July 2019 | Number 2

BULLetin

Newsletter of the IUCN/SSC Asian Wild Cattle Specialist Group

IUCN

SSC
Species Survival Commission

AWCSG
Asian Wild Cattle Specialist Group

BULLetin

Journal of the Asian Wild Cattle Specialist Group

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Cover Photo

Tamaraw in Mts Iglit-Baco Natural Park, Mindor, Philippines. ©Jezryl Jaeger Garcia / MBCFI

Asian Wild Cattle Specialist Group

TABLE OF CONTENTS

Editor's note

by Stuart Young, Programme Officer, IUCN SSC Asian Wild Cattle Specialist Group

Welcome to the second issue of *BULLetin*, the newsletter of the IUCN SSC Asian Wild Cattle Specialist Group (AWCSG). In *BULLetin*, we present novel research on the ecology and conservation of all Asian wild cattle species, as well as sharing stories about all activities of conservation interest involving Asian wild cattle.

This issue highlights the One Plan Approach that we take to Asian wild cattle conservation, showcasing research from both field and *ex situ* activities. Here, we have a report from field verification surveys of Critically Endangered tamaraw (*Bubalus mindorensis*) in Mindoro, as well as a report of zoo-based research on using non-invasive hormonal assays to monitor the reproductive cycle in captive banteng (*Bos javanicus*). These reports and research will provide crucial information to help monitor and manage the wild and captive populations of these species.

We also have updates from meetings earlier this year in Indonesia and the Philippines as the Action Indonesia Global Species Management Plans (GSMPs) for anoa, banteng and babirusa and the Tamaraw Conservation and Management Action Plan (TCMAP) both move forward. The developing TCMAP was recently featured in a Mongabay article (https://news.mongabay.com/2019/07/the-ambitious-plan-to-recover-and-rewild-the-feisty-dwarf-cow/)

There is also news about Action Indonesia Day. This day of awareness raising is an initiative of the Action Indonesia GSMPs Education Working Group. The aim of this day is to raise awareness about banteng, anoa and babirusa—no doubt well known species to the people reading this but little known and underappreciated by the general public (unbelievable, I know!). This day hopes to change that, and will hopefully increase conservation support for these threatened species. Please save the date and join us for this on August 18th!

The third issue of *BULLetin* will come at the end of the year. We are keen to hear from you if you would like to contribute—this could be a novel research article, an update from the field, an update on your work or just about anything else relating to Asian wild cattle. Please get in touch via social media or contact me at s.young@chesterzoo.org.

Please keep up to date with our activities and other news relating to Asian wild cattle on our website (www.asianwildcattle.org) and social media (Facebook: IUCN Asian Wild Cattle Specialist Group, Twitter: @IUCN_WildCattle and Instagram: @iucn_wildcattle). We hope you enjoy this issue, and look forward to hearing from you.

Specialist Group Update

by James Burton, Chair, IUCN SSC Asian Wild Cattle Specialist Group

In March the AWCSG held meetings with senior Philippine government officials to discuss the completion of the Tamaraw Conservation and Management Plan (TCMAP), following the PHVA workshop in December. James Burton, Manu Schütz of the D'Aboville Foundation, and June Pineda from the Tamaraw Conservation Programme had meetings with the assistant director of the Biodiversity Management Bureau, Armida P. Andres and regional executive director (MIMAROPA Region) Henry A. Adornado. We also met with long-term Tamaraw supporters Josie de Leon and Anson Tagtag of the Biodiversity Management Bureau. The discussions were very positive, providing hope that the Plan will be endorsed by these offices and an effective coordinating body will be set up to ensure that the implementation of activities occurs. Achieving these next steps will be critical once the Plan is published in the coming months. We are working as part of the TCMAP editing team to complete a comprehensive plan to reflect the agreed actions from the workshop.

In Indonesia in March there were important discussions about the future partnership of the Global Species Management Plan for Banteng, Anoa, Babirusa and Sumatran tiger. This collaboration involves *in situ* and *ex situ* conservation of these four species with many international partners. The Indonesian Ministry of Environment and Forestry and the Indonesian Zoo and Aquarium Association shared their positive interest to continue the partnership with a new agreement for the period 2019-2024. In the Ministry we met with the Director Biodiversity Conservation, Drh. Indra Exploitasia as well as members of her team who are involved with the GSMPs. They are key partners for this work to be supported and effectively implemented in Indonesia. The next step is drafting an MOU, to be shared and agreed by the seven signatories. The AWCSG will be leading this strategic phase.

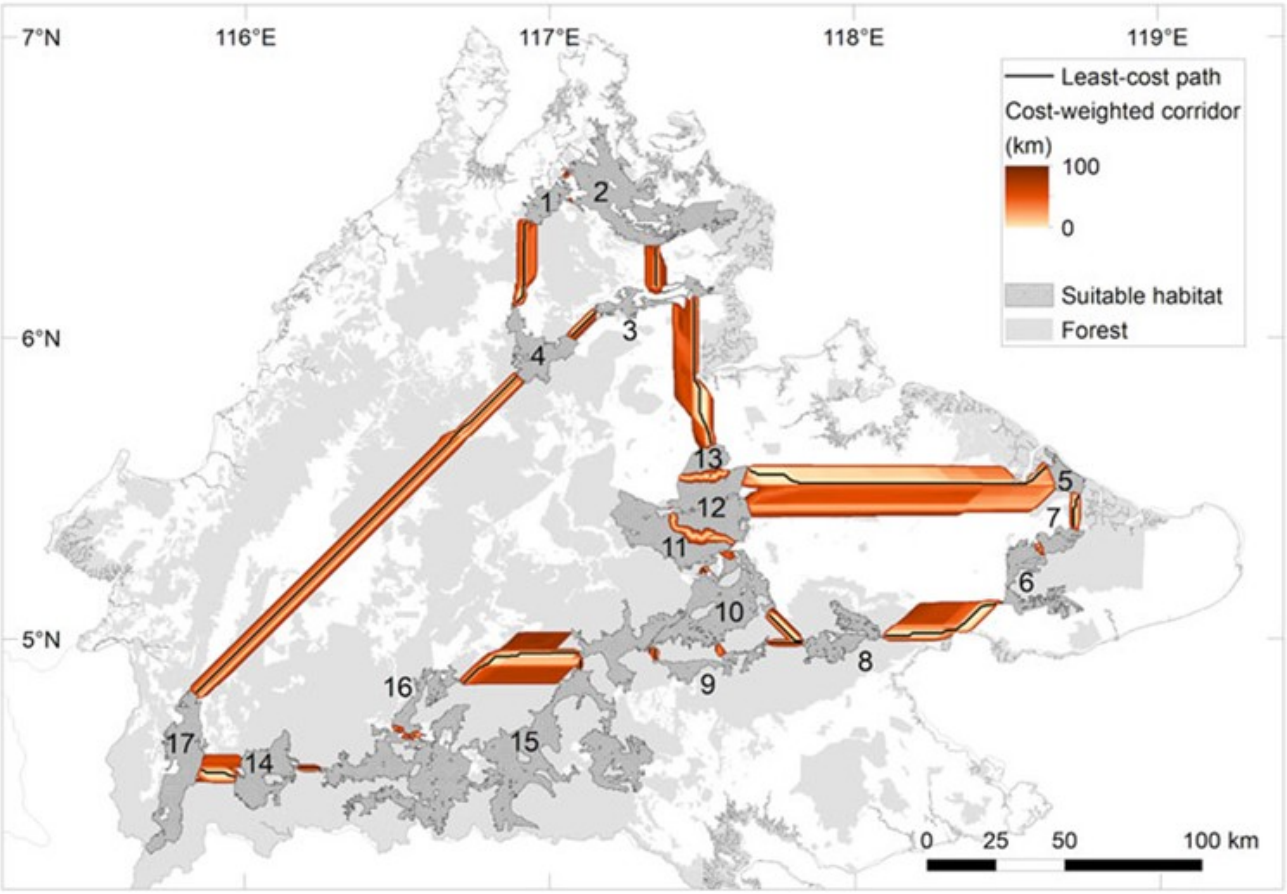
James participated in the Conservation Centers for Species Survival (C2S2) Annual Meeting in April, near Toronto, Canada. C2S2 (https://conservationcenters.org/about-c2s2/) is an innovative group of partners that are creating self-sustaining, secure populations *ex situ* and *in situ*. They mainly work *ex situ* with large population sizes. They are becoming involved with banteng and anoa and so this provides a great opportunity to work together to increase the potential breeding space, and bring expertise to the GSMP partnership. There was much discussion about the best ways to achieve the One Plan approach, linking *in situ* and *ex situ* activities. We look forward to developing our links with this inspiring group!

New research into habitat and movement resistance for the Endangered Bornean banteng in Sabah, Malaysia

Summary by Ellen Marandola, Field Programmes Intern, Chester Zoo

Hong Ye Lim and colleagues (including Banteng Species Coordinator, Dr Penny Gardner) have recently published research into the habitats used by the Bornean banteng (*Bos javanicus lowi*). They used a presence-only maximum entropy (MaxEnt) approach in order to assess which habitats were suitable. This, along with camera trap data and least-cost path analysis , was used to understand the resistance to movement through the landscape they were able to create models of key habitats and movement. These models can provide invaluable evidence for the creation of future constructive conservation strategies and land use planning. For example the modelling indicates precipitation in the driest times of the year is a predictor of how suitable a habitat is for banteng.

Lim, H., Gardner, P., Abram, N., Yusah, K., & Goossens, B. (2019). Identifying habitat and understanding movement resistance for the Endangered Bornean banteng *Bos javanicus lowi* in Sabah, Malaysia. Oryx, 1-9. https://doi.org/10.1017/S0030605318001126



The 17 habitats suitable for Bornean banteng in Sabah, Malaysia as well as the result of least–cost path analysis.

Action Indonesia Day 2019

By Stuart Young, Programme Officer, IUCN SSC Asian Wild Cattle Specialist Group

This year, we are holding the first ever Action Indonesia Day; a day of awareness raising for the anoa, banteng and babirusa Global Species Management Plans (GSMPs).

Action Indonesia Day, on August 18th 2019, will raise the profile of these little known and underappreciated ungulates. This will hopefully lead to increased support for their conservation.

There are a number of ways to get involved. On the Action Indonesia website are a range of talks, games, activities and fundraising ideas that can be downloaded and used (www.actionindonesiagsmp.org/educate) - or feel free to create your own. If you are going to get involved, please sign-up on the website and use the contact box to let us know what you will be doing.

We will also be sharing posts on the AWCSG social media accounts (Facebook, Twitter and Instagram) with the hashtag #ActionIndonesia. Please follow along and share your photos, videos and stories using this hashtag.

For more information, please visit www.actionindonesiagsmp.org or contact Stu Young (s.young@chesterzoo.org).

ACTION INDONESIA
GLOBAL SPECIES MANAGEMENT PLAN

Tamaraw Verification Surveys in the Upper Amnay Watershed Region, Mindoro

Emmanuel Schütz
Program Manager: Mangyan – Tamaraw Driven Landscape Program

Background

In 2017, only three tamaraw sub-populations were officially known to survive in Mindoro. They are all located in Occidental Mindoro. Mts Iglit-Baco Natural Park, in the center of the Island, holds the largest population with probably more than 400 animals. Mts Aruyan-Malati Tamaraw Reservation (Municipality of Sablayan) shelters a small population facing imminent threat of local extinction with no more than 15 animals according to the latest reports. Mt. Calavite Wildlife Sanctuary is a historical range of tamaraw, however, the species might already have been extirpated from this area since no sightings have been reported for several years.

These three sub-populations are officially recognized by local authorities and represent a total population of around 430 animals, as stated in the IUCN Red List Assessment (2016).

Yet, the inner mountainous range, dividing both Mindoro Provinces, has been producing regular reports of tamaraw presence for decades (Eagle Pass region and Mt. Halcon Range) suggesting there is still tamaraw outside of these official sub-populations. However, this remains only an assumption since no solid surveys have assessed possible populations in these areas. The Eagle Pass region was last surveyed by tamaraw rangers in the 1990s, with no recent information until now.

In January 2017, the Tamaraw Conservation Program (DENR TCP) received information from some Indigenous Peoples, about the persistence of tamaraws in a remote area at the border between Occidental and Oriental Mindoro, in the Upper Amnay Watershed Region. Thereafter, the TCP and the D'ABOVILLE Foundation (DAF) initiated some consultations with the local communities in order to plan a verification survey.

Outlines of the series of field surveys

An initial verification survey was conducted in June 2017 by TCP rangers to reach the said area, progressing upstream the Amnay River from the point it crosses the Nautical Highway at Barangay Pag-Asa, Occidental Mindoro. The team was guided by local community chieftains of the residing Indigenous communities who are part the Mangyan Alangan Tribe. The mission was aborted after a week due to bad weather conditions. But the team was able to reach the supposed area of presence and collect some tracks. The mission confirmed the presence of tamaraw s in the Upper Amnay Watershed Region on the Municipality of Sablayan, Occidental Mindoro, near the border with Oriental Mindoro. Rangers estimated a minimum of 15 animals in the surveyed area according to indirect signs of presence.

Thereafter, new consultations were undertaken with residing community chieftains to plan and coordinate a series of more extensive verification surveys.

The verification survey conducted in February 2018 consisted of a complete crossing of the Mindoro Island from East to West. The headwater of the Amnay River watershed was surveyed up to the different summits of the mountain range demarcating the border between both Provinces. The team was able to evaluate the tamaraw area of occupancy on the occidental side of the surveyed zone. This area is a 3 to 4 day hike from the nearest lowlander non IP settlement, either Oriental (Barangay San Andres Putik, Municipality of Naujan) or Occidental (Barangay Pag-asa).

Two additional verification surveys conducted in June and September 2018 confirm that the tamaraw distribution is wider than previously thought, with signs observed only one days hike from the nearest road access on the Oriental side (Sitio Sido, Barangay San Andres Putik). This also substantiates the presence of the species in Oriental Mindoro, thus being qualified as the "rediscovery" of the species in the Province.

This series of surveys gives us a substantial understanding of the region, its social and natural context, as well as an estimate of the species range and population size. As a matter of fact, this finding proves the existence of a totally new tamaraw population in Mindoro.

The surveyed area encompasses the previous tamaraw capture site for the translocation of animals to the tamaraw breeding centre, the Tamaraw Gene Pool Farm. Two unsuccessful capture attempts were conducted back in 1986.

Survey teams were composed of TCP rangers, DAF representatives, Alangan guides and porters, as well as biologists from MBCFi during the last mission in September 2018.

Each survey was preceded and/or followed by consultations and exit meetings with local community representatives and local officials (LGUs, military outpost, DENR, NCIP). In July 2018, a turnover ceremony of the skull found during the third survey was organized by the Provincial Government of Oriental Mindoro in presence of the Governor. Another multi-stakeholder meeting was conducted in Calapan Municipal Hall in September 2018, to present the results of the series of surveys and discuss their outcomes in presence of the Alangan Tribe's representatives and NCIP.

Results and findings - observation

Method and equipment used

Due to the rough terrain and lack of knowledge about the natural areas to be surveyed, it was decided to use simple, non-prohibitive survey methods. Each survey team was equipped with a pair of binoculars, a GPS device and a photo camera.

Assessment method was based on three types of indicator: (a) direct observation (Fig. 1) , (b) hoof marks and dung (Fig. 2) and (c) estimates given by residing IPs living and using the area of presence of the species. Additionally, indirect signs of presence such as wallowing pools and resting places were also recorded.

These indicators were thereafter computed and reported on maps to evaluate the total species area of presence and estimate the number of animals in the region.

Figure 1. Tamaraw sighting in Mt. Gimparay (courtesy of MBCFi)

Figure 2. Tamaraw hoof mark in forest undergrowth (E. Schütz)

The environmental knowledge of our local guides and porters was used as valuable inputs to select survey itinerary and comprehend the ecological context and animals' behaviors. Besides, estimates are based on the experience of the TCP rangers.

Physical and natural context of the surveyed area

The surveyed areas cover the two sides of the mountain range that demarcates both Mindoro Provinces, along the Provincial border in the Municipalities of Naujan and Sablayan. It includes the main following summits: Mt. Batu-Oy, Mt. Gimparay and Mt. Lamlamayan, reaching up to 1700m elevation. These mountains shelter the Amnay River headwaters, one of the major watersheds of Occidental Mindoro, as well as the headwaters of the Bucayao Grande River, one of the tributaries of the Magasawang-tubig River, the largest watershed in the Island.

This is also the demarcation between both of the climatic types of Mindoro. Most of the Amnay watershed up to 700m elevation experiences a Type 1 climate, with two pronounced wet and dry seasons during the year. This is the main climate type of Occidental Mindoro. On the other hand, the North-east side of the mountain range experiences an evenly distributed wet season with rainfall all over the year. Climate types reflect the ecosystems and vegetation types that can be found in the region.

Table 1. Actual tamaraw sightings and locations

Date	Feb 4, 2018	Feb 10, 2018	Sept 5, 2018	Sept 5, 2018
Area	Mt Batu-oy range	Mt Batu-oy range	Mt. Gimparay	Mt. Gimparay
Location	Tagnok	Kabag-tuan	North-east side	West side
Bull	1	2	1	1
Cow	1	1	1	1
Other	1 juvenile	1 juvenile	1 sub-adult female	0
Total	**3**	**4**	**3**	**2**

The Bucayao Grande watershed in Oriental Mindoro is covered by dense tropical rainforest up to 1200m asl, while the Upper Amnay region shows dry seasonal tropical forest. Areas at higher elevation are covered by various mountain habitats including upper montane/mossy forest, creeping bamboo thickets, tropical sub-alpine forest and dwarf scrublands habitats.

Grassland type vegetation is predominant along both sides of the Amnay River up to the forest line, with extensive open areas being interspersed with patches of secondary dry seasonal forest.

On the Oriental side, numerous dipterocarp tree species (*Dipterocarpus ssp*, *Hopea ssp*, *Chorea ssp*), combined with other tropical trees observed along the trail, reflect the persistence of the tropical lowland evergreen rain forest that once covered most of the north-eastern great plain and hills of the Province.

Tamaraw

Tamaraw distribution and population estimate

Signs of presence were collected in all habitat types, from 500m elevation up to summits. However, the species was predominantly assessed in semi open areas at higher elevation along the mountain ridge parallel to the Provincial boundary, on related habitats (Fig. 3). These are remote areas, hard to access with little or no human disturbance. Only four actual tamaraw sightings occurred in the four missions, with a total of 12 animals spotted (table 1).

A few tamaraw remains, including two old skulls , were found during the surveys. Cause of death is unknown but possibly natural.

Only one photograph of tamaraw was shot during the four surveys, by MBCFi biologist in Mt. Gimparay on September 2018.

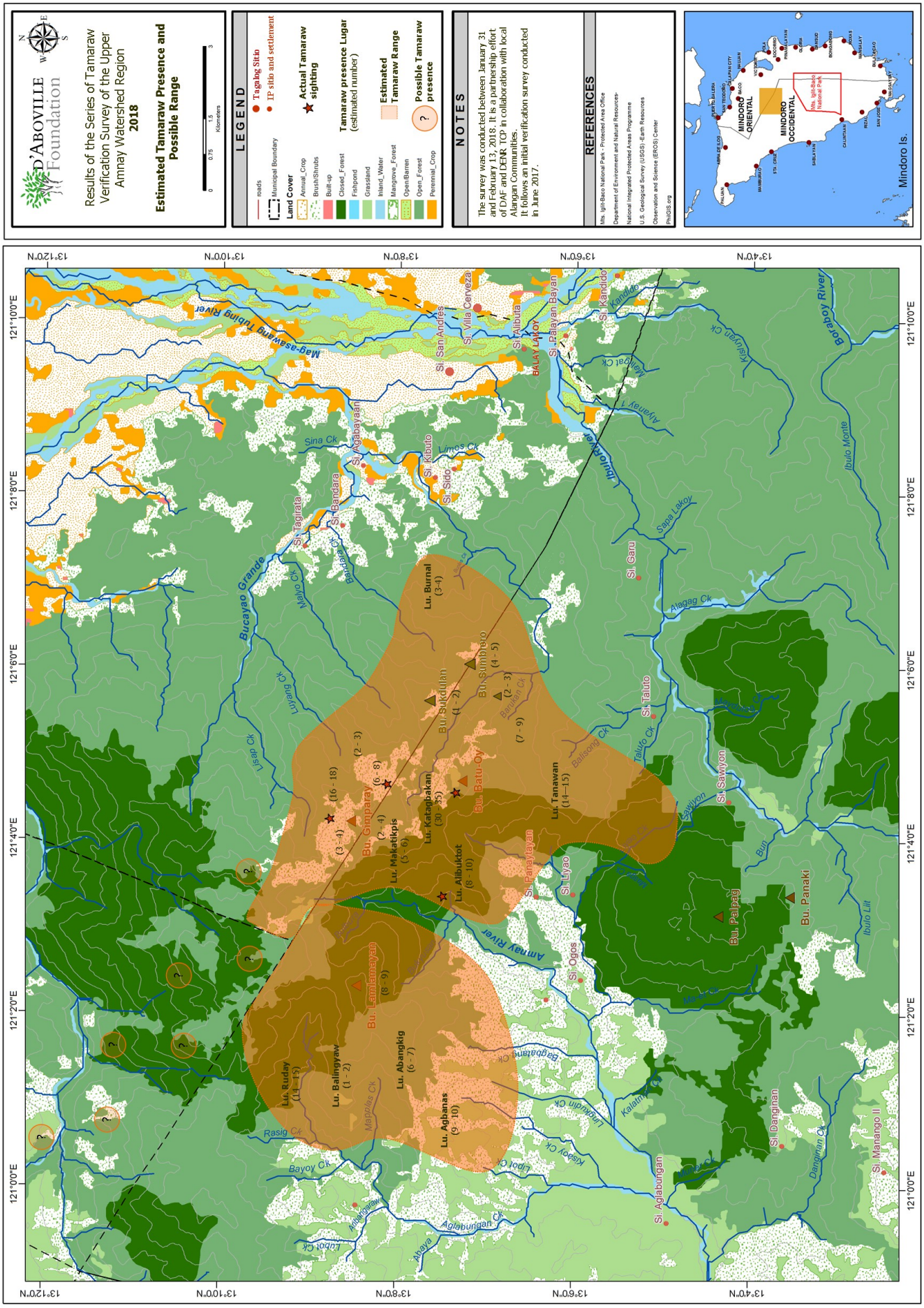


Figure 3. Close-up Map of the Upper Amnay Watershed Region - Result of the verification surveys

In general, tamaraw range shows two distinct distribution blocks:

- The Mt. Batu-Oy and Mt. Gimparay range with contiguous tamaraw distribution on both sides of the Mindoro Provincial border. On the Oriental side, the closest tamaraw sign (Burnal Area) was collected at an elevation of 1100m, only a half day hike away from the last passable road in IP Sitio Sido. The area is located just above forested slopes with relatively limited land-use pressure. On the Occidental side, tamaraw are seen very close to upland community settlements (Sitio Liyao, Panaytayan, Ogos, Taluto), with evidence starting at 500m asl in valley area. However, animals are more often seen above the tree line, with limited evidence in open grasslands. These IP communities are located a two to three long days hike away from the last passable roads and lowland Christian settlements on either side of the Island.

  According to the assessment of indirect signs and esti mates from local communities, this area shelters be tween 100 and 116 tamaraws.

- Mt. Lamlamayan range, within Occidental Mindoro, with tamaraw signs collected in grassland areas dominated by cogon grass and talahib, seasonal tropical forest, montane rainforest and mossy forest up to 1600m asl. The population estimate is 38 to 43 animals. There are currently no IP settlements within the range of the species assessed there.

The estimate from direct observation and indirect signs of presence, combined with IP interviews, suggest that there are between 138 and 159 tamaraws in the entire surveyed region. The total confirmed area of tamaraw presence covers nearly 6000ha. However, these estimates have to be considered cautiously and must be corroborated using stronger scientific methods. Besides the verification survey stopped at the border with the Municipality of Baco in Oriental Mindoro, while connectivity of the mountain range suggests that tamaraw signs could be found further North-East towards Mt. Halcon.

Tamaraw ecology and behaviour

Tamaraws that can be found in the Upper Amnay Watershed Region show natural history traits adapted to the climate, habitats and disturbance regime prevailing in this area. In a general manner, these tamaraws are focusing on forest resources and highland vegetation types with little access to lower grassland habitats.

Their diet is quite fibre rich as they are adopting a rather browsing behaviour in comparison to tamaraws found in Mts Iglit-Baco Natural Park. Interviews with our local guides and porters prove that animals forage on a large variety of shrubs, semi woody and woody species (more than 20 species reported during the mission). Those palatable species are abundant in local tropical forest undergrowth, glades or open highlands, but slightly less inside mossy forest habitats.

There is less evidence of the species in dense mossy forest, as well as forest with deep muddy soil as both biotopes seem to be avoided. More tracks can be seen in scrublands and open highlands.

According to our local guides and porters, animals roam the forest at night time but move up to summits and open areas on a daily basis to avoid occasional disturbance as well as to access specific resources and to get heat from the sun.

This pattern of home range use is in rattan rich forest areas where tamaraw s cross rivers or change mountain sides to avoid disturbance caused by community members harvesting this natural resource at certain periods of the year.

Despite this fact, animals seem to have their own territory with little competition for food and space. Groups are below six animals. According to the TCP rangers, these tamaraws look stockier with larger front head and darker body colour

compared to tamaraw s in MIBNP.

Other wildlife

Mindoro warty pig (*Sus oliveri*) is reported as quite common in the region by local IPs, which is corroborated by numerous signs of presence observed during the different surveys. The species can be found in all types of habitat but become less frequent, or even absent at higher elevation in mossy forest and thick vegetation.

Philippine brown deer (*Rusa mariana barandana*) seems to be rare and occupies forest areas of lower elevation. No signs of deer were collected during the surveys.

Besides, IP communities report the presence of the following fauna: Asian palm civet (*Paradoxurus hermaphroditus*), Malay civet (*Viverra tangalunga*), monitor lizard (*Varanus bangonorum*), Mindoro hornbill (*Penelopides mindorensis*), bleeding heart pigeon (*Gallicolumba platenae*), imperial pigeon (*Ducula sp.*), long tailed macaque (*Macaca fascicularis*). IPs are also reporting the presence of large species of rodent and shrew types, including an animal that is likely to be a cloud rat species. Such assumption requests further investigation.

On a general perspective, it is likely that these mountains shelter far more biodiversity that what could be described at first glance. The variety of biotopes and remoteness of the area that preserve it from major disturbance makes it most probably one of the biologically richest and still to be surveyed regions of Mindoro.

Ethno-ecological and Socio-cultural context

Mangyan Alangan Ancestral Domain

The assessed tamaraw range is entirely located within the Ancestral Domain of the Mangyan Alangan Tribe of Mindoro (map.1 appendix.1). The Alangan Tribe has already achieved and retrieved its CADT (Certificate of Ancestral Domain Title). Their Ancestral Domain extends over most of the Amnay River watershed and nearby rivers in Occidental Mindoro, Municipalities of Sablayan and Santa Cruz and the Upper Bucayao Grande River in Oriental Mindoro, Municipality of Baco, Naujan and Victoria

We can distinguish two blocks within the Alangan Tribe, which diverge in terms of land-use system, organization and connection with lowland Mindoro:

Communities living within the Amnay River watershed are mostly under influence and interaction with government offices of Occidental Mindoro (DENR, LGUs). They acknowledge the leadership of the legal Alangan representative, Mayor Junio Calamita, who resides in Barangay Pag-Asa at the junction of the Amnay River and the Nautical Highway. Over twenty five community settlements of various sizes are scattered along the Amnay River and its tributaries. Except for a few settlements that can be accessed during the dry season when motorbikes or tricycles can use the riverbed, most communities have no access to roads nor energy sources, therefore being isolated from the facilities and economical activities spreading along the nautical highway.

On the other hand, the Alangan residing in the Oriental side are nowadays predominantly living in a few permanent settlements in the lowland nearby other Mindoreño settlements. Sitio Sido in Barangay Balite hosts nearly 50 IP families and is accessible by road, thus connecting nearby IP sitios located along the Bucayao Grande River to lowland activities. According to them, there is no real Tribal Leader: Instead, Alangan people must rely on the decisions of Elders (Aplaki) and the leadership of the chieftain of each community. However, these communities seem to be under influence of non-IP people, claiming to be the messengers and accepted representatives to talk in the name of the Alangan people to LGUs, NCIP or Mining Company.

Upland IP communities that are located in the vicinity of the tamaraw range (Sitio Ogos, Panaytayan, Liyao, Taluto) are the most isolated among all Alangans. They are within the jurisdiction of Sablayan and leadership of Mayor Calamita. However and due to travelling distance, they are rather connected with lowland communities of Oriental Mindoro, thus being somewhat disconnected from initiatives and decisions taken in Sablan

The Ancestral Domain is divided into numerous parcels that have been distributed between local chieftains and elders. They have control over those areas even so they are not living on it.

This overall situation creates some tension within the tribe which is reflected by issues in governance and leadership and conflicts of legal representation. Besides and due to the nearly pristine rainy forest that stretches along the mountain range, the oriental side contains more valuable natural resources, therefore putting this region under interest of non IPs.

Lifestyle, belief and land-use system

From a general perspective, the Alangan Tribe is well aware of the benefits they can get from the natural resources found in their Ancestral Doman and the importance of properly managing them.

Alangan communities residing in the rainy East side conduct a form of agro-forest farming system in the forested hills up to a certain extent and below 600m asl. Above this line, the forest is practically intact. They plant banana, cassava, sweet potato, gabi (taro), tobacco, as well as coconut trees and betel palm trees. Pest problems and cold weather limit the plantation of rice. Banana plantations suffer from typhoons during the rainy season. Rattan is an important resource being harvested for multiple uses.

Several animals are raised for use and consumption within communities, such as domestic pigs, chicken, ducks, goats, cows and carabao. Dogs are also common. Furthermore and besides the coconut that can be sold to lowlander non IPs (siganon), most crops are harvested for community consumption only. Contravention of this rule may result in bad harvest due to the wrath of the “Kapwan Bolod”, the spirit who owns the mountains, forests, animals and water.

Communities living in the upper Amnay River region, near the border with Oriental Mindoro, benefit from the mixed ecological pattern and different biotopes found in that altitude and location. They conduct swidden agriculture with various crops. Families live in communal huts or group of huts nearby creeks or rivers. Native domestic pigs (baboy allaga), chicken, dogs and cats are now common. Diet is based on local crops and natural resources, including freshwater fishes, eel, or crayfish.

Some community members go once or twice a month down to Barangay San Andres Putik in Oriental Mindoro (two to three days hike away) in order to make some earnings by selling craft products (hammock, rattan basket…) or honey (in April) at the Barangay Hall or by exchanging upland crops for other goods.

Items that are primarily purchased are, in order of priority: salt, tobacco, rice and canned food. Rice remains a very occasional food item in the diet of these upland communities.

Agoho pine tree (*Casuarina equisetifolia*) is very common in the Amnay Watershed region and represents an important resource to residing communities for making charcoal thanks to its property to produce high heat.

Alangan communities hunt all type of wildlife. Hunting season with traps (palakaya) occurs between the months of December and April. Spear traps are designed for large animals such as tamaraw (tambakon) and wild pig (pangilan) while snare traps are used to catch palm civet (alamid), rodents (daga), monitor lizard (bayawak), jungle fowl, python (sawa), long tail macaque (bakos) or wild pigs. Specific traps using nets are also set up to catch bats and birds, while small forest openings are used for hunting fruit bats.

Specific rituals (barongbong) must be practiced before hunting to please the Kapwan bolod and ensure a successful catch. Offerings (sula) of pigs or chicken are regularly needed to prevent the anger of the Kapwan bolod.

Alangan people fear tamaraw due to its aggressive behaviour. To avoid unfortunate encounters, they wear a special necklace (bayumbi) that produces noise.

Alangan still follow their own tribal customary law and use a range of punishment to solve internal problems and issues.

Alangan communities have collectively engaged into specific habitat management measures within their Ancestral Domain

in order to prevent unsustainable pressure on natural resources resulting from population growth and new needs created by the progressive modernization and lowlander lifestyle.

Nowadays, their farming system is restricted below the forest edge and in open areas, thus to avoid additional encroachment to upland forest habitats, to preserve natural resources, secure clean water production and reduce disturbance to tamaraw. Hunting of tamaraw is very restricted or prohibited. Many areas are barely used or visited, and many settlements or temporary huts are currently abandoned, emphasizing the progressive shift in land-use system and movement of the communities towards lower locations or in existing settlements.

From a general perspective Upland Alangan people are eager to break their secluded lifestyle and to become more connected with lowland communities in order to be part of government initiatives and to benefit from development programs.

Concerns and remarks of local indigenous communities

The different consultations conducted with local communities highlight several concerns:

The Alangan people of Oriental (sitio Sido) were afraid that the purpose of the missions was to capture tamaraw s to be translocated in another location. This is in reference to the unsuccessful capture attempts that occurred in 1980s in the frame of the Gene Pool Farm establishment.

They also pointed out the fear of creating disorder within the Tribe with, on one side, IP members involved in DENR activities (hired as guides or porters or expecting to become future rangers) or having tamaraw confirmed in the land parcel they control, from IPs not concerned by tamaraw presence or involved in field surveys on the other side. In other words, all community members are looking to be involved in DENR activities in order to preserve equity inside the tribe and receive financial benefits from projects.

They were also concerned that the tribe would be affected by having strangers and field activities entering sacred places inside the Ancestral Domain.

However, it is palpable that the field missions have created expectations among the communities, first through the expectancy to become rangers and receive compensation from DENR and secondly by raising hopes that the DENR would help the tribe to address the problem of illegal activities and intrusion of non-IPs (siganon) inside the Ancestral Domain. Chieftains confessed that they are powerless on that matter.

Threats and pressure

Due to the remoteness of the area where tamaraws are found and the rough terrain, pressure is relatively low. However, local chieftains relate on several sources of threats and disturbance:

Tamaraw are still victims of traps used by residing IPs hunting local fauna. Besides, wildlife poaching from lowlander siganons and map problem, especially in Burnal area and Barukan creek area. Electric fishing is also reported to occur in these areas. Illegal activities are considered an important problem for the Alangans because it results in the violation of their CADT and abuse of local natural resources by other groups.

Community members report that tamaraw suffered from regular deliberate poaching incidents in the past decades but that this source of pressure dried up after main culprits (local officials) passed away. However, this means that poaching is a fluctuating human based source of threat that requires continuous protection efforts.

Furthermore, there is an ongoing road construction that will connect Barangay Pag-asa, Municipality of Sablayan in Occidental Mindoro, to Barangay Villa Cerveza in Municipality of Victoria, Oriental Mindoro. The itinerary runs on the left bank of the Amnay River, through the mountains, within the CADT of the Alangan Tribe. This road, when completed, is likely to become a major source of threat by opening this still preserved Inner Mindoro region to illegal activities or unsustainable developments.

Discussion

The recently confirmed tamaraw population of the Upper Amnay Watershed Region can be considered as a new official tamaraw sub-population in Mindoro. A total of seven different animals have been clearly observed, while assessment method through indirect signs of presence suggests that more than 65 animals are roaming these mountains and possibly more than 100 according to local communities. The second figure is similar to the number of tamaraw stated in the literature for the Mt. Halcon – Eagle Pass range in the 1980s (CRMF 1987, CRMFi 1990: n = 65).

Furthermore, the surveyed area suggests an area of occupancy of more than 6000ha. Despites the fact that these estimates remains unclear, it is de facto the second largest tamaraw population on Mindoro after Mts Iglit-Baco Natural Park in terms of size and the largest in terms of range. Besides, it confirms the "re-discovery" of the species in Oriental Mindoro.

This finding is therefore of major importance for the long term conservation of the species but implicates new responsibilities for local stakeholders and urgent needs to coordinate protection and monitoring efforts between agencies or other organizations.

Tamaraw are confined to mountain habitats from 500m asl up to 1700m asl, adopting browsing behaviour and a more fibre rich diet than the well-known rather grazing tamaraw s of Iglit. This demonstrates the ecological flexibility of the species and its ability to survive in a large spectrum of habitats.

Furthermore, it shows that more natural areas of Mindoro could be considered as suitable for the species.

Nevertheless, and if the figures are correct, the overall density of tamaraw in the Upper Amnay Watershed Region is less than 2 heads for 100ha. In comparison, the core zone of the monitoring in MIBNP shows a density of 20 heads for 100ha in 2018.

This may suggest that the potential optimum density of animals in upland forests and mountain related biotopes is much lower that what grassland and seasonal habitats of lower elevation can sustain.

This assumption must take into account that the Iglit population might already be reaching carrying capacity. Besides, and according to local communities, the population of tamaraw is increasing in the Upper Amnay Watershed Region, suggesting that this population is on a positive trend and has not yet reached ("back") its optimal natural density.

Additionally, limited disturbance, accessibility to food resources and constant availability of water supply through rainfall, permanent creeks and wallowing holes, is likely to reduce intra specific competition. In other terms, the sub-population of the Upper Amnay Watershed Region might be a unique example where tamaraw s are expressing the natural behaviour of the species.

Publicity that has followed the surveys and subsequent meetings, including through local media, have made people aware of the presence of a substantial number of tamaraw in the region, with exact location being communicated. This raises concerns of a possible sudden increase of poaching and illegal activities.

Alangan people have clearly expressed their consent to collaborate with the DENR and its partners for the protection of the tamaraw as far as the tribe is involved and has given consent to the proposed projects. Besides, they have highlighted their desire to increase official protection of the upland forest habitats where tamaraw are found. These matters were properly discussed with Alangan representatives during the Tamaraw Population and Habitat Viability Assessment and Action Planning workshop that was held in Mindoro in December 2018.

Conclusion and recommendation

The Upper Amnay Watershed Region shelters the second largest Tamaraw population of Mindoro in size and the largest in term of range. Tamaraws are confined to upland forest habitats at the border between Occidental and Oriental Mindoro. The assessed population is located within the Ancestral Domain (CADT) of the Mangyan Alangan Tribe.

In regards to the results, findings of the mission and context of the region, human pressure seems currently low with no apparent urgent actions needed. Nevertheless, the surveys have brought out expectations among the Tribe that seek to receive financial benefit by being involved into future activities. Besides, findings have generated excitement among the Provincial Government and DENR of Oriental Mindoro. They are eager to participate in protection actions.

Therefore, it seems important to properly engage into continuous discussion and collaboration with the tribe and concerned offices, but also to avoid inconsistent and precipitated intervention until broader plans are clearly elaborated.

First of all, additional surveys are needed to assess the exact range of the species and better estimate the population size.

Thereafter, it will be possible to design suitable conservation actions and landscape approach closely integrating the needs, claims and rights of the local Alangan communities. These plans have to be in line with the Ancestral Domain Sustainable Development and Protection Plan (ADSDPP).

This range of intervention must be properly coordinated by concerned agencies and seek for inputs and support from relevant partners and experts. The TCP seems currently the proper entity to undertake the work directly related to Tamaraw. Therefore, its capacities must be enhanced accordingly it order to fulfil this task.

This tamaraw population is definitely of major importance and a crucial asset in the frame of the long-term conservation of the species. It will be a central element of the meta-population conservation and management strategy that will be properly elaborated in the upcoming Species Action Plan.

Acknowledgements

These verification surveys were coordinated and implemented together with DAF local institutional partner, the Department of Environment and Natural Resources / Tamaraw Conservation Program, through its coordinator, Ms. Maria Teresita P. David Jr, TCP Field Head Officer E. Bata, Tamaraw rangers G. Barcena, G. Fantuyaw, N. Samson, M. Encado and J.R. Casuncad.

Invaluable information was collected by DAF Field Technical Assistant J. Belmonte. Jr.

The mission was conducted in collaboration with CENRO Victoria, Pasu of Naujan Natural Park, R. Natividad and NCIP of Sablayan and Calapan.

Invaluable evidence was collected by biologists D. G. Tabaranza, V. Natural Jr. and E Hazel Tan of Mindoro Biodiversity Conservation Foundation Inc.

The full mission was implemented in the frame of the Mangyan - Tamaraw Driven Landscape Program of the D'ABOVILLE Foundation. The program is supported by international partners:

Global Wildlife Conservation

Berlin Tierpark

Zoologische Gesellschaft für Arten- und Populationsschütz

Association Française des Parcs et Zoos

Center for Conservation of Tropical Ungulates

The Mohamed Bin Zayed Conservation Fund

The successful non-invasive endocrine monitoring of oestrous cycles in Banteng (Bos javanicus)

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The use of endocrinology to monitor reproduction and fertility is an important tool in our efforts to conserve and support sustainable populations of endangered species. In this research we describe the use of an enzyme linked immunosorbent assay (EIA) to assess the faecal progesterone metabolite concentrations in female banteng (*Bos Javanicus*) at Chester Zoo, UK. An oestrous cycle length of 21 days (n=5 cycles) with reproductive synchronicity was observed. This work outlines a non-invasive method for collecting female banteng reproductive physiology data, which can be applied on an individual or herd level. This data could be utilised to support future Global Species Management Plan (GSMP) *ex situ* breeding efforts by confirming reproductive status of female banteng and feeding this information into husbandry and breeding management.

Introduction

The reproduction and fertility of a species is fundamental for survival, for conservation efforts to be successful it is vital that there is a solid understanding of reproductive processes (Sontakke, 2018). When breeding is being managed though timed introductions or techniques such as artificial insemination, an accurate assessment of reproductive parameters such as species oestrous cycle length and estimated ovulation can be key to a successful captive breeding program (Herrick, 2019).

Circulating blood hormone concentrations are the most accurate indicators of reproductive state. However, most wildlife species are intractable or require extensive training which makes repeated blood collection very difficult (Kersey and Dehnhard, 2014). A less invasive alternative to monitoring hormone concentrations in the blood is measuring concentrations in faeces (Lasley and Kirkpatrick, 1991). The non-invasive monitoring of reproductive hormones has the added benefits of negating short-term fluctuations through pooled samples, permitting routine sampling over long periods of time and having little or no contact with the animal (Kersey and Dehnhard, 2014). The analysis of mainly unconjugated faecal progesterone metabolites is a well-known approach for monitoring mammal reproductive function in farm, wild and zoo animals (Schwarzenberger et al., 1996).

Reproductive Endocrinology of Cattle

The reproductive physiology of cattle is of major economic importance in both the dairy and beef industry and therefore the reproductive physiology and subsequently endocrinology of female cattle has been explored extensively (Garverick and Smith, 1993). The mean duration of the oestrous cycle in the domestic cow is 21 days (range 18-24 days) and consists of four phases, pro-oestrous, oestrous, metoestrus and dioestrus (Noakes, 1997). Hormone monitoring is not routinely used to manage breeding in domestic cattle; rather visual observation is the most traditional and commonly used form of oestrus detection (and presumed ovulation) but has labour costs and human error. Hormone monitoring of wild cattle species for conservation purposes is a little explored area of research and has the potential to be an important tool for captive breeding programmes.

Banteng (*Bos javanicus*) are an endangered species of wild bovid from South-east Asia. The species is considered to have a decreasing population trend which is estimated to range

between 4,000 and 8,000 individuals (IUCN, 2014). The major cause of decline is due to hunting, habitat destruction and fragmentation, as well as being subject to hybridization and disease from domestic livestock (Sansinena et al., 2005). Bali cattle are a domesticated descendent of the wild banteng and represent 27% of the total cattle population in Indonesia, where artificial insemination is practiced in limited locations (Purwantara et al., 2012). In banteng, serum estradiol and progesterone profiles have previously shown a mean cycle length of 20 days ± 0.68 (Asa et al., 1993). Urinary non-invasive endocrine monitoring has also previously been used successfully to assess fertility control techniques (Kirkpatrick et al., 1995). The aim of the current study is to add to the body of knowledge on female banteng reproductive physiology and develop a non-invasive method to measure oestrous cycles and estimate periods of oestrus through faecal progesterone metabolite concentrations.

Materials and Methods

Faecal Sample Collection

The banteng herd used for this research comprised 14 individuals housed separately in two distinct groups at Chester Zoo, UK. The first group consisted of 1 mature male, 4 adult females and 3 calves; the second group is consisted of 4 adult females and 2 juvenile females.

Faecal samples (n=44) were collected 2-3 times per week from two sexually mature parous females (age 3 and 4 years) over a 162 day period. The two individuals were housed in the second group in a small, off-show herd away from the mature male. In order to ensure the samples were collected from the specified individual, the herd were observed for two hours on any given day and samples were collected if either of the individuals defecated and stored in individually marked bags. Individuals were identified by unique physical features and ear tags. Samples were stored at -20°C immediately following collection.

Faecal Extraction and EIA

Faecal samples were extracted using a wet-weight extraction technique adapted from Walker et al. (2002) and described elsewhere (Watson et al., 2013; Edwards et al., 2014), whereby 0.5 g of faecal matter was extracted with 5 ml of 90% methanol, shaken overnight, dried and reconstituted in 1ml of 100% methanol, and stored at−20°C until being analysed with a progesterone enzyme immunoassay (CL425; supplied by Coralie Munro, University of California Davis, CA, USA). The progesterone CL425 cross-reactivities are published elsewhere (Watson et al., 2013).

The progesterone antibody was diluted (1:10,000) in coating buffer (0.05 M NaHCO3, pH 9.6), loaded 50 µl/well on a 96-well Nunc-Immuno MaxiSorp microtitre plate (Thermo-Fisher Scientific, UK), covered with a microplate sealer and incubated overnight at 4°C. Plates were washed five times (0.15 M NaCl, 0.05% Tween 20), and the entire plate loaded with 50 µl/well of progesterone standard (P0130 Sigma–Aldrich, UK) in EIA buffer (0.1 M NaPO4, 0.149 M NaCl, 0.1% bovine serum albumin, pH 7.0), or Banteng faecal extract (diluted 1:100 in EIA buffer) immediately followed by 50 µl/well of horseradish peroxidase conjugate (diluted at 1:35,000 in EIA buffer). Following incubation for 2h at room temperature (RT), plates were washed 5 times and incubated with 100 µl/well substrate [0.4 mM 2,20-azino-di-(3-ethylbenzthiazoline sulfonic acid) diammonium salt (ABTS), 1.6 mM H2O2, 0.05 M citrate, pH 4.0), until average optical density (OD) reached 0.8 to 1.0. The resulting OD of all individual wells was then measured at 405 nm. Intra- and inter-assay coefficients of variation (CVs) were <15% for high- and low-binding synthetic controls.

Biochemical Validation

A parallelism was used to confirm progesterone metabolites present in the faecal extracts behave in a similar way to the synthetic progesterone to which the antibody was raised. A serial dilution of faecal extract was run in duplicate on the EIA, alongside a serial dilution of the synthetic standard. The parallelism was also used to determine the correct dilution to run biological samples. To obtain accurate results, ideally

faecal samples will be run on the EIA at a dilution to give approximately 50% binding, as this is the most sensitive and accurate portion of the calibration curve as it is steep and linear.

A matrix interference assessment was used to determine whether the sample matrix causes any interference to sample measurement. A serial dilution of synthetic standard was spiked with an equal volume of diluted faecal extract. Once the background has been accounted for, the observed concentration was compared to the expected concentration.

Both parallelism and matrix interference data were subject to regression analysis.

Results

The progesterone EIA was biochemically validated for measuring progesterone metabolites in female banteng faecal extracts through parallelism with the standard curve (R2=0.99, F1,7=923.966, P <0.00) and no matrix interference (R2=0.99, F1,7=460.85. P <0.00; Figure 1). An oestrous cycle length (based on the number of days between observed baseline faecal progesterone metabolite concentrations) was determined to be of 21 days for both individuals (Figure 2).

Faecal progesterone metabolite concentrations of the two females also follow a similar profile over the collection period, indicating reproductive synchronicity (Figure 2).

Discussion

This study has both chemically and biologically validated a non-invasive technique to monitor ovarian activity in female banteng. The data presented here indicate a cycle duration of 21 days which is in agreement with other cattle species (Noakes, 1997). One challenge during the current study was the ability to routinely collect known faecal samples from individuals. To improve the frequency of collection the use of indigestible markers (for example dye or cracked corn) for identifying individual faeces could be utilised in future attempts (Fuller et al., 2010). Additionally, monitoring could be updated to include behavioural observations to confirm oestrus and ensure sexual behaviours are aligning with the rise in progesterone metabolite concentrations from baseline.

The current study also demonstrated that faecal progesterone metabolite concentrations of the two females were synchronized. In a commercial setting, reproductive synchronicity is

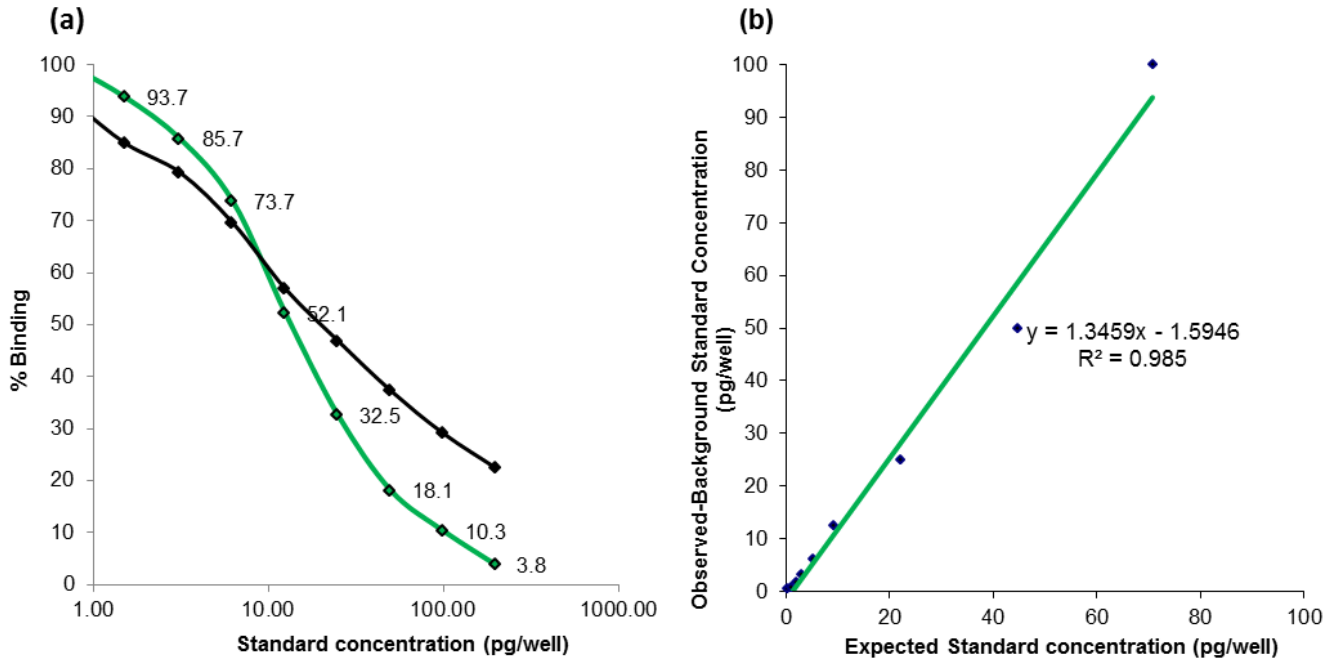

Figure 1. (A) Female banteng faecal pooled extract (green) parallelism with progesterone synthetic standard curve (black) on the progesterone EIA (CL425 antibody) and (B) Assessment of matrix interference of female banteng extract when spiked with progesterone synthetic standards on the progesterone EIA (CL425 antibody).

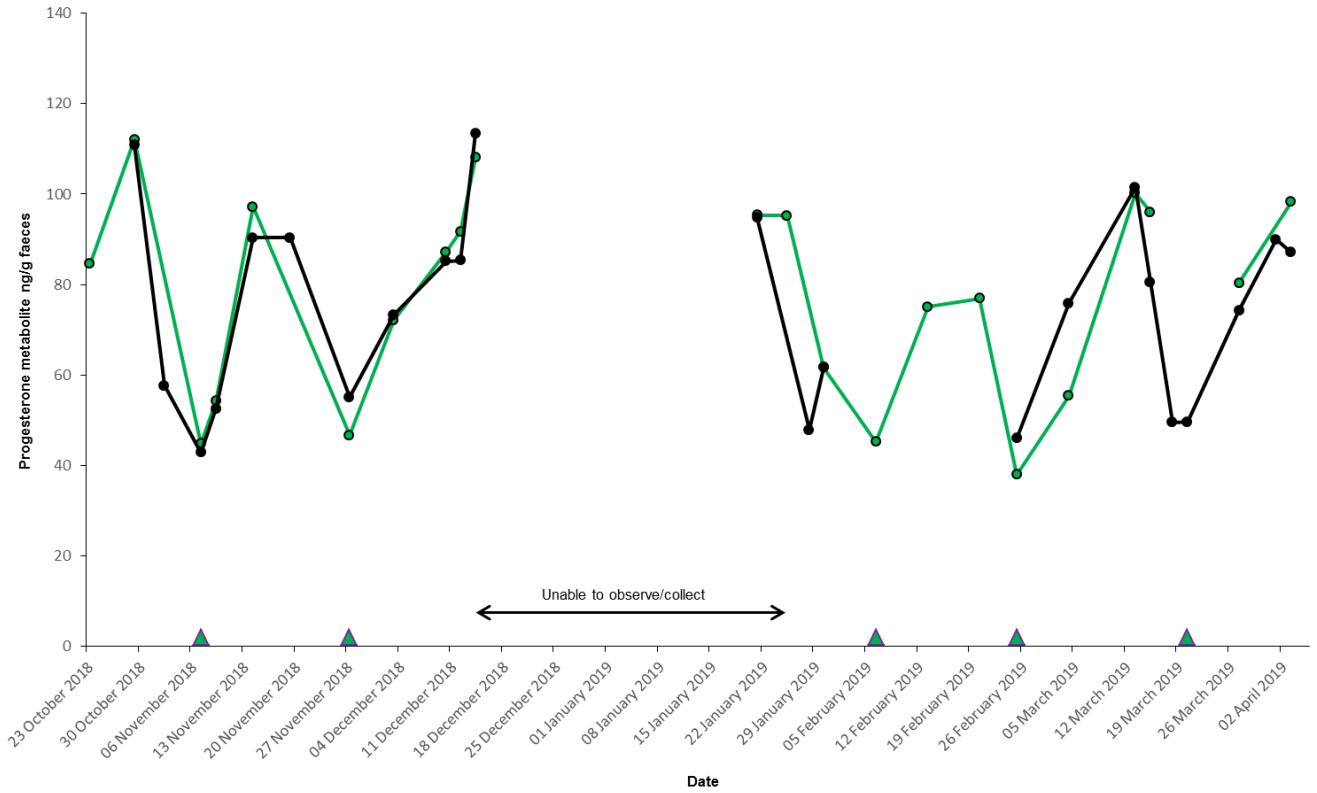

Figure 2. Faecal progesterone metabolite concentrations (ng/g) from two female banteng (individual 1 (○), individual 2 (●) (n = 44 samples) on the progesterone EIA (CL425 antibody) over 162 days and estimated periods of oestrus (△).

advantageous for increasing produce yield and such synchrony is usually artificially maintained. Cattle have been shown to exhibit highly synchronised behaviour in such activities as feeding and resting (Bouissou et al., 2001). It is well known that reproductive synchronicity exists in certain mammals and has been demonstrated in other mammals such as the captive African elephant (*Loxodonta africana*) (Weissenböck et al., 2009; Edwards et al., 2016). However, there has been limited exploration into this potentially adaptive advantage in wild or captive bovid herds. Given the small sample size of the current study, further sample analysis is required to confirm if reproductive synchrony is commonly observed in this and other banteng herds.

In conclusion, this work outlines a non-invasive method for collecting female banteng reproductive physiology data, which can be applied on an individual or herd level. This methodology could be utilised to realise future banteng GSMP objectives (Metzler et al., 2016) by providing further data to support natural breeding attempts, timed introductions or artificial insemination within the ex situ population.

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AUTHOR GUIDELINES

Aim & Scope

BULLetin is the official, peer-reviewed publication of the IUCN/SSC Asian Wild Cattle Specialist Group. It aims to provide information on all aspects of natural history for the relevant species (Anoa, banteng, gaur, kouprey, saola, tamaraw, water buffalo and yak), with a particular focus on their conservation and management, both *in* and *ex situ*.

BULLetin accepts manuscripts of original research findings that have not been published or submitted simultaneously to other journals, and with a minimal overlap of contents with other published papers. As well as these, *BULLetin* also accepts and encourages submission of other relevant news, thesis abstracts, book reviews, summaries from workshops and meetings as well as a "notice-board" to publicise relevant upcoming conferences, funding opportunities etc.

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We prefer manuscripts in English. If English is not your first language, then please have your text thoroughly reviewed by a native speaker before submitting. Abstracts must also be in English, but we encourage an additional abstract in the language of the country where the project has been conducted. We will consider manuscripts in other languages; speed of publication in that case depends on availability of reviewers. If the article is not in English, then an English abstract must be provided.

Manuscripts should be submitted in MS Word and sent to James Burton (jamesaburton@yahoo.co.uk). Submitted manuscripts will initially be evaluated by the editors. Manuscripts which fail to meet the editorial requirements will be returned to the author without review. Research articles and reviews will be sent to one or two independent reviewers. We aim for less than two months between initial submissions until final acceptance for publication.

Types of contributions and requirements

News and field notes

Relevant news and notes from the field that may contain figures and tables (up to 2,500 words)

Book reviews

Short evaluations of recently published books and monographs of interest to the AWCSG (up to 1,500 words)

Review papers

Unbiased reviews of the existing knowledge on a specific topic, providing novel insight and synthesis are welcomed (up to 6,000 words)

Research papers

Original research articles (up to 8,000 words including all text, references and legends). Manuscripts should adhere to the following structure:

- Title
- Author details (names, affiliations and contact details for corresponding author)
- Abstract (not more the 250 words)
- 4-8 key-words (additional key-words not appearing in the title – if any)
- Introduction
- Materials and methods
- Results
- Discussion
- Acknowledgements (optional)
- References (Harvard style)
- Figures and tables, presented alongside individual captions (please also send photos and figures in separate files in the highest available resolution)

Numbers and units

The metric system should be used for all measurements and weights with a space between the number and the unit of measurement. Temperature should be expressed as degrees Celsius (^{o}C). Numbers from one to nine should be spelled out except when used with units; e.g. one anoa but ten banteng and 3 km.

Nomenclature

Please use common English names of plants and animals, and adhere to the taxonomy used in the IUCN Red List. At first mention in the main text, give both the common and scientific names (in italics). If possible, also add the local name of the species in the area where you work.

Figures and tables

Figures and tables should be cited in the text in the order that they should appear. Figures and images should be in one of the following file formats:

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References

We use the Harvard style and the name-year method of citing and listing references. Citation to work by one or two authors should give the author names in full, e.g. (Smith 2017) or (Smith & Miller 2017). Citation to work with three or more authors should be abbreviated with the use of et al. (e.g. Smith et al. 2017). Citations in the text should be separated by a semicolon and listed in chronological order. Works with the same first author and date should be coded by letters (e.g. Smith 2017a). The reference list should be organised alphabetically by first author, punctuation should be minimised and journal names should be unabbreviated. The minimum reference information required is as follows:

- ***Journal article***
  Author(s) in full, year of publication, article title, journal title (not abbreviated), volume number, issue number, page range. References to online research articles contain the same information, but have a DOI instead of vol ume, issue and page range.
- ***Book***
  Author(s) in full, year of publication, book title, place of publication, publisher, number of pages.
- ***Book chapter***
  Author(s) in full, year of publication, chapter title, book author/editor, book title, place of publication, publisher, page range.
- ***Thesis***
  Author in full, year of publication, thesis title, type of thesis (e.g. MRes, PhD etc.), awarding institute.
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Newsletter of the IUCN/SSC Asian Wild Cattle Specialist Group

July 2019 | Number 2

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