Assessing the impacts of habitat fragmentation and subsequent anthropogenic expansion on the behavioural, population, and nesting ecology of the estuarine crocodile, *Crocodylus porosus*

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Overview

The project sought to examine the effects of habitat loss and fragmentation on the ecology and population genetics of the estuarine crocodile (*C. porosus*). Additionally, the role played by humans in this anthropogenically-altered landscape was examined. The project utilised a host of technologies, some previously established, some completely novel in crocodilian research, in order to provide a new insight into how the landscape is utilised by these cryptic predators. This project represents a first detailed look at Sabah's crocodilian population, as well as being the first active crocodile research carried out in Sabah's longest river.

A major aim of the project was to establish base-line behavioural ecology data in equatorial rainforest ecotypes, whilst also examining how prior population fluctuations have impacted the genetic health of the regions crocodiles. One major output from the project will be an understanding of how to move forward with a future management plan for Sabah's crocodiles, in order to mitigate future conflict whilst maintaining active and healthy wild populations.

Methods

Three major technological methodologies were employed during the project, namely satellite tracking, drone reconnaissance, and microsatellite and mitochondrial analysis.

Satellite Tracking

Implementation of three distinct satellite tracking technologies, that included Iridium, ARGOS, and remote download systems. Tags were all attached at the nuchal plate, in accordance with the method set forth by Kay (2004). Tags were attached to both male and female crocodiles, ranging from 2.12 m up to 5.18 m.

Drone Reconnaissance

Drone technology was utilised for the first time in crocodilian research. This aerial photography utilising programmable autopilot technology allowed for the selective surveying of potential nesting habitats. Using a 'fixed wing' aircraft enabled single flights of in excess of 35 km. This level of aerial coverage provides a repeatable method of nest surveying. The results from confirmed nest sites allowed further refinement of modelled flight areas ensuring that a high proportion of detection could be ensured with the minimum of flight time. For further details regarding methodology please see Evans et al. (2015).

Microsatellite and mtDNA

Both microsatellite and mtDNA analysis are established methodologies utilised to provide an understanding of a range of demographic traits. The project sought to utilise these analyses to gain an understanding of genetic health of the population, as well as to understand whether or not recent a population bottleneck had resulted in decrease in observable heterozygosity. In order to do this, a locus from the control region of the mitochondrial genome was sequenced for 122 individuals captured from the Kinabatangan. Additionally, 24 microsatellite loci were selected from previously published works.

Results

A total of nine individuals were tagged, with seven of those units providing usable data. Males were found to adhere to one of two behavioural strategies, territorial and nomadic, mirroring findings of Campbell et al. (2013). Territory sizes were, however, found to be smaller than those described in Australia, this was attributed to increased prey availability and ecosystem productivity. Only two females were tagged and appeared to also displaying differences in behavioural strategy. However, due to the small sample size further work is required to confirm this.

Nests were detectable aerially through the use of drones and medium-large scale surveys shown to be feasible. Nests were found to all display a number of similarities in terms of habitat characteristics allowing for refined modelling of survey locations. This allows for a larger survey area to be completed given a limited number of flights highlighting its cost effectiveness versus traditional methods of nest surveying

Genetic analysis suggested that there was no evidence of a genetic bottleneck following the population recovery that has occurred over the last 30 years. Geographically indistinct haplogroups were discovered as well as limited levels of inbreeding. The project also indicated that the population studied had undergone a population expansion that seems to have coincided with the onset of the last ice age and is likely attributable to changes in climate.

Expected Outcomes

- 3-5 publications in peer reviewed journals.
- Stepping stone to tangible management plan.
- Placing of warning signs in areas deemed to be at high risk of human-crocodile conflict.

Future Work

This work is a stepping stone to a future management plan in Sabah and will pave the way for work next year (2016) to be carried out assessing populations throughout

Sabah. This work may culminate in an application for the downgrading of *C. porosus* from CITES Appendix I to Appendix II.

Sponsors and Collaborators

Chester Zoo; Columbus Zoo; IUCN-SSC Crocodile Specialist Group; Wildlife Rescue Unit, Sabah Wildlife Department, Local counterpart – Silvester Saimin.

References

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