Institution: Cardiff University		
Unit of Assessment: Biological Sciences (5)		
Title of case study: Protecting flagship endangered species in Borneo		
Period when the underpinning research was undertaken: 2014-2019		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s): Goossens, Benoit	**Role(s) (e.g. job title):** Professor	**Period(s) employed by submitting HEI:** 01/07/2005 - present
Period when the claimed impact occurred: 2014-2020		
Is this case study continued from a case study submitted in 2014? No		

1. Summary of the impact (indicative maximum 100 words)

The Bornean rainforest is a crucial enclave for endangered wildlife, under threat from habitat loss and poaching. Cardiff research, facilitated by its Danau Girang Field Centre (DGFC, established with the Sabah Wildlife Department), identified that forest preservation and the creation of wildlife corridors were vital for the survival of four flagship species. The research findings underpinned new government policy in the form of Action Plans for the Bornean elephant, Bornean banteng, proboscis monkey and Sunda clouded leopard. Measures enacted by the Plans included reforestation, land protection and approaches to combat poaching. The DGFC further used the research to advocate for sensitive land development and ensure greater animal protection in Sabah.

2. Underpinning research (indicative maximum 500 words)

Habitat fragmentation impacts on animal ranges and access to food, reduces forest health, decreases water quality, and increases human-animal conflict. Cardiff's Danau Girang Field Centre (DGFC), a collaborative research and training facility in the Lower Kinabatangan Wildlife Sanctuary, aims to facilitate research designed to support long-term conservation projects, protecting flagship species and their habitats in Sabah, Malaysia. Establishment of the DGFC was an impact within the REF 2014 case 'Genetic data optimises conservation of endangered species'.

In this REF period, supported by funding from the Sime Darby Foundation and Ocean Park Conservation Foundation, Cardiff's DGFC researchers applied their expertise in mapping habitats to analyse the spatial ecology of endangered species in Sabah. The research utilised camera traps **[3.1, 3.2]**, satellite, GPS telemetry tracking and LiDAR technology **[3.3]** and drones **[3.4]** to enable wide-scale analysis of forest use, and the creation of modelling distributions. This research uncovered the crucial landscape factors affecting the persistence of four key endangered species in tropical forests:

2.1 Bornean elephant

Bornean elephants are listed as endangered on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species, with an estimated 1,000 - 1,600 remaining in Sabah. Cardiff research undertook the largest analysis of forest use by Bornean elephants to date, and showed that the stature of degraded forest landscapes, particularly in flat and low-lying areas, made them the most suitable habitats for the Bornean elephants. To maintain the species, it was recommended that these habitats (often converted to more profitable palm oil plantations and large-scale agriculture) should be protected and recovered **[3.3]**.

2.2 Bornean banteng

The Bornean banteng is an endangered species of wild cattle endemic to Borneo. Sabah is believed to be their last stronghold with approximately 326 individuals left in the wild. The research found that a mixture of open grassy pastures, sedge areas, and forest shade was needed for the banteng to successfully forage and shelter **[3.1]**. While around 11% (7,719km^2) of Sabah had suitable habitat for the banteng, only 12.2% of this was in protected forests leaving the species

vulnerable to poaching. The research recommended developing and maintaining suitable pastures within the home ranges of existing herds to support the banteng population **[3.1, 3.2]**.

2.3 Proboscis monkeys

Listed as endangered on the IUCN Red List of Threatened Species, Cardiff research demonstrated the critical importance of increasing mangrove and riparian forest to maintain a viable population of proboscis monkeys. Drone images showed that 47.5 hectares of Sabah forest suitable for the proboscis monkeys had been cleared, resulting in a loss of 30% of home range area and 11% of sleeping sites for this species **[3.4]**.

2.4 Sunda clouded leopard

The Sunda clouded leopard is one of the world's rarest and least-studied big cats, with Sabah currently home to 750 individuals. Cardiff research showed that the leopard's movements were facilitated by forest canopy cover and impeded by recently cleared, planted and/or flooded plantation areas with low canopy closure. The research further revealed that proposed road and rail developments in the area would decrease connected habitats by up to 23% and recommended that critical forest canopy cover needed to be protected and improved to maintain the current endangered leopard population **[3.5, 3.6]**.

Cardiff's research provided evidence that protection of distinct types of forest (mature and degraded) in Sabah, and implementation of measures to increase habitat connectivity (by replanting forest to make wildlife corridors to support movement across wider areas) was fundamental to the survival of the Bornean elephant, Bornean banteng, proboscis monkey and Sunda clouded leopard.

3. References to the research (indicative maximum of six references)

[3.1] Gardner PC, **Goossens B**, Wern JGE, Kretzschmar P, Bohm T, Vaughan IP, 2018. Spatial and temporal behavioural responses of wild cattle to tropical forest degradation. *PLoS ONE*. 13(4): e0195444. doi: 10.1371/journal.pone.0195444.

[3.2] Lim HY, Gardner PC, Abram NK, Yusah KM, **Goossens B**, 2019. Identifying habitat and understanding movement resistance for the endangered Bornean banteng *Bos javanicus lowi* in Sabah, Malaysia. *Oryx.* 55(1): 122-130. doi: 10.1017/S0030605318001126

[3.3] Evans LJ, Asner GP, **Goossens B**, 2018. Protected area management priorities crucial for the future of Bornean elephants. *Biological Conservation.* 221: 365-373. doi: 10.1016/j.biocon.2018.03.015

[3.4] Stark DJ, Vaughan IP, Evans LJ, Kler, H, **Goossens B**, 2018. Combining drones and satellite tracking as an effective tool for informing policy change in riparian habitats: a proboscis monkey case study. *Remote Sensing in Ecology and Conservation.* 4 (1): 44-52. doi: 10.1002/rse2.51

[3.5] Hearn AJ, Cushman SA, **Goossens B**, Macdonald E, Ross J, Hunter L, Abram NK, Macdonald DW, 2018. Evaluating scenarios of landscape change for Sunda clouded leopards in a human dominated landscape. *Biological Conservation.* 222: 232-240. doi: 10.1016/j.biocon.2018.04.016.

[3.6] Kaszta Z, Cushman S, Hearn A, Burnham D, Macdonald E, **Goossens B**, Nathan SKSS, Macdonald D, 2019. Integrating Sunda clouded leopard (*Neofelis diardi*) conservation into development and restoration planning in Sabah (Borneo). *Biological Conservation.* 235: 64-76. doi: http://dx.doi.org/10.1016/j.biocon.2019.04.001

4. Details of the impact (indicative maximum 750 words)

Cardiff research led to detailed understanding of forest use by endangered animals in Sabah, Malaysia, and provided critical evidence for implementation of new approaches designed to provide enhanced protection for the Bornean elephant, Bornean banteng, proboscis monkey and Sunda clouded leopard.

4.1 Species-specific State Action Plans

The Cardiff team co-wrote four State Action Plans based on the Cardiff research in collaboration with the Sabah Wildlife Department, the key government authority responsible for the protection of wildlife in Sabah. Three of the Action Plans were new and focused on the Bornean banteng, proboscis monkey and Sunda clouded leopard (all 2019-2028). The fourth Action Plan, on the Bornean elephant (2020-2029), was an updated version continuing from the prior 2012-2016 plan (which had been previously developed with the Cardiff team) **[5.1a-d]**. The Action Plans outlined key steps designed to support all four endangered Sabah species, based on requirements identified from the Cardiff research **[3.1-3.6]**. For example, recommendations included safeguarding of appropriate habitats by:

- improving landscape connectivity for all four species to access suitable habitats **[5.1a,** p.18, **5.1b** p.iv, **5.1c** p.iii and **5.1d**, p.iv**]**;
- working with NGOs, the palm oil industry and local communities to recover underproductive palm oil plantations and return these sites to degraded forest suitable for Bornean elephants **[5.1a,** p.18-21**]**;
- preventing "any loss and degradation of suitable habitat (open grassy and sedge areas and forest shade) for bantengs" and planning the development and maintenance of pastures within the range of existing herds **[5.1b,** p.25**]**;
- increasing mangrove and riparian forest areas suitable for proboscis monkeys **[5.1c**, p.iii**]**;
- halting loss and degradation of habitats used by Sunda clouded leopards (such as forest canopy cover) **[5.1d,** p.iii**]**.

The Plans also included objectives to support wildlife enforcement and reduce poaching **[3.1, 3.5, 3.6]**, for example:

- a commitment to "improve protection and halt elephant killing to reduce current levels of elephant deaths" **[5.1a,** p.10**]**, through improving local coordination and field enforcement **[5.1a**, p.13**]**;
- increased measures to combat poaching including to "hire and train crime analysts, investigators and intelligence gatherers" to track poaching and assess the levels of hunting in Sabah **[5.1b,** p.23**]**.

The Action Plans for the Bornean banteng, proboscis monkey and Sunda clouded leopard were officially launched by the Minister of Tourism, Culture and Environment in September 2018 and approved by the Sabah State Government in June 2019 **[5.2, 5.3]**. Sime Darby Foundation Governing Council Member, Caroline Christine Russell, noted her hope that the Action Plans would be implemented as part of conservation policy, and that the *"launch of the state action plans will serve as a catalyst for other organisations to come in and be part of these important efforts to conserve"* the endangered species **[5.3]**.

The total investment from the Sabah Government for all four ten-year Plans, approved by the Sabah Ministry of Finance, is RM37.84M (£7M) for the ten-year period, which includes funding of RM10M (£1.8M) for an Endangered Species Conservation Unit and RM20M (£3.75M) for an Enforcement Unit **[5.1a-d].**

4.2 Forest recovery and wildlife enforcement

To date, implementation of recommendations outlined in the four Action Plans have focused on forest recovery and replanting, as well as improved wildlife enforcement.

a. Forest recovery and replanting

Following the publication of the Action Plans, which contained specific commitments and measures for forest recovery and replanting, the Sabah government started the first phase of reforestation in 2019 with the planting of a million trees on over 4,000 hectares of degraded forest land **[5.4a]**. The Action Plans also provided a framework to coordinate replanting efforts by NGOs and the government, for example in 2020 the Rhino and Forest Fund (RFF) worked with the Sabah

Wildlife Department to purchase a 65 hectares oil palm plantation for replanting. This will benefit Bornean elephants and banteng, as well as reconnect two key protected areas of forest **[5.4b]**.

The Cardiff DGFC team further facilitated implementation of the Action Plans' measures for reforestation; in 2020, the team worked with the local community to replant three hectares of forest with 4,100 trees, with a further 8,400 saplings ready to be planted in 2021 after seasonally flooded areas dry out **[5.5,** p.5-6**]**. Planting is planned with, and carried out by, members of the local community through the DGFC's partner, KOPEL Bhd, which represents four local villages and supports sustainable livelihoods and training for local people through biodiversity conservation **[5.5**, p.5**]**.

b. Improving wildlife enforcement

Cardiff research findings on poaching and wildlife trafficking **[3.1, 3.6]** improved wildlife enforcement through the Sabah Forestry Department's Protect Team. The Team monitors 2M hectares of protected conservation areas with the aim of reducing illegal forestry activities and encroachment on forest reserves, as well as poaching and wildlife trafficking **[5.6a]**.

Following the specific Action Plan measures on enforcement capacity, often successfully delivered via investment in intelligence officers, in June 2019 the Sime Darby Foundation awarded RM4M (£750K) to enable employment of 25 new rangers and a crime analyst **[5.6a]**. Sabah's Chief Conservator of Forests, Datuk Mashor Bin Mohd Jaini, noted that the funding would: "*boost the enforcement capacity of the State Government, especially Sabah Forestry Department to reduce the number of poaching cases in Sabah, in particular within forest reserve areas*" **[5.6a]**. Building on this, in September 2019 the US State Department's Bureau of International Narcotics and Law Enforcement Affairs committed a further RM4M (£750K) of funding for a new Intelligence Unit within the Sabah Wildlife Department, designed to combat poaching and conduct genetic wildlife forensic work **[5.6b]**. The new Unit employs eleven staff from the Sabah Wildlife Department and is developing a new forensic lab designed to "*maintain a wildlife crime database that will be shared effectively with the relevant national and international agencies*" **[5.6b]**.

Evidencing the success of this investment, linked to delivery of Sabah's new Action Plans, 200 enforcement operations were carried out between January-December 2020, resulting in more than 68 arrests, the prosecution of two suspects for possession of elephant tusks and confiscation of RM3.1M (£560K) worth of illegally-obtained forest products **[5.6c, 5.6d]**.

4.3 Conservation legacy

Additional conservation legacies delivered by Cardiff's DGFC team during the REF period included:

a. Successful campaigning against the construction of the Sukau Bridge

Cardiff's research into the Bornean elephant's movements **[3.1]** led Goossens, as Director of DGFC, to campaign strongly against the planned construction of a bridge over the Sukau river, which would further fragment the elephant's habitat. This campaign raised the profile of the issue, attracting Sir David Attenborough's support, and as a result, the bridge was scrapped **[5.7]**. Wildlife Impact's independent DGFC Evaluation Report stated: "DGFC delivered scientific evidence regarding impacts of the proposed Sukau bridge to the Minister of Tourism, Culture and Environment, particularly based on satellite data of elephant movements, which helped contribute to rejection of the proposal" **[5.8**, p.7**]**.

b. Advocating sensitive development of the Pan Borneo Highway

Based on DGFC's research data, and following advice from Coalition 3H (Humans, Habitats, Highways), an alternative route for the Pan Borneo Highway is now being considered by the Sabah government **[5.9]**. The Highway was due to cross mangrove forest reserves which the Cardiff research had identified as the last remaining habitat of the proboscis monkey **[3.4]**, as well as forest reserves critical for the Bornean elephant and Sunda clouded leopard **[3.3, 3.5, 3.6]**. Building the highway would have led to further fragmentation of these important habitats and a decline in the endangered species.

Movement and distribution maps from the four flagship species, created from the Cardiff research, were used to develop new proposals for the highway, including road alignment changes, eco-links and wildlife overpasses to mitigate the impact on wildlife. This was supported by Coalition 3H, who advised the Sabah government on how to minimise the environmental impact of road expansion, with the Highway now currently under construction in line with these revised plans **[5.9]**.

In summary, Cardiff's work secured greater protection for four key endangered species in Malaysian Borneo. Wildlife Impact's DGFC Impact Evaluation Report notes that through the DGFC, Cardiff research "has been instrumental in advocating and providing data for rare species action plans, particularly charismatic megafauna such as clouded leopards, banteng and proboscis monkeys" **[5.8**, p.5**]**.

5. Sources to corroborate the impact (indicative maximum of 10 references)

[5.1] Action Plans: **a.** *Elephant Action Plan for Sabah 2020-2029;* ***b.*** *Bornean Banteng Action Plan for Sabah 2019-2028*; **c.** *Proboscis Monkey Action Plan for Sabah 2019-2028*; **d.** *Sunda Clouded Leopard Action Plan for Sabah 2019-2028*

[5.2] Sime Darby website press release: 'Sunda clouded leopard, proboscis monkey and Bornean banteng action plans launched to conserve species'

[5.3] 'Sabah approves 10-year plan to conserve elephants', *New Straits Times*, 13th February 2020 Press coverage of the government approval and launch of the four Action Plans

[5.4] Press coverage of reforestation work: **a.** 'Sabah Steps Up to Lead Restoration of Malaysia's World Class Forests, As Teresa Woos the West', *Sarawak Report*, 2 April 2019; **b.** 'Conservationists replant legal palm oil plantation with forest in Borneo', *Mongabay*, 9 November 2020

[5.5] 'Pilot Year Impact Report'*, Regrow Borneo* (2020)

[5.6] Press coverage of wildlife enforcement **a.** 'Sabah gets RM4 million boost to combat wildlife crime' *New Straits Times*, 30 June 2019; **b.** 'Wildlife dept to set up intelligence unit', *Daily Express,* 17 January 2020; **c.** 'Indonesian couple arrested in Sabah for possessing elephant tusks', *Malay Mail,* 6 January 2020; **d.** 'Despite pandemic, Sabah Forestry Department continues battle against wildlife crime', *New Straits Times*, 29 January 2021

[5.7] 'Sukau Bridge Cancellation: Civil Society Thanks Musa, Sabah Govt', *Borneo Today,* 21 April 2017

[5.8] Wildlife Impact Danau Girang Field Centre Evaluation Report (2018)

[5.9] Press coverage on 3H coalition and the Pan-Borneo Highway: 'The Pan Borneo Highway on a collision course with elephants', *Mongabay,* 28th August 2019; 'Coalition praises Sabah Chief Minister's concern for the environment', *Borneo Post* Online, 25th March 2019