

QUARTERLY PUBLICATION OF THE EUROPEAN ASSOCIATION OF ZOOS AND AQUARIA

# ZOOQUARIA

SUMMER 2023

ISSUE 118



## Digesting the data

How research is the key to conservation success



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**KEY: a quick guide to frequently used acronyms**

- CITES:** Convention on International Trade in Endangered Species
- EEP:** EAZA Ex situ Programme
- IUCN SSC:** International Union for Conservation of Nature Species Survival Commission
- LTMP:** Long-term Management Plan
- RCP:** Regional Collection Plan
- TAG:** Taxon Advisory Group
- ZIMS:** Zoological Information Management System

Zooquaria

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## FROM THE DIRECTOR'S CHAIR

As a self-confessed data geek, I am delighted to share with you this special research-focused issue of *Zooquaria*. Throughout my career I have had to reconcile that I am not precise enough in the laboratory (too much 'bucket-chemistry' technique), not suited to fieldwork (early mornings required to track most animals are never my best times) or indeed zoo work (despite many attempts during my employment, I never could correctly identify all the individuals in the Chester Zoo chimpanzee group!) and thus becoming a true research scientist was not for me. Instead, I transferred my interest into teaching research skills to students, avidly consuming research articles, and talking about the outcomes of research wherever possible.

One of the ways in which we disseminate research at EAZA is via our conferences. You can read articles about the EAZA Conservation Education Conference on page 9 and Directors' Days on page 8. I was absolutely delighted by the amount of data presented by our Directors' Days keynote speaker, Colleen Dilenschneider from IMPACTS Experience – and equally pleased by all the different Directors who asked her questions about things such as sample size, techniques and for even more data than was shared! Colleen's data provided excellent evidence that efforts by zoos and aquariums to reach audiences during COVID-19, especially when combined with good examples of their conservation work, have resulted in increasing levels of trust in scientific messaging, and that people feel that zoos and aquariums are important, educational, immersive, world-class places that are a source of civic pride. This is just one example of how important evidence-based research is, and how it can productively inform our decision-making.

I would also like to highlight the relevance of the EU Zoos Directive (Directive 199/22/EC) when it comes to promoting research. Most of you know that this legislation aims to protect wild species by strengthening the role of zoos and aquariums in the conservation of biodiversity. The majority of EAZA Members are licensed by authorities implementing this legislation, and Member States have developed licensing systems to ensure zoos and aquariums respect certain conservation measures, including taking part in research from which conservation benefits accrue to the species. Results of an evaluation of the EU Zoos Directive shared at the end of 2018 show that 'zoos are involved in many different research topics that frequently indirectly benefit conservation'; however, it also stated that 'the extent to which zoos carry out research is hard to quantify' and thus 'the overall conservation impact of zoo research is impossible to judge on the basis of available evidence.'

Even before the results of this evaluation, EAZA was working on addressing concerns relating to research evidence. When developing our open access [Journal of Zoo](#)

[and Aquarium Research \(JZAR\)](#), we strongly believed that it should not only serve to widely share research results, but also provide a place where research could be collated and used to demonstrate our evidence-based impact across a variety of fields. The joint EAZA and VdZ initiative in launching the Zoo Science Library (see page 24) is a perfect accompaniment to JZAR to further extend and quantify the considerable amount of zoo and aquarium research that is being carried out.

The EAZA Research Standards lay out our expectations for research activities. Members are subsequently assessed against the Standards as part of the EAZA Accreditation Programme, and this also helps to guide and quantify research activities. I will take the opportunity to emphasise once again the value of Members adding data to the [EAZA Conservation Database](#). Data can be categorised according to the seven areas identified in the [EAZA Guidelines on the definition of a direct contribution to conservation](#). One of these areas is Research, and thus we can pull this specific data from the database to help evidence our work and answer questions from politicians or authorities regarding the research activities of zoos and aquariums.

All of this is well and good; however, there is a bit of a contradiction in society where zoos and aquariums are called upon with increasing frequency to back up their activities and decisions with research, yet when such evidence is provided it is often undermined or ignored. People often rely on more emotional messaging as truth, disregard facts as 'fake news' or think that having a social media account means that they are a qualified 'expert'. Combating these aspects and presenting research in a trusted and accessible way is hard, but that doesn't mean we should stop. Now more than ever we need to intensify our research activities across animal and social sciences and beyond. We need to fully expand the 'with you' aspect of our EAZA vision to be 'Progressive zoos and aquariums saving species with you' and embrace partnerships with universities and other stakeholders. In this way we will ensure that good research continues to inform understanding and decision-making in our zoos and aquariums, and across the whole of society.

**Myfanwy Griffith**  
Executive Director, EAZA

# NOTICEBOARD

## EAZA SPRING COUNCIL AND AGM

EAZA Directors' Days conference took place in April (see page 8). The conference included a meeting of EAZA Council and the Annual General Meeting (AGM) of the Association.

## COUNCIL DECISIONS

EAZA Council approved the following membership decisions:

## NEW MEMBERS

### Full Membership

Dierenpark Zie-ZOO, the Netherlands

### Temporary Membership to Full Membership

Río Safari Elche, Spain; Zoo delle Maitine, Italy

### Temporary Membership

Sofia Zoo, Bulgaria; Parc de l'Auxois, France

### Corporate Membership

Zigong Lantern Group; ArtSystemDeco; Magic Memories; Fahlo; Fame Media Tech; MAT Filtration Technologies; Reynolds Polymer Technology

## EAZA ACCREDITATION PROGRAMME

### Accreditation and continuing Full Membership

Chomutov Zoo, Czechia; Łódź Zoo, Poland; Wuppertal Zoo, Germany; Osnabrück Zoo, Germany; Twycross Zoo, UK; Zoo des Sables d'Olonne, France; Punta Verde Zoo, Italy; Heidelberg Zoo, Germany; Mulhouse Zoo, France; Colchester Zoo, UK; Welsh Mountain Zoo, UK; Knowsley Safari Park, UK; Darmstadt Vivarium, Germany

### Temporary Membership to Full Membership

Ueckermünde Zoo, Germany; Poznań Zoo, Poland

### Temporary Membership

Eberswalde Zoo, Germany; Walsrode Birdpark, Germany

## DISCONTINUING MEMBERS

Aïn Sebaâ Zoo, Morocco; Skopje Zoo, North Macedonia; Romanian Zoo and Aquaria Federation, Romania (RZAF); Eurogames; Mazuri Europe; Wisbroek

Council also approved the following documents:

- [EAZA Guidelines to Managing Operations to Reduce Your Environmental Footprint](#)

- [Updates to EAZA Management Euthanasia/Culling Statement](#)
- [EAZA/EAZWV Position Statement: Application of the Veterinary Medicines Cascade in relation to zoological species](#)

## AGM DECISIONS

Members approved updates to the following two documents:

- [EAZA Code of Ethics and Conduct](#)
- [EAZA Conservation Education Standards](#)

Work was ongoing to finalise the 2022 accounts and audits. These will be shared with Members in due course.

There was inclusive discussion about the proposed 2024 and 2025 budgets and associated models for a membership fee increase. The increase was recommended in order to bring the Association out of the recent deficit years related to COVID-19, address increased costs due to the energy crisis and support additional new costs relating to the activities and staffing required to aid the successful continuation of the ambitions of the EAZA Strategy 2021–2025. The Members approved option 1 as presented in the meeting documents and a fee change will be implemented across 2024 and 2025. Please contact the EAZA Executive Director if you require more information.

The AGM also received a report on the activities of the EAZA Ukraine Zoos Emergency Fund, detailing how the donations of more than €1.9 million have been used to support 24 organisations in Ukraine over the past 14 months. You can find more information about the Fund and how to donate on [www.eaza.net](http://www.eaza.net).

## EAZA BOOK AUCTION

When the EAZA Executive Office relocated, we sadly did not have enough space for our extensive book collection. An auction of 793 books will take place in the Klaus Schüling bookshop in Münster, Germany, and via online bids, on 22 July. Klaus has held auctions of books for the international zoo community for more than 25 years and we are grateful for his help. Proceeds raised will go to the EAZA Ukraine Zoos Emergency Fund.

## EAZA CORPORATE MEMBERS

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Africa Style  
Animals Concept  
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Arie Blok Animal Nutrition/Kasper Faunafood  
ArtSystemDeco  
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Zigong Lantern Group  
Zoological Adviser  
Zoologistics  
Zooprofs

The full catalogue can be found at: [www.tiergarten.com/auktionen](http://www.tiergarten.com/auktionen).

## FIFTH JOINT TAG CHAIRS MEETING

This meeting will be hosted by RZSS Edinburgh Zoo, UK, from 6 to 9 May 2024, with parallel TAG meetings on 6 and 7 May. The meeting is aimed at TAG Chairs, TAG Vice Chairs and colleagues from around the world in equivalent positions who play an active role in Regional Collection Planning. Previous meetings provided an opportunity to share ideas and connect with other stakeholders from organisations such as IUCN, the IUCN Specialist Groups and Species360. More information will be available soon on the events page of the EAZA website.

## NEW ARRIVALS



© PRAGUE ZOO

## FIRST PANGOLIN BIRTH AT PRAGUE ZOO

PANGOLINS ARE EXTRAORDINARILY DIFFICULT MAMMALS to keep, and although many European zoos – including Prague – had repeatedly imported both the African and Asian species, the zoos have never managed to keep them for long. The births of young have always been a matter of coincidence, as the females were imported already pregnant, and no offspring were successfully raised. The long-term keeping of pangolins in Europe has only recently been successful at Leipzig Zoo (Germany).

Prague Zoo (Czechia) obtained a pair of Taiwanese pangolins from Taipei Zoo (Taiwan) in April 2022. Intensive communication with colleagues from Taipei preceded their arrival, which resulted in fundamental adjustments being made to the nocturnal exhibit in the Indonesian Jungle House. Not only did it require the creation of a larger space and the building of artificial burrows, but also we adjusted the temperature, increased the humidity and provided the best possible lighting and finishes to the surfaces. In addition, our keeper David Vala learned how to prepare the feeding mixture for pangolins combining the experience of colleagues from Leipzig Zoo and experts from Taipei Zoo. The suitable substitute food that replaces ants and termites is the key factor in providing pangolins with the best care. The slightly modified recipe, which we use in Prague Zoo, consists of frozen bee larvae supplemented by mealworm larvae, detoxifying clay, chitin and other components.

After their arrival at our zoo, the

pangolin couple adapted well, and on 15 June 2022 we recorded mating for the first time. David trained the female to lean on a special bar made for her during feeding so she could undergo an ultrasound examination. That confirmed her pregnancy on 7 October.

The young was born on 2 February 2023 and its postpartum weight (without the umbilical cord) was 113.5 g. Although the mother showed interest in it and the young tried to suck, it was not gaining weight. Based on advice from Taipei Zoo, we started artificial feeding. This took place two or three times a day using artificial cat's milk and after that it was always returned to the mother. By 18 February, when the young reached a weight of 180 g, we offered only the morning feed, and soon afterwards dropped that feed as well. On 20 April, when this article was submitted, the young weighed 870 g, was very active and had already started tasting the mixture prepared for its parents. However, there is still a critical period of transition from the mother's milk to the feeding mixture. Only in August will we be able to consider it successfully raised.

This young Taiwanese pangolin has aroused tremendous public interest and fuelled interest in these mammals and their conservation. In a way, it can be considered the ambassador of these endangered species in Europe. Our efforts to breed the species also fulfilled this key objective.

We would like to thank our colleagues from Taipei Zoo not only for providing the animals, but also for their continuous support and cooperation.

## FOUR CUBAN ROCK IGUANAS

© JONAS VERHULST, ANTWERP ZOO



## ZOO DVŮR KRÁLOVÉ WELCOME

ON 4 MARCH 2023 A BLACK RHINOCEROS (*Diceros bicornis michaeli*) calf was born at Zoo Dvůr Králové (Czechia). While every black rhino calf born anywhere in the world is a reason to celebrate, as the species is Critically Endangered according to the IUCN Red List, this birth marked a unique achievement – it is the third black rhino calf to be born in the zoo within one year.

In March 2022, the staff at Dvůr Králové were happy to welcome a newborn after four long years. The hiatus was well planned as the park staff needed to dedicate all its space and energy to the project of relocating five black rhinos to Akagera National Park in Rwanda, which took place in June 2019. After the rhinos left for Rwanda, it was necessary to move some of the remaining individuals and form new pairs.

The hard work paid off – a male was born on 4 March 2022. As it was only a week after the Russian invasion of Ukraine, he was named Kyiv after the capital of the Ukraine to honour the resistance of the nation that was attacked by its neighbour.

While Kyiv was born to experienced parents, the female born on 13 December

## BORN IN ANTWERP ZOO

THE BIRTH OF FOUR CUBAN ROCK IGUANAS (*Cyclura nubila*) is an unexpected first for Antwerp Zoo (Belgium) because it is the very first time the 15-year-old male and 16-year-old female have successfully reproduced.

Also known as Cuban ground iguana, the species is endemic to Cuba. They inhabit coastal and inland rocky areas, dry forests and undergrowth. At Antwerp Zoo, the adults are housed with a group of six red-footed tortoises (*Chelonoidis carbonarius*) in a large indoor exhibit inside the reptile house.

The iguanas used to be housed as a trio of one male and two females. During this period, no mating behaviour was seen, nor were fertile eggs laid. After one of the females passed away in 2019, the remaining iguanas were housed as a couple. In June 2022, the female buried seven

eggs approximately 50 cm deep underneath the roots of a plant. After an incubation period of  $\pm$  95 days at 29°C, five hatchlings were born (two eggs did not fully develop). Shortly after, one of them died for unknown reasons. The remaining four are healthy and growing steadily.

*Cyclura nubila* is a large, heavily built and rather slow-moving lizard, with males being larger than females and reaching a length of around 1.5 m and weighing up to 8 kg. In the wild, the animals live an average of 60 years. They have thick, armoured scales, which are very variable in colour, ranging from grey, brown and olive green to bright greenish-blue. Their tails are long and powerful, and are used as a defence mechanism against predators and rivals.

These iguanas are diurnal. They spend most of their time basking,

foraging for food and defending their territory. They are primarily herbivorous, feeding on a variety of plant matter, including leaves, flowers, fruits and berries. However, they are also known to opportunistically feed on small invertebrates and carrion.

The solitary species has minimal social interactions. However, during the breeding season, males become territorial and compete for access to females. Females lay clutches of 2–10 eggs, which they bury in sandy soil or soft substrate.

Habitat loss, hunting by feral cats and dogs and the exotic pet trade severely impacted the population size of the Cuban rock iguana. There are several conservation programmes to protect and preserve the species, including breeding programmes in human care, habitat restoration, and education and awareness campaigns.

## THREE BLACK RHINO CALVES IN ONE YEAR

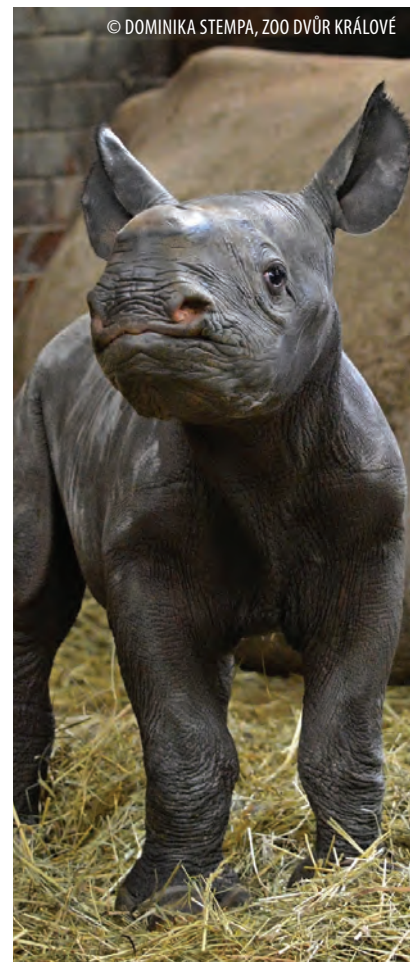
2022 was the first calf to be born to female Molly. However, the mother behaved so well that she not only provided perfect care to her baby, but also, thanks to training, even allowed keepers to milk her and freeze the milk for later use in case of rearing problems with newborn calves. The baby was named Mihindi after a lake in Akagera National Park, close to the area where the EAZA rhinos were released.

Finally on 4 March 2023, another male was born. This time it was the first calf from the new breeding bull Embu, brought to Dvůr Králové in 2020 from Chester Zoo (UK). The baby was named Magashi –another

connection to the new home of EAZA rhinos in Rwanda, as it is the very peninsula in Akagera where they now live.

All three births took place without problems and Magashi is now the 49th eastern black rhinoceros born in Zoo Dvůr Králové, which currently holds 15 individuals of this taxon.

Thanks to successful breeding in EAZA facilities, the zoo community is now able to supply rhinos for reintroduction. Both Akagera National Park in Rwanda and Mkomazi National Park in Tanzania are great examples – in both parks the rhinos brought from European zoos flourish and in Tanzania they even breed successfully!



# At the heart of the fjords

FOR THE SECOND TIME SINCE THE GLOBAL PANDEMIC, A HOST OF DELEGATES CONVENED FOR EAZA DIRECTORS' DAYS TO DISCUSS CONSERVATION'S MOST PRESSING ISSUES

Tomasz Rusek, Director of Advocacy and Communication, EAZA Executive Office

The 2023 edition of EAZA Directors' Days was hosted by Bergen Aquarium in Norway, from 25 to 28 April. More than 120 EAZA Member CEOs, directors and managers from 26 countries, along with a set of excellent guest speakers, addressed topics that are vital for the work of EAZA and its Members – from conservation and population management to policy influencing, sustainable operations and branding.

Keynote speaker Colleen Dilenschneider from IMPACTS Experience discussed recent polls of public trust toward European zoos and aquariums, which revealed both positive and negative trends that were amplified by the COVID-19 pandemic. Colleen's talk was packed with data on the value of conservation efforts in overcoming the challenges encountered by our sector, and provided her audience with many practical ideas and actions that they could take.

The choice of the hosting institution was not accidental; strengthening aquarium engagement is one of EAZA's strategic objectives, which was also reflected in the agenda. In the aquarium-themed session, our host Aslak Sverdrup, CEO of Bergen Aquarium, presented his institution's upcoming makeover into a state-of-the-art One Ocean Centre 'O', with ocean literacy as the main driver. The stunning visuals of the project made everyone keen to visit Bergen again in a few years to see the new site. João Falcato (Oceanário de Lisboa, Portugal) discussed novel ways of engaging people in environmental action. On the species conservation side, Eduardo Nogués and Daniel García Párraga (Oceanogràfic Valencia, Spain) summed up 15 years of work for loggerhead turtle conservation. Katy Duke from The Deep (UK) shared her experiences with cross-sectoral work for local (marine) environment and human communities.

Taking an even 'deeper dive', the participants discussed EAZA's policy for



animal acquisitions and dispositions by zoos and aquariums, which is being updated by the EEP Committee. To set the scene, David Roberts (University of Kent, UK) shared lessons learned from CITES and outlined the ways in which a specimen can be deemed to be legally or illegally traded. EEP Committee Chair Kirsten Pullen (Wild Planet Trust, UK) presented key principles of the draft policy which aims to ensure that all transfers carried out by EAZA Members are legal, sustainable and ethical. The valuable comments raised will inform the final version of the policy. The session on culling and management euthanasia as a tool in population management saw an equally engaged exchange of views. Facilitated by Thomas Kölpin (Wilhelma Zoo, Germany), it featured presentations by Mads F. Bertelsen (Copenhagen Zoo, Denmark), Dag Encke (Nuremberg Zoo, Germany), Severin Dressen (Zürich Zoo, Switzerland), and Arne Lawrenz (Wuppertal Zoo, Germany).

Another cluster of topics focused on innovative fundraising and brand personality. Bernard Ross from MC Consulting demonstrated how behavioural science may enhance donor funding, exemplified by a successful project at Edinburgh Zoo, UK. Ross Ballinger (Drayton Manor Park, UK) spoke about the advantages and challenges of rebranding a 70-year-old institution, while Cameron Whitnall (Paradise Wildlife Park and The Big Cat Sanctuary, UK) shared advice for increasing social media success and

monetisation. The programme also reflected the importance of education, social involvement and storytelling, linked to the recently updated EAZA Conservation Education Standards. Kirsten Pullen, Communications Committee Chair Sanna Hellström (Helsinki Zoo, Finland) and Antonieta Costa (Lisbon Zoo, Portugal), who chairs the Conservation Education Committee, all gave presentations during this session. Sustainable operations were also discussed, with a case study presented by Javier Almunia (Loro Parque, Spain).

Participants also heard from EAZA Chair Endre Papp and received a progress update on the EAZA Strategic Plan 2021–2025 from Myfanwy Griffith (EAZA Executive Director), while WAZA's CEO Martín Zordan presented updates on the WAZA strategy. Tomasz Rusek from the EAZA Executive Office shared key news from legislation and policy, along with advice for engaging with policymakers. The AGM was held, allowing Members to vote on key EAZA decisions. EAZA Council and four EAZA Committees also met during the event.

From the icebreaker at the Bergen Aquarium through the formal programme all the way to the farewell dinner in the spectacular medieval King Håkon's Hall, the excellent hospitality of our hosts proved that coming to Bergen was well worth the three-year wait due to the pandemic. We hope that everyone who attended this year's Directors' Days found them interesting and beneficial!



# Measuring our success

THE 2023 EAZA EDUCATION CONFERENCE DISCUSSED HOW TO MAKE THE MOST OF EDUCATORS' SKILLS AND COMMITMENT AND HOW TO MEASURE AND DEMONSTRATE THEIR SUCCESS

Laura Myers, EAZA Academy Manager, EAZA Executive Office

The 2023 edition of the EAZA Education Conference took place at Wrocław Zoo in Poland from 13 to 17 March, and was the first opportunity for EAZA educators to meet in person since 2019.

The conference theme, 'Conservation Education of the Future – from Ideas to Measurable Outcomes', was chosen to encourage participants to think about how we can harness the creativity, innovation and passion displayed by so many educators and marry that with the tools and frameworks we have available to support and guide our work (such as the EAZA Conservation Education Standards, the World Zoo and Aquarium Conservation Education Strategy and the UN Sustainable Development Goals). Evidence-based approaches are increasingly important, not only because it's essential for us to continuously improve our own work, but also because of our current context, where zoos and aquariums are increasingly called upon to clearly demonstrate their contribution to biodiversity conservation.

The keynote speech was delivered by the president of the International Zoo Educators Association, Judy Mann, whose powerful and inspiring talk was entitled 'Effective Communication for Conservation Action – from Strategy to Impact'. This was supplemented

by poster submissions and oral presentations delivered by delegates in thematic sessions such as 'Breaking Boundaries in Conservation Education' and 'Cooperation in Conservation Education', which showcased good practice and creative ideas. All submitting authors were asked to address the topic of evaluation in their presentations.

There were 155 delegates present from 32 countries across the EAZA region as well as some global representatives. More than half of the delegates were first-time attendees, perhaps reflecting the substantial changes and staff turnover that occurred in many education teams during the COVID-19 pandemic, but there was also a small group of veterans who have attended at least six previous conferences. Although the conference was not a fully hybrid event, sessions were live-streamed through EAZA social media and attracted several hundred views during the conference.

The conference was preceded by an EAZA Academy workshop on 'Exploring Digital Tools for Educators', led by Lizzie Seymour and Beccy Angus from the Royal Zoological Society of Scotland, which saw 35 participants doing some hands-on exploration of different tools, from collaborative whiteboards

to augmented and virtual reality tools, and discussing how those tools could be applied in their work to engage with a range of different audiences.

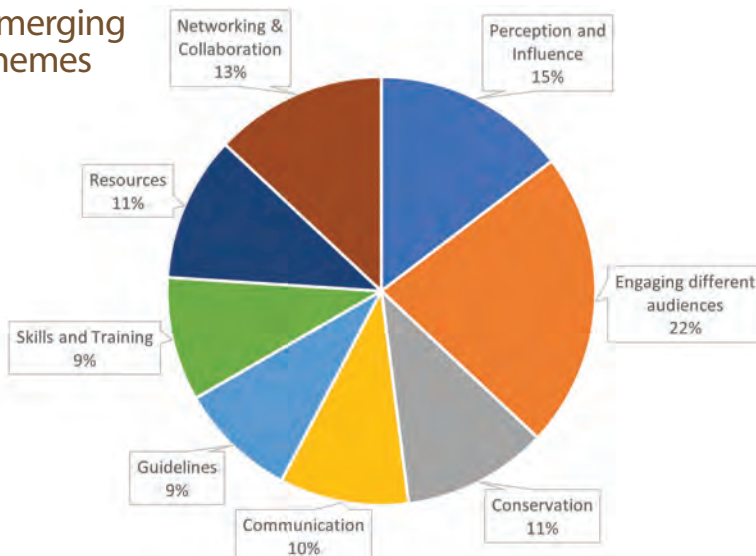
When building the conference programme, the organising committee wanted to provide space for discussion, so the programme included two plenary workshops where participants gathered in regional groups to define what education looks like now, how we would like that to change by 2030, and what steps we need to take to get there. The top three themes emerging from the discussions were: engaging different audiences, the perception and influence of education and educators, and networking and collaboration between educators (see figure). The workshop outputs were summarised during the conference and will be used by the EAZA Conservation Education Committee to shape their future work.

The programme also included two semi-structured discussion panels and an Open Space session where all delegates could propose and lead a discussion on a topic of their choice; topics ranged from the power of play to developing ocean literacy. After the formal sessions of the conference finished, the final half day consisted of informal sessions where small groups gathered to discuss ideas and do some fun activities; this included planning for the next EAZA Conservation Campaign, and playing the EAZA 21+ game 'Walk a mile in my shoes'.

Of course, the conference was not all business and included social events such as the karaoke icebreaker session, an unexpectedly snowy zoo visit, and a superb gala dinner including a special song prepared by the German-speaking contingent. Delegates also made full use of breaks to explore the zoo, and spent free evenings exploring the city of Wrocław with friends old and new.

It was a highly successful conference, but there is much work still to do and it was just one step on a continuing journey towards further success.

## Emerging themes



# From global to local

HOW THE NEW GLOBAL BIODIVERSITY FRAMEWORK CAN HELP EAZA MEMBERS TO TURN GLOBAL AMBITIONS INTO LOCAL ACTIONS

Alice Albertini and Tomasz Rusek, EAZA21+ Campaign Coordinators, EAZA Executive Office

The world's track record in saving its biodiversity through official plans isn't exactly strong. Not one of the 20 Aichi Biodiversity Targets for 2020 was fully achieved, and yet a new plan, known as the Kunming-Montreal Global Biodiversity Framework (GBF), has just been launched, promising to reverse biodiversity loss by 2030. Is there still room for optimism? And what role is there for zoos and aquariums in this biodiversity puzzle? To address these questions, we held an EAZA21+ webinar after the GBF launch and asked our speakers how the new framework can be turned into meaningful actions.\*

## REASONS TO BE CHEERFUL

Aichi Target 12 sought to prevent the extinction of known threatened species by 2020. Even though it wasn't fully met globally, it's important to realise that conservation actions did reduce extinction risks for many species. As we heard from Professor Philip McGowan of Newcastle University (UK) during the webinar, between 28 and 48 bird and mammal species have been saved from extinction since the Convention on Biological Diversity (CBD) came into force in 1993. This positive narrative is grounded in scientific data and the hard work of the conservation sector at large. Are we too often overlooking or undervaluing our success stories?

In December 2022, after a two-year delay due to the pandemic, the 15th Conference of Parties of the CBD adopted the GBF during the largest ever biodiversity summit in Montreal. Building on the previous 10-year plan, which included the Aichi Targets, the GBF introduces a broad package of actions to counter biodiversity loss. It comes with more measurable targets, a monitoring framework with indicators SMARTer than Aichi's, more accurate guidance for country reporting, and a mechanism for mobilising financial resources. Each ratifying country must implement all 23 targets by 2030.



The first step for each country is a revision of national biodiversity strategies and action plans (NBSAPs). As Matea Vukelic of the United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) highlighted, the essence of the GBF is translating the global framework into local reality by identifying national priorities and indicators, which some countries have already begun to do. Since CBD parties are including non-state actors in their national reporting, zoos and aquariums can play a significant role here.

## HOW WE CAN ACT LOCALLY

The most relevant GBF target for the EAZA community is Target 4 for halting species extinction and conserving species and genetic diversity. It recognises the need for *in situ* as well as *ex situ* management for conservation. Other relevant targets include:

- Target 3 (conserving and managing at least 30% of land and sea)
- Target 5 (wildlife trade)
- Target 6 (invasive alien species)
- Target 12 (native biodiversity and green and blue urban spaces)
- Target 16 (facilitating pro-conservation behaviour, and education, which also features in Targets 20 and 21)

Individual zoos and aquariums as well as zoo associations can contribute to many of the above, so we asked our

speakers where we should start. 'Be realistic and focus on those targets where you think you can really make a difference,' Prof McGowan replied. Dr Cristiano Vernesi from Genomic Biodiversity Knowledge (G-BiKE) added, 'Be simple in your plans and rely on good networking.' It is impressive to see that some EAZA Members, such as Dublin Zoo (Ireland), have already begun to translate the GBF into their own conservation strategies, as presented by Dr Andrew Mooney in the webinar.

With 2030 fast approaching, it's time to act together for success.

To get started, consider the following steps:

- Read the recently published paper 'The Role of Zoos and Aquariums in Contributing to the Kunming-Montreal Global Biodiversity Framework' by Andrew Moss et al. (*Journal of Zoological and Botanical Gardens*, 2023).
- Brainstorm with colleagues to identify primary GBF targets for your zoo or association and how your country can benefit from your knowledge, expertise and networks.
- Contact your country's CBD focal point ([www.cbd.int/countries/nfp](http://www.cbd.int/countries/nfp)) to learn about their needs and how you can contribute to NBSAP planning.
- Align your zoo's conservation strategy with the GBF goals and targets that you are supporting or wish to support – and then communicate it.

Together, we have an opportunity to turn global ambitions into local action and enhance our impact in biodiversity conservation!

\*EAZA Members can access EAZA21+ webinar recordings in the EAZA Member Area and on the EAZA21+ Facebook page – scan the QR code for direct access.



# Research is the key

IN THIS SPECIAL RESEARCH-FOCUSED ISSUE OF *ZOOQUARIA*, WE EXAMINE THE IMPORTANCE OF RESEARCH IN EVERY AREA OF OUR WORK, FROM OUR DAILY ACTIVITIES TO THE VITAL CONTRIBUTION WE CAN MAKE TO THE CONSERVATION OF NATURE

Zjef Pereboom, EAZA Research Committee Chair, Antwerp Zoo

Scientific research is one of the cornerstones of modern zoos and aquariums, next to conservation, education and recreation. The recently published EAZA Research Standards emphasise that scientific research and training underpin EAZA Member activities in animal husbandry, *ex situ* population management, animal welfare, education, wildlife conservation and many other areas. This special issue of *Zooquaria* aims to showcase some of the scientific work carried out by zoos and aquariums (collectively referred to as 'zoos' for the rest of this article) and our partners at universities and museums.

The articles not only highlight some interesting approaches and the latest developments in research in and by zoos, but also show how zoos contribute to addressing challenges and providing evidence-based solutions to animal husbandry, welfare and population management in zoos, and ensure the protection of natural populations and their habitats by advancing scientific knowledge in general.

This issue is too short for a complete overview of all the research taking place in our zoos. However, the new online Zoo Science Library (see page 24) aims to provide a more comprehensive list of scientific publications in international peer-reviewed journals to which zoos have contributed directly or indirectly. With this repository we expect to further promote knowledge transfer and scientific exchange and provide a searchable resource. Another similar initiative (see page 26) is the creation of a global database of scientific evidence for the effectiveness of husbandry and management interventions in zoo animals.

## THE POWER OF DATA...

Zoo science often doesn't require full-scale research departments and expensive laboratories. Ways in which zoos can be used for research

may include providing access to animal enclosures, access to records and samples, staff time allocated to sample or data collection, student (co-) supervision etc. For example, record-taking is inherent to daily zoo practice, as is using 'scientific methods' without the primary aim of performing a scientific study, but just for professional monitoring purposes: from weighing animals to evaluate their development, using image-based body condition assessments, to assessing reproductive hormones and evaluating enclosure planning and design (see page 27). The excellent record-keeping system in ZIMS allows us to collect and use these data for research purposes and informed decision-making, complemented by supplementary resources such as the EAZA Contraception Database and the EAZA Conservation Database, as explained on page 25. Welfare assessment protocols, which are gradually becoming an integral part of zoo practice, are also based on scientific research (see pages 28 and 29), and if well developed can be used as a tool to collect data for research purposes as well.

## ...AND SAMPLES

And then there is the EAZA Biobank, which supports the collection, storage and, most importantly, the use of valuable samples from zoo and aquarium collections (see pages 19 and 20). Contributing to science can be as simple as sending your samples to the EAZA Biobank. They will not only help to genetically support decision-making processes in population management and reintroductions, such as in the Cinereous vulture EEP example (see page 16), but also can more generally contribute to scientific research by third parties. The EAZA Biobank also recognises the need for cryopreservation of live cells and their use – see the example of the Markhor EEP on page 17.

## BUILDING RESEARCH COLLABORATIONS

Zoos not only contribute to current scientific knowledge by providing access to their collections, data and samples, but also are directly involved in research activities that go beyond professional husbandry and zoo practice. Zoos initiate, perform, participate in and contribute to research that increases our scientific knowledge of animals in fields ranging from social sciences and conservation education (see pages 12 and 14), to comparative and zoo animal nutrition (see page 18).

Most importantly, zoos can significantly increase their research potential by developing close research partnerships with other zoos, universities, and research organisations. Two examples that are explored in this issue are the close collaboration between Rotterdam Zoo, Wageningen University & Research and the Free University of Amsterdam (see page 20), and the Zoo Biology Department at Goethe University Frankfurt that is funded by Opel-Zoo (see page 22).

A key added advantage of such structural collaborations is that they allow zoos across the world to tap into the newest methodological developments in scientific research, such as the latest tools in genomics, automated analysis of data and the use of Deep Learning Software. In addition, partnerships with universities can provide zoos and aquariums with access to governmental and research council funding, and even to EU research funding programmes.

To sum up, my hope is that the examples provided in this special research-focused issue of *Zooquaria* will inspire more zoos and aquariums to take action, and at the same time make compliance with the EAZA Research Standards less of a challenge for you as an EAZA Member institution.



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# Looking at people looking at animals

ZOOS AND AQUARIUMS PUT CONSIDERABLE EFFORT INTO RESEARCHING THE ANIMALS IN THEIR CARE – BUT WHAT ABOUT THE PEOPLE? WE LOOK AT WHY HUMAN RESEARCH IS JUST AS IMPORTANT FOR ANY CONSERVATION INSTITUTION

João Neves, Director of Science and Education, ZooMarine

For some, the title of this article may evoke Harry Schram's work of the same name, a compilation of an extensive list of visitor studies in zoos and aquariums, for which I am professionally thankful. For others, and hopefully also for the former, it is a clear soundbite capturing the essence of what a zoo or aquarium is. In fact, the whole concept of a zoo or aquarium is anchored in the idea of having people visit the animals. I will go one step further and say that it doesn't even make sense to talk about zoos or aquariums without acknowledging our impact on the visitors.

So why does our community focus so strongly on animal research but invest much less time and effort in studying and understanding our visitors' behaviour? Why are published studies on visitor attitudes and behaviours so scarce in number when compared to animal studies? The answer may well be related to the need to further advance the biological and ecological knowledge of the species under our care, for either

welfare or conservation. This is fine and fundamental, but it still leaves us with an annoying question: what do we know about the people who are looking at our animals?

Just as public concerns tend to shift with the evolution and maturity of each society (education, environment, human rights, and so on), the same has occurred with zoos and aquariums. In the past, achieving the highest standards of animal welfare was the fundamental pillar of any modern zoo. These days, no one can imagine a zoo or aquarium without considering the social impact it has in such an increasingly environmentally focused world. And this is good. But to do this properly, we need also to look carefully at people and not just at the animals.

## A CHANGING APPROACH

As I write, no one really doubts that conservation is much more than a biologically focused concerted effort. That was the premise back in the 1980s and 1990s, following Michael Soule's fundamental work for

conservation biology. Conservation as a science now includes and depends on a wide range of social sciences (anthropology, sociology, psychology, etc.) mostly because conservation is not, philosophically, a biological problem but a human problem. Unless we address it by focusing on the human perspective and influence, we will be a long way away from reaching our goals as conservation-minded institutions. But this philosophical shift within our community is still not reaching its full potential and influence. It is true that there has been a recent refocus on the human dimensions of conservation, but the movement is still in its youth. Nevertheless, many zoos and aquariums have been investing some effort in the development of specific lines of research based on social sciences.

## REACHING INTO VISITORS' MINDS

Not having enough background information on our visitors makes it difficult to outline effective programmes that promote behaviour

change. This has been a crucial discussion for many years within the education community and one that has been the subject of close attention from the EAZA Conservation Education Committee. Fortunately it has now spilled over into other areas of strategic interest for zoos, getting the necessary nudge to become a fundamental issue in the future of our community.

To understand what the visitor wants and is willing to change for conservation, we need first to acknowledge and understand their attitudes, beliefs and motivations. If we do not understand why visitors come to the zoo, what they hope to gain from their visit and what their existing attitudes and behaviours are, it is hard to offer programmes that will persuade them to adopt more pro-conservation behaviours.

For example, let's say a zoo wants to encourage visitors to reduce a specific behaviour such as plastic use, a topic common to most zoos worldwide. It can easily ask visitors to bring their own reusable water bottles instead of buying single-use bottled water. That sounds pretty straightforward, but without understanding the visitors' motivations for buying bottled water, such as convenience or preference for a specific brand, the zoo might well design a strategy that does not effectively address these motivations and is therefore unlikely to achieve the desired behaviour. On the other hand, if the zoo starts by conducting research or gathering data on visitors' attitudes and behaviours related to plastic use and bottled water, it can create targeted programmes that address these motivations and encourage behaviour change. These may include offering refill stations throughout the zoo or partnering with a preferred bottled water brand to offer reusable bottles as a souvenir.

### **NOT A ROSY PATH**

Recently ZooMarine has made a concerted effort to implement an institutional research strategy focused on social sciences. A research plan focused on the zoological collection has been in place since its foundation in 1991, but the same is not true for those looking at the animals.



Fortunately, and true to the nature of any progressive zoo, evolution is part of our business (both biologically and operatively).

However, it is not as simple as it might have seemed initially, as the biggest challenge was, and still is, the cultural change within the company. Just like our visitors, our employees suffer from a crucial but fundamental biological flaw – being human. And because of this, the challenges of asking for behaviour change – i.e., changing routines in favour of implementing a strategic plan – apply to visitors and employees alike. In a context where animals have always been the protagonists and targets of so much research, it is easy to understand that this behavioural barrier exists.

### **A PERCEPTION CHALLENGE**

Most social science research at zoos usually depends on methods such as questionnaires, interviews, behaviour observation and so forth, none of which really uses the state-of-the-art technological instruments that we sometimes see in research with animals. This usually results in a perception problem within the institution, as the word 'research' is associated with white coats and technology. This is yet another barrier to be removed in the early stages of the action plan. It is only when outputs (publications) or outcomes (improving programmes) are visible that our colleagues start to change their own perception of social science research. Unless there is a long-term plan with a constant stream of studies being deployed, this perception shift and its effect may not last long.

### **STARTING FROM WITHIN**

The adoption of a new plan means

creating a new set of routines within the operating structure. Just as the theory of planned behaviour states and guides so many research studies, change is a process and starts from within. For the plan to be implemented correctly, and if you have a similar structure as ZooMarine (without assigned research officers), we have to count on the active and, ideally, motivated participation of all those who, in their daily routine, are not involved in research methods (i.e., not only educators and animal care teams, but also cashiers, visitor services, and so on, depending on how bold and original your research ideas may be).

Rather than a top-down approach, our strategy has been to first reach out to those teams who will be directly involved with research and getting them on board by finding out what makes them tick. Asking these ground teams, otherwise known as 'appointed researchers', what their doubts and concerns are can also result in interesting studies that make them feel a true sense of belonging. Finding and understanding their motivation is also critical. Remember that most voluntary behaviour change happens when there is a positive consequence for those who are changing. For some, their motivation may be research outputs; for others, it may simply be understanding that their work is directly and positively influencing conservation behaviours with a measurable output.

### **CLOSING THE CIRCLE**

All in all, visitor studies are a vital component in the future of zoos and aquariums. Similar to the tremendous contribution our community had and still has on species conservation, social sciences are the next much-needed step to close the circle of our overall mission. Fortunately, there are many good examples within EAZA where one can find inspiration and guidance for the implementation of a social science research plan. More than just implementing a strategic plan, this process was, for ZooMarine, the start of a philosophical shift, putting the visitors and what they think, know and expect on equal terms (conservation-wise) to the traditional biological research plan.

# The human dimension

A PROJECT TO PROTECT THE MADAGASCAN FOREST BROUGHT UP SOME FASCINATING AND CRUCIAL INSIGHTS INTO RESEARCH METHODOLOGY

Greg Counsell, Conservation Scientist, Chester Zoo

The Agnalazaha forest in Mahabo-Mananivo, Madagascar, is home to 200 endemic plant species, five species of lemur, four species of tenrec and 66 bird species. This littoral forest remnant was part of a great forest believed to have stretched hundreds of miles along the east coast of the country. What remains is threatened due to over-harvesting of young trees by local farmers for the construction of fences designed to protect their crops from free-ranging cattle. Here, Chester Zoo (UK) is supporting partner Missouri Botanical Gardens (MBG, USA) and local farmers to trial the introduction of hedgerows in place of fencing, taking the pressure off Agnalazaha. This novel approach is reliant on community engagement, as it will be many years before the hedges are established enough to replace the fences entirely. Since immediate or short-term benefits may not be visible to the participant farmers, it is vital that we monitor their opinions and motivations towards the project throughout this period.

At Chester Zoo, the social science team support both *in situ* and *ex situ* conservation by providing data on human dimensions. *In situ* we monitor and evaluate the social impacts of initiatives delivered by partner organisations in our focal regions, including Madagascar and the Mascarenes. In such contexts, we often face practical, logistical and cultural

challenges that require us to trial and adapt research methods as we go, ensuring that the data we gather is robust while not inadvertently influencing the participants or the initiative itself.

In January 2022, we conducted bespoke baseline surveys with participant farmers in Mahabo-Mananivo to capture their views on the hedgerows project, their value beliefs around Agnalazaha and their wider concerns and aspirations relating to their livelihoods. To account for the Antesaka dialect and cultural norms, we trained two local members of the MBG team to conduct the surveys, with one researcher asking the questions and the other recording responses on paper datasheets. However, when we analysed the baseline data it was apparent that something had gone wrong, as many survey items were unanswered. Missing data is common enough in social research, but the extent here suggested barriers to participation that we had not anticipated. During a review of the process, it became clear that the problem was twofold.

The majority of participant farmers were illiterate, or had only very basic literacy skills, and the only time they saw pen and paper was in the hands of police or government officials. Despite our efforts to reassure them that their answers would go no further, they

did not feel comfortable in giving their full and honest opinions for fear that we might pass them on to other parties. The obvious solution was to ditch the paper datasheet in favour of audio recordings; however, this 'simple' solution also brings complications, such as different ethical considerations and data protection issues, as well as the added workload of transcribing recordings for analysis. To ensure that we would not go to this additional effort only to hit another wall, we spoke with participant farmers directly during a site visit, who informed us that they would be happy for us to use audio recording.

The second barrier appeared to be the survey tool itself. Our MBG colleagues informed us that many of the participant farmers grew visibly bored and increasingly distracted as the survey went on, leading to fewer meaningful responses. We decided to redesign the methodology around semi-structured conversations. This approach retains the engaging quality of a conversation, but is based loosely around a script containing our questions and topics of interest. In August 2022 we successfully trialled our new approach and gained a rich insight into the lives of the farmers who spoke freely under this revised methodology, giving us a deeper understanding of their relationship with Agnalazaha and their thoughts and concerns around the hedgerows. Follow-up interviews planned for the second and third years of the project will allow us to monitor if opinions change as the hedgerows mature.

Traditional conservation approaches have often overlooked the importance of human dimensions, hindering the success of initiatives. While there is still a way to go before we can claim success in Agnalazaha, our flexible, iterative approach to research reflects the reality of conducting the meaningful social science that is needed to shift conservation towards a 'people and nature' model.

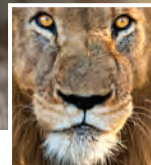




*Primates*



*Herbivores*



*Carnivores*



*Birds*



*Fish-Eaters*

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# In search of quality and quantity

## HOW TAKING THE SCIENTIFIC APPROACH CAN IMPROVE CINEREOUS VULTURE BREEDING

Philippe Helsen, Researcher; Marleen Huyghe, Bird Curator; Zjef Pereboom, EAZA Research Committee Chair, Antwerp Zoo and Planckendael Zoo

Over the past decade, curators and researchers working at Planckendael Zoo (Belgium) have joined forces to optimise the management of the EEP for the Cinereous or Eurasian black vulture (*Aegypius monachus*). As well as maintaining a sustainable zoo population, the EEP serves as a source population for reintroductions in southern Europe; however, this has proved to be a challenging combination as indicated by a recent population viability analysis, which this article will discuss. But first, let us go back to where this all began.

In 1986 an *ex situ* breeding network was initiated by the Black Vulture Conservation Foundation, which turned into an EEP one year later. At first, birds held in zoos and breeding centres were managed as one population, partly to avoid taking individuals from the wild for *ex situ* breeding purposes, but also, more importantly, to secure the production of nestlings for reintroduction projects. Several breeding nuclei have been restored in Spain, France and the Balkans, but we are not there yet. As long as the isolated south-eastern and south-western European populations remain disconnected, reintroductions are still required.

The recent population viability analysis showed that the EEP has failed to meet its original conservation goals simultaneously. The main driving factor of this failure seems to be the limited success of breeding pairs. With an average of fewer than eight surviving chicks per year in the EEP population over the last 10 years, too few birds are being born to sustain a demographically healthy *ex situ* population as well as support the reintroductions. To solve this issue, the recently published LTMP for the species highlighted that the EEP should first focus on securing

the long-term viability of the *ex situ* population and only then should it consider the release of birds for reintroduction.

The obvious question is whether there's an easy fix for this problem. Alongside the more practical husbandry-related solutions, three major lines of research were initiated under the supervision of Marleen Huyghe as former EEP Coordinator to identify the key issues and to work towards improved population health and sustainability.

### DEMYSTIFYING THE DRIVERS OF REPRODUCTIVE SUCCESS

First and foremost, to explain the low breeding success, research was directed at increasing our understanding of the breeding biology of the species. All available information captured since the launch of the programme was combined to reconstruct historic pairs and their breeding performance, resulting in more precise fecundity estimates. The data showed that shortly after reaching its peak at a young age, female fecundity decreases more rapidly compared to male fecundity. In addition, the results indicated that the continuous release of young vultures from the *ex situ* populations for reintroduction not only reduces population size directly, but also results in the EEP getting older, as it contains a higher proportion of post-reproductive individuals. We therefore decided to revise the release strategy and keep more young birds in the EEP breeding population.

### WHEN SCIENCE MEETS BREEDING MANAGEMENT

The analysis also highlighted additional factors that explained the breeding outcome both of specific pairs and at an institutional level.

For example, breeding experience, age difference and social structure are three key factors driving breeding success. Therefore, over the last breeding seasons, kinship breeding and providing mate choice opportunities for young vultures in a dating aviary were complemented by new breeding recommendations, which were to re-pair unsuccessful pairs to accommodate for breeding experience, to minimise the age difference between mates, and to mimic a social structure that more closely resembles natural conditions. Because of the immense number of alternative re-pairing combinations, computer simulations are now used to help us solve this complex puzzle.

### WHEN SPACE IS LIMITED

There are many more vulture species in need of *ex situ* conservation actions, so we have to think wisely about how best to use our resources to secure good welfare and viability for the populations we manage. One recently launched line of research therefore focuses on defining the optimal population structure for the cinereous vultures, trying to answer how many dating, breeding and post-reproductive socialisation aviaries are needed and what the optimal transfer or re-pairing frequency would be to most efficiently manage this EEP population.

### MORE EFFICIENT CONSERVATION TRANSLOCATIONS

Meanwhile in the field, reintroduction success was evaluated by using molecular genetics. In collaboration with local partners such as Ligue pour la Protection des Oiseaux (LPO), feather samples were collected from vulture nests in the release sites to study the reproductive success of released birds. The data clearly indicate that released males tend to stay in the release area and breed, whereas females are more likely to move to other areas post-release. These patterns were integrated in a new release strategy in that males will be targeted first when requests for reintroductions arrive from the field.

This work is an example of how data has value and could be enormous helpful in improving conservation breeding.



# It's a kind of magic



TURKMENIAN MARKHORS (*CAPRA FALCONERI HEPTNERI*) IN THEIR ROCKY ENCLOSURE AT HELSINKI ZOO © ANNIKA SORJONEN

## HOW ASSISTED REPRODUCTION AND CRYOPRESERVATION COULD OFFER NEW HOPE FOR SPECIES CONSERVATION

Nina Trontti, Turkmenian markhor EEP Coordinator, Helsinki Zoo, and Yann Locatelli, Associate Professor, Réserve de la Haute-Touche

The role of zoos and aquariums as a source for genetic material and a key partner for building biological resource banks is still growing. In addition, zoos can help researchers to develop techniques that ensure the conservation roles for the EEPs they manage. The EU Zoos Directive requires zoos to take part in research that benefits species conservation – and what could be more beneficial to research than developing skills that conserve potential new founder individuals?

One example of a successful collaboration between zoos and scientists is cryopreservation and artificial insemination in markhors. In 2021 a Turkmenian markhor kid (*Capra falconeri heptneri*) was born at Réserve de la Haute-Touche (France) as the result of artificial insemination of a female with cryopreserved semen collected from a male in Helsinki Zoo (Finland). This followed the recommendation in the Caprinae TAG RCP to establish a markhor *ex situ* population, with insurance and research into artificial insemination techniques as direct conservation roles. The latter role was recognised by the TAG as relevant for more Caprinae species, and the markhor could serve as a model species for further developing assisted reproduction techniques (ART). It was recommended also that blood samples be collected for the EAZA Biobank to support future genetic research and the identification

of possible introgression of domestic goat into markhor populations both *in situ* and *ex situ*.

### ASSISTED REPRODUCTION IN ENDANGERED SPECIES

Assisted reproduction was considered science fiction a decade ago. Therefore researchers recommended that for critically endangered species any genetic material, including biopsies from reproductive organs, should be collected. Obviously, in farm and domesticated animals these techniques are well developed. However, for several endangered species, assisted reproduction and conserving embryos and sperm are both possible, but only through intense research and many years of testing and developing solid protocols. The key issue is that ART involve several steps, which can each lead to success or failure. Success depends mainly on whether it is possible to collect germ cells from males and females. Germ cells can be recovered from living or dead animals from *ex situ* or wild populations. However, the optimal environmental circumstances and the exact timing of the operation are crucial and not always known.

In Caprinae, the timing of the mating season and the reproductive cycle clearly affect the efficiency of different ART and the quality of the gametes. Further study is needed to better understand this influence and optimise the techniques used. Markhors, for

example, are seasonal breeders.

Mating takes place in late autumn or winter, gestation lasts between 135 and 170 days and the rutting season of adult males starts in late October and lasts into early December. Semen production happens only during rutting season and therefore semen should be collected towards the end of the rut. In zoos, however, rutting has been observed also in January, which needs to be taken into account for successful assisted reproduction.

Sperm is easier to recover than oocytes but it requires a lot of equipment. The semen is collected in straws and transport is the next challenge. It needs official documents and permits, including CITES permits for markhors. Air cargo has strict rules related to research equipment. If transport cannot be arranged immediately after the operation, a suitable cryobank is needed for storage of the cryopreserved straws.

It is even more difficult to collect oocytes from ovaries, which is necessary for *in vitro* fertilisation (IVF). Yann Locatelli's group at Réserve de la Haute-Touche successfully recovered good quality oocytes in laparoscopic ovum pick-up from healthy females in seven replicates (total 107 oocytes), which resulted in 50–70% IVF rates (number of oocytes fertilised). Optimal oocytes storage is tricky. As it is easier to cryopreserve embryos, blastocysts were frozen and stored until embryo transfer.

### A 'THIRD POPULATION'

This markhor's birth was a remarkable contribution to the conservation of this species. Most importantly, this milestone not only proved that Locatelli's team were able to validate the sperm cryopreservation methods and AI techniques set up for markhor, but also gave us a look into the future. Frozen semen and cryopreserved embryos can be added as 'a third population' of the species to support the IUCN's One Plan Approach to save endangered animals. A cryopreserved population together with *ex situ* and *in situ* populations could offer biodiversity a second chance.

*For more information about the EAZA Cryopreservation Network linking our community with cryo-partner institutions to develop similar and other projects, see the EAZA website.*



# Dietary enrichment

HOW A NEW FEEDING REGIME FOR GIRAFFES PROVED THAT ENRICHMENT IS THE KEY

© WILLIAM WALLDÉN

Sarah Depauw, Zoo Nutrition Researcher, Odisee University of Applied Sciences; and Marcus Clauss, EAZA Research Committee Vice Chair, University of Zürich

There is an ever-increasing understanding among nutritionists that feeding and enrichment are intertwined. Enrichment is not some treat that is given in addition to the daily diet – instead, it is the way the daily diet is provided. In other words, if you feed only a quarter or a third or half of the daily diet in a way that makes access physically or cognitively challenging, you evidently do not use the full enrichment potential of your feeding regime. At the European Zoo Nutrition Conference in Riga (Latvia) in January, two presentations showed how this principle can be taken to its ultimate consequence in giraffes.

In two zoos, Kolmården Zoo (Sweden) and Planckendael Zoo (Belgium), the feeding regime of giraffes was changed so that the whole diet (apart from browse on branches) was available only in slow feeders, barrel drums and other enrichment items that require the use of the tongue to extract the food. Thus these zoos put recommendations into practice that giraffes should not be able to dip their snout into a trough of pellets or vegetables, or into a hayrack filled with lucerne hay. Forcing them to use their tongue mimics more closely the conditions in their natural habitat, where they have to pluck individual leaves from branches, often

from between long acacia thorns. At Planckendael Zoo, this was also accompanied by a change in diet composition towards more browse and forage.

Why is it important that these changes are accompanied by scientific monitoring? One could argue that simply monitoring whether the animals cope with the new situation is enough – because the fact that they will have to spend more time feeding is self-evident. Actually, the fact that some zoos put such a feeding regime into practice without negative consequences is probably the most important message. Nevertheless, at both zoos, the effect of the new feeding regimes on the behaviour of the giraffes was assessed in detail, using direct and video observations.

The observations indicated that the animals spent more time feeding and less time stereotyping on the new regime. The changes were particularly distinct during the night – a time often still neglected when considering the activity budget of zoo animals. Detailed observations on the use of tongue or snout during feeding actually confirmed that snout feeding dropped dramatically. No negative effects on body condition were noted.

Making detailed recordings of the effect of changes is a scientific

approach. It ensures that the results of efforts are made visible not only to the scientific or zoo community, but also, most importantly, in house to those responsible for doing the work, to show that these efforts are well worthwhile. Once a sufficient number of similar results have been produced in several zoos, other facilities might adopt the new feeding regimes even if they do not have capacity for more than routine health surveillance.

For giraffes, the time is ripe to adopt these feeding methods in all zoos. And who knows – maybe under these feeding regimes, offering a bunch of leaves directly by hand to your giraffe is a new way to enrich their day: not because it gives them something to do, but because it is a treat to receive something without having to work very hard for it.

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# Safe deposits

THE EAZA BIOBANK IS A TREASURE TROVE OF KNOWLEDGE FOR CONSERVATION RESEARCH, AND THE MORE SAMPLES IT RECEIVES, THE GREATER ITS VALUE TO GLOBAL CONSERVATION

Philippe Helsen, EAZA Biobank Working Group member, Antwerp Zoo; Christina Hvilsom, EAZA Biobank Working Group Chair, Copenhagen Zoo; and Anna Mękarska, Biobank Coordinator, EAZA Executive Office

Research is the backbone of zoos and aquariums and has guided and shaped our activities over many years. Driven by the interest of former zoo directors and employees, a vast body of scientific work was conducted, and even today some of our daily routines, husbandry and management are guided by this early work. Over the years, the research gradually became more structured, which was further enabled by the establishment of dedicated research institutes embedded within zoological institutions: zoo research was born as a discipline.

Despite our efforts to increasingly integrate zoo research within our community, this mostly goes unnoticed by the wider public. At a higher level, however, globally renowned organisations such as the IUCN and the UN are starting to appreciate the role of zoos and aquariums in species conservation and have adopted specific biodiversity targets relevant to our community, such as those included in the recent Kunming-Montreal Global Biodiversity Framework.

## WHY EVERY SAMPLE COUNTS

Because of our close contact with the species we manage, we are at the frontline when it comes to discovering unique, abnormal, fascinating or even problematic biological patterns or to formulate dedicated research questions for the species we manage. Some EAZA Members have the capacity to perform in-house research or to engage with external academic partners, whereas others do not. Over the past decades many brilliant research questions have therefore ended up in a desk drawer, in many cases because appropriate data and sample collection was deemed impossible.

Over time, technology has revolutionised the conservation research arena. More can be done with fewer samples and resources. This is

where all zoos and aquariums, from the smallest to the largest, can come to the rescue. It needs only the submission of biological samples to our precious shared resource – the EAZA Biobank.

Zoos and aquariums house diverse species, from the rare ones that are difficult or impossible to sample in the wild to more common species. What makes our collections even more valuable is the metadata we have available for all that is managed in the EAZA community. Whenever data are linked to biological samples, those samples create a treasure trove for research. A simple sample taken from a red river hog (*Potamochoerus porcus*) can, for instance, give a new insight into understanding African swine fever resistance in Suidae. As there is no crystal ball telling us which species will need research and conservation efforts in the future, every species, from the smallest insect to the largest vertebrate, is important for upholding biodiversity and needs to be banked.

The EAZA Biobank unites all of this and even all of us: jointly we can create a unique sample repository to be used for species conservation in the widest sense. This concept is also embedded within the most recent EAZA Research Standards, which clearly describe what you can do as an individual zoo or aquarium to facilitate research. Securing samples for banking and research is low-hanging fruit. Together we can create momentum, ensuring

that all brilliant ideas are pulled out from the back of our desk drawers and used to carry out the research that nature, including us, urgently needs.

## SPREADING THE MESSAGE

Research is crucial to further improve our conservation efforts, and we have the capacity to go the extra mile. Being at the interface of conservation science, policy-making and the broader public, our communication efforts are pivotal for bridging the gap between all stakeholders. Communicating our pure biobanking efforts to the wider public (from visitors to local authorities) has never been as easy. Using the ZIMS Biobank module as a primary resource for up-to-date tracking and tracing of what goes in and what goes out, we can more directly demonstrate our contribution to science.

By contributing to the EAZA Biobank, zoos and aquariums are acknowledged in scientific papers based on their sample submissions. Besides feeding this information back to contributing institutions, their acknowledgement will also be encapsulated in the Zoo Science Library, amassing our scientific output. Sharing research insights is equally pivotal to adjusting our conservation management practices to the most recent scientific insights. Consequently, researchers granted access to EAZA banked samples are required to provide a summary in layman's terms on how their study might improve (*ex situ*) species management, which will further facilitate communications with the broader public.

In times when species conservation is tough and often frustrating, sampling might feel like a small thing to do, but it is in fact a huge step towards achieving global biodiversity goals.



BLOOD SAMPLES AT THE EAZA BIOBANK HUB IN ANTWERP © ANTWERP ZOO

# Preserving genetic diversity

CREATING AND MAINTAINING HEALTHY AND DIVERSE ZOO POPULATIONS OF ENDANGERED SPECIES IS A CHALLENGE, BUT A COLLABORATION WITH THE EAZA BIOBANK IS PRODUCING EXCELLENT RESULTS

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Zoo populations can form a valuable reservoir for the preservation and potential reintroduction of threatened species. Therefore, populations in human care need to be sustainable, which is defined as being able to persist with available resources for an indefinite amount of time. Zoo populations of threatened species need to be managed so that genetic diversity is maintained, inbreeding minimised and hybridisation avoided. Finding this balance is a challenge, illustrated by the slower growth rate of, for example, inbred Indian rhinoceros (*Rhinoceros unicornis*) calves in human care, but higher mortality of hybrids.

Zoos face many challenges in *ex situ* conservation. Typically, population sizes are small, with generally only a few individuals per zoo, which may pose several risks to the genetic integrity of the population, such as lower genetic diversity and increased inbreeding rates. Likewise, *ex situ* populations are generally made up of a small number of founders, thus increasing the risk of deleterious alleles becoming expressed, leading to inbreeding depression. Existing methods to maintain high levels of genetic diversity and minimise

inbreeding are based on pedigrees but often the underlying assumptions are not met. For example, founders are assumed to be unrelated, which might not actually be the case. Additionally, *ex situ* populations may have diverged from the original wild population due to random genetic drift and inbreeding, hybridisation and artificial selection, and they may have adapted to the zoo environment.

## EEPS AT ROTTERDAM ZOO

Rotterdam Zoo (the Netherlands) coordinates the EEPs for the Asian elephant (*Elephas maximus*), Red panda (*Ailurus fulgens*), Egyptian tortoise (*Testudo kleinmanni*), Dalmatian pelican (*Pelecanus crispus*), Tufted deer (*Elaphodus cephalophus*) and Rüppell's vulture (*Gyps rueppelli*). The coordination of the EEP for each of these species faces unique challenges. To optimise their management and provide genomic support to the EEP coordination, we started a long-term collaboration between our research group, Rotterdam Zoo and the EAZA Biobank. The extensive genomics expertise and tools for livestock can also benefit endangered species. Thus we started to expand the genomic toolbox for

these six species. Our DNA research can solve not only practical issues about the breeding programme, but also more fundamental issues regarding the wild status of these species. Naturally, such efforts start with the availability of high-quality samples from the species of interest. With tremendous support from the EAZA Biobank and a willingness of individual zoos to contribute, we were able to collect and use DNA samples from hundreds of animals, derived from faeces, feathers, hairs and – most informatively – blood.

After DNA isolation and screening of the sequences, we can compensate for the lack of information about the original genetic diversity and founder relationships by merging molecular data with pedigree analyses to ensure that breeding decisions maximise genetic diversity. For example, this allowed us to resolve whether the airport-confiscated Egyptian tortoises that arrived at Rotterdam Zoo in one batch were direct relatives and therefore should not interbreed. Also, presumed parent-offspring relatedness can be validated for species in which paternity is difficult to assess. When there has been an exchange of animals between zoos, we can monitor

changes in inbreeding as a result of the population management decisions in the programme. Because DNA can point to the genetic basis for observed heritable diseases, sequences also provide important information about inbreeding and harmful mutations when lineage-specific malformations seem to pop up in a population.

Besides these practical issues, we can dive further into the evolutionary history of these species that is written in their genome sequence. The EAZA Biobank samples allow us to extract the high-quality DNA needed to perform such analyses. With Critically Endangered species for which so little is known, each sample and individual can already provide a wealth of information about the wild history of the species. Therefore we are extremely pleased with the efforts of the EAZA Biobank to secure samples for future research purposes so the story written in the DNA is not lost.

#### NEW INSIGHTS

We are very excited about gaining fundamental insights into the evolutionary history of the species while simultaneously applying our obtained knowledge by contributing to the population management of the EEPs. In our Asian elephant project, we have identified the presence of at least three subspecies in the EAZA collection. This has implications not

only for how the EEP is managed, but also for the conservation status of these subspecies in the wild. For example, genomic analyses supported the recent split of African elephants (*Loxodonta africana*) into two distinct species, which in turn has implications for their status of endangerment.

For some EEP species such as the Egyptian tortoise, tufted deer and Rüppell's vulture, we have no clear image of the population structure in the wild, which complicates Studbook management. We are now generating full genome sequences of different founders to better understand population structures in the wild and in human care. Finally, by generating many genomes and compiling genomic information from zoo and wild animals (including online repositories), we aim to develop cheap and simple genomic screening tools so that geographical origin can be traced for animals with unknown origin. This is relevant for *ex situ* collections but can also contribute to a better understanding of routes of illegal trade in countries of origin. This information can help to make decisions about supplementation or reintroduction from zoo populations back into the wild. For example, we have now started to apply genomic information obtained from red pandas in the EEP to a wild context, e.g. to ensure that no hybrids from the EEP

will be reintroduced into the wild and that the individual fit to local genetic diversity is optimised.

This close collaboration between Rotterdam Zoo and the universities has had many additional advantages. On the one hand, scientists have access to data from non-model species through the EAZA network. On the other hand, for the zoo, the collaboration opens new doors to the academic world and allows easy access to expert knowledge and research council funding. Although we jointly work on writing funding proposals for our research projects, generally the university takes the lead on applying for large research grants from governmental funding bodies such as the Dutch research council NWO and the EU's Horizon programme. Rotterdam Zoo on the other side is more involved in securing funding from individual donors or small private funds. Most importantly, our partnership enables undergraduate students to obtain practical experience on how to integrate genomic data in small population management. Students love working with zoo animals, and because we have established this long-term research collaboration, each student thesis contributes to expanding our knowledge expertise and further developing the genomics toolbox for these endangered species.



# Research partners

THE OPEL-ZOO ENDOWED PROFESSORSHIP OF ZOO BIOLOGY IS A PROMISING EXAMPLE OF HOW LONG-TERM COLLABORATIVE PARTNERSHIPS BETWEEN ZOOS AND UNIVERSITIES CAN BENEFIT CONSERVATION RESEARCH AND PRACTICE

Paul W. Dierkes, Head of the Department of Bioscience Education and Zoo Biology, Goethe University Frankfurt

The EAZA Research Committee encourages zoos and aquariums to engage in and contribute to high-quality research and to see their facilities as a suitable place for applied and academic research. To this end, the EAZA Research Standards encourage EAZA Members to develop partnerships with academic institutions. In this regard, strategic approaches can help anchor research in zoos and aquariums at research institutions in a long-term manner. To build such a long-term strategic partnership, Opel-Zoo (Germany) funded an endowed professorship in zoo biology in 2014 at Goethe University Frankfurt (Germany) through the von Opel-Hessische Zoostiftung (zoo foundation). The idea of Thomas Kauffels, Opel-Zoo director and former EAZA Chair, was to sustainably implement zoos as research sites at the university and to contribute to scientific research and teaching. This type of structural collaboration between zoos and universities is still rare, and so far there has been little experience in establishing the content of such a research group and integrating zoo topics into university teaching and research in a sustainable way.

## ESTABLISHING A ZOO BIOLOGY RESEARCH GROUP AT GOETHE UNIVERSITY FRANKFURT

The basic considerations for the structure and approach of the zoo biology working group in the initial phase included the three following key points:

**1) A non-invasive research approach** is advantageous for the broad acceptance of zoo animal research among students, but also among the general public. In this context, it is necessary to determine which research methods are scientifically competitive for publication in peer-reviewed journals.

**2) Zoos provide a unique opportunity to conduct research in**

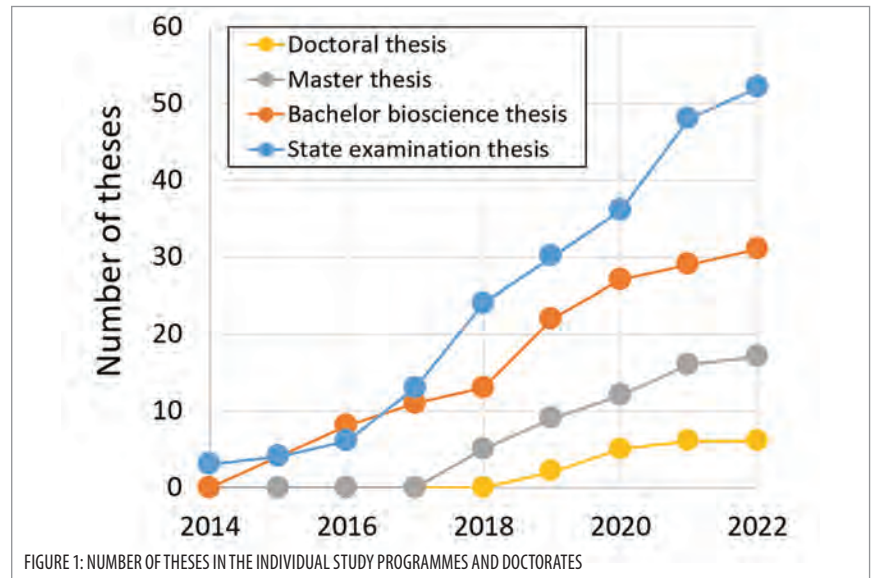


FIGURE 1: NUMBER OF THESES IN THE INDIVIDUAL STUDY PROGRAMMES AND DOCTORATES

**a broad range of topics**, including life sciences, conservation, animal welfare, social sciences, education and environmental sustainability. This thematic breadth should be considered and implemented in the research group. In animal-related research, on the one hand, the application-related topics such as animal welfare and enrichment are to be implemented, but on the other hand, space is also to be given to basic research that is not directly related to zoos' own needs. Further important topics are social sciences and conservation education, which are of increasing importance, especially with regard to the Sustainable Development Goals and their connection to zoos.

**3) The commitment to individual species and animal groups** appears attractive at first glance. However, larger comparative studies across many systematic groups offer the opportunity to obtain statements that allow general implications. The zoological collection at Opel-Zoo serves as a basis for teaching and research at the undergraduate level. At the master's and doctoral levels, in addition to Opel-Zoo as a starting point, a larger network of partner zoos in research should be established,

enabling large-scale comparative studies whose scientific relevance is greater. With this in mind, new, innovative methods need to be developed that allow for (partially) automated recording and analysis of large data sets.

## LET'S GET STARTED – UNIVERSITY TEACHING AND TRAINING OF YOUNG SCIENTISTS

For a broad anchoring of zoo-related topics in research and teaching, it is important to integrate different courses in different study programmes. At Goethe University Frankfurt, therefore, courses were first established in the biosciences department in the training of biology teachers and in the bachelor's degree in biosciences. The courses offered include zoo excursions, zoo-related seminars and a more intensive introduction to scientific work in zoos. Two years later, a six-week master's module in zoo and wildlife biology was established to provide practical and theoretical instruction in the fundamentals of zoo biology. Teaching topics include the basics and methods of behavioural research, wildlife ecology, history of zoos, husbandry, animal welfare and enrichment, conservation, feeding and nutrition,

population management, exhibit design, education and environmental psychology. The module includes a strong practical component, providing intensive insights into different zoos and research methods and discussions with experts in zoos, and is offered for three different master's programmes (Biodiversity and Ecosystem Health, Interdisciplinary Neuroscience, Environmental Science). After a short start-up phase following the introduction of the course offerings, they have been accepted very well by the students, which can also be seen in the number of final theses (Fig. 1).

### SCIENTIFIC RESEARCH PRIORITIES AND NEW METHODOLOGICAL DEVELOPMENTS

Our zoo biology group conducts research using non-invasive methods in the areas of behavioural research with imaging and bioacoustic techniques, fecal microbiome analysis, and environmental psychology. A particular concern is large-scale, comparative studies, which we conduct with many partner zoos and partly in the field. As an example, in a comparative study of giraffe nocturnal behaviour (13 EAZA zoos, 63 individuals), it was shown that the nocturnal behaviour of giraffes in zoos likely depends more on individual characteristics such as age, subspecies and maternity than on environmental factors, such as group or enclosure size (Burger et al., 2021). To be able to carry out these studies, one focus of the working group is on the development of new measurement and analysis methods. For behavioural research in zoos, a tablet-based app (ZooObserver) was developed, which has already been successfully tested at several partner zoos and improved according to hints. For automated analysis of video data, BOVIDS (Behavioural Observations by Videos and Images using Deep-Learning Software, see Fig. 2) was developed (Gübert et al., 2022) to handle large amounts of video data. For bioacoustic measurements, LASER (Localize Animal Sound Events Reliably) has been developed to determine the correct position of a sound source with a high accuracy (Schneider and Dierkes, 2021) and currently a piece of software for the

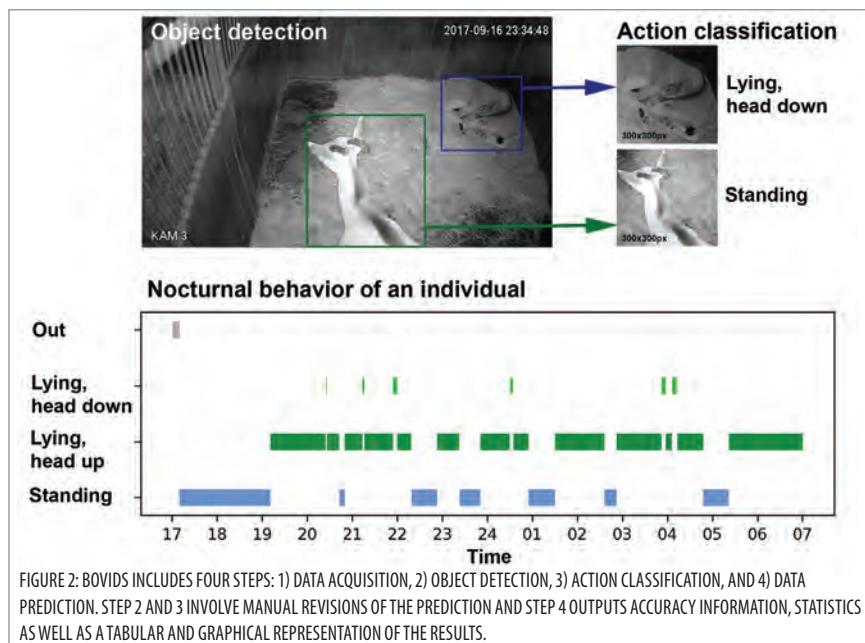


FIGURE 2: BOVIDS INCLUDES FOUR STEPS: 1) DATA ACQUISITION, 2) OBJECT DETECTION, 3) ACTION CLASSIFICATION, AND 4) DATA PREDICTION. STEP 2 AND 3 INVOLVE MANUAL REVISIONS OF THE PREDICTION AND STEP 4 OUTPUTS ACCURACY INFORMATION, STATISTICS AS WELL AS A TABULAR AND GRAPHICAL REPRESENTATION OF THE RESULTS.

automated detection of vocalisations in long-term recordings is being developed, based on deep learning algorithms. Appropriate laboratory capacities have been created for microbiome analyses, which also allow the processing of larger sample quantities. Due to this existing methodological know-how, research work combining the methods is also possible. Adapted measurement instruments for interviewing people have also been developed in the field of environmental psychology. These are used, for example, in the zoo to evaluate the promotion of connectedness to nature through guided tours (Kleespies et al., 2020). However, such instruments can also be used in international comparative studies in a broader context, for example to survey connectedness to nature among students of environmental and biological sciences (Kleespies and Dierkes, 2023).

### FIRMLY ANCHORING RESEARCH AND TEACHING AT THE UNIVERSITY TAKES TIME

For a long-term implementation of the research direction, time is needed to build up structures in teaching and research. In particular, competitive research submitted to peer-reviewed journals requires well-trained master's students and dedicated PhD students, who are usually only available after an initial phase. The financial support of Opel-Zoo by the von Opel-Hessische Zoostiftung has already been in place for 10 years and provides a solid basis to successfully implement teaching and research. Furthermore, this basic

funding makes it easier to acquire additional third-party funds, so the working group has reached a size that allows it to successfully implement the broad content-related orientation. In the meantime, four members of the research group have already found employment in EAZA zoos, which documents the great interest and preference for zoos and their animals in the group. For more information, please go to [www.zoobiology-frankfurt.de](http://www.zoobiology-frankfurt.de).

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# The library of ideas

THE RECENTLY LAUNCHED ZOO SCIENCE LIBRARY WILL POOL ALL OF OUR KNOWLEDGE AND RESEARCH TO CREATE AN INVALUABLE AND EVER-GROWING RESOURCE FOR THE CONSERVATION COMMUNITY

Julia Kögler, Deputy CEO, Association of German-speaking Zoological Gardens; Zjef Pereboom, EAZA Research Committee Chair, Antwerp Zoo; Marcus Clauss, EAZA Research Committee Vice Chair, University of Zürich; and Raymond van der Meer, Director of Conservation and Population Management, EAZA Executive Office

Research is one of the direct *ex situ* conservation roles a zoo can have, and scientific studies can support the implementation of global and regional biodiversity conservation strategies. Research can cover a range of disciplines and support various goals, whether it's for direct application in the zoo or in the field, or to advance our knowledge of species and ecosystems. Any small- or large-scale study that is done in-house and focuses on a specific research question can be useful to guide evidence-based decision-making and improve zoo standards. But to advance our collective knowledge and increase the impact that we can make both within the zoo community and outside for the direct conservation of species, it is necessary to publish and share results through peer-reviewed publications in scientific journals.

An increasing number of papers are published with contributions from zoos and aquariums, and the role of zoos in research is undisputed within the zoo community. However, we see a discrepancy between this self-image held by zoos and public perception – possibly, because the contribution of zoos to research is not sufficiently documented. Just saying that zoos 'do a lot' is not convincing, and citing publications that summarise zoos' contribution to science, such as those given in the references below, has a limited effect.

To accommodate the need for making the contribution of zoos and aquariums to science more transparent and visible to society,

EAZA and the Association of German-speaking Zoological Gardens (VdZ) launched the Zoo Science Library ([www.zoosciencelibrary.org](http://www.zoosciencelibrary.org)) on 3 March 2023, international World Wildlife Day. The website lists publications from peer-reviewed literature in which zoos and aquariums were involved and is freely accessible to the public, with user-friendly search options. Filters allow users to search for publications by year, country and specific zoo or zoos, or search for key words for topics or certain species, and the search results can be downloaded and exported as an Excel database for further analytics or use.

With this new online tool, we hope to achieve several goals: most importantly, to make the contribution of zoos and aquariums to science visible, public and transparent with one click. The Zoo Science Library will help zoo representatives and zoo associations to showcase zoos and aquariums as valuable contributors to science and biodiversity conservation to politicians, the media, the public, critics, decision-makers and scientists.

Within our community, it is a way of documenting our efforts, and might create a gentle and friendly competition (is your zoo in there, with contributions on the species for which you manage the Studbook?) The Zoo Science Library will both display what we do and invite us to keep doing it, so please make every effort to contribute to the database yourself!

Currently, the Zoo Science Library contains around 600 publications from the years 2020 and 2021. New

papers will be added on an annual basis, and historic records will gradually be included over time. The Zoo Science Library is also open to publications from outside EAZA and VdZ members, and metadata on peer-reviewed publications which are not yet included in the databank. We will remind you of the annual update by sending out a survey to all EAZA zoos, but of course you can also submit data on the website itself.

The database is currently maintained by a team of VdZ and EAZA volunteers. We are looking for retired zoo staff with some experience of dealing with scientific publications to help us expand the Zoo Science Library backwards in time. Please contact any of the authors of this article if you are interested.

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# The power of data

WHEN IT COMES TO RESEARCH, EVERYONE NEEDS DATA – AND THANKS IN PART TO MEMBERS' INPUT AND PARTICIPATION, EAZA'S DATABASES HAVE GROWN INTO AN INVALUABLE RESOURCE FOR US ALL

Veronica Cowl, Reproductive Biology Coordinator, Chester Zoo and EAZA Executive Office

'Data is more valuable than oil.' This phrase first emerged in the early 2000s, and marked this century as one in which data reigns supreme. Of course, we in zoos and aquariums are no strangers to data. We track everything from visitor numbers and the temperature and humidity of our exhibits to the diets and enrichment we offer our animals (and visitors). On a daily basis, data empower every Member to make evidence-based operational decisions. While data are undoubtedly powerful at an institutional level, it is when we look at data as a community that they truly become a force for nature.

To highlight the value of databases, in this article I explore the contents of three key EAZA databases: the **Contraception Database**, the **Conservation Database** and the **Biobank Sample Module**, demonstrating the value they hold in supporting EAZA Members with informed decision-making.

## EAZA CONTRACEPTION DATABASE

Established in 2012, the Contraception Database (<https://eazarmg.org>) forms part of a long-standing partnership between the Association of Zoos and Aquarium's Reproductive Management Centre and the EAZA Reproductive Management Group. In total, the Contraception Database holds more than 50,000 records from over 600 institutions worldwide. It holds data on contraceptive use in 750 species and has been the key to discovering trends in the safety, efficacy and reversibility of contraception when used in managed species. In Europe, we use these data to answer more than 200 queries from the community per year, and data from the Contraception Database have been used to publish peer-reviewed

papers reviewing contraceptive products and use in diverse taxa, ranging from tigers to Rodrigues fruit bats (*Pteropus rodricensis*).

## EAZA CONSERVATION DATABASE

Developed to maximise the conservation impact of EAZA Members, the EAZA Conservation Database ([www.eazaconservation.org](http://www.eazaconservation.org)) tracks which *in situ* projects receive support from our Members, and highlights gaps and opportunities for Members who are looking for new projects to support. In the last five years alone, more than 200 EAZA Members have submitted their data to the Conservation Database, which to date holds information on almost 2,000 projects, and more than 1,200 species. The database is not only a valuable tool for EAZA Members but also a vital tool for showcasing the incredible *in situ* work of our membership to external stakeholders, tracking both financial and in-kind contributions.

## BIOBANK SAMPLE MODULE

The newest database to the 'EAZA club' is the Biobank Sample Module ([www.eaza.net/conservation/research/eaza-biobank](http://www.eaza.net/conservation/research/eaza-biobank)). Since 2019, more than 240 EAZA Members have contributed to the module, equating to more than 18,000 samples from close to 6,000 individuals and almost 900 species! These samples combine to create a powerful tool that is used to answer critical, community-driven veterinary and genomic questions. The EAZA Biobank has approved more than 30 research proposals, and samples have already contributed to several projects. Resulting publications include the genetics of brown bears (*Ursus arctos*) and chimpanzees (*Pan troglodytes*)

respectively, as well as vitamin D status in chimpanzees under human care, with many more to come.

Of course, I would be remiss to not mention the largest database available to us, and host to the Biobank Sample Module – the **Zoological Information Management System (ZIMS)**. More than 1,300 zoos and aquariums across the globe contribute data to ZIMS, with more than 10 million animals recorded in the database in the last 50 years. With this volume of data, it's no surprise that their hashtag is *#DataSavingSpecies*. Data from ZIMS and the Contraception and Biobank databases are key to helping us decipher what 'normal' is for the species we manage and for driving evidence-based management.

Best practice for our community builds on knowledge amassed by decades of work. Ultimately, the value of the databases we use depends on the input. While we are no strangers to sharing successes, sharing failures and opportunities for improvement are also important. The beauty of these databases is that they provide a mutual exchange of value – you entrust them with your data, and they in turn provide valuable insights that help advance best practice.

I am grateful to Anna Mękarska and Merel Zimmermann from the EAZA Executive Office for providing data on the Conservation and Biobank Databases and to all of you for submitting your data and samples to these databases.

For more information, please contact:

- Contraception Database: [contraception@chesterzoo.org](mailto:contraception@chesterzoo.org)
- Conservation Database: [info@eazaconservation.org](mailto:info@eazaconservation.org)
- Biobank: [biobank@eaza.net](mailto:biobank@eaza.net)
- ZIMS: [Support@Species360.org](mailto:Support@Species360.org)

# Body of evidence

A GLOBAL EVIDENCE MAP FOR ZOO AND AQUARIUM HUSBANDRY HAS THE POTENTIAL TO TRANSFORM THE QUALITY OF OUR KNOWLEDGE AND OUR WORK

Andrew E. Bowkett, Projects and Partnerships Manager, Paignton Zoo, Wild Planet Trust; Thomas E. Martin, Zoo Evidence Officer, Paignton Zoo, Wild Planet Trust and School of Natural Sciences, University of Bangor; Anaëlle J. Lemasson, Post-Doctoral Research Fellow, School of Biological and Marine Sciences, University of Plymouth; and Silviu O. Petrovan, Rebecca K. Smith and William J. Sutherland, Conservation Evidence Project Team, Conservation Science Group, University of Cambridge

Evidence-based practice is becoming a familiar term, but the tools and approaches developed in this area have yet to be widely adopted or integrated in zoos and aquariums. To this end, Wild Planet Trust (UK) has teamed up with Conservation Evidence, a free and authoritative information resource based at the University of Cambridge (UK), to create the first global database of scientific evidence for the effectiveness of husbandry and management interventions in zoo animals.

We refer to this database as an evidence map, as it lays out the findings of more than 1,000 scientific studies looking at the success or failure of husbandry options in more than 600 species. To find and categorise these studies we used the systematic methods developed by the Conservation Evidence group.

The public-facing component of Conservation Evidence is a free, searchable website (<https://www.conservationevidence.com>), which summarises evidence of the effectiveness of management actions, found from scanning more than 1.6 million articles in 17 languages. Alongside this, the group has developed other tools and resources to overcome barriers to evidence use and ensure more effective decision-making in conservation practice. Given the many potential conservation benefits of *ex situ* species management, Conservation Evidence has been working with Wild Planet Trust, based at Paignton Zoo (UK), to integrate the work of zoos and aquariums into this toolbox.

## SUMMARISED, SYNTHESISED, ASSESSED AND SCORED

The process used is known as subject-wide evidence synthesis. As well as systematic and comprehensive

literature searches, this involves summarising each study that meets the criteria and synthesising the combined evidence for a particular topic in a synopsis. The collated evidence for each action is also assessed by an expert panel and scored for effectiveness, certainty and harms. Staff and students at Wild Planet Trust assessed the relatively narrow range of zoo topics covered by the current Management of Captive Animals synopsis published in 2018. Ultimately, we would like to see all the evidence for the husbandry and management of all taxonomic groups covered by synopses and freely available through the Conservation Evidence website.

## MAPPING THE EVIDENCE

As the first major step towards this goal, we conducted the searches required for a systematic map following a protocol that we published in EAZA's *Journal of Zoo and Aquarium Research* (JZAR). To create this 'zoo evidence' map, we scanned 27,705 articles in 45 academic journals for evidence-based assessments related to 424 specific husbandry and management interventions (actions) implemented in zoos, which were determined by an international advisory board of 26 zoo science experts. We identified 1,082 unique studies reporting empirical tests of these actions. These studies spanned 516 institutions in 69 countries, focusing on 637 different species. Subject to peer review, we aim to publish this data in JZAR later in 2023.

While most actions had some published evidence, diet modification and enclosure enrichment were particularly well-studied actions for most taxa, but there was comparatively little research on behaviour management, visitor

management and transport actions. Behaviour and condition were particularly common measured outcomes, while population genetics and survival rates were comparatively poorly studied. Similarly, mammals were particularly well-studied, whereas birds, reptiles, amphibians and invertebrates were comparatively poorly studied. The vast majority of studies were undertaken in North America and Western Europe, particularly the USA (48% of all studies). This research provides curators and keepers with the first database of evidence-based evaluations of husbandry and management actions used in zoos and aquariums.

## CONTRIBUTING TO THE ZOO EVIDENCE MAP

The integration of research into zoo and aquarium operations has greatly expanded in recent decades, but we need to be constantly learning and becoming more effective given the current biodiversity crisis. Accredited zoos and aquariums must participate in scientific research to comply with the new EAZA Research Standards. Once published, our evidence map will highlight key gaps by identifying specific actions which have not been studied in specific species. Our hope is that the community will test these and share results. While it can be difficult to publish relatively simple tests of routine husbandry in traditional journals, both JZAR's Evidence-based Practice section and the *Conservation Evidence Journal* (<https://conservationevidencejournal.com>) are designed to peer review and publish research that investigates the effectiveness of conservation actions in zoos or elsewhere. In this way, the evidence base for what works in zoos and aquariums will continue to grow, leading to more effective practice.



EXHIBIT BARRIER BY THE WORLD'S LARGEST INSECT HOTEL. LOOK CLOSELY TO SPOT THE THREE PIED TAMARINS FORAGING © MICHELLE REKERS

## Bugs in the wall

A STUNNING NEW 100-METRE INSECT WALL SHOWS HOW ENRICHMENT CAN BE INCORPORATED INTO ZOO HABITAT DESIGN AND AT THE SAME TIME CREATE OPPORTUNITIES FOR VALUABLE RESEARCH

Anouk Fens, Zoo Animal Nutritionist, Apenheul; Lisette van den Berg, Research and Animal Welfare Coordinator, Apenheul; Rachel Knetsch, Research Intern, Utrecht University; Michelle Rekers, Research Intern, Utrecht University; and Marcus Clauss, EAZA Research Committee Vice Chair, University of Zürich

In the creation of habitats – rather than mere ‘enclosures’ – for zoo animals, zoos are constantly pushing the boundaries: literally by creating larger habitats and figuratively by using innovative ideas. Whereas ‘enrichment’ was historically understood as adding special efforts to a pre-determined enclosure and husbandry routine, it is increasingly becoming an integral part of enclosure planning and design.

The recently developed habitat for small New World primates at Apenheul (the Netherlands), is a current example. In 2020, the park opened a new, free-roaming primate exhibit for callitrichids and other small New World monkeys in which natural foraging behaviour was stimulated. Perhaps the most impressive, and surely most innovative, part of this new exhibit is its barrier, which consists of a more than 100 metre-long insect hotel, the largest of its kind in the world. The idea is that once this wall harbours a speciose insect population, it will provide the insectivorous callitrichids with countless foraging opportunities.

One could argue that this idea is so self-explanatory that there is no need for specific scientific assessment.

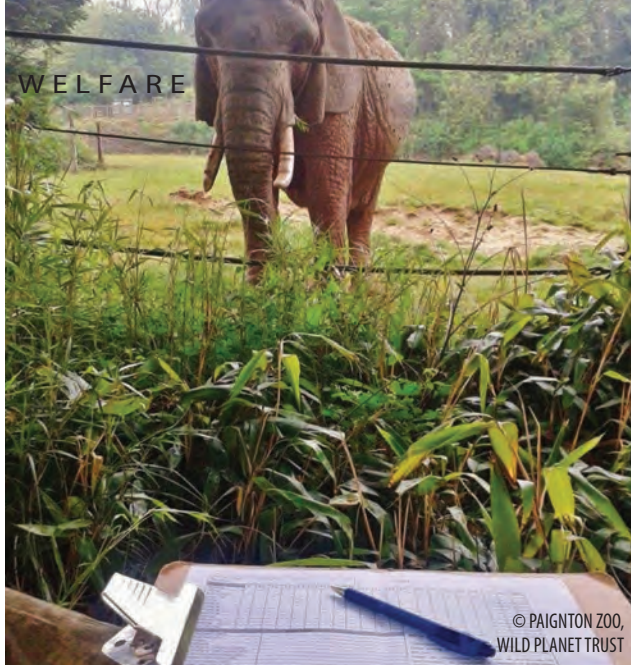
However, for scientifically managed zoos, data-based monitoring is not only a component of its objective ‘to do science’, but also a self-evident tool to evaluate and integrate measures into the overall animal management. Thus, students under supervision by Apenheul staff performed tablet-supported direct observations of four selected individuals; two pied tamarins (*Saguinis bicolor*) and two silvery marmosets (*Mico argentatus*). Behavioural observations were performed during approximately six hours of daylight hours in winter (with up to 30 minutes of access to the outside area, spent sunbathing) and spring (with outside access for two to four hours, including one food provision).

The proportion of time spent foraging increased from winter to spring in tamarins (from 9 to 42% of observed time) and marmosets (from 19 to 55%). Foraging at the insect wall represented 2% of the observed time (approx. 9 minutes per day) for tamarins and 5% (19 minutes per day) for marmosets (spring only), whereas other foraging activity outside in other parts of the enclosure on non-provided items represented 13% and 11% (47 and 41 minutes per day), respectively.

Two things are evident: first, compared to winter, foraging activity indoors was higher in spring, which speaks of a general seasonal effect on the animals’ activity; and second, the time spent foraging on non-provided items in the enclosure, including the insect hotel barrier, was high at about one hour out of two to four hours of outside access per day.

These first observations are a prime example of how zoos can work with undergraduate students to acquire data on their animals, which then may be useful in management decisions and monitoring. For example, these data will facilitate comparisons with other seasons, other years (of better or worse weather) or with other feeding regimes; we could also test whether less food provision outside increases foraging behaviour on non-provided exhibit elements.

When such observations are made on a continuous basis, boundless opportunities are created: ontogenetic changes and long-term animal character traits could reveal themselves, or detailed features of the insect hotel wall might turn out to be more attractive to the primates than others. Only if you look will you see.



# Welfare matters

## HOW EAZA IS SUPPORTING ITS MEMBERS IN ADOPTING ANIMAL WELFARE ASSESSMENTS

Sally Binding, Animal Welfare Coordinator and April Adams, Director of Member Development, EAZA Executive Office

Whether you are embracing them or anxious about them, leading the way or have no idea where to start, you will be hard-pressed to find a modern zoo professional who has not heard of animal welfare assessments. This rapidly developing subject – both in science and application – is traversing the fields of research and animal management, as both areas of expertise come together to put the science into practice and provide valuable information about the welfare of the animals in our care.

Animal welfare assessments come in a wide range of styles and it is clear that one size does not fit all. They range from highly researched taxa-specific assessments that include taxa-specific validated welfare indicators (these are often the most scientifically valid assessments due to the large amount of scientific testing and inclusion of species-specific indicators) to assessments that contain more generalised questions, which can be used across a range of species. Assessments can be adapted to assess welfare-surrounding events such as before-and-after enclosure changes, visitor events, quarantine, change in social groups, transportation and many more.

The more generalised assessments potentially compromise depth of detail in favour of the need to assess a diverse array of species and individuals, including many species for which the research is not yet available. However, they can still be a very valuable tool to identify areas of animal welfare which may need prioritising for improvement or require additional studies. This may be, for example, identifying behavioural opportunities lacking in the habitat, changes in food presentation, changes in UV levels, visitor sound levels or a nutritional analysis of diet. It is important to recognise that no assessment is perfect, but if you can gain valid information about the welfare of the animals in your care then this can be used to take action to improve welfare and be welfare-progressive in your organisation.

There is a wealth of information available, both in publications and shared by other institutions, to support the zoological community in its welfare progression. Both as part of EAZA's 2021–2025 Strategy to be progressive in animal welfare, and as a member of WAZA, EAZA is adopting *The WAZA 2023 Animal Welfare Goal*, which requires the following steps to have been taken by 31 December 2023:

1. WAZA National and Regional Associations must have an animal welfare evaluation process in place and such a process must include specific elements approved by WAZA.
2. All WAZA institutional members must be compliant with this process.

EAZA's Accreditation Programme is currently being assessed by an expert panel from WAZA to determine whether the Programme meets WAZA's welfare requirements. One expectation of the WAZA requirements is for all members to have a continuous welfare monitoring programme, of which welfare assessments are a vital part.

### DIRECT SUPPORT FOR EAZA MEMBERS

To support meeting EAZA and WAZA's welfare goals, the EAZA Executive Office (EEO) is supporting EAZA Members in the following ways:

- The EAZA Member Development Team, with the support of the Membership and Ethics Committee and EEP Committee's Animal Welfare Working Group, is revising and updating the EAZA Standards for the Accommodation and Care of Animals in Zoos and Aquariums and the accompanying Screening Team Questionnaire to incorporate the latest animal welfare science.
- The EEO has a range of resources available to support Members in developing their own animal welfare assessment that meet the needs of their institution, teams and animals. These resources include:
  - The **EAZA Animal Welfare Assessment Library** ([www.eaza.net/about-us/areas-of-activity/animal-welfare](http://www.eaza.net/about-us/areas-of-activity/animal-welfare)), provides seven different animal welfare assessment templates and associated guidance, shared by their authors. The template from the Wild Planet Trust (UK) is now available in 17 languages.
  - The **EAZA Academy** is now offering an **Animal Welfare Assessments workshop**. This face-to-face workshop takes a start-to-finish approach of understanding assessments, gathering objective data, analysing the results and developing your supporting procedures.
  - The **EAZA Welfare Webinars** are free to attend, and the recordings are available via the EAZA website. Topics include welfare assessments, nutrition, training, reproduction and understanding welfare science, among many others.
  - The **EAZA Animal Welfare Facebook page** continues to attract Members and shares relevant animal welfare publications and resources.

### FUTURE RESOURCES

EAZA will continue to promote high standards of animal welfare and the tools to measure it within the membership by developing further welfare-related resources and online and in-person courses, and sharing the latest science. For more information please contact the EAZA Animal Welfare Coordinator Sally Binding ([sally.binding@eaza.net](mailto:sally.binding@eaza.net)).

# Improving the welfare system

WITH INCREASING PRESSURE ON *IN SITU* POLAR BEARS AND THEIR *EX SITU* MANAGEMENT, RESEARCH ON THEIR WELFARE IS TIMELY AND CREATES A BLUEPRINT FOR THE IMPROVEMENT OF WELFARE ASSESSMENTS ACROSS OUR COMMUNITY

Cecilie Ravn Skovlund, Postdoctoral Researcher, Copenhagen Zoo and University of Copenhagen

Besides the moral human obligation to provide adequate care for the animals we house, ensuring high standards of animal welfare is important for institutional conservation efforts, whether it concerns funding, education, changing societal attitudes, promoting engagement, species reintroduction and 'insurance' populations, or general research benefiting *in situ* counterparts. The success of these efforts is affected by the wellbeing of the animals, impacting such things as species-specific behaviour (important for educational value and reintroduction), reproduction (for viable populations) and the validity of research conducted on the animals, among others. As such, there is an increasing focus on zoo animal welfare, and welfare is today part of the mission statement of EAZA, placing it as a central part of zoos' conservation work. Moreover, global and regional associations (e.g. the WAZA 2023 Animal Welfare Goal) require institutions to monitor welfare based on scientific evidence.

## EVIDENCE-BASED WELFARE ASSESSMENT

Welfare assessment should be evidence-based, i.e. tools and indicators for its evaluation should be *valid* and *accurate*. While the promotion of natural behaviour and environments has been a focal point in zoos for multiple reasons, the expression of natural behaviour or living a natural life does not necessarily equal positive welfare; this is why investigating the validity of welfare indicators is crucial. Indicators should also be *reliable* (repeatable within and between assessors) and *feasible* in zoo settings, accounting for constraints on time and resources. Naturally, compared to research output on farm animals, zoo animal welfare research is falling behind owing to the vast number of species each having different needs, further complicated by small numbers of individuals in geographically scattered institutions. Consequently, although there is a pressing need for zoo welfare assessment protocols, gathering the evidence across a full range of species will take time.

## A PROTOCOL FOR POLAR BEARS

In zoos, polar bears (*Ursus maritimus*) serve as a flagship species for the effects of climate change. With increasing pressure on this species in the wild, the *ex situ* population contributes to conservation efforts through public education and by serving in research that benefits *in situ* conspecifics. However, in the case of impaired welfare, or a societal perception of it, housing polar bears may have negative impacts on conservation efforts, e.g. through impaired health, reproduction, behavioural flexibility and reduced visitor support. Consequently, the welfare of polar bears is a priority for multiple reasons. Therefore, Copenhagen Zoo (Denmark) and the University of Copenhagen initiated a project in collaboration with the Zoo Animal Welfare Education Centre (Autonomous University of Barcelona,



Spain) to develop a welfare assessment protocol for polar bears. Although the focus was on behavioural indicators, the result was a holistic welfare assessment protocol, based on the Welfare Quality® and Five Domains framework, covering Nutrition, Environment, Health, Behaviour and Mental State. Valid welfare indicators were identified through a literature review, and along with information from the AZA Bear TAG Care Manuals, these indicators were incorporated into the framework, highlighting large gaps in knowledge. To fill in some of these knowledge gaps (including appropriate behaviour, social dynamics and evaluating positive mental state), data were collected from 22 polar bears at nine EAZA Member institutions. This facilitated the development and validation of three novel behavioural welfare indicators – Behavioural Diversity, Social Dynamics and Qualitative Behaviour Assessment – thereby closing some of the knowledge gaps. The information is currently available in two publications in the peer-review journals *Animal Welfare* (February 2021) and *Applied Animal Behaviour Science* (May 2023), and the protocol can be found in the PhD thesis 'Towards a welfare assessment protocol for polar bears (*Ursus maritimus*) in zoos' (2022).

## WHERE NEXT?

The project took the first step towards an evidence-based welfare assessment protocol for polar bears, highlighting indicators, scoring systems and knowledge gaps. While we have gained insight into polar bears' welfare assessment, which is important for their management and conservation, there remain many species in zoos for which there is a lack of evidence-based indicators with which to assess their welfare. Fortunately, we can instead draw upon the knowledge of the many dedicated people and experts within the EAZA community and the available resources (e.g. the EAZA Animal Welfare Working Group) to develop evidence-based welfare tools. Inter-institution knowledge sharing is a valuable resource for institutions facing the impending global and regional requirements, and is encouraged for maintaining and increasing the welfare standards in zoos and aquariums – and hence their conservation efforts.

# Maximise Productivity and Minimise Stress with these Five Simple Tips

Like most of the zoo industry, Hannover Zoo (Germany) is facing a staff shortage. To resolve this issue, they had to find new processes to streamline their operations. Sebastian Bär, the Senior Manager of Digital Development at Hannover Zoo, recently engaged in a conversation with Convio to share his insights on optimising operations, enhancing staff experience and improving the overall success of your venue.

Convio is a leading technology company specialising in providing innovative solutions for the leisure industry. Their tool helps zoos optimise operations and enhance their visitors' digital experiences. With the help of Convio, zoos can leverage the power of Artificial Intelligence to make data-driven decisions. Thanks to thorough reports and forecasts, selling tickets online has never been easier!

During this conversation, Hannover Zoo shared valuable tips on how to optimise operations and minimise stress, ensuring a smooth and efficient experience for both staff and visitors.

## TIP 1: MAKE DATA-DRIVEN DECISIONS

*'It doesn't matter how many people are at the zoo, the animals are there and the keepers are there. On a day when there are just a few visitors, sales don't cover the costs. On another day with thousands of people, you can say the day is paid. The only things you can really control are the variable costs, so you have to plan the days and know how many people you expect in the next days or the next week.'* **Sebastian Bär, Hannover Zoo**

Having a clear overview of your data is a crucial first step. Analysing relevant data can help you make more informed decisions in order to avoid biases and subjectivity. The key here is to make sure that you are tracking the data across all your sales channels.



## 5 TIPS TO EASE THE LIFE OF YOUR STAFF & OPTIMISE OPERATIONS

By Hannover Zoo & Convio's experts  
Re-live the exclusive webinar



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SEBASTIAN BÄR

This way, you can have a better overview of what is going on in your venue on a particular day and plan your staff and resources accordingly. This includes restaurants in your venue or the number of employees you will need for a specific day.

## TIP 2: STREAMLINE YOUR COMMUNICATIONS

*'In Hannover we have big teams with very different roles. We have zookeepers, accountants, kitchen staff and so on. Everybody needs different kinds of information, the accountants need figures, the zookeepers need everything concerning the animals. The problem is that the team is spread all over the venue, and there are 22 hectares; that's not really big but it's big enough to cause a problem when you need to talk to everybody.'*

To ensure good communication between your employees you need to find the right tools and make the most out of automated systems. Sebastian talks about how at Hannover Zoo they streamline their internal communication by making use of their own app. Keeping all the communication in a single place has enabled them to improve communication between the different

teams and be one step ahead of any unexpected events.


## TIP 3: USE DYNAMIC PRICING

Another challenge the zoo has been facing was that the majority of people visiting the zoo would buy their tickets at the gate. This translated to long queues on busy days and very low attendance on quiet days. After implementing a dynamic pricing strategy, they noticed a better visitor spread. With this innovative way of pricing, Hannover Zoo could offer lower prices on their website, promote online bookings, and get insights into the expected visitors so they could plan better for the day. Sebastian agreed that: *'Offering limited early bird tickets allows us to know very early on how many people will come to the zoo on a particular day.'*

Ultimately, it all comes down to embracing technology!

*If you want to see more tips from Hannover Zoo on how they streamline their operations, tune in to see the replay of the webinar at <https://hubs.ly/Q01RbPzn0>*

*Brought to you by EAZA Corporate Member Convio*

A photograph of a modern building with a curved facade and a central entrance, surrounded by a fence and landscaping. The words "Panda House" are overlaid on the image.

Panda House

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A close-up photograph of a giant panda sitting on a log and eating bamboo. The panda is the central focus, with its black and white fur and bamboo stalks clearly visible.

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