Institution: The University of South Wales		
Unit of Assessment: B7, Earth Systems and Environmental Sciences		
Title of case study: Informing best practices and national policy for tropical terrestrial biodiversity conservation		
Period when the underpinning research was undertaken: August 2011 to 31st December 2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	**Role(s) (e.g. job title):**	**Period(s) employed by submitting HEI:**
Dr David Lee Dr Tracie McKinney	Senior Lecturer in Wildlife Ecology Senior Lecturer in Biological Anthropology	2011 – Present 2014 – Present
Period when the claimed impact occurred: 1st August 2013 to 31st December 2020		
Is this case study continued from a case study submitted in 2014? N		

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

Globally, anthropogenic stressors threaten nearly 28% (35,765) of species for which there is an evaluation of their conservation status. Since 2011, University of South Wales research on human-wildlife coexistence for globally threatened species has focused in the biodiversity hotspots of Costa Rica, an exemplar of conservation success, and Indonesia, a key area of biodiversity losses. USW researchers have developed new methods for evaluating anthropogenic influences on primates, and guiding biodiversity evidence bases underpinning Ecosystem Restoration Concessions (ERCs). This research has 1) through Species Survival Commission (SSC) Specialist Groups (SGs) of the International Union for the Conservation of Nature (IUCN), transformed best practice for species in central America and southeast Asia, leading to ecosystem benefits, and 2) influenced environmental policy in Indonesia, co-benefiting biodiversity, people, and ecosystems.

2. Underpinning research (indicative maximum 500 words)

Since 2008, the conservation status of major taxonomic groups has deteriorated by >5% (IUCN's global Red List Index), indicating continued increases in extinction risk and biodiversity losses. Thus, as human population and resource needs continue to expand, practitioners must consider "land sharing" approaches to wildlife conservation. This perspective has two key components, to: (a) consider human-modified landscapes valuable in conservation efforts; and (b) recognize that human-animal interactions are a key factor in a species' continued survival.

From 2008-11, **Lee** completed baseline biodiversity studies in the first ERC in Indonesia, which manages the largest remaining tract of dry lowland forest in Sumatra. Since then, his research on biodiversity responses in human-modified landscapes has supported the objectives, actions and outcomes of this ERC. It has also helped demonstrate the necessity for Indonesian ERCs to incorporate empirical evidence on biodiversity for concession management, providing a baseline for measuring restoration successes (**R1**), and to quantify ERC conservation value for key wildlife and inform strategies supportive of threatened species conservation (**R2, R3**). This demonstrated that while local populations and habitat utilisation of important species are reduced in the most degraded forests, these habitats could retain sufficient functionality to support source populations that contribute significantly to their conservation (**R3**). Additionally, it revealed that protecting large mammals in ERCs is a win-win scenario for forest restoration and biodiversity conservation, since a high diversity of mammalian seed dispersers important for forest regeneration can be retained despite considerable habitat degradation (**R1**). In 2019, he presented the work of **R2** to the IUCN SSC Bear SG, who subsequently invited him to become a scientific advisor for monitoring and evaluating responses of Asian bears to habitat degradation.

Since 2016, **Lee** has developed a research project partnership with Kanahau Utila

Research and Conservation Facility, Honduras (funded by the International Iguana Foundation, The Mohamed bin Zayed Species Conservation Fund), producing an empirical evidence base for landscape conservation management supportive of the Critically Endangered Utila spiny-tailed iguana (*Ctenosaura bakeri*). Presented annually at the IUCN SSC Iguana SG conference (**R4**), this work has provided a robust global population estimate for the species, qualified its current threats, and delivered an autecological basis for prioritising conservation areas.

McKinney began working in Costa Rica in 2006, focusing on non-human primate responses to anthropogenic disturbance. Since 2014, her research has focused on the ecological and behavioural flexibility of Neotropical species in response to habitat and tourism disturbances (**R5, R6**). Her work demonstrated a clear difference in human-monkey interactions dependent on species, with capuchin monkeys (*Cebus imitator*) more likely to instigate interactions, and having more frequent and more intense interactions with humans than howler monkeys (*Alouatta palliata*) living at the same site. This shows that efforts to mitigate human-animal interactions need to be species-specific, even within a single tourism site. **McKinney's** work also considers methodological approaches, and she has developed a classification system for the consistent reporting of anthropogenic influences on non-human primates at primate field sites (**R7**). This research provides a standardised framework for meta-analyses of specified field conditions across a range of different landscapes, and strengthens understanding and evaluation of anthropogenic influences on primates. The published classification system (**R7**) led to an invitation to present at the 2016 International Primatological Society Congress, Chicago, and later to a 2018 review paper in the Ethnoprimatology in the 21st Century special issue of the International Journal of Primatology.

Since 2019, **McKinney** has engaged in wider inter-disciplinary work, looking at human-primate relationships in an archaeological context. This collaborative research is helping archaeologists better understand ancient trade associations. Together, this team came to a new identification for monkeys depicted in Bronze Age art, providing support for cultural exchange between the Aegean and Indus Valley (**R8**). This work helps modern primatologists understand historical cultural practices surrounding human-primate interactions – an exciting new area of study that will inform current work on human-animal conflict and conservation.

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

USW researchers are in **bold**. [Citations from Scopus] and {selected Altmetrics} as of December 2020. All references are of output type D – Journal Articles. USW can provide all outputs on request.

R1. Lindsell, J.A., **Lee, D.C.**, Powell, V.J., & Gemita, E. (2015). Availability of large seed-dispersers for restoration of degraded tropical forest. *Tropical Conservation Science* 8(1):17-27. https://doi.org/10.1177/194008291500800104. [13].

R2. **Lee, D.C.**, Powell, V.J., & Lindsell, J.A. (2019). Understanding landscape and plot-scale habitat utilisation by Malayan sun bear (*Helarctos malayanus*) in degraded lowland forest. *Acta Oecologica* 96:1-9. https://doi.org/10.1016/j.actao.2019.02.002. [1]. {Top 25%, 83rd percentile of all research outputs tracked}.

R3. **Lee, D.C.**, Powell, V.J., & Lindsell, J.A. (2015). The conservation value of degraded forests for agile gibbons *Hylobates agilis*. *American Journal of Primatology* 77(1):76-85. https://doi.org/10.1002/ajp.22312. [10].

R4. **Maryon, D.F.**, Pasachnik, S.A., Clayson, S., Higgins, E., Brown, T., & **Lee, D.C.** (2015-19). IUCN SSC Iguana SG Annual Conference Proceedings, 2015 to 2019.

R5. **McKinney, T.** (2019). Ecological and behavioural flexibility of mantled howlers (*Alouatta palliata*) in response to anthropogenic habitat disturbance. *Folia Primatologica* 90(6):456-469. https://doi.org/10.1159/000499825. [1]. {Top 25%, 89th percentile of all research outputs tracked}.

R6. **McKinney, T.** (2014). Species-specific responses to tourist interactions by white-faced capuchins (*Cebus imitator*) and mantled howlers (*Alouatta palliata*) in a Costa Rican wildlife refuge. *International Journal of Primatology* 35(2):573-589. https://doi.org/10.1007/s10764-014-9769-1. [13]. {73rd percentile of all research outputs tracked}.

R7. **McKinney, T.** (2015). A classification system for describing anthropogenic influence on nonhuman primate populations. *American Journal of Primatology* 77(7):715-726. https://doi.org/10.1002/ajp.22395. [25].

R8. Pareja, M.N., **McKinney, T.**, Mayhew, J.A., Setchell, J.M., Nash, S.D., & Heaton, R. (2020). A new identification of the monkeys depicted in a Bronze Age wall painting from Akrotiri, Thera. *Primates* 61:159-168. https://doi.org/10.1007/s10329-019-00778-1. [5]. {Attention Score of 204; top 5% of all research outputs ever tracked}.

The Ohio State University's Institutional Animal Care and Use Committee approved the study protocols for **R5**, **R6** and **R7**, which adhered to the American Society of Primatologists principles for the ethical treatment of primates.

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

Transformed best practice for species and ecosystem benefits.

Indonesia has 494 Key Biodiversity Areas (KBAs), covering ~344K km^2 and including >1,900 globally threatened species. Of these KBAs, more than half are unprotected and threatened by land-use change. Developed as a market-oriented framework by the Indonesian government in 2008, ERCs aim to conserve biodiversity, counter deforestation, and address wider environmental impacts (**C1**). Since this regulation's implementation, the Indonesian government has licenced 15 ERCs covering ~573K ha, 13 of these since 2013.

Lee's work (**R1**, **R2**, **R3**) informs best practice for biodiversity conservation and fulfilment of government reporting requirements (**C1**, **C2**, **C3**), which have since been applied to ERCs covering forest landscapes in Sumatra and Sulawesi (totalling ~405K ha) that would otherwise be lost to anthropic activities (**C2**, **C4**, **C5**), potentially emitting up to 185Mt CO_2 (based on Global Forest Watch figures).

- "*Dr Lee's work can take credit for making the complexities and inter-relationships of species and habitat in ERC degraded landscapes more explicit, leading to more effective conservation and restoration*." (**C1**; Advisor to the Department for Environment, Food and Rural Affairs (Defra)).
- "*It has helped us design appropriate studies on key animals in our landscape* [Bukit Tigapuluh Landscape Conservation ERC, Sumatra]." (**C2**; Indonesia Program Director, Frankfurt Zoological Society).
- "[This biodiversity monitoring] *work helped greatly, including informing aspects of our four-phase model of protection, restoration and conservation for our ERCs*" (**C4**; Deputy Head of Conservation, Asia Pacific Resources International Limited APRIL).

Monitoring restoration success against biodiversity gains in Indonesia's first ERC, covering 98K ha and overlapping two KBAs, is informed by **Lee's** research baseline (**C6**). Overarching environmental and economic significance of this is demonstrated by the Institute for Global Environmental Strategies' (IGES) promotion of private investment for forest conservation in Indonesia (2017; **C7**). Based in Japan and founded in 1998, the IGES conducts strategic research that supports environmental concerns, reflecting this in policy development in the Asia-Pacific region and globally. The IGES is affiliated with the Intergovernmental Panel on Climate Change (IPCC) and Asia-Pacific Network (APM) for Global Change Research.

Since 2014, **McKinney's** research (**R5**, **R6**, **R7**) stemming from previous baseline work in Costa Rica has informed best *in situ* research practice for non-human primates and has global application across a range of threatened species (48% of primate species are threatened with extinction); "*The work that* [Dr McKinney] *has done is incredibly important*

in the field, certainly because it recognises the influence of humans on primates in conservation. It is no doubt used by other researchers worldwide" (**C8a**; Co-Vice Chair IUCN SSC PSG Section for Human Primate Interactions). **McKinney** has, and continues to contribute to the IUCN SSC PSG best practice guidelines for primate tourism, which are going through an internal consolidation and review process overseen by the Chair of the IUCN SSC PSG Section for Human-Primate Interactions. These guidelines are expected to be published in 2021, and will provide expert advice for governments and landowners in primate habitat countries (**C8a**).

The impact of **McKinney's** 2015 anthropogenic influence scale (**R7**) is especially relevant in 2020, where the effect of the COVID-19 pandemic has resulted in some primates going hungry, as people are no longer feeding them, further highlighting the need for good site management and recording of anthropogenic influences at primate field sites (**C8a**).

In 2018, as an international endorsement of her primatological research, **McKinney** became an invited member of the IUCN SSC Primate SG's (PSG) Section for Human-Primate Interactions, working on primate tourism and primates in agroecosystems. She is regarded as one of the world's leading academics in this field (**C8a**).

Lee's research on the globally Endangered Agile gibbon (*Hylobates agilis*; **R3**) has improved conservation assessment methodologies for gibbon species, which are all at risk of extinction, by providing "*a robust field test of* [this new research method's] *capabilities … while negating some of the challenges faced when surveying gibbons using approaches that are more traditional*" (**C8b**; Vice Chair IUCN SSC PSG Section on Small Apes). Furthermore, the "… *practical lessons learnt, and the empirical data generated on this threatened species have been shared amongst researchers and stakeholders, which helps us as a* [Primate] *Specialist Group to set conservation policy and direction*" (**C8b**).

Lee's work on the Utila spiny-tailed iguana, Honduras, provided evidence for the species' 2018 IUCN Red List assessment (**C9**), which delivers environmental impact by informing conservation actions for government agencies, non-governmental organisations (NGOs), and the business community, e.g. through protected area designation. Participants (17 since 2016) in the Iguanas and Conservation Workshops, Honduras, are trained in these field research techniques, building capacity impact in iguana range countries (**R4**).

Influenced Environmental Policy in Indonesia.

Around 75% of Indonesia's land has tree cover, while only 12% of land is protected. From 2002 to 2019, Indonesia lost 26.8M ha (17%) of its tree cover, with land-use change and the forestry sector contributing 65% of Indonesia's greenhouse gas emissions over that period. Without ERCs, remaining unprotected forest and its biodiversity would likely be lost through unregulated anthropogenic activities (**C3, C5**).

Lee's work "*demonstrated that sampling approaches designed for biodiversity work … generate robust, informative data for management and policy decisions, helping transform best practice and refine governmental reporting requirements for ERCs* …", which were previously exhaustive, costly and embedded in production forest regulation (**C6**; Conservation Scientist, The Royal Society for the Protection of Birds (RSPB), University of Cambridge). The impact of **Lee's** research has been to help "…. *reduce* [these] *monitoring requirements….* [which] *has considerable reach and significance as the number of ERCs in Indonesia increases* …." (**C6**), and inform amendments to Indonesian ERC policy (**C5**):

- Regulation No. P5/VI-BPPHH/2014, *Standard and Guidelines on Performance Assessment of Sustainable Forest Production Management*; now includes assessment indicators for vegetation and wildlife, moving away from production forest evaluation of timber stock to co-benefits of ERC success.
- Ministerial Decree No. P.64/Menhut-II/2014, *Implementation of Silviculture in ERC License Area*; now enables ERC licence holders to plant non-commercial tree species important for maintaining or restoring key wildlife habitats.

Lee's research has contributed empirically to evaluating the biodiversity conservation

potential outside protected areas in Indonesia by:

- Providing "*evidence that remaining logged-over forest is still very important for biodiversity in Indonesia"* (**C3**; Biodiversity Advisor (retired), Ministry of Environment and Forestry, Indonesia), including for globally important species (**C8b**, **C10**): "*Dr Lee's work has identified* [an ERC] *as a globally important landscape for the conservation of the threatened agile gibbon*" (**C3**); "[sun bear] *can subsist in degraded forests,* [which] *means that preventing these forests from regressing into agriculture is a paramount priority for conservation*" (**C10**; Co-Chair of the IUCN SSC Bear SG);
- Contributing "*to our current understanding of how these* [key] *species utilise degraded forest landscapes and how this information can guide our restoration activities*" (**C6**; Conservation Scientist, RSPB, University of Cambridge) and "*providing a species-specific benchmark for ecosystem restoration*" (**C10**); and
- Directly supporting the legal targets of ERCs (**C5, C6**).

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

C1. Testimonial from a Forestry Development Specialist for Defra's Darwin Initiative grant scheme, providing regional context for the impact of **Lee's** work.

C2. Testimonial from the Indonesia Program Director of the Frankfurt Zoological Society, evidencing the impact associated with **Lee's** ecosystem restoration research in Sumatra.

C3. Testimonial from the Biodiversity Advisor (retired) of the Directorate General of Nature Conservation and Ecosystem of the Ministry of Environment and Forestry (MoEF), Indonesia.

C4. Testimonial from the Deputy Head of Conservation, Asia Pacific Resources International Holdings Limited, and Head of Operations for the Riau Ecosystem Restoration programme, Sumatra, evidencing the impact of **Lee's** work.

C5. Testimonial from the Ecosystem Restoration and Conservation Advisor of BirdLife International, explaining the reach and significance of **Lee's** work at the national level in Indonesia, including detailed national policy changes.

C6. Testimonial from a Conservation Scientist at the RSPB, Cambridge Conservation Initiative, and the Department of Plant Sciences, University of Cambridge, outlining the reach and significance of **Lee's** work seen today.

C7. Presentation by the Forest and Biodiversity Adviser, Burung Indonesia and Director of Operations, PT Restorasi Ekosistem Indonesia / Hutan Harapan on *Current Management and Challenges of Ecosystem Restoration Concessions* at the Institute for Global Environmental Strategies seminar on Ecosystem Restoration Concessions in Indonesia, and including the importance of research for ecological restoration; 13:00, 15th June 2017.

C8. Testimonials from the Co-Director of the Borneo Nature Foundation, Vice Chair IUCN SSC Primate SG (PSG) Section on Small Apes, Co-Vice Chair IUCN SSC PSG Section for Human Primate Interactions, and Lecturer in Biological Anthropology, Oxford Brookes University, outlining the impact associated with **a. McKinney's** research in Costa Rica; and **b. Lee's** research in Sumatra, Indonesia.

C9. **Lee's** research contributed to the 2018 IUCN Red List assessment and conservation action planning for the Critically Endangered Utila spiny-tailed iguana, a single-island endemic in Honduras threatened by land use change, hunting and invasive species.

C10. Testimonial from the Co-Chair of the IUCN SSC Bear SG outlining the reach and significance of **Lee's** work on sun bear.