facility has also been playing a key analytical role in supporting DGFC's inter-related, and multi-agency projects, that have received significant national and international funding to help fight illegal wildlife trafficking.

SCHOLARLY ACHIEVEMENTS

PhD

1. BRUNKE J, 2020. Effects of habitat fragmentation in a tropical rain forest ecosystem: a case study on the genetic diversity of small mammal communities in the Lower Kinabatangan floodplain on Borneo, Sabah, Malaysia. PhD thesis, University of Hannover, Germany, 135 pages.

2. EVANS MN, 2020. The price of persistence: small carnivore ecology within the anthropogenically-degraded Kinabatangan landscape. PhD thesis, Cardiff University, UK, 332 pages.

3. LEON JMA, 2020. Understanding anuran responses to rainforest fragmentation and oil palm agriculture in the Lower Kinabatangan Wildlife Sanctuary, Sabah, Malaysia. PhD thesis, Cardiff University, UK, 201 pages.

4. THIRY V, 2020. Proboscis monkey, *Nasalis larvatus*: feeding ecology and seed dispersal in a fragmented forest landscape. PhD thesis. Université Libre de Bruxelles, Belgium, 242 pages.

Masters Degree

1. JUMAIL A, 2020. Application of thermal imaging in primate studies in the Lower Kinabatangan Wildlife Sanctuary, Sabah. Master of Science thesis, Universiti Malaysia Sabah, Malaysia, 73 pages.

2. KOOROS SJ, 2020. Using accelerometers to investigate nocturnal activity in proboscis monkeys (*Nasalis larvatus*) in Sabah, Malaysia. Master of Science thesis, Utrecht University, Holland, 30 pages.

PUBLICATIONS
(DGFC PERSONNEL APPEAR IN BOLD)

1. **BRUNKE J**, RUSSO IRM, OROZCO-TERWENGEL P, ZIMMERMANN E, BRUFORD MW, **GOOSSENS B**, RADESPIEL U, 2020. Dispersal and genetic structure of a tropical small mammal, the Bornean tree shrew (*Tupaia longipes*), in a fragmented landscape along the Kinabatangan River, Sabah, Malaysia. BMC Genetics 21: 43.

2. **EVANS LJ**, **GOOSSENS B**, DAVIES AB, REYNOLDS G, ASNER GP, 2020. Natural and anthropogenic drivers of Bornean elephant movement strategies. Global Ecology and Conservation 22: e00906.

3. **EVANS MN**, **GUERRERO-SANCHEZ S**, KILLE P, MULLER CT, ABU BAKAR MS, **GOOSSENS B**, 2020. Physiological implications of life at the forest interface of oil palm agriculture: blood profiles of wild Malay civets (*Viverra tangalunga*). Conservation Physiology doi: 10.1093/conphys/coaa127.

4. HASEGAWA H, **FRIAS L**, PETER S, HASAN NH, **STARK DJ, SALGADO LYNN M**, SIPANGKUI S, **GOOSSENS B**, MATSUURA K, OKAMOTO M, MACINTOSH AJJ, 2020. First description of male worms of *Enterobius* (*Colobenterobius*) serratus (*Nematoda: Oxyuridae*), the pinworm parasite of proboscis monkeys. Zootaxa 4722(3): 287-294.

5. **JUMAIL A**, THOR SENG L, **SALGADO LYNN M**, FORNACE K, **STARK DJ**, 2020. A comparative evaluation of thermal camera and visual counting methods for primate census in a riparian forest at the Lower Kinabatangan Wildlife Sanctuary (LKWS), Malaysian Borneo. Primates doi: 10.1007/s10329-020-00837-y.

6. LORD E, DUSSEX N, KIERCZAK M, DIEZ-DEL-MOLINO D, RYDER OA, STANTON DWG, GILBERT MTP, SANCHEZ-BARREIRO F, ZHANG G, SINDING MHS, LORENZEN ED, WILLERSLEV E, PROTOPOV A, SHIDLOVSKIY F, FEDOROV S, BOCHERENS H, NATHAN SKSS, **GOOSSENS B**, VAN DER PLICHET J, CHAN YL, PROST S, POTAPOVA O, KIRILLOVA I, LISTER AM, HEINTZMAN PD, KAPP JD, SHAPIRO B, VARTANYAN S, GOTHERSTROM A, DALEN L, 2020. Pre-extinction demographic stability and genomic signatures of adaptation in the woolly rhinoceros. Current Biology 30: 3871-3879.
7. LUBBERS M, HOVIUS SA, **CHAI RR**, BYNG JW, SCHILTHUIZEN M, 2020. An observation on the ecology and behaviour of *Metallyticus splendidus* on a dead dipterocarp tree in Sabah, Malaysia (*Mantodea*, *Metallyticidae)*. Journal of Tropical Biology and Conservation 17: 165-170.
8. MATSUDA I, **STARK DJ**, **SALDIVAR DAR**, TUUGA A, NATHAN SKSS, **GOOSSENS B**, VAN SCHAIK CP, KODA H, 2020. Large male proboscis monkeys have larger noses but smaller canines. Communications Biology doi: 10.1038/s42003-020-01245-0.
9. **WAI L**, **EVANS MN**, BERNARD H, **GOOSSENS B**, 2020. Holt-based activity patterns of smooth-coated otter (*Lutrogale perspicillata*) in the Lower Kinabatangan Wildlife Sanctuary, Sabah, Malaysia. IUCN Otter Specialist Group Bulletin 37(1): 20-28.

IN THE NEWS

13 January Bornean elephants actively avoid urbanised areas, study shows
Daily Express, New Sabah Times, See Hua Daily News & The Borneo Post

16 January INL Workshop on Illegal Wildlife Trade
Harian Ekspres, New Sabah Times, Overseas Chinese Daily News, See Hua Daily News & The Borneo Post

17 January INL-Sabah Wildlife Department to set up intelligence unit
Daily Express

22 January Tourism players urged to play role in fight against wildlife crime
Asia Times, Daily Express, Harian Ekspres, Overseas Chinese Daily News, See Hua Daily News, Sin Chew Daily & The Borneo Post

19 February CSOs: Bornean Elephant Action Plan must address habitat fragmentation issue
New Sabah Times, See Hua Daily News, Sin Chew Daily & The Borneo Post

20 February Jumbos: NGOs believe State Govt is serious
Daily Express

10 March Hairy nosed otter in Kinabatangan
Daily Express

26 April DGFC: Elisa Panjang
Sin Chew Daily

22 July Sabah Wildlife Department to work with Malaysia Anti-Corruption Commission
Asia Times, Daily Express, New Sabah Times, See Hua Daily News, Sin Chew Daily & The Borneo Post

28 July Avoid Mangroves when building roads: Coalition
Daily Express, New Sabah Times & The Borneo Post

GRANT AWARDS

GRANT AWARDS	RM
Houston Zoo: PhD funding:	36,371.00
Regrow Borneo: JustGiving (UK) donations:	105,197.00
Panthera Corporation (Health at the Edge project):	6,320.00
Orangutan Appeal UK (Regrow Borneo):	28,070.00
Waterloo Foundation (Regrow Borneo C19 Project):	33,684.00
Total	**209,642.00**
(Total	**= US$ 49,761.00)**

ACKNOWLEDGEMENT

Despite COVID-19 travel restrictions and the financial impact the pandemic brought, DGFC still managed to undertake its core activities in support of ongoing ecological research as well as cater for its visiting students and scientists, albeit on a reduced scale.

As we prepare for the challenges ahead, we will inevitably have to become more reliant upon our financial reserves and, therefore, wish to record our sincere thanks to those stakeholders and donors who have lent their support during this extraordinary year.

Your support next year will be invaluable, and should you wish to learn more about the various ways you can help, please email jrobertson@dgfc.life or visit www.dgfc.life to see how the work undertaken by the DGFC continues to make such a valuable contribution to the future conservation of our wildlife and habitats in Sabah, Malaysia.