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Asian elephants in the Prey Lang Extended Landscape

STUDY FINDINGS AND RECOMMENDATIONS

August 2022

Introduction

The Asian elephant (*Elephas maximus*) is categorised as globally Endangered on the IUCN Red List, with a decreasing population trend. The species is threatened predominately by widespread habitat loss, fragmentation, and increasing anthropogenic pressures.

In Cambodia, fewer than 600 individuals are thought to remain, with core populations found in the Cardamom Mountains and Eastern Plains landscapes (Maltby and Bourchier, 2011). Small scattered populations persist in other areas of the country, including within the Prey Lang Extended Landscape (PLEL).

A robust understanding of the population of elephants is necessary to design effective management interventions to support population recovery and effectively leverage elephants as a flagship and keystone species to the benefit of overall landscape-level biodiversity conservation. However, prior to this study, there were no reliable estimates of elephants in the PLEL.

Further, understanding the species' habitat use at the landscape and local levels is therefore important to inform effective conservation planning. At 3.5 million hectares, the PLEL encompasses a vast area with the potential to underpin population recovery of this ecologically and culturally significant species.

Fauna & Flora International (FFI) is supporting the USAID Greening Prey Lang (GPL) project to meet its conservation and governance objectives by assessing the Asian elephant population within key protected areas of the PLEL to improve understanding of the population's size and distribution and inform landscape-level conservation planning and management.

As part of this work, we have produced an estimate of the Asian elephant population size and composition, including genetic diversity, using genetic analysis. Additionally, we have assessed the species' range in the landscape, and conducted habitat suitability and connectivity modelling. Key findings are presented in this document, along with recommendations.

This study aligns directly with Strategic Action 7 (research and monitoring) of the Asian Elephant Conservation Action Plan for Cambodia 2020-2029. Additionally, it provides a sound evidence base to advance implementation of the Action Plan more broadly.

Key findings

Population assessment

We conducted non-invasive genetic sampling, involving collection of dung samples, during the 2020-2021 dry season in Prey Lang, Chhaeb and Preah Roka Wildlife Sanctuaries, in areas identified on the basis of available data to have regular elephant presence. We produced population insights derived from genetic analysis of more than 150 samples collected across the landscape. DNA was extracted from dung samples and this was used to produce 'genetic fingerprints' to identify individual elephants, as well as to determine the sex of those elephants. We further used the data to estimate population size and to calculate genetic diversity. The genetic analysis work was conducted at the Royal University of Phnom Penh (RUPP) genetics laboratory, with technical support from the Royal Zoological Society of Scotland (RZSS).

Key findings of this work were:

1. Thirty-five unique genotypes were observed within 112 samples.

2. Six of the unique genotypes were shared between Chhaeb and Preah Roka Wildlife Sanctuaries, providing evidence that elephants are moving between these neighbouring protected areas.

3. The two populations sampled in this study (Preah Roka/Chhaeb and Prey Lang) both have higher mitochondrial diversity than the population in the Cardamom mountains. The haplotype mitochondrial diversity was similar between the Prey Lang and Preah Roka/Chhaeb populations, and average compared to populations studied in other countries. But in terms of nucleotide diversity, the Preah Roka/Chhaeb population had the highest levels when compared to all populations except Sri Lankan elephants.

4. There was an even sex ratio in the sample set as a whole. However, a male-biased sex ratio was observed in Prey Lang, whereas a female-biased ratio was observed in Preah Roka/Chhaeb. A severely skewed female-bias sex ratio is indicative of elephant populations that have been subjected to high levels of ivory poaching, as males are targeted for their tusks. This result could therefore be indicative of a higher poaching threat in the Preah Roka/Chhaeb population compared to the Prey Lang region, although this is based on a very small sample size.

5. The Prey Lang Wildlife Sanctuary population is estimated to number 31 individuals (95% confidence interval of 24 - 41 individuals). The Preah Roka / Chheb Wildlife Sanctuaries population is estimated to number 20 individuals (95% confidence interval of 13 - 22 individuals). These estimated population sizes are relatively small but somewhat larger than had been anticipated. Considering the high genetic diversity found, and with adequate landscape-level habitat protection and threat management, there is potential for these populations to recover.

Geographic range

To provide an estimate of elephant range, we aggregated a total of 533 presence locations obtained as part of this study and from other sources (Figure 1).

Based on available occurrence records, Figure 2 shows the area of occupancy (AOO), representing the area currently occupied by the species, and represented in 2 x 2 km grid cells generated by summarising occurrence points within a grid.

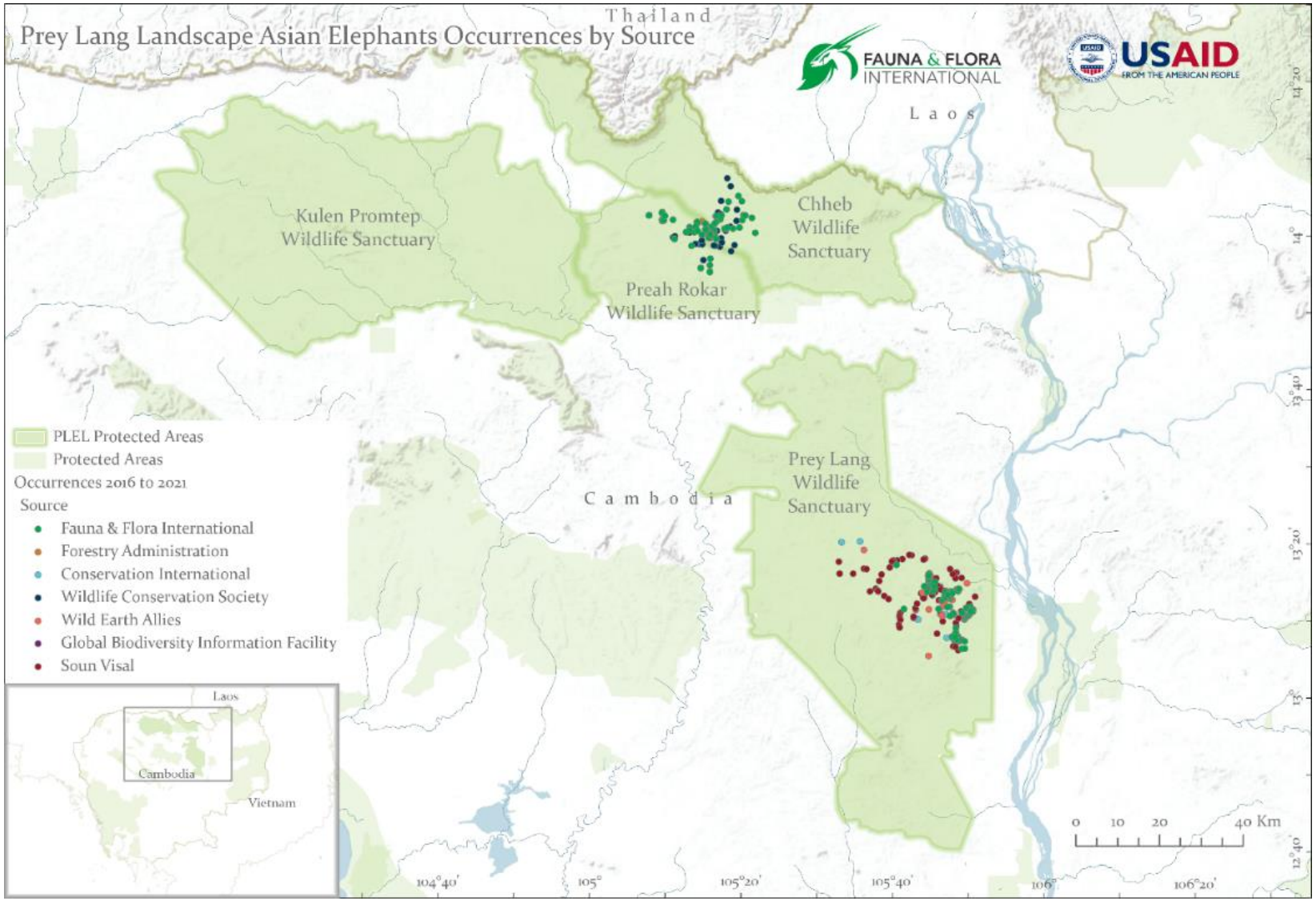

Figure 1: Asian elephant occurrence records in the Prey Lang Extended Landscape, by source.

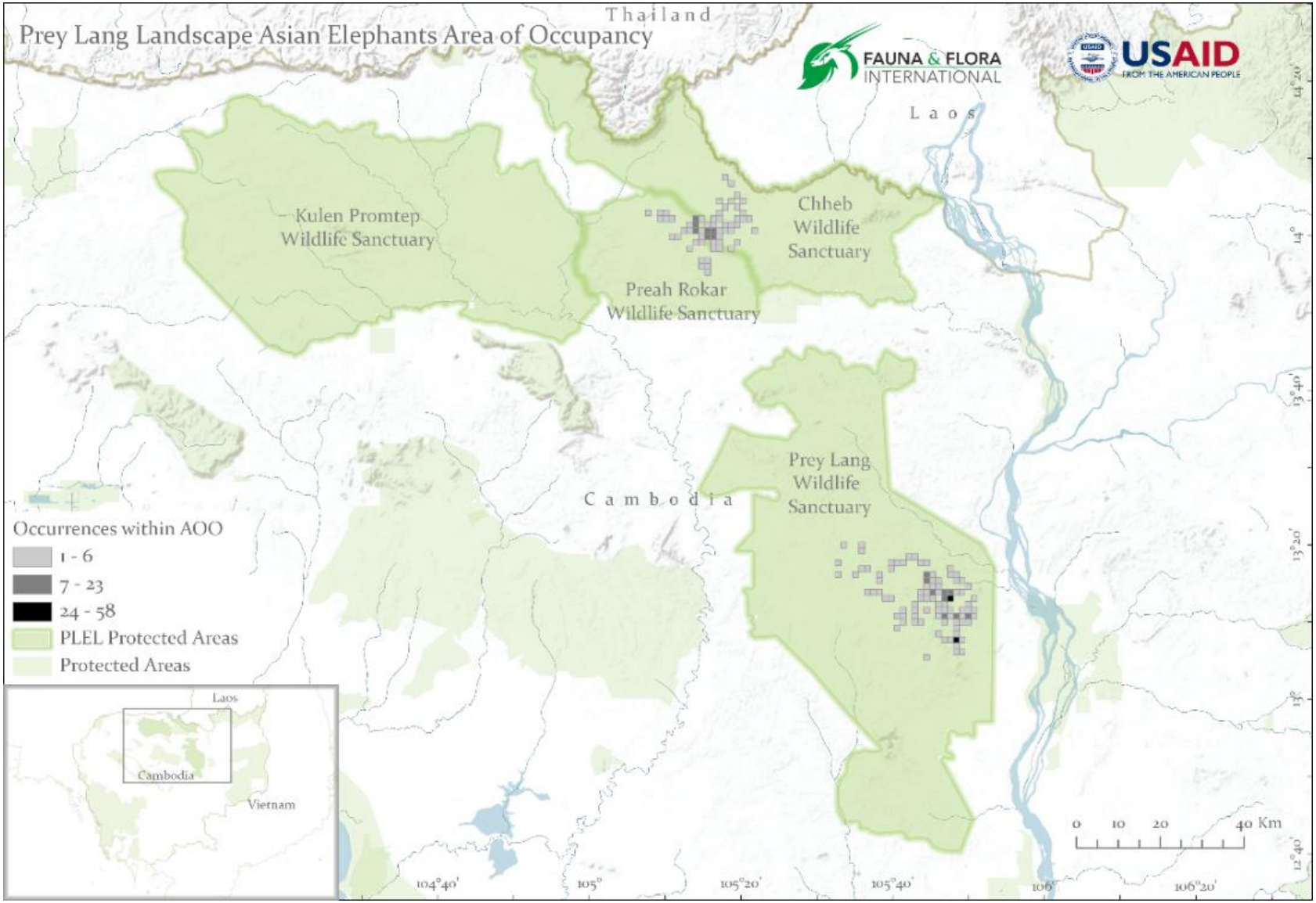

Figure 2: Area of occupancy of Asian elephants in the Prey Lang Landscape created following IUCN guidelines

Habitat suitability

Habitat suitability models (HSM) provide a useful assessment of key habitat areas within a species landscape. A 'fuzzy' habitat suitability model (used to represent imprecise information) was run to provide a preliminary description of suitable habitat based on forest cover, slope, distance to water, distance to roads, distance to villages, and deforestation as the physical variables influencing suitable habitat and the threats increasing habitat loss. However, fuzzy habitat suitability modelling does not allow for considerations of relationships between variables nor is it tied to any presence or absence data. Following preliminary runs of the fuzzy HSM, we weighted particular variables so that those that had a higher impact on elephant presence had a higher weight on the model. Due to the limited quantitative data available on how habitat variables influence elephant presence in Cambodia, a preliminary MaxEnt model (used to predict species occurrence taking into account environmental variables of known locations) was run to identify variables that had higher contributions to the model performance. These weightings were then relatively applied to the variables within a weighted fuzzy HSM. The results of this modelling are presented graphically in Figure 3, showing habitat suitability in a gradient from green (most suitable) to red (unsuitable).

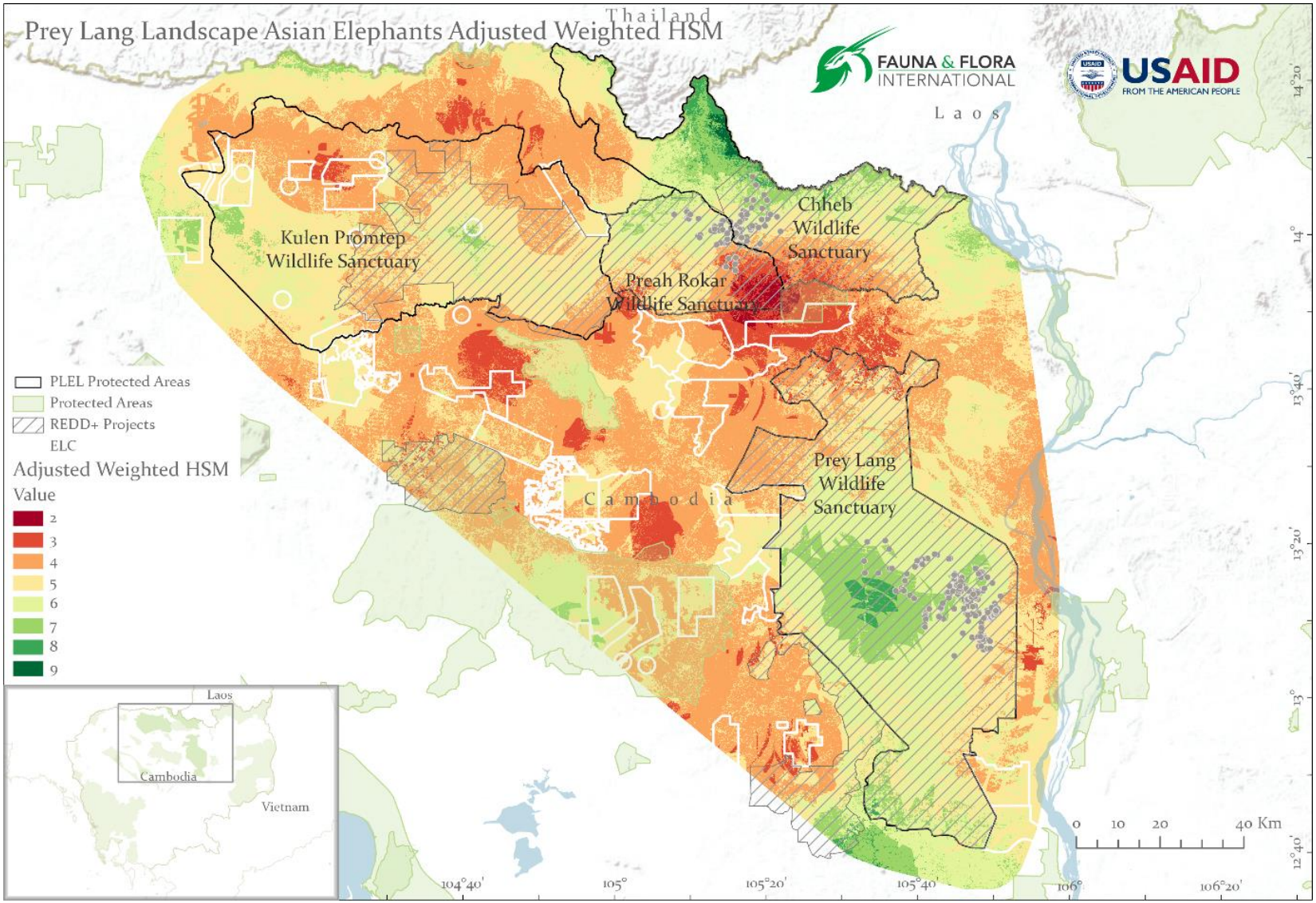

Figure 3: Relatively adjusted fuzzy habitat suitability model. Variables were weighted relatively according to percentage contribution to the MaxEnt model, with maximum contribution limited to 25%.

Connectivity

Structural and functional connectivity are key to maintaining genetic flow within metapopulations. Fragmented subpopulations with limited connectivity are at increased risk of localised extinction. Structural connectivity relates to the physical aspects of the landscape that facilitate subpopulation connectivity, for example forest cover provides corridors for wildlife to move within a heterogenous landscape. Functional connectivity demonstrates resistance to movement across the landscape with consideration of species interactions with the landscape, for example Asian elephants have been shown to avoid roads which would affect functional connectivity.

Structural connectivity was assessed for Asian elephants in the Extended Prey Lang Landscape using the Morphological Spatial Pattern Analysis (MSPA) tool. MSPA was run using 2010 Global Forest Watch (GFW) forest cover data and 2020 adjusted GFW forest cover. Change detection analysis from the 2010 MSPA to the 2020 MSPA allowed for comparison and identification of areas of structural connectivity that have been lost in the past decade. Connectivity was further assessed using the Gnarly Landscape Utilities, an ArcGIS toolbox that enables the creation of resistance and habitat layers. The Resistance and Habitat Calculator tool generated a resistance to movement layer, identifying non-forest as a barrier to connectivity and forest (>15% canopy cover based on GFW data) as an enabler. Following this, the Linkage Mapper, an ArcGIS toolbox, was used to identify adjacent core areas and map least-cost corridors between them. Using the resistance layer created from the Gnarly Landscape tool, Linkage Mapper generates a connectivity mosaic that shows the high cost areas to movement in the landscape (areas with low connectivity) and the low cost areas to movement between core areas in the landscape (areas with high connectivity). Finally, the *Pinchpoint Mapper* tool was used to identified bottlenecks within these forest corridors. The tool used the core forest layer, the resistance raster, and the corridor composite to identify areas where connectivity is restrained within the corridors.

Functional connectivity was modelled in the same way as structural connectivity and utilised Linkage Mapper and Pinch Point tools. Resistance values for variables included within functional models were assigned based on research showing that roads and settlements offer high resistance values. A map displaying results is presented as Figure 4.

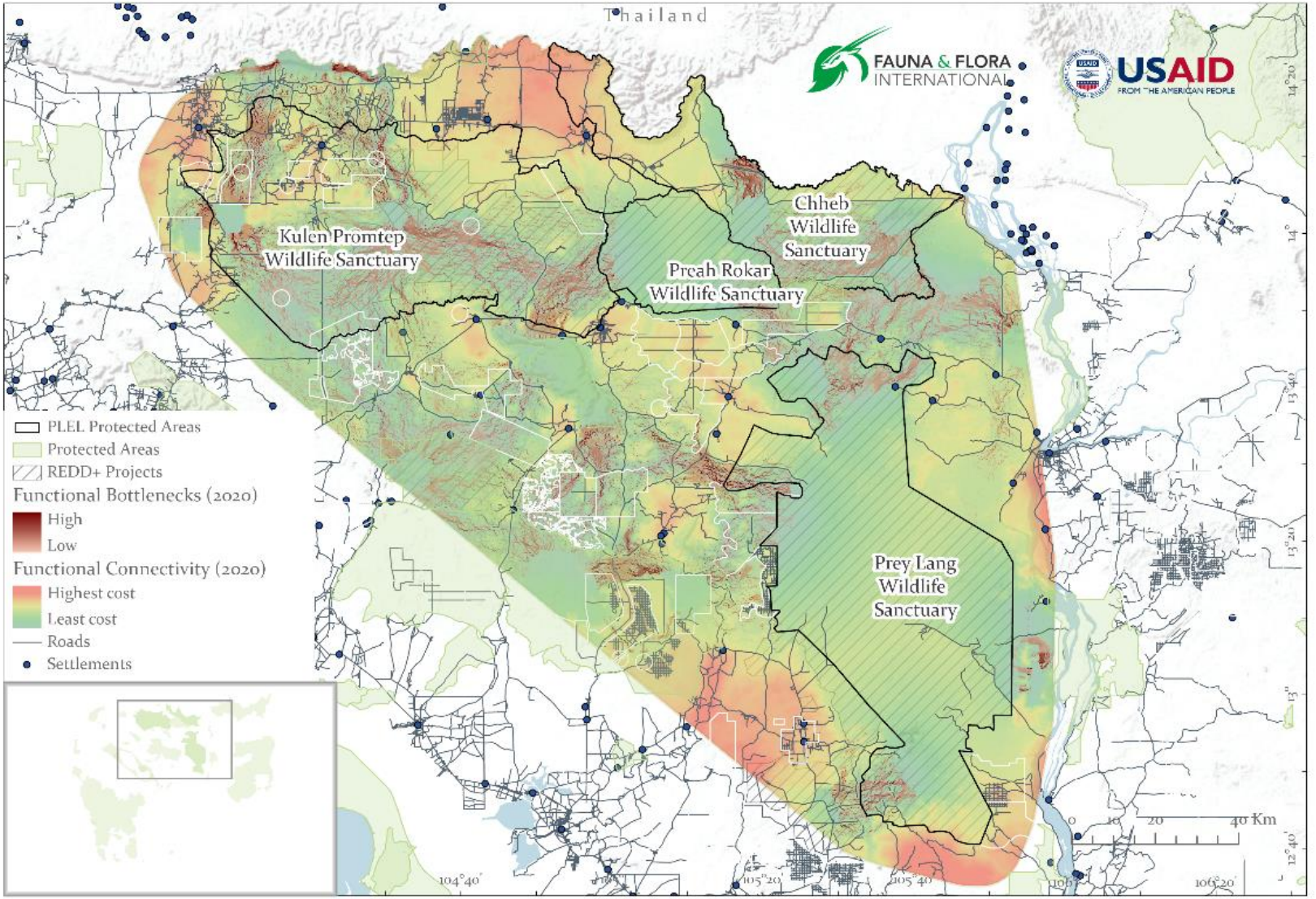

Figure 4: Functional connectivity results show the impact of non-forest cover, settlements and roads on Asian elephant connectivity within PLE

Recommendations

The recommendations below arise from the results of the present study and were reviewed by Ministry of Environment and conservation NGO participants at the National Workshop on Distribution and Status of Asian Elephants in Cambodia, Pursat, 8-9 June 2022.

Recommendations are aligned with and are organized based upon the Strategic Actions in the Asian Elephant Conservation Action Plan for Cambodia (2020-2029).

Certain recommendations are currently being implemented as part of the Annual Protected Area Management plans for Prey Lang, Chhaeb, and Prey Rhoka Wildlife Sanctuaries. Those management plans are being implemented by the Provincial Departments of Environment of Preah Vihear, Kratie, Stung Treng, and Kampong Thom in coordination with civil society, local authorities, and conservation NGO partners.

Strategic Action 1 | Reduce Habitat Loss

- **Recommendation 1**: Integrate study findings, including on elephant presence, suitable habitat and connectivity considerations, into the zonation processes for Prey Lang, Chhaeb and Preah Rhoka Wildlife Sanctuaries. Suitable elephant habitat, as well as less optimal areas with good potential to act as corridors between areas of suitable habitat, and in particular key areas known to be frequented by elephants and where traditional land uses would not be unduly impacted, should be considered for designation at an appropriate level according to protected area laws and zonation guidelines. Potential future population growth, as well as community views on elephants should also be considered when undertaking zonation.
- **Recommendation 2**: Consider creation of additional water sources (e.g. watering holes), as access to water sources in the dry season is likely to be disrupted by connectivity issues. However, this should be carefully balanced against the potential for such water sources to facilitate poaching or to attract elephants to areas where they may enter into conflict with humans. Analysis on the location of additional watering holes has not been conducted as part of this study.

Strategic Action 2 | Conserve and improve connectivity between habitats and subpopulations

- **Recommendation 3**: Consider/explore feasibility of extending PLWS (south) and Chhaeb WS (east) boundaries to include additional elephant habitat.
- **Recommendation 4**: Improve understanding of trans-boundary elephant movements between Cambodia and both Lao PDR and Thailand and develop trans-boundary conservation strategy to support ecologically-sound elephant conservation approach.

- **Recommendation 5**: Explore feasibility of restoring connectivity between PLWS and PRWS and Chhaeb, including through restoration of forest cover and installation of wildlife crossing structures.

Strategic Action 3 | Improve law enforcement

- **Recommendation 6:** Increase protection of remaining habitat, including through adequate enforcement and management, with a particular focus on suitable elephant habitat, to avert further degradation.
- **Recommendation 7**: Targeted patrolling to reduce to a minimum disturbance from human activities, particularly motorized access, logging and other activities likely to cause distress to elephants, in areas within the landscape found to be particularly important for the species.
- **Recommendation 8**: Map threat hotspots, using available SMART data, to inform enforcement efforts. Including dedicated snare removal efforts in key areas to reduce the risk of elephant calf mortality.

Strategic Action 5 | Mitigate human-elephant conflict

- **Recommendation 9:** Explore need/potential for a Prey Lang Extended Landscape Elephant Management Plan in future, which should include human-elephant-conflict (HEC) considerations

Strategic Action 7 | Research on and monitoring of elephant populations

- **Recommendation 10**: Continue supporting research of resident elephant populations at a landscape level, and monitoring the status of the population at 5-year intervals on the basis of the baseline established as part of this study.
- **Recommendation 11**: Further investigation to understand uneven distribution of the species over suitable habitat, as well as historical events that led to population decline and fragmentation, so population recovery plans can be better informed.
- **Recommendation 12**: Further investigation into apparently skewed sex ratios at a local level maybe warranted, particularly in the PLWS where a relative lack of females could have longer-term conservation impacts. This could include investigation of the possibility of poaching in Preah Roka/Chhaeb WS.

Acknowledgments

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