

Progress of the Action Indonesia GSMPs 2016-2020: Global collaboration to conserve the anoa, banteng, babirusa and Sumatran tiger

Burton, J.^{1,11}, Bailey, C.^{1,11*}, Yonathan, Y.², Andrews, J.³, Chandra, I.⁴, Forys, J.⁵, Fitzpatrick, M.⁶, Frantz, L.⁷, Mustari, A. H.⁸, Holland, J.⁹, Hornsey, T.¹⁰, Humphreys, A.¹¹, Hvilsom, C.¹², Leus, K.^{12,13,21}, Metzler, S.¹⁴, Pentawati, S.¹⁵, Rode-Margono, E. J.^{20, 21}, Rowlands, T.¹¹, Semiadi, G.^{2, 16}, Smith, C.¹¹, Sumampau, T.^{2,4,17}, Traylor-Holzer, K.¹⁸, Tri Hastuti, Y.¹⁷, Tumbelaka, L.^{2,19}, Young, S.¹¹

¹IUCN SSC Asian Wild Cattle Specialist Group

²Perhimpunan Kebun Binatang Se-Indonesia (PKBSI) / Indonesia Zoos and Aquariums Association (IZAA)

³AZA Population Management Center at Lincoln Park Zoo, USA

⁴Taman Safari Indonesia II, Prigen, Pasuruan, Indonesia

⁵Audubon Zoo/ Audubon Nature Institute, USA

⁶Zoological Society of London, UK

⁷School of Biological and Chemical Sciences, Queen Mary University of London, UK

⁸Department of Forest Resources Conservation and Ecotourism, IPB University, Indonesia

⁹Center for Conservation of Tropical Ungulates, USA

¹⁰Africa Alive, UK

¹¹Chester Zoo, UK

¹²Copenhagen Zoo, Denmark

¹³European Regional Resource Centre of the IUCN SSC Conservation Planning Specialist Group; EAZA Population Management Advisory Group

¹⁴San Diego Zoo, USA

¹⁵Surabaya Zoo, Indonesia

¹⁶Zoology Division, Resources Center for Biology, Indonesian Institute of Science

¹⁷Taman Safari Indonesia I, Cisarua, Bogor, Indonesia

¹⁸IUCN SSC Conservation Planning Specialist Group

¹⁹Faculty of Veterinary Medicine, IPB University, Indonesia

²⁰Stiftung Artenschutz (Species Conservation Foundation), Berlin, Germany

²¹IUCN SSC Wild Pig Specialist Group

*Corresponding author (c.bailey@chesterzoo.org)

Abstract

Action Indonesia is a collaborative partnership for the conservation of anoa, banteng, babirusa and Sumatran tigers. The aim of the partnership is to contribute to the conservation of these species *in situ* to prevent species extinction and to achieve genetically and demographically healthy *ex situ* insurance populations, providing future options for restoration of

wild populations. Action Indonesia uses the International Union for Conservation of Nature Species Survival Commission Conservation Planning Specialist Group (IUCN SSC CPSG) “One Plan Approach” to species conservation (Byers et al. 2013), partnering with key organisations to bring together a group with wide-ranging expertise, knowledge sharing and decision making authority to address the ongoing conservation challenges of these species. This

group consists of Indonesian government departments, national and international zoos, NGOs and research institutions. Significant achievements have been made in the past four years of the collaboration. These include working with Indonesian institutions to develop and implement breeding and transfer

recommendations for collaborative breeding of the four taxa to strengthen Indonesian *ex situ* populations. Other achievements include the creation of a global awareness-raising day for the Action Indonesia species, as well as planning and delivering education and husbandry training in Indonesian zoos and raising funds for projects supporting *in situ* populations of the species. Action Indonesia will continue to strengthen the global *ex situ* populations of these four taxa through globally aligned collaborative breeding programmes. Long-term support will be provided to increase capacity in animal husbandry, education, population management, and institutional development. We anticipate that lessons learned during this process can act as a model for expansion to other Indonesian species as well as elsewhere that require global conservation action across the *in situ-ex situ* continuum.

Conservation rationale

Anoa (*Bubalus depressicornis* and *B. quarlesi*), banteng (*Bos javanicus*), babirusa (*Babyrousa* ssp.) and Sumatran tigers (*Panthera tigris sumatrae*) are some of Indonesia's most threatened large mammals. Primary threats to these charismatic, protected species and subspecies (hereafter referred to collectively as species) include illegal hunting for trade and consumption, habitat loss and, for Sumatran tigers, de-

pleted prey base and human-tiger conflicts. The Indonesian government has listed all four species as national priority taxa that are threatened with extinction (KKH, 2015). The Sumatran tiger is listed as Critically Endangered (Linkie et al., 2008) on the IUCN Red List, with anoa (Burton et al.; 2016a, Burton et al., 2016b), Togian island babirusa (Macdonald et al., 2016) and banteng (Gardner et al., 2016) listed as Endangered and Sulawesi (Leus et al., 2016) and hairy babirusa (Macdonald et al., 2008) listed as Vulnerable.

The long-term survival of these species in the wild requires increased management intervention that includes research, protection and genetic management of populations in the wild as well as building up genetically viable *ex situ* populations to strengthen the genetic diversity of the global meta-populations. Therefore, key partners must work together to develop holistic conservation strategies for the four species and ensure that these strategies are implemented. For anoa, babirusa, banteng and Sumatran tigers it was decided that the most effective way to organise conservation interventions was to develop a Global Species Management Plan (GSMP) for each of the species, administered by the World Association of Zoos and Aquariums (WAZA). GSMPs bring together zoos, governments, and conservation organisations from multiple regions to achieve globally agreed *ex situ* and *in situ* conservation goals for a species (WAZA, 2019).

The banteng, anoa and babirusa GSMPs were initiated under the Action Indonesia name to promote these lesser known species. Since 2018, the Sumatran tiger GSMP – the longest running GSMP joined forces with Action Indo-

nesia to align the processes for governmental and organisational evaluation and approvals and endorsements of initiatives and to maximise opportunities for training, education, awareness raising and fundraising. This is the first time that multiple GSMPs have been developed as a single partnership. The Action Indonesia partnership has chosen to follow CPSG's One Plan Approach concept (Byers et al., 2013; Vanzer et al., 2018), which promotes positive conservation outcomes through building and maintaining strong national and international institutional links, sharing of knowledge and expertise between partners, and strengthening the links between *in situ* and *ex situ* organisations.

Development of the Action Indonesia partnership

Starting with the first planning workshop in January 2016, Action Indonesia has evolved into a global partnership of organisations, with representatives from Indonesia, Europe and North America (Leus et al., 2017), driven by the IUCN SSC Asian Wild Cattle Specialist Group (AWCSG). By following the GSMP concept, the partners produced a masterplan in

2016 to guide conservation interventions and activities for anoa, banteng and babirusa. This masterplan was developed using the *IUCN SSC Guidelines for the Use of Ex situ Management for Species Conservation* (IUCN, 2014), and is aligned to the priorities described in the Indonesian National Species Conservation Strategy and Action Plans (SRAK) for these taxa (Ministry of Forestry Indonesia, 2014a; Ministry of Forestry Indonesia 2014b; Ministry of Forestry Indonesia, 2012). Among the top priorities identified by partners were to facilitate husbandry and education skills sharing, and draft the first ever breeding and transfer recommendations for anoa, banteng and babirusa in Indonesian zoos. The second Action Indonesia planning workshop took place in February 2018, and the Sumatran tiger GSMP was invited to join (Fig.1). The workshop was attended by 91 participants from 50 institutions, including Indonesian, European and US zoos as well as NGOs, universities and the Indonesian Ministry of the Environment and Forestry (KLHK). During this phase, a second three-year masterplan was developed.

The complexity of this programme and the collaborative working entails that many steps over



Figure 1: Participants of the second GSMP Planning Workshop, February 2018. Photo: PKBSI

activities to the long-term aim on a strategic level. A Theory of Change process was used to develop a monitoring framework to guide activities (Weiss, 1995). In addition to identifying and prioritising activities that address threats to the species, the framework acts as a tool for monitoring and evaluating progress. Since 2018, nine thematic working groups (WGs) have been implementing sets of activities described in the monitoring framework. These WGs consist of experts from partner organisations that volunteer their time and skills, often representing all three regions involved. Partner organisations are defined as a) those whose staff provide technical advice, b) whose staff participate in planning and training or c) organisations that donate funds for activities, or d) organisations conducting breeding and transfers according to recommendations. The number of partner organisations has increased greatly in the past four years, growing from 29 in 2016 to 51 partners in 2020. The greater number of partners is due to many Indonesian zoos subscribing to the GSMP concept and following the breeding recommendations, as well as the increased awareness about the GSMP species and programme.

In addition to the implementing partners, there are six organisations that make up the organisational partners for the ungulate GSMPs: European Association of Zoos and Aquariums (EAZA), Association of Zoos & Aquariums (AZA), Indonesia Zoo and Aquarium Association (PKBSI), IUCN SSC, AWCSG, and IUCN SSC Wild Pig Specialist Group. These partners also are the signatories of a five-year MOU describing the partnership in Indonesia, signed and witnessed by the Indonesian Ministry of

Environment and Forestry in 2014, and then extended for a further five years in 2019.

The coordination of the WGs and alignment to the monitoring framework is carried out by PKBSI and the AWCSG, as well as leaders of each WG. PKBSI leads on the planning and implementation of many of the activities. In PKBSI, strategic direction is provided by the Board and thematic divisions (1. Conservation, 2. Education and Training and 3. Organisation, Law, Membership, and Research). Implementation of activities is conducted by the PKBSI-GSMP Programme Officer (50% time working on GSMP activities) and the Board and divisions.

Alignment of the Sumatran tiger GSMP and the Action Indonesia GSMP:

The Sumatran tiger GSMP collaborates closely with the Action Indonesia activities; however, this GSMP was initiated much earlier. The Sumatran tiger GSMP was established in 2008, based on the Tiger Global Animal Survival Plan developed in 1992 by the IUCN SSC Conservation Breeding Specialist Group (now known as CPSG) and subsequent international *in situ* collaborations in Indonesia. The partners for the Sumatran tiger GSMP include EAZA, AZA and PKBSI as well as the Zoo and Aquarium Association Australasia (ZAA), Japanese Association of Zoos and Aquariums (JAZA), and CPSG. Sumatran tiger GSMP meetings were held in 2010, 2012, and 2016 to assess *ex situ* conservation contributions for Sumatran tigers using the *IUCN SSC Guidelines for the Use of Ex situ Management for Species Conservation* (IUCN, 2014) and to make breeding and transfer recommendations

to meet these programme goals.

Achievements

One of the Action Indonesia partnership's main achievements is the realisation of a strong partner network that raises greater interest in the species and implements priority activities more effectively working collaboratively than institutions working in isolation of each other. An additional principal achievement has been the international support to PKBSI in access to resources, funding support for selected activities, and strategic planning. This has led to the development of greater capacity within PKBSI that is in turn delivering more leadership and support to Indonesian zoos. An example of this includes the enrolment of the PKBSI GSMP Programme Officer in the IUCN CPSG Mentoring Program to support the development of his skills in facilitation and conservation planning. There also has been a lot of learning by European and North American colleagues from our Indonesian partners.

Understanding differences among regions and institutions has been essential to the GSMPs' development. Over the past four years, we have learned to work together and be flexible to the variations in our timeframes, resources and the speed at which things happen in our collaborative approach. Regular communication and coordination without an overly rigorous structure has helped to encourage and foster participation with the GSMPs.

Ex situ:

A primary aim of the Action Indonesia GSMPs is to achieve healthy backup *ex situ* populations for each species. This is particularly im-

portant for Indonesian zoos, as they have a number of founder animals, whose genetics are underrepresented in the Indonesian and global zoo population. National target sizes for *ex situ* populations of anoa, banteng and babirusa were developed within Indonesia during the planning workshop in 2016, and have also been established for the Sumatran tiger population (Table 1). Achieving these target population sizes requires population management, including maintaining accurate studbook data, cooperative breeding and the development of breeding recommendations for the Indonesian zoo population.

Cooperative breeding is a method of *ex situ* management that focuses on building relationships among participating institutions to help everyone meet their needs and for the goal of healthy self-sustaining populations. This enables the species to be managed at the population level rather than at the institution level. Cooperation involves making your animal collection available and providing data to make recommendations on breeding often necessitating transferring animals between zoos. This is a new process for Indonesia, which requires a strong commitment from participating institutions to follow breeding recommendations in their own facilities and transfer animals among institutions for *ex situ* conservation. In order to do this effectively, institutions and governing bodies need to commit to a significant change in perspective towards working together. A significant financial input is required to transfer animals, and in some cases zoos do not own and keep one animal for its entire lifespan, but commit to working together with other institutions to improve the health of the population,

rather than focusing on a single animal. Facilitating cooperative breeding in Indonesia also requires the development of new administrative procedures to enable the completion of effective and efficient animal transfers in line with recommendations. PKBSI is developing new processes to align with cooperative breeding and working closely with the Directorate of Biodiversity Conservation (KKH), Directorate General of Natural Resources and Ecosystem Conservation (KSDAE), Ministry of Environment and Forestry of Indonesia to allow animal transfers to happen as effectively as possible. Continued support from PKBSI, KSDAE and the GSMPs will help to facilitate more transfers in the future.

A key milestone towards the *ex situ* aim of Action Indonesia was the development of two sets of breeding and transfer recommendations for the ungulate species in 2016 and 2018. The recommendations were developed and agreed collaboratively during the large planning workshops. So far, recommendations have resulted in 30 recommended births in Indonesian institutions (at the time of writing), including nine anoa, 17 banteng, and four babirusa (e.g. Fig. 2). New recommended births are important steps forward in the goal of achieving genetically diverse global *ex situ*

Table 1: Indonesian National *ex situ* cooperative breeding targets and the current *ex situ* population of anoa, banteng and babirusa.

Species	Current population (Nov 2020)	Target
Banteng	86	100
Anoa	37	75
Babirusa	75	100
Sumatran tiger	103	140



Figure 2: Anoa calf, born at Surabaya Zoo in July 2020 following GSMP breeding recommendations. Image: Surabaya Zoo

populations and reaching national population size targets (Table 1). It is recognised that an increase in breeding efforts will take time to happen, as zoos become familiar with the cooperative population management approach and identify how they can increase space to hold offspring of the GSMP species.

The Sumatran tiger GSMP has also demonstrated progress in implementing breeding and transfers in PKBSI zoos in recent years. Population goals for the PKBSI Sumatran tiger population are to maintain at least 90% gene diversity for 100 years with a population of ~140 managed tigers (Table 1). A short-term goal is to increase Zoo reproduction to stabilize the age structure of the population and prevent decline and to breed potential founders. Five of the six breeding recommendations made in 2016 had been attempted by the February 2018 meeting, 15 months later. Since then, seven litters have been born (14 births, 8 still living). Other recommended breedings have been attempted, but some are on hold waiting for institutional transfers to be approved. Similarly, although there has been positive progress with some

ungulate transfers completed under the collaborative breeding ethos, other transfers are still in process or delayed.

Supporting the development and implementation of cooperative breeding processes is an ongoing activity of the Action Indonesia GSMPs, and it is acknowledged that the socialisation, administration and implementation of cooperative breeding will take time to achieve successfully

Genetics:

One of the most important long-term threats to the survival of the GSMP species is the loss of genetic diversity, a common issue in endangered large mammal species (Lacy, 1997). Tigers generally have low genetic diversity (Luo et al. 2004), and recent work on anoa and Sulawesi babirusa suggests that they have lost a significant amount of genetic diversity in the wild over the last few hundred years (Frantz et al. 2018). Due to the alarming threats to the survival of the GSMP species, *ex situ* populations have become important backup populations, should the wild populations need future supplementation. In order to serve as backup populations, effective *ex situ* population management is needed to preserve genetic diversity representative of that of the wild populations. To achieve this goal there is a need for genetic analyses of both *ex situ* and *in situ* populations. This is where the fruitful collaboration of the Genetics WG between Indonesian and international partners comes into play, fostering knowledge sharing and technical capacity.

PKBSI has developed a collaboration with the Indonesian Institute of Science (LIPI) to sam-

ple the founder animals of the PKBSI member zoo populations of anoa, banteng and babirusa. The genetic diversity of the Sumatran tiger *ex situ* population may be assessed in future. Once samples have been collected, international GSMP partners will provide support to Indonesian scientists to develop the skills necessary for the genetic analyses, empowering Indonesian scientists to utilise these skills in the future with other species. Verified and accurate studbook data are needed to assess genetic status of zoo populations in order to set management goals to preserve gene diversity in *ex situ* populations for some of the GSMP species.

Husbandry:

Maintaining a high standard of husbandry and animal care is essential to zoo management and to the success of cooperative breeding efforts and *ex situ* conservation of the GSMP species. Extensive on-site husbandry and veterinary training efforts were conducted in 1992-1995 for Sumatran tigers in Indonesian zoos (Tilson et al. 1997, 2001); however, staff have changed since then and further training may be required.

Training workshops were designed by Action Indonesia to build capacity, optimise husbandry and to facilitate successful cooperative breeding practices within Indonesian zoos. During three workshops in 2017, 53 participants gained skills in the husbandry and transportation of anoa, babirusa and banteng, which they have been able to use in their own institutions. Further, in a 2018 workshop, 32 participants built their capacity in enclosure design and collection planning. This workshop

familiarised PKBSI zoos with the processes that ensure that there is more space available for healthy *ex situ* populations of anoa, banteng, babirusa, Sumatran tigers and other priority species. Pre- and post-training surveys have been used to monitor the effectiveness of the training and to help to identify areas of future training. Tailored advice and guidance has also been delivered through zoo visits to 17 zoos, which have included on-site discussions and follow-ups with keepers, curators, vets and directors. This combination of formal workshop and more informal, tailored in-person advice has been successful in increasing the reach of the capacity building efforts to give broad training as well as specific input to many zoos that may not have joined the workshops.

Virtual husbandry training webinar sessions have been trialled in 2020 as a response to the Covid-19 pandemic and are being delivered by experts and practitioners from PKBSI and the GSMPs. This continued global collaboration demonstrates the motivation of GSMP mem-

bers to adapt and progress with the husbandry training. Thus far, the virtual training sessions have had high participation, with up to 76 participants from up to 33 institutions attending per session. A range of participants have joined the webinars, including zookeepers, vets, curators, managers and directors. Pre- and post- questionnaires to participants have demonstrated an overall increase in knowledge during the sessions (Fig. 3). The virtual training sessions will be available to Indonesian zoos in the future and will be a valuable resource in the development of a sustainable, more widely accessible and cost-effective husbandry training programme. The range of husbandry topics taught will be part of a framework of learning, as a comprehensive zoo professional training programme is developed by PKBSI.

A further ongoing achievement of the GSMP Husbandry Working Group and PKBSI is the development of comprehensive husbandry

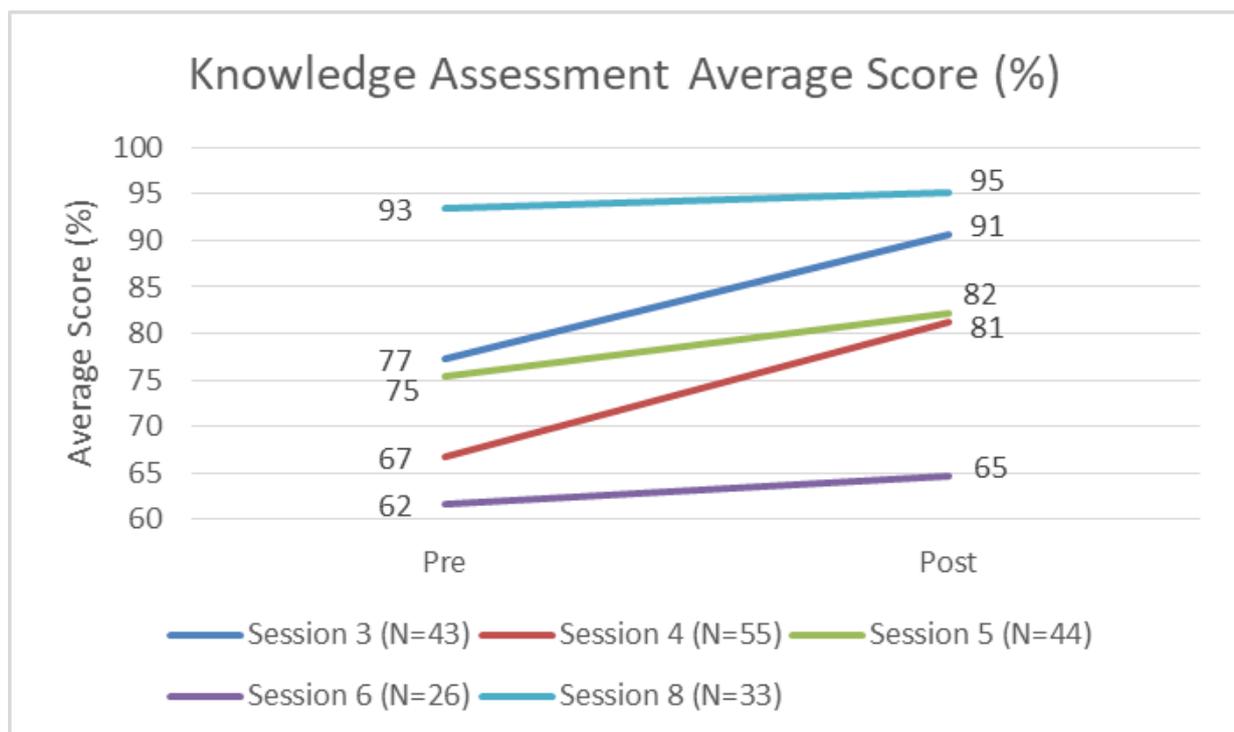


Figure 3: Average percentage score achieved in the pre- and post- knowledge questionnaires for each session (1-8)

guidelines for banteng, anoa, and babirusa in Bahasa Indonesia to support the improvement and standardisation of zoo practices for these species. These guidelines are being developed as a manual, along with other resources that can be used by all zoo staff for their daily husbandry care. A care manual for Sumatran tigers in Bahasa Indonesia was provided as part of the 1990s training but would benefit from being updated.

In situ:

Effective population monitoring of *in situ* populations of the GSMP species is essential to increasing knowledge of population sizes and trends, helping to identify potential threats to the population and informing conservation actions.

In early 2019, the banteng GSMP, PKBSI and Alas Purwo National Park – a priority location for banteng conservation in East Java – agreed to collaborate on a monitoring project for Javan banteng. The project will begin in

2020, with the objective to provide longitudinal data of banteng population density of at least four years to inform future management in Alas Purwo National Park. The data will also inform future conservation planning at a Conservation Strategy and Action Plan (SRAK) Population and Habitat Viability Assessment (PHVA) workshop.

Another priority area for banteng conservation is Baluran National Park (NP) in East Java. Until 30 years ago, it was by far the main stronghold, being home to almost 300 banteng. Due to habitat loss and extensive poaching, the population decreased to approx. 20 individuals in 2012. In 2013, the Directorate of Biodiversity Conservation (KKH) and Copenhagen Zoo commenced on a joint project to restore Baluran NP to its original ecological condition, including restoring the park's banteng population. An extensive camera trapping monitoring system was set up in 2014 covering the entire park. The system delivers annual population trends and sizes and detects the magnitude of



Figure 4: A Baluran staff team effort, with the Baluran NP vet Rudi Anisa darting her first ever banteng for collaring and genetic sampling. Image credit: Copenhagen Zoo / Baluran National Park



Figure 5: Guiding an adult anoa during the Anoa and Babirusa Rescue Training in Makassar

the poaching in the park too. These data are essential for the park management to address habitat restoration and anti-poaching activities. In 2018, the Baluran NP management and Copenhagen Zoo team became the first ever to sedate a wild Javan banteng and fit it with a GPS-radio-collar (Fig. 4). To date, nine wild banteng have been fitted with a GPS-collar and they form part of a long-term study about banteng ecology.

With the added vigilance in Baluran NP, the banteng population has increased to 70-80 individuals in 2019 (Traeholt pers. comm.). In 2016, Baluran NP was declared as the national banteng conservation breeding centre. Basic breeding facilities were set up and the first three banteng were transferred from Taman Safari Indonesia in 2016. Currently, Copenhagen Zoo and Baluran NP are looking into developing a dedicated banteng breeding and rehabilitation plan.

In the recent years, we achieved a greater understanding of how zoo expertise can be trans-

ferred to support *in situ* projects, for example through providing husbandry training in which 29 participants learned to improve the handling and health assessment of rescued and confiscated anoa and babirusa in Sulawesi (Fig. 5). The GSMPs and PKBSI also aim to provide KKH with recommendations about how to implement an island-wide strategy for the management of rescued anoa and babirusa with a network of transit centres at KSDA offices. The GSMP has also supported *in situ* work through providing small grants to projects carrying out conservation and awareness raising activities in Sulawesi. An example of this includes supporting a survey on Buru island in 2017 that confirmed the presence and some biological traits of babirusa on the island (Macdonald & Pattikawa, 2017).

Education:

Effective conservation education has been shown to increase knowledge of species and conservation (Nekaris et al. 2017) and can influence public behaviour through fostering

connectedness to nature and sense of environmental responsibility (Ancrenaz et al. 2018; Van den Born et al. 2017). The Education Working Group aims to increase global awareness and support for conservation and to build capacity to deliver conservation education for these species in Indonesia. The education programme of activities was developed with the involvement of educators from AZA and EAZA institutions, and from a survey of Indonesian zoo educators carried out in 2016. This foundation of understanding about education being delivered by Indonesian zoos established the resource and capacity building requirements for raising awareness of the target species. Over the last four years, an educational toolbox of resources and materials has been developed to support zoo educators and others engaged in educating about these species in the design and delivery of their education programmes: actionindonesiagsmp.org/educate.

Through multiple training sessions and workshops over the last four years, 67 participants have gained skills in conservation education,

which has helped to build a global network of zoo educators that are sharing materials and ideas to improve their engagement of visitors.

In 2019, the Education WG developed an annual global awareness raising day 'Action Indonesia Day', to maximise education efforts and communication about the species and their conservation. This was a major achievement in raising awareness and in the collaboration between regions. Over 40 organisations across four continents got involved for a day of events and activities to connect people to anoa, banteng and babirusa and raise awareness about the global efforts to conserve them. The events held in zoos, and posts on social media (searchable with the #ActionIndonesiaDay hashtag), helped to increase the profile of these largely unknown and under-appreciated threatened taxa. Many participants utilised the educational resources available to download from the Action Indonesia website, with some zoos also using the day as an opportunity for fundraising (Figs. 6 and 7).



Figure 6 (left): Action Indonesia Day signage at Bandung Zoo. Image: James Burton.



Figure 7 (right): Action Indonesia Day Activities at Bali Safari & Marine Park. Image: TSI Bali Safari

It was particularly successful in that there were 22 Indonesian organisations involved in Action Indonesia Day 2019. This is a positive indicator of the strong engagement of Indonesian institutions with the GSMPs. This year, as engagement in many zoos was challenging due to Covid-19, Action Indonesia Day was held virtually, with over 30 institutions from three continents sharing their animal facts, images, keeper talks and other content on social media.

Looking ahead

In the next five years, we aim to reach the national *ex situ* population targets for the three ungulate taxa in Indonesia. This will then mean that a more integrated global population can be developed, through transfers between regions to maximise the genetic diversity across all regions. The Sumatran tiger GSMP already is collaborating internationally and currently is focusing on improving the demographic and genetic health of the PKBSI population. These targets need to be supported by demonstrable improvements in welfare standards and husbandry expertise. For *in situ* populations further focused planning is needed, underpinned by reliable data on population trends and threats. Action Indonesia will support this for at least one population for each of the ungulate species, and we hope that local or international partners can cover other key populations. Greater awareness of these species and change in behaviour of key groups should be achieved through targeted awareness raising activities using social marketing approaches to mitigate the threats to the species.

In the coming two years we will plan and implement the third set of breeding and transfer rec-

ommendations for the ungulate taxa. In parallel, we will also work with specific Indonesian zoos to discuss how they can maximise their capacity to hold larger populations of GSMP species, so that they can continue to conduct breeding. We hope that permissions for zoos to start DNA sampling for the PKBSI-led genetic assessment on zoo populations is granted from the Ministry of Environment and Forestry and that sampling can begin in 2021. We plan to continue with webinar husbandry training courses for Indonesian zoos within a wider training framework developed with PKBSI. We are excited to continue holding annual Action Indonesia Day events to raise awareness globally. We are also planning more *in situ* activities, including supporting outreach about GSMP species in Sulawesi, with the aim to promote behaviour change to protect babirusa and anoa from illegal hunting for consumption and trade.

The considerable awareness of the GSMP framework in Indonesian conservation community means that there is a strong opportunity to expand this to include additional Indonesian species that require *in situ* and *ex situ* efforts. This should be done once the current objectives are well underway, capacity is in place and processes are working effectively. We recommend that the process for developing a more coordinated One Plan approach to conservation of any species should begin with following the decision-making framework outlined in the IUCN SSC *Guidelines on the Use of Ex situ Management for Species Conservation* (IUCN SSC, 2014).

There has been strong involvement from many zoos and other conservation organisations to

date, and Action Indonesia has benefited hugely from all the support provided. We hope that this network of partners will grow further with more organisations offering their support through breeding the species, sharing their expertise and skills in husbandry and education, or contributing funds or technical expertise to the *in situ* projects. We have made major progress since 2016 and all partners and individuals should be proud of what has been achieved through collaboration. We rely on all the partners' continued support to deliver the amount of work that still needs to be done over many more years. Together, we can achieve our aim of stable and healthy populations of banteng, anoa, babirusa and Sumatran tigers.

References:

- Ancrenaz, M., Barton, C., Riger, P. & Wich, S.A. 2018. Building relationships: how zoos and other partners can contribute to the conservation of wild orangutans. *International Zoo Yearbook*, 52. ISSN 0074-9664
- Burton, J., Wheeler, P. & Mustari, A. 2016a. *Bubalus depressicornis*. The IUCN Red List of Threatened Species 2016: e.T3126A46364222. Downloaded on 30 August 2020.
- Burton, J., Wheeler, P. & Mustari, A. 2016b. *Bubalus quarlesi*. The IUCN Red List of Threatened Species 2016: e.T3128A46364433. Downloaded on 30 August 2020.
- Byers O., Lees C., Wilcken J. & Schwitzer C. 2013. "The 'One Plan Approach': The philosophy and implementation of CBSG's approach to integrated species conservation planning." *WAZA Magazine* 14: 25.
- Frantz, LAF., Rudzinski, A., Nugraha, AMS., Evin, A., Burton, J., Hulme-Beaman, A., Linderholm, A., Larson, G., et al. 2018. Synchronous diversification of Sulawesi's iconic artiodactyls driven by recent geological events. *Proceedings of the Royal Society B: Biological Sciences*, 285 (1876), DOI: 20172566. 10.1098/ rspb.2017.2566 .
- Gardner, P., Hedges, S., Pudyatmoko, S., Gray, T.N.E. & Timmins, R.J. 2016. *Bos javanicus*. The IUCN Red List of Threatened Species 2016: e.T2888A46362970. Downloaded on 30 August 2020.
- IUCN SSC. 2014. Guidelines on the Use of *Ex situ* Management for Species Conservation. Version 2.0. Gland, Switzerland: IUCN Species Survival Commission.
- IUCN 2020. The IUCN red list of threatened species. Version 2020. Available at: <http://www.iucnredlist.org> [Date accessed: 27 July 2020]
- Lacy, R. C. 1997. Importance of genetic variation to the viability of mammalian populations. *Journal of Mammology*, 78(2):320-335
- Leus, K., Holland, J., Nugroho, J., Semiadi, G., Sumampau, T., Kauffels, T., Mustari, AH., Meijaard, EE., Burton, J. & RodeMargono, J. (2017). Global collaboration to conserve three threatened Indonesian animal taxa: Babirusa, Anoa and Banteng. *Suiform Soundings* 15(1) 27-31.
- Leus, K., Macdonald, A., Burton, J. & Rejeki, I. 2016. *Babyrousa celebensis*. The IUCN Red List of Threatened Species 2016: e.T136446A44142964. Downloaded on 30 August 2020.
- Linkie, M., Wibisono, H.T., Martyr, D.J. & Sunarto, S. 2008. *Panthera tigris ssp. sumatrae*. The IUCN Red List of Threatened Species 2008:

- e.T15966A5334836. Downloaded on 30 August 2020.
- Luo S-J., Kim, J-H., Johnson, WE., Walt, Jvd., Martenson, J., Yuhki, N. et al. 2004 Phylogeography and Genetic Ancestry of Tigers (*Panthera tigris*). PLoS Biol 2(12): e442. <https://doi.org/10.1371/journal.pbio.0020442>
- Macdonald, A.A., Burton, J. & Leus, K. 2008. Babirusa babyrussa. The IUCN Red List of Threatened Species 2008: e.T2461A9441445. Downloaded on 30 August 2020.
- Macdonald, A., Leus, K., Masaaki, I. & Burton, J. 2016. Babirusa togeanensis. The IUCN Red List of Threatened Species 2016: e.T136472A44143172. Downloaded on 30 August 2020.
- Macdonald, A. & Pattikawa, M. 2017. Babirusa and other pigs on Buru Island, Maluku, Indonesia. Suiform Soundings 16 (1), IUCN/SSC Wild Pig, Peccary and Hippo Specialist Groups
- Ministry of Forestry Indonesia. 2014a. Strategy and Action Plan for Anoa Conservation 2013-2022. Indonesian Ministry of Environment and Forestry. pp. 50. https://www.asianwildcattle.org/uploads/1/2/1/8/121825577/strategy_and_action_plan_for_anoa_conservation_2013-2022_english.pdf [Date accessed: 27 July 2020]
- Ministry of Forestry Indonesia. 2014b. Strategy and Action Plan for Babirusa Conservation 2013-2022. Indonesian Ministry of Environment and Forestry. pp. 48. https://www.asianwildcattle.org/uploads/1/2/1/8/121825577/strategy_and_action_plan_for_babirusa_conservation_2013-2022_english.pdf [Date accessed: 27 July 2020]
- Ministry of Forestry Indonesia. 2012. Strategy and Conservation Action Plan for the Banteng (*Bos javanicus*) Conservation 2010 to 2020. Indonesian Ministry of Forestry. pp. 46. https://www.asianwildcattle.org/uploads/1/2/1/8/121825577/strategy_and_action_plan_for_banteng_conservation_2010-2020_english_final.pdf
- Nekaris, K., McCabe, S., Spaan, D., Imron Ali, M. & Nijman, V. (2018). A novel application of cultural consensus models to evaluate conservation education programs. Conservation Biology 32(2): 466-476.
- Tilson R., Manansang J., Traylor-Holzer K., Brady G., Armstrong D., Byers O., & Nyhus P. 2001. Training, transferring technology, and linking *in situ* and *ex situ* tiger conservation in Indonesia. AZA Field Conservation Resource Guide. Association of Zoos and Aquariums: Silver Springs, MD, USA.
- Tilson, R., Siswomartono, D., Manansang, J., Brady, G., Armstrong, D., Traylor-Holzer, K., Byers, A., Christie, P., Salfifi A, Tum belaka L, Christie S, Richardson D, Reddy S, Franklin N, & Nyhus P. 1997. International co-operative efforts to save the Sumatran tiger. International Zoo Yearbook 35: 129-128.
- Traylor-Holzer K, Leus K & Byers O. 2018. Integrating *ex situ* management options as part of a One Plan Approach to species conservation. in: Minter BA., Maienschein J., Collins JP. (eds.) The Ark and Beyond. University of Chicago Press, Chicago.
- Van den Born, R.J.G., Arts, B., Admiraal, J., Beringer, A., Knights, P., Molinario, E., Horvat, K.P, Porrás-Gómez, C., Smrekar, A., Soethe, N., Vivero-Pol, J.L., Ganzevoort, W.,

Bonaiuto, M., Knippenberg, L. & De Groot, W.T. 2018. The missing pillar: Eudemonic values in the justification of nature conservation. *Journal of Environmental Planning and Management* 61(5-6): 841-856.

World Association of Zoos and Aquariums 2019. Global Species Management Plans (GSMP) Fact Sheet. [https:// www.waza.org/wp-content/uploads/2019/02/2019-GSMP-Fact-Sheet.pdf](https://www.waza.org/wp-content/uploads/2019/02/2019-GSMP-Fact-Sheet.pdf) [Date accessed: 27 July 2020]

Weiss, C. H. 1995. Nothing as practical as good theory: exploring theory-based evaluation for comprehensive community initiatives for children and families. Pages 65-92 in J. P. Connell, J. L. Aber, and G. Walker, editors. *New approaches to evaluating community initiatives: concepts, methods, and contexts*. Aspen Institute, Washington, D.C., USA.