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Binturong *Arctictis binturong* conservation: the relationship between the zoo community and ABConservation for an integrated conservation programme in Palawan, Philippines

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Zoological institutions play an ever-greater role in awareness of biodiversity and are increasingly involved in conservation initiatives. The Binturong *Arctictis binturong* is an elusive and poorly known carnivore of the family Viverridae, found in South East Asian ecosystems. This species, affected by diverse human-related threat processes, is listed as Vulnerable on the International Union for Conservation of Nature Red List. This paper reports on the collaborative efforts involving the Binturong European Endangered Species Programme, the French non-governmental organization ABCconservation, the European Association of Zoos and Aquaria, the zoo community and researchers at the Muséum National d'Histoire Naturelle, Paris (France), all aimed at the conservation of Binturongs. The resulting multidisciplinary initiatives allow the development of an integrated conservation programme for this species in Palawan (Philippines), including community awareness, education programmes, research projects and empowerment of range communities in nature conservancy. Zoos contributed significantly to the development of the field initiatives of ABCconservation. Participation of zoos in field programmes for conservation is beneficial for both parties, because zoos support conservation through funding, raising awareness and expertise, and at the same time they acquire increased knowledge about the species they have in their care, and gain relevance in defining their role and missions.

Key-words: binturong; collaboration; community awareness; conservation; conservation education; field research; One Plan approach; Palawan; zoo community.

INTRODUCTION

The missions of zoological institutions have evolved in the recent decades. Facing the loss of biodiversity and what is called the sixth mass extinction (Ceballos *et al.*, 2017), there is a stronger need to focus on conservation efforts. The United Nations Convention on Biological Diversity (CBD) in its *Strategic Plan for Biodiversity 2011–2020* has defined goals known as Aichi Biodiversity Targets (<https://www.cbd.int/sp/targets>) (CBD, 2010). Increasingly zoos aim to be dedicated to these goals (Gusset *et al.*, 2014; Conde *et al.*, 2015; Moss *et al.*, 2015; Olive & Jansen, 2017).

The World Association of Zoos and Aquariums (WAZA) members distributed worldwide over more than 1300 linked institutions represent a great capacity for conservation support through a variety of actions, from threatened species breeding programmes to fundraising and conservation education (Miller *et al.*, 2004; Barongi *et al.*, 2015). Zoos are thus well placed to use a wide spectrum of activities to promote conservation and to broaden their

involvement in *in situ* projects. Collaboration with field-based organizations can improve conservation efforts in focusing on more effective actions on the ground (Hutchins & Conway, 1995; IUCN/SSC, 2014; Barongi *et al.*, 2015). Furthermore, conservation-leading zoological institutions tend to be integrated into a more global strategy to preserve threatened species and habitats. They work beyond the former distinctions between *in situ* and *ex situ*. This new and emergent mindset is the One Plan approach which supports a continuum that bridges *ex situ* and wild populations through the joint development of management strategies and conservation actions by all responsible parties to produce one comprehensive conservation plan for the species (Redford *et al.*, 2012, 2013; Byers *et al.*, 2013). Given this challenge, conservation requires the collaboration between multiple stakeholders and multidisciplinary programmes that integrate scientific and educational approaches (Robert *et al.*, 2007; Ariefiandy *et al.*, 2015).

This paper reports the current multidisciplinary initiatives aimed at the conservation of an elusive yet threatened small carnivore, the Binturong *Arctictis binturong* (Raffles, 1821). We highlight the links between the diverse protagonists, the synergy of their combined actions from community awareness and genetic surveys to fundraising and empowerment of range communities in nature conservancy. These collaborative efforts involve the European Endangered Species Programme [EEP: now the European Association of Zoos and Aquaria (EAZA) Ex situ Programme], the zoo community, the French non-governmental organization (NGO) ABConservation and researchers from the Museum National d'Histoire Naturelle (MNHN), Paris (France).

THREATS AND CONSERVATION STATUS

The Binturong is one of the largest members of the family Viverridae, found in South East Asian ecosystems (Plate 1). This

species is part of the Paradoxurinae subfamily where it is the only representative of the *Arctictis* genus. The Binturong is predominantly frugivorous and thought to be an important seed disperser (Jennings & Veron, 2009).

Binturongs have been affected by diverse human-related threat processes in past decades. Their populations are declining and thought to reach national extinction in some countries (Willcox *et al.*, 2016). The main causes of this decline are the extension of illegal trade, hunting and poaching for meat or traditional medicine, the use in civet coffee farms or the pet trade on the black market facilitated by the use of the social media (e.g. Facebook), as well as massive deforestation (Schreiber *et al.*, 1989; Duckworth *et al.*, 1999; Corlett, 2007; Robertson, 2007; Chutipong *et al.*, 2014; D'Cruze *et al.*, 2014; Krishnasamy & Stoner, 2016; Willcox *et al.*, 2016; Gray *et al.*, 2017).

The Binturong, as an arboreal species, is strongly impacted by gradual destruction of its natural habitat as a result of fast human development in South East Asia and agricultural expansion for palm oil, rubber trees and teak. This threatened species is listed on Appendix III of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and considered Vulnerable according to the International Union for Conservation of Nature (IUCN) Red List (Willcox *et al.*, 2016). The regulatory measures are not homogeneous in South East Asian countries. Poor law enforcement and low levels of prosecution across the Binturong's range may be worsened by an inadequate scientific knowledge about the species. This lack of legal consideration impedes conservation efforts (Nabhitabhata & Chan-ard, 2005; Lynam *et al.*, 2006; Shepherd, 2008).

BREEDING PROGRAMME AND GENETICS

The European studbook for Binturongs was initiated in 1997 and has been coordinated by A. Bourgeois since 2013. In 2016 the



Plate 1. A Binturong *Arctictis binturong* from the Palawan Wildlife Rescue and Conservation Center (PWRCC). *ABConservation*.

studbook was upgraded to an EEP. At the end of 2018, 132 Binturongs [67.65 (♂♂.♀♀)] were maintained at 57 European institutions. This *ex situ* conservation programme faces a major genetic challenge: the pedigree is plagued with missing or unknown parentage (more than 70%), which makes pedigree analysis useless and hampers conservation of genetic diversity (Oliehoek & Bijma, 2009).

Genetic investigation is an essential tool for an increasing number of breeding programmes. It has revealed to be particularly so for the Binturong EEP. The most recent studies on systematics and biogeography of Binturongs (Cosson *et al.*, 2007; Veron *et al.*, 2020) have been conducted by G. Veron, who is also a member of the IUCN Small Carnivore Specialist Group. The exchanges of information, clarifications and discussions about the needs and results of these studies are facilitated by the geographical proximity of the EEP species coordinator and the genetic research team.

According to Cosson *et al.* (2007), up to nine subspecies of Binturongs have been described, but only two main lineages were obtained using genetic data. However, those results came essentially from captive animals and needed to be

confirmed. The multiple subspecies possibilities add a veil of complexity to the management of the European *ex situ* population of Binturong of mainly unknown origin. A lack of taxonomic determination might lead to further inadvertent hybridization in the future. On account of the known origins of some animals and the results of the study of Cosson *et al.* (2007) and Veron *et al.* (2020), it appears that several lineages are represented in the studbook, but lineages might have not always been managed separately.

The EEP has the dilemma of whether to combine animals from unknown and/or different origins without regards to the taxonomic issues or to manage the populations from separate geographical origins independently. The first option may remove the conservation value of the EEP population, which would lose any insurance population role. It would also lead to a redefinition of the role of the EEP, which would become more orientated towards education and as an awareness programme. The Binturongs from the EEP would act as ambassadors to address specific threats or constraints to the conservation of the species or its habitat (IUCN/SSC, 2014). The second option of managing all the lineages separately would lead to an

inbreeding depression and poor gene diversity (Edmands, 2007; Senn *et al.*, 2014).

The utility of subspecies to conservation has been discussed among scientific community because subspecies boundaries have sometimes been contradicted by molecular phylogenetic data. The scientific community has defined Evolutionary Significant Units (ESUs) that are of considerable conservation utility (Moritz, 1994; Phillimore & Owens, 2006; Gippoliti & Amori, 2007). The Cosson *et al.* (2007) study, based on control-region sequences, suggested the presence of a main divergence between the Indochinese and Sundaic regions, and helped in defining the ESUs that deserved to be considered important conservation units. The results of that study have orientated the breeding and transfer recommendations from the Binturong EEP.

Another challenge for the EEP is related to the importation of Binturongs from Asia by European institutions adding more complexity to the subspecies issue and raising the ethical question of importing animals of uncertain origin with the risk of contributing to the illegal wildlife trade. Some of these imported Binturongs originated from Palawan. Systematics of the Palawan Binturong presents a thorny subject. Populations on islands should diverge at a faster rate than their continental-dwelling counterparts (Phillimore & Owens, 2006). Whether the Binturong from Palawan is a full species (Allen, 1910; Taylor, 1934; Goodwin, 1953), a subspecies (Pocock, 1933) or not distant from other Binturongs (Oustalet, 1901) has been discussed among taxonomists. The most recent study on Binturong systematics demonstrated that the Palawan Binturongs are genetically very close to Bornean Binturongs but constitute a monophyletic group, which dispersed from Borneo a long time ago (Veron *et al.*, 2020). Palawan Binturongs may thus represent an important conservation entity that suffers from anthropogenic pressures on its population and habitat. Conservation attention is essential and is of fundamental relevance. Both studies on Binturong taxonomy from the

MNHN provide important outcomes for the management of the EEP as well as for prioritizing *in situ* conservation actions (Cosson *et al.*, 2007; Veron *et al.*, 2020).

ABCONSERVATION

Created on 8 July 2014, ABConservation is a non-profit organization (as per French Law, 1901), with a head office in Paris (France). The NGO is committed to generating, sharing and applying scientific knowledge aimed at the conservation of the Binturong. ABConservation works to create public awareness, to carry out *ex situ* and *in situ* studies on biology and ecology, and to collect and disseminate information on the Binturong. The organization was initiated by P. Kayser, a zoo keeper at La Ménagerie du Jardin des Plantes (Paris, France). The EEP Binturong coordinator and P. Kayser are in daily contact through their work at the same institution. Two volunteers work full time for ABConservation on its field project in the Philippines, including A. Debrulle, the scientific officer and co-president who has completed her masters and veterinary degrees working on Binturongs beside the EEP species coordinator. ABConservation, the EEP species coordinator and G. Veron regularly interact, and have established a system of teamwork that is an effective tool to emulate for the conservation of Binturongs.

ZOO COMMUNITY ENGAGEMENT

An essential component of the synergy for conservation of Binturong is the involvement of the zoo community, which participates through a variety of activities ranging from fundraising to the supply of expertise and public-awareness programmes. Zoological facilities have played a significant role in the mindset of ABConservation as its forewoman and originator stems from the zoo community (i.e. a keeper).

ABConservation attends every important European zoo conference, such as the EAZA annual conference, EAZA

Conservation Forum and EAZA Small Carnivore Tag Meetings. Through these meetings, the NGO expands its network, shares its advances in the field study of Binturong in Palawan and continues its capacity building through the expertise of zoo professionals. The international zoo community has imparted significant support to ABConservation, not only through funding support but also through knowledge transfer on conservation education, studying animal behaviour, designing a research study, technical expertise and construction skills.

Participation in research

Field-based organizations can benefit from research conducted at zoo facilities and research carried out in the field can in turn contribute to better management of *ex situ* breeding programmes by improving welfare, nutrition and/or husbandry (Barongi *et al.*, 2015). ABConservation solicited zoological institutions to start a study on Binturong morphology. Clear differences in size, weight and fur in Binturongs have often been observed in zoos, and these have given rise to discussions about a possible link between a morphological characteristic and belonging to a subspecies. Questions about pair compatibility are consequently emerging from these observations. Thus, these studies aim to measure the disparity of Binturong morphology and to link it to the different bloodlines or subspecies. The data are collected in institutions across the world through a simple survey. At the time of writing, 20 zoos and two rescue-centre institutions have completed the questionnaire. Data are still being collected and every interested zoo can participate.

Public awareness

One of the decisive goals of the United Nations *Strategic Plan for Biodiversity 2011–2020* is that ‘by 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably’ (i.e. Aichi

Biodiversity Target 1) (CBD, 2010). The intention of this first target is to raise awareness (in local communities, organizations and governments) about the loss of biodiversity the world is facing and the drivers for change that have been established to protect that biodiversity. With over 700 million visits to zoos and aquariums worldwide every year (Gusset & Dick, 2011), zoological institutions play an important role in striving to achieve this first target (Moss *et al.*, 2015). Several studies emphasize the supportive action of zoos and aquariums to increasing the number of people who understand biodiversity and know what actions they can take to protect it (Falk *et al.*, 2007; Barongi *et al.*, 2015; Moss *et al.*, 2015; Clayton *et al.*, 2017). An attachment to animals is critical to foster reconnection with nature and to encourage pro-environmental behaviours. Animals in zoological institutions play a role as flagship species acting as ambassadors for the conservation of biodiversity (Colléony *et al.*, 2017; Grajal *et al.*, 2017). However, people are naturally prone to connect with some charismatic species independently of their conservation status or their ecological role. This tendency, if expanded to research and conservation, might interfere with the survival chances of many species regarded as less attractive (Colléony *et al.*, 2017). An awareness programme on Binturongs should aim at rendering it more appealing to the public and favour the inception of a sense of connection to these unusual animals. Such education and communication strategies aspire to empower the zoo audience to participate in conservation efforts (Grajal *et al.*, 2017). Pursuant to this strategy, World Binturong Day was launched in 2014 by ABConservation to promote the visibility of Binturongs and to ameliorate their perception by the public. Six World Binturong Days have taken place with increasing participation by zoos and other organizations every year. World Binturong Day takes place on the second Saturday of May, and global zoos, rescue centres and localities in range

countries all participate. A variety of initiatives are undertaken: for example, educational meeting events with animal-care staff, provision of educational toolkits (panels, booklets and brochures), workshops and school contests, quizzes, games and other activities. A focus on children is implemented with various activities, such as mask-making, colouring, display of enrichment devices and face-painting sessions. ABConservation relays the World Binturong Day events and spreads knowledge about Binturongs on the Web (<http://abconervation.org>), in its Newsletter and through social-media outlets (e.g. Facebook, Instagram, Twitter).

ABConservation also intervenes with timely events in zoos holding workshops and conferences in order to raise awareness about the Binturong work being carried out and the conservation of this species. These events provide the public with better insight into the realities of working in the field and conservation actions.

The collaboration between zoos and an organization such as ABConservation that actively works in the field, ensures that an accurate and up-to-date message is provided to zoo audiences. It not only creates emotional connections between visitors and Binturongs but it also gives the impression of closeness and of a more effective involvement in field-conservation actions.

Funding

Another important aspect of collaboration between zoos and field-conservation projects is fundraising. As an illustration of the potential for zoos to contribute financially to conservation, WAZA-member institutions spend over US\$ 350 million on wildlife conservation every year. This substantial amount places the collective effort of zoos at the third highest ranking of non-governmental contributors to global conservation (Gusset & Dick, 2010; Barongi *et al.*, 2015). Over the last 5 years, ABConservation has received Euros 63 500 to fund its *in situ* research and conservation

programme. The contribution from the zoo community represents 63% of the operational budget. This participation is growing and in 2019 the proportion of the operational budget contributed by zoos was 80%. The financial support from donors and sponsors has allowed this NGO to reach satisfactory financial statement objectives so far. However, the diversification of *in situ* initiatives and the high technical necessities required to continue the research programme will lead to significant increased expenses and further financial involvement from donors is greatly needed.

IN SITU CONSERVATION INITIATIVES

Palawan is an important conservation area for Binturongs (Veron *et al.*, 2020). ABConservation selected this island to initiate a long-term protection process which integrates conservation education, community-orientated programmes, research and exchange of knowledge, and expertise.

A scientific approach: Bearcat Study Program

The Bearcat Study Program was initiated in 2016 by ABConservation, in order to improve knowledge about the ecology and behaviour of the Binturong of Palawan, which had never been studied. At the start of the programme, regular trips were made to the Philippines to meet local government organizations and forge key partnerships. In 2017, a research permit was issued by the Palawan Council For Sustainable Development and Memoranda of Agreements were drawn up with the City Environment & Natural Resources Office (City ENRO), the City Government of Puerto Princesa and the local government of Langogan. Preliminary visits to several forest regions made it possible to interview range inhabitants about the presence of Binturongs and to locate a suitable study area in Barangay Langogan, in the Municipality of Puerto Princesa, on the east coast of the island. As

the Binturong is an arboreal and nocturnal species, observations in the wild are scarce (Chutipong *et al.*, 2014; Semiadi *et al.*, 2016). Passive infrared camera trapping was selected as the method of choice for the head-starting programme. Studies on Asian wild-animal populations primarily use camera traps set up on the ground, which can explain why photographs of Binturongs are rare (Chutipong *et al.*, 2014; Semiadi *et al.*, 2016). In order to increase the chances of taking photographs of Binturongs, 20 camera traps were set up in the canopy up to 20 m high, in 15 different locations. To date, 63 photographs of Binturongs, representing 41 different events, were caught in 2973 trap nights. This is the highest detection rate of Binturongs by camera traps. This study also collected photographs of five other mammal species, including the endemic Philippine pangolin *Manis culionensis*, and 14 species of birds including some rare endemic bird species; for example, Palawan hornbill *Anhracoceros marchei* and Great slaty woodpecker *Mulleripicus pulverulentus*. Building on this success, in 2019 an additional study site was selected in El Nido (north of the island). At this stage, a key step of the field-based programme is the establishment of a Memorandum of Agreement with the local authorities City ENRO for ABConservation to act as consultant and collaborator for the management plan of the natural reserve of Cleopatra's Needle Critical Habitat. As an essential part of the study, ABConservation has heavily invested with local people. A transfer of technical knowledge has been undertaken to enable the long-term monitoring of Binturongs by two local guides, who are employed by the NGO.

The next step in the study with camera traps will be to investigate population density. A better understanding of the ecology, feeding habits and behaviour of Binturongs will lead to the concurrent implementation of an intensive survey using telemetry techniques. Several trials were carried out with Binturongs at the Palawan Wildlife Rescue

and Conservation Center (PWRCC) to make adjustments to a collar design specifically developed for the Binturongs in Palawan by a wildlife tracking company (Wildspy©). The results of the population-density study will provide the data necessary to assess the relevance of population reinforcement. The local authorities would like to release Binturongs that they have confiscated from the illegal wildlife trade or private ownership, or those in rescue centres. However, some animals are not fit for release but might become founders for an *ex situ* breeding programme aimed at providing individuals for population reinforcement. Zoos have considerable expertise in population management, which could helpfully be applied to conservation efforts for the Binturong in Palawan.

Local partnerships

Field-based conservation projects build their success on long-term cooperation with *in situ* stakeholders, and this requires strong bilateral involvement. As a result of ABConservation's commitment with local partners, several satellite projects have been developed in Palawan. A collaboration with Sabuya Coffee Trading (Puerto Princesa, Philippines), a cooperative producer of wild-civet coffee, promotes the production of coffee without the exploitation of captive animals. The company benefits from the natural visitations of wild Binturongs and Philippines palm civets *Paradoxurus philippinensis* for the production of partially digested coffee cherries that can then be collected. In general, such coffee production requires intensive farming and exploitation of wild civets kept in captivity.

ABConservation has also established a collaboration with Rurungan Sa Tubod Foundation (Puerto Princesa, Philippines), a rural community of women creating products, such as fabric made from pineapple fibre, which are sold for the benefit of the Bearcat Study Program.

As the only NGO dedicated to the Binturong, rescue centres increasingly contact

ABCConservation for its expertise. A major achievement of local partnership is the cooperation with PWRCC, located in the Barangay of Irawan, south of Puerto Princesa City. Established in 1987, PWRCC historically focused on crocodile conservation and sustainable development through the farming of two native species of crocodiles (see Manalo & Alcala, 2015). Progressively the institution became the unique rescue centre for wildlife in Palawan and opened to the public for guided tours. The Center maintains Binturongs, rescued mainly from the illegal pet trade, that cannot be released. The partnership between PWRCC and ABCConservation encompasses numerous activities, including the testing of radio collars on Binturongs, the transfer of knowledge and expertise to the staff at the Center about husbandry, enrichment, enclosure building, improvement of the rehabilitation, quarantine and veterinary facilities, development of an educational programme and the involvement of volunteers. This collaboration aims to expand skills and ensure the development of an efficient infrastructure designed for conservation.

Conservation education

A key challenge to ensure the success of Binturong conservation is to raise awareness in the local community. Bringing conservation education to range communities involves imparting knowledge about Binturongs living in the adjacent environment, particularly to advocate the importance of the sustainable use of nature and habitat protection. These campaigns aim to encourage cooperation, mobilize support and promote conservation actions (Rao & Ginsberg, 2010). ABCConservation has developed community-orientated programmes targeted at rural communities who are encouraged to reconnect with the range species and habitat in their regions through celebrations such as World Binturong Day, or attendance at local conferences and workshops. ABCConservation also provides activities for children in schools, such as

painting, games or quizzes. These intensive educational programmes are long-term initiatives; therefore, individual actions in schools are not sufficient to sustain conservation education. A new project has been launched, called 'From Awareness to Actions for Nature Conservation'. Memoranda of Agreements have been signed with three universities in Palawan: Western Philippines University, the Palawan State University and the Holy State University. These partnerships will develop teacher-training sessions to enhance the teaching of a sensitivity to nature and the environment in schools, and provide the teachers with the tools they need to create educational programmes about wildlife and the importance of respect for natural habitats. Students interested in conservation will also have the opportunity to gain experience by working with the NGO through different internship opportunities; for example, participating in radiotracking studies or the analysis of photographs taken by camera traps during the Bearcat Study Program, being involved in environmental-awareness sessions for schoolchildren or during World Binturong Day.

CONCLUSION

Comprehensive conservation programmes usually encompass a diverse range of initiatives including awareness campaigns, research projects and education programmes. Collaboration between different stakeholders and a multidisciplinary approach are crucial for building success. Here, the link between different parties combining their efforts towards a mutually reinforcing tool aimed at the conservation of the Binturong is emphasized. This undertaking of the integrated conservation of an unfamiliar species emanates from the MNHN, a scientific institution from which the key stakeholders (researcher, NGO founder, EEP coordinator) all originate. The contribution of the zoo community is an integral component of this synergetic interaction. Participation of zoos in field

programmes for conservation is essential if they are going to meet the requirements of the One Plan approach. This involvement is beneficial all round: zoos support conservation through funding, awareness and expertise, and they acquire increased knowledge about the species in their care, and gain relevance in defining the role and mission of their institutions.

ABCConservation is a young NGO with some great achievements. It draws its strength from partnerships and collaborations, which facilitate the enhancement of skills. The NGO engages with communities and industry to raise awareness and provide effective protection for the Binturong. The integration of nature protection into the cultural context of Palawan should be improved when local people gain employment as guides and research assistants within the Programme.

The genetic investigations and the Bearcat Study Program are ambitious research projects that should provide a better understanding of the genetics, ecology, physiology and behaviour of this little-known species. It is hoped that this knowledge will contribute to the development of an appropriate conservation action plan along with improved animal husbandry, health and welfare for the *ex situ* breeding programme.

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PRODUCT MENTIONED IN THE TEXT

Wildspy©: telemetry collars, manufactured by Wild Spy Pty Ltd, Banyo, QLD, Australia.

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