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A pragmatic science-based model to sustainable crocodile conservation in the Philippines

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Abstract

The crocodile farming industry in the Philippines is the result of the successful captive breeding program initiated by the Philippine government. The innovative closed-cycle farming strategies and approaches of Crocodylus Porosus Philippines Inc. (CPPI) continue this conservation effort through sustainable use and population management. In this paper, we gathered information from multiple sources (including unpublished research and reports), and synthesized these with review of published literature, to provide a comprehensive report. Major findings were supported by published news articles sourced online, government archives, and the CPPI database from April to June 2019. Through the years, CPPI's plan of actions has evolved into a species conservation catalyst for both *Crocodylus porosus* and *C. mindorensis in-situ* conservation programs. The *C. mindorensis* conservation introduction project, a study on fishery productivity, and a review of the status and population of *C. porosus*, were among priority programs with long term, self-sustaining financial mechanisms from CPPI's internal funding source. The adaptive conservation management approach employed by CPPI is a new model for a practical, science–based solution for species sustainability.

Keywords: Conservation breeding, Crocodile industry, *Crocodylus mindorensis, Crocodylus porosus*, Sustainable industry

Introduction

The crocodiles of the Philippines, *Crocodylus porosus* Schneider 1801 and *C. mindorensis* Schmidt 1935 are considered critically endangered, at least in Philippine wildlife listings, due to population reduction, habitat loss due to conversion for agriculture and development, and constant hunting through misconceptions of people living near crocodile habitats. Both species have suffered indiscriminate hunting for the skin trade that pushed the Philippine crocodile (*C. mindorensis*) towards imminent extinction in the early 1980s (Regoniel *et al.* 1994).

Crocodile conservation began in 1980 when Charles Andrew Ross met Dr. Angel C. Alcala in Silliman University (SU) in Dumaguete City. An investigation of the natural history and conservation of *C. mindorensis*, under the Smithsonian Institution/World Wildlife Fund (SI/WWF) Philippine Crocodile Project was initiated in cooperation with the Forest Research Institute in Los Baños, the Bureau of Forest Development, and SU. Ross and Alcala (1983) determined that the distribution of *C. mindorensis* at the time was limited, with just a few extant populations remaining in the wild. Population estimate placed the combined number of individuals in captivity and in the wild at 500 (Messel *et al*. 1992). Recent International Union for Conservation of Nature (IUCN) species assessment for *C. mindorensis* showed an inferred population size of 92–137 mature individuals in 2012, with continuing decline (van Weerd *et al*., 2016). The Indo-Pacific crocodile (*C. porosus*) was reported to be more widespread, with most extant populations in freshwater habitats and riverine mangrove forest (Ross 1984; Manalo *et al.,* 2016b) with majority observed on Mindanao and Palawan (Regoniel 1992).

Captive breeding efforts of the Philippine government, through the Department of Environment and Natural Resources (DENR), managed to mitigate the threat of extinction but were not sufficient to replenish the wild population (Ortega 1992). The foremost conservation breeding program for *C. mindorensis* was established in 1980 in Silliman University Environmental Center (SUEC). This program provided the first reproductive behavioral observations under captive conditions for this species (Ross 1982b). From 1987 to 1991, the Crocodile Farming Institute (CFI) acquired for its nucleus population a total of 135 individuals (Regoniel 1992). Captive breeding was believed to be the most practical and only management option at the time to conserve *C. mindorensis* (Ortega 1992). To address a perceived

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impending extinction crisis, the IUCN Species Survival Commission (SSC) Crocodile Specialist Group (CSG) supported the renewed effort to find viable populations of *C. porosus* on Palawan and Mindanao, and acquire *C. mindorensis* breeding stock, as a "safety net" for wild populations. This assurance colony was also maintained as a potential source of individuals for future release of crocodiles in sanctuaries (Messel *et al.* 1992).

In 1999, the Palawan Wildlife Rescue and Conservation Center (PWRCC)—known previously as RP-Japan Crocodile Farming Institute (CFI)—launched its commercial breeding program for *C. porosus* in the Philippines. The issuance of the DENR Department Administrative Order (DAO) No. 99-45, or "Rules and Regulations on the Sale and Farming of Saltwater Crocodile (*Crocodylus porosus*)" partly fulfilled one of its primary objectives "*to promote the socio-economic well-being of local communities through the development of a suitable farming technology*." The DAO facilitated the development of local capacity for crocodile farming through the transfer of technology generated by the CFI, promoted the conservation and sustainable use of *C. porosus*, ensured equitable-sharing of benefits derived from commercial crocodile farming, and laid the framework to generate revenue to sustain crocodile conservation activities in the Philippines. Following the issuance of this DAO, CFI subsequently received more than 200 applications for industrial crocodile farming in the country.

Of these applicants, six farms successfully passed the stringent selection process to become the first government-accredited commercial crocodile farms in the country (Mercado 2008). In 2000, the farmers organized to form the Crocodylus Porosus Philippines Inc. (CPPI), a non-profit, non-government organization, focused primarily on crocodile conservation. The members of CPPI legally acquired 3,900 juvenile *C. porosus* from the Philippine government CITES-registered facility to serve as founder stock. The DAO 99-45 provided the legal framework for utilizing this stock for industrial crocodile leather production, but it took six years before this innovative development of *C. porosus* closed-cycle farming industry became commercially viable (Manalo and Alcala 2013).

All progeny from this captive breeding program fulfilled CITES Appendix II which allows for international trade. However, CPPI's farming operation did not fully achieve sustainable use and conservation of crocodiles because it focused on animal husbandry and captive breeding and not on in-situ conservation due to less investment. Subsequently in 2006, CPPI member farms initiated interaction with the global crocodilian community and, as a result, began investing substantially in various conservation efforts (Mercado 2008). Webb (2013) reviewed these efforts positively stating that experimental and adaptive management employing new approaches was the best way forward.

This retrospective paper documents CPPI's involvement in sustainable ex-situ and in-situ crocodile management. We review these innovative conservation approaches primarily as they promoted sustainable crocodile conservation and management, and as participating entities and individuals have been mentored by Dr. Angel C. Alcala in his capacity as the Chairman of Crocodylus Porosus Philippines Inc. (CPPI).

Materials and Methods

Concepts and strategies developed through the collaborative guidance and mentorship of Dr. Angel C. Alcala and the late Charles Ross and which influenced CPPI's strategic conservation plan, were gathered and synthesized for this review. Information was sourced from IUCN guidelines (IUCN 1998; IUCN/SSC 2013), proceedings of the IUCN – CSG world crocodile conference (Ross 1984; Regoniel *et al.* 1994; Gonzales *et al.* 2013; Bucol *et al.* 2014; Manalo *et al.* 2016b), *Crocodylus porosus* Action Plan 2010 (Webb *et al.* 2010), *Crocodylus mindorensis* Action Plan 2010 (van Weerd 2010), SUEC research articles on Philippine crocodiles (Ross 1982b; Ross and Alcala 1983), SI/WWF Philippine Crocodile Project reports (Ross 1982a) and CFI annual accomplishment reports & unpublished reports (Messel *et al.* 1992; Ortega 1992; Regoniel 1992; Sumiller 2000; Manalo 2004).

The major conclusions of these studies were augmented with information from online articles including IUCN CSG (www.iucncsg.org) newsletters, Department of Environment and Natural Resources Biodiversity Management Bureau (DENR-BMB) E-Library (www.bmb.gov.ph/index.php/e-library) on laws and policies, and information collected from the CPPI database from April to June 2019. Outcomes of programs and projects were achieved in coordination with the DENR-BMB and concerned Local Government Units (LGUs).

All of the above sources were incorporated into CPPI's basic blueprint for supporting government conservation and research directives of the PWRCC. Recommendations from the IUCN Crocodile Specialist Group workshop (February 24–25, 1992; "Prospects and future strategies of crocodile conservation") for the two Philippine species were also incorporated in CPPI's General Plan of Action.

Results and Discussion

At the onset of CPPI's activities, crocodile conservation strategies in the Philippines had been straightforward: providing species protection through creation of sanctuaries, public

education, and removal of nuisance crocodiles. However, these efforts often resulted in unsustainable resource use and financial fatigue. As such, the CPPI General Plan of Action was implemented for long-term sustainable conservation practices.

Remodeling conservation perspectives

Six years into crocodile farming operations, Charles Ross together with Dr. Angel C. Alcala instigated a paradigm shift among the farmers towards species conservation. They convinced the farmers that the crocodile farming industry ought to share the responsibility of conserving and managing the wild crocodile populations. As proof of their commitment to support crocodile conservation, the farmers entered into a Memorandum of Agreement (MOA) with SU, the National Museum of the Philippines (NMP), and the City Veterinarian's Office of Manila to organize the first ever Forum on Crocodiles in the Philippines.

In 2007, the first Forum held at NMP's Museum of the Filipino People was considered a major turning point for CPPI. Representatives from national and international institutions gathered together for a three-day forum, for structured dialogue on the conservation of *C. mindorensis* and sustainable management of *C. porosus*. This sparked the beginning of nationwide collaborative program in the country.

The crocodile farmers realigned the commercial crocodile industry towards sustainable use and conservation, to serve as a species conservation catalyst. Caldwell (2017) noted that the crocodile farming industry in the Philippines contributed 17,111 *C. porosus* skins in direct commercial exports to international markets from 2006–2015. This economic contribution generated long-term financial mechanisms to fund *in-situ* conservation programs, firmly recognizing the industry's responsibility to the Filipino people and future generations. The crocodile farmers envisioned healthy human-crocodile coexistence through sustainable crocodile management and conservation efforts.

Twelve years after the first forum, a subsequent meeting, themed "*Strengthening Partnerships in Crocodile Research and Sustainable Management of Crocodiles in the Philippines*" was held (6–8 March 2019) at the University of the Philippines, Los Baños, Laguna. Dr. Alcala strongly encouraged all stakeholders to intensify their collaborations to sustain the future of crocodile management in the country. At this meeting, the need for strong collaboration among partner institutions was emphasized and the implementation of national programs was recognized as vital for wetland ecosystems and socio-cultural development. Notable experiences and practical knowledge in relation to both Indo-pacific and Philippine crocodile conservation were shared among ASEAN representatives. As a result, novel opportunities emerged and commitments were made formally, enabling interested parties to participate in conservation action, targeting both species present in the Philippines.

Conservation introduction program

Parallel to the primary objectives of the PWRCC, the CPPI opened its facility to host the conservation breeding of *C. mindorensis* in a semi-wild setting. Two breeding adults (from SU, received in April 2006) and ten sub-adults (from PWRCC, in January 2007) were transferred to the newly-built semi-wild enclosure at the Pag-asa Farm facility of J.K. Mercado & Sons Agricultural Enterprises Inc. (JKMSAEI) in Kapalong, Davao Del Norte. This semi-wild facility was conceived as part of a tripartite crocodile conservation partnership among DENR, SU, and JKMSAEI.

All individual crocodiles were kept in a communal enclosure with a waterlogged area and natural trees. Dr. Alcala advised against supplemental feeding and for reduced interactions with humans. Thus, animals were allowed to independently function in near-pristine, enclosed, semi-natural habitat, with disturbance minimized; movements were monitored by CCTV camera. The first progeny emerged from a naturally-incubated nest in 2009, and breeding has continued with reduced breeding aggression compared to CFI's previous reports from a space-limited enclosure (Elsey *et al*. 1990; Sumiller 2000). A total of 73 crocodiles successfully hatched between 2009 and 2018. Shared nesting mound use was documented, and is believed to involve three different females (Cruz *et al.* 2012). Progeny from this breeding colony were slated for a new introduction program, on Siargao Island in Surigao del Norte.

In 2010, the Siargao Island Philippine Crocodile Conservation Introduction Project, inspired by Dr. Alcala, was launched with the sustained support from CPPI. Documentation of biological and social feasibility of the program, regulatory compliance, and habitat risk assessment were conducted from 2011 to 2013, in compliance with Republic Act 9147 "Implementing Rules and Regulations" (Section 12). All management activities also followed IUCN's "Guidelines for Re -introductions" (1998), and IUCN/SSC's "Guidelines for Reintroductions and Other Conservation Translocations" (2013; ver.1.0).

Thirty-six juvenile *C. mindorensis*, bred and reared in the semi-natural facility, were released in Paghungawan Marsh, Siargao Island Protected Landscape and Seascape (SIPLAS) in 2013 (Manalo *et al.* 2016a), regarded by the Philippine government as a well-organized crocodile conservation introduction action (Manalo and Alcala 2015). Subsequent to the introduction, the Protected Area Management Board (PAMB) issued a resolution supporting the delineation of the marsh as a

Strict Protection Zone (PAMB Res. No. 2013 – 23). Likewise, upon the integration of Community-based Sustainable Ecotourism, the local government unit of Pilar, Surigao del Norte issued Municipal Resolution No. 67, series of 2015:"*Declaring the month of May as crocodile conservation month in the municipality of Pilar, Surigao del Norte*" and Municipal Resolution No. 70, series of 2015: "*Requesting CPPI to conduct supplemental release of* C. mindorensis *in Paghungawan Marsh*." Thus in 2017, an additional 29 juvenile *C. mindorensis* were released.

The release program marked a major boost to the realization of *C. mindorensis* conservation in the country. Social acceptance of this kind of activity had often previously been perceived as an insurmountable hurdle. The PWRCC experience, while attempting re-introduction on Palawan and in Agusan Marsh met numerous challenges, the most substantial of which was a lack of resident community acceptance, which eventually led to suspension of the program. The Siargao experience, however, was quite the opposite, because it came with potential sustainable benefit to local community, through the enhancement of their ecotourism activities. The local group operating crocodile tours was capacitated for operational management of sustainable ecotourism, deputized as Wildlife Enforcement Officers, and trained to track animals with caution and skill. With installation of radio-telemetric devices on some crocodiles, CPPI engaged the community in citizen science, empowering residents to monitor the population themselves.

Fishery productivity

Providing tangible evidence of crocodilian function as keystone species was of primary concern to Dr. Alcala. The most commonly known ecological role of crocodiles included important nutrient recycling in aquatic ecosystems, making these ecosystems productive for fish and other animals recognized as sources of food for humans. Fittkau (1970) first hypothesized this role when noting a dramatic decline in caiman population in the Amazon, which subsequently coincided with the disappearance of fish populations.

Together with monitoring of introduced *C. mindorensis* in Paghungawan Marsh in 2013, a study was conducted to determine the effect of crocodiles on local fish productivity. Catch composition and catch-per-unit effort (CPUE) were compared in places with, and without, existing crocodile populations. Bucol *et al.* (2014) observed that CPUE was higher in areas inhabited by crocodiles than those without and concluded that these values were not likely affected by primary aquatic productivity. They interpreted increased catch as largely due to reduced fishing pressure from humans in the presence of crocodiles; thus, crocodiles may act as deterrents, and thereby create a veritable fish sanctuary. Gonzales *et al*. (2013) witnessed a similar account in Agusan Marsh, in which Manobo people regarded the crocodile habitat as a fish sanctuary—akin to a natural assurance population of healthy fish stocks which should be protected to sustain their fishing practices. These findings support that sustainable local fishery could result from wetland ecosystem and crocodile conservation.

Status and population estimate of C. porosus

The Philippine populations of Indo-Pacific crocodiles are listed under CITES Appendix I, and treated as Least Concern (LC) in the IUCN Red List of Threatened Species assessment (IUCN 1996). In the more recent IUCN Crocodile Specialist Group Red List assessment (2019; as yet unpublished), the global wild population was estimated in excess of 400,000 non-hatchlings and is treated as secure (LC). However, a provision of the DENR DAO 2004-15 (Section 2A) states that all species listed under CITES Appendix I are treated by the Philippine government as Critically Endangered (CR) under the Philippine Wildlife Resources Conservation and Protection Act of 2001. Wild Philippine populations of *C. porosus* were comparatively less studied which likely led to the government's precautionary measures.

Records of remaining wild *C. porosus* appear to be fragmented; they are recorded as single individuals, or small groups of individuals, usually from areas less densely populated by humans or from more pristine wetlands (Ross 1982b, 1998; Regoniel *et al.* 1994; Brown *et al*., 2013). In some wetland habitats especially in Mindanao and Palawan, *C. porosus* were found in exceedingly low numbers (Messel *et al.* 1992). Resident communities have been documented intentionally killing crocodiles perceived as pests, or accidentally caught in fishing nets when agricultural encroachment reduced remaining natural habitat (Manalo 2004). Yet, despite very few remaining individuals in southern Palawan, crocodile attacks still have still been reported (Webb *et al.* 2010). Although crocodiles in these localities were regarded previously as "abundant," no estimates of local population size are available.

In 2014, Dr. Alcala encouraged DENR–BMB to support a nationwide census of *C. porosus*. To complement government initiatives, CPPI spearheaded the effort to establish population estimates of *C. porosus* in southern Palawan. Manalo *et al.* (2016b) yielded an overall average relative density of 0.47 individuals/km^2 at a detection probability of 37.38%, which translates to an estimated population of 346 individuals; the small islands of Balabac had higher densities (0.75 individuals/ km^2) than mainland Palawan (0.09 individuals/km^2). In 2018, a population survey for non-hatchlings revealed an average relative density of 0.39 individuals/km^2 at a detection

probability of 44.11% — translating to an estimated population of 425 individuals. High human pressure on habitats in southern Palawan may result in increased human-crocodile conflicts (HCC); Corvera *et al.* (2017) noted 20 of 26 cases (77%) of Philippine HCC (2000–2015) in this region. Persecution by humans, mangrove disturbance, or habitat conversion for agricultural purposes were interpreted as stressors of this population, possibly triggering HCCs (Corvera *et al.* (2017).

New data suggest that the southern Palawan population is higher than previously assumed (Manalo *et al*. 2016b), and that causes for decline—due to negative public attitudes towards crocodiles, human-crocodile interactions, and habitat conversion—were clearly understood. The implementation of sustainable use models focusing on incentivizing communities should enable coexistence and possibly reverses declines in this wild population. Combining the estimated, inferred, and projected population estimates in other parts of the Philippines (Palawan, Ligwasan Marsh, Sulu Archipelago, and other parts of Mindanao), a conservative estimate suggests not less than 1,000 mature individuals still remained in the wild—which could potentially justify conservation status downgrading.

Conclusions and Recommendation

Crocodile farming industry is a non-traditional but potentially lucrative commercial industry in the Philippines. Crocodile conservation, on the other hand, is a challenge requiring costly and strategic action. CPPI's General Plan of Action contains a self-sustaining mechanism which could provide financial support for long-term conservation in collaboration with the Philippine government. CPPI's commitment to crocodile conservation through sustainable use and conservation management is primarily motivated by the protection and conservation of its main resource, the Indo-Pacific crocodile.

For more than a decade of project implementation aligned with government plans, CPPI has been a conservation catalyst with capacity to ensure its funding stability. The provisions of annual mandatory members contributions, levy on the sales of exported raw crocodile skins, corporate partner donations, and crocodile farm logistical support for fieldworks are among the foremost sources of CPPI's internal funds. A portion of revenue generated from commercial farming are reserved for conservation action involving the remaining wild populations of the endemic *C. mindorensis*. CPPI's budget over the last decade has contributed approximately US$500,000 to field operations in southern Philippines which has been fundamental to species conservation. This amount is on top of the industry's contribution to national government revenue, through remittance of mandatory 3% of crocodile skin export value necessary for CITES permitting. By directly obtaining industry support, financial sustainability—the often-missing ingredient necessary for species conservation—can be secured. This adaptive conservation management approach employed by CPPI represents a new model for science-based, practical solutions for species survival in the Philippines.

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