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ON THE 25TH ANNIVERSARY OF THE PUBLICATION OF ZOOQUARIA, WE LOOK FORWARD ANOTHER QUARTER OF A CENTURY TO HOW THE ZOO AND AQUARIUM COMMUNITY MIGHT LOOK IN 2043

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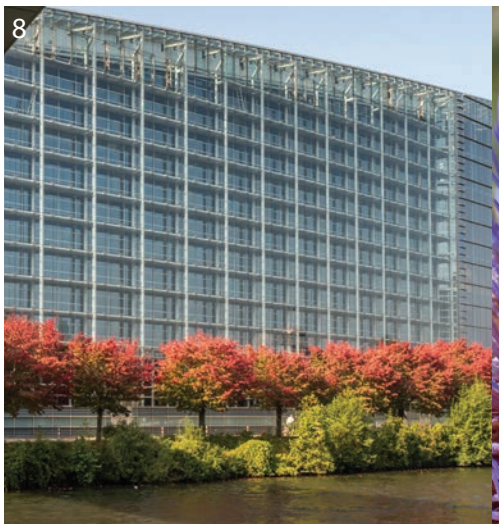

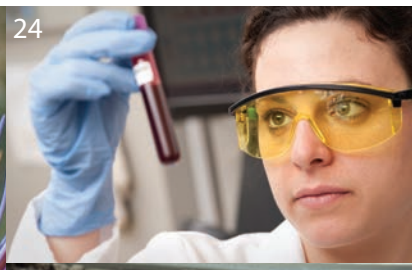

Zooquaria

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FROM THE DIRECTOR'S CHAIR

I am delighted to share with you this 100th special edition of *Zooquaria*. The first *EAZA News* was issued a little over 25 years ago in May 1992. In his editorial, the Chairman, Fred Damen, discussed the change from ECAZA to EAZA, as well as the announcement that IUDZG (now known as WAZA) was moving from individual to institutional memberships. He also hinted at collaboration between the IUCN SSC Captive Breeding Specialist Group (now Conservation Planning Specialist Group), IUDZG and regional associations in producing the first ever 'World Zoo Conservation Strategy'.

It wasn't long before the content of *EAZA News* grew so much that the original in-house photocopy leaflet format needed changing, and in 1996 a professional magazine was produced. In his editorial the Chairman, Roger Wheater, promoted the newly approved EAZA logo (with the lion looking left and the fish right); I'll be happy to confirm guesses on who was the first EAZA Member reported to have used it! There was also discussion of development of the EAZA Constitution – a very apt topic given our desire to have updates to it approved at our recent Annual General Meeting (see more on page 5). However, my favourite article has to be the one titled 'An introduction to the internet' whereby common terminology and the advantages and disadvantages of this new phenomenon were explained!

Issue 50 saw a move from editorials by the Chairman to those from the editorial team and, ultimately, by the Executive Director. Collection planning was the focus of one of our first ever special issues (# 64), plus information about an update to the logo (lion now looking right and fish looking left – which one are you using?) Issue 68 in 2009 was also memorable. This was the issue where *EAZA News* was changed to *Zooquaria* to reflect the further expansion of the magazine to appeal to both internal and external audiences. The full magazine was also now available to download from the EAZA website; a far cry from the 'introduction to the internet' required in the previous decade.

Enough of looking back (though I must admit I have been totally fascinated while looking through the archives) – this issue is all about looking forwards. Given how far we have come since the first issue, where will we be by issue 200? In this issue we have some excellent, thought-provoking articles. Some are written from today's perspective and predict what challenges we may face over the next 25 years, while others are boldly written as if we were already publishing issue 200. I am truly hopeful that we'll see the successes predicted in our 2043 Births and Hatchings section and, needless to say, while I will be proud of the data presented in the future Conservation Database snapshot, I will still be calling for more input and higher numbers!

Most articles contain a mix of sadness and hope about our future, but all have EAZA and our Members at the centre of involvement in positive outcomes. We have difficult obstacles such as climate change, human population growth, apathy and uncertainty to face. Nevertheless, when I think about what I found in the archives and combine it with my experience of working for EAZA to date, it is clear to me that we absolutely have the experience and ability to rise to whatever challenges the future holds. One thing that has not changed and will not change over time is our commitment to collaboration for the greater good of the species in our care and on our planet, and the people who interact with them.

Myfanwy Griffith
Executive Director, EAZA

NOTICEBOARD

DIRECTORS' DAYS 2018

The annual Directors' Days meeting took place in Antwerp from 18–21 April. Hosted by KMDA Antwerp Zoo in the historical wing of their new conference centre (pictured, right), the meeting introduced several topics that are relevant to the current and future practice of zoos and aquariums across a number of areas.

The event started with an icebreaker on the evening of Wednesday 18th, which was sponsored by new Corporate Member Syx Ticketing. Held at the Leopold Hotel in Brussels, just a few steps away from the European Parliament building, it welcomed members of the World Association of Zoos and Aquaria (WAZA) and its Council as well as EAZA Directors.

On Thursday morning, the day began with welcome addresses from Dries Herpoelaert, CEO of KMDA, and Koen Kennis, Deputy Mayor of Antwerp with responsibility for the tourism sector in the city. The keynote speaker, Dr Jenny Gray, President of WAZA and CEO of Zoos Victoria, gave a compelling address looking at leveraging traditional philosophical analysis to incorporate a clearer ethical dimension into the mission of progressive zoos and how we present ourselves to the public and legislators. The second session looked at partnerships between EAZA and other organisations, including CITES (Tiit Maran, Tallinn Zoo), Species360 (Jim Guenter, who looked at scientific work empowered by ZIMS) and EAAM (Arlete Sogorb, Lisbon Zoo). Christoph Schwitzer (Bristol Zoo) examined how zoos can help to shape conservation priorities through involvement with IUCN, and Doug Cress, CEO of WAZA, explained how the organisation was working with a coalition to reduce plastic pollution of the ocean.

The third session of the day was dedicated to an in-depth discussion of issues related to the care and management of elephants, and featured presentations from TAG Chair Thomas Koelpin of Stuttgart Zoo on current issues facing the TAG, and Kris Vehrs, CEO of the US Association of Zoos and Aquariums, on the history of AZA's move towards protected contact as a requirement of membership. Communications Committee Chair Colomba de la Panouse of Thoiry Zoo presented an analysis of the media and communications implications of several of the issues, which was followed by a spirited discussion between Directors.

The second day discussed politics: Gloria Svampa of Italian Zoo Association UIZA recommended that EAZA should work to assist national licensing authorities with implementation of the EU Zoos Directive in line with the likely recommendations of the REFIT inquiry. David Williams-Mitchell of the EAZA Executive Office encouraged Members to input into a possible EAZA manifesto for the 2019 European Parliamentary elections, and Dag Encke of Nuremberg Zoo demonstrated how Members can achieve significant results through sincere and energetic engagement with key committees and groups within the EU structure.

The next session examined the many options for zoos to engage with corporate partners in the funding of conservation. Dr Lesley Dickie of Jersey Zoo demonstrated how long-term engagement with partners can pay off to the mutual benefit of both the zoo and the partners, and Mike Barclay of Singapore Zoo showed how the zoo's governance can ensure that ethical standards are maintained while achieving strong funding outcomes.

EAZA Council met on Thursday evening (see below for decisions) and the Annual General Meeting took place on Friday morning. Unfortunately, the voting quorum of two-thirds of Full Members needed for constitutional changes was not achieved, so for the time being, there will be no change to the EAZA Constitution. This is expected to be addressed at the next EAZA Annual Conference in Athens in September.

DECISIONS OF COUNCIL MEMBERSHIP

NEW MEMBERS

Full Membership was awarded to Galway Atlantaquaria (Ireland), Bergen Aquarium (Norway) and Camperdown Wildlife Centre (UK).

Temporary Membership was awarded to Aquatis Aquarium-Vivarium, Lausanne (Switzerland).

Associate Membership was awarded to Singapore Zoo (including Night Safari and River Safari), Jurong Bird Park (Singapore) and Hansenberg School (Denmark).

TEMPORARY MEMBERS

Woodside Wildlife Park (UK) was upgraded to Full Membership. Temporary Membership was retained by Exmoor Zoo (UK, 1 year extension), Monde Sauvage (Belgium, 6-month extension), Terra Natura Murcia (Spain), Serengeti Park Hodenhagen (Germany), and Pécs Zoo (Hungary).

EAZA Accreditation Programme: Belfast Zoo (UK) was reinstated as a Full Member following two years as a Temporary Member. After a two-year period of Temporary Membership, the EAZA Membership of South Lakes Safari Zoo (UK) was terminated.

CORPORATE MEMBERS

Syx Ticketing (Belgium), Bureau d'Etudes d'Akongo (France), BioZoo Information (Denmark) and Bureau d'Etudes Bioparc (France) were all approved as Corporate Members of EAZA.

EAZA would like to thank the sponsors of the Directors' Day conference, Syx Ticketing and KaGo & Hammerschmidt, our Corporate Members and KMDA Antwerp Zoo for their exemplary hosting of the event.

The 2019 event will be hosted by Jersey Zoo in Jersey.

G.LANTING

NEW ARRIVALS – WHAT MIGHT WE SEE IN 2043?

EUROPEAN MINK KITS BORN AT TALLINN ZOO

EUROPEAN MINK HAS BECOME A FLAGSHIP SPECIES FOR EUROPEAN BIODIVERSITY

A HEALTHY LITTER of six European mink (*Mustela lutreola*) kits was born at Tallinn Zoo in late April after an easy seven-week gestation. The kits, four females and two males, gained weight rapidly, trebling in size over the first 10 days. The animals are part of the latest generation of animals bred from the cross of Spanish and Estonian populations. The EEP is in discussion with IUCN-approved European mink projects in Poland and Germany on the subject of whether or not any of the kits could help with the goal of reinforcing the genetic diversity of wild populations in those countries. European mink are still Red Listed as Critically Endangered, although the situation has improved somewhat since the European Union added American mink to the Invasive Alien Species list in 2024, partly in response to EAZA campaigning on European fresh water biotopes. The European mink has become one of the key flagship species for these efforts, thanks in large part to a concerted effort by the EEP to encourage the construction of enclosures that replicate the running water habitat of wild mink, and strong educational initiatives based on encouraging Europeans to do more to protect wild freshwater habitats. While American mink populations are still well entrenched in the Danube delta, despite strong eradication efforts from the Romanian government, the relatively new populations in Germany and Poland are now beginning to stabilise. These programmes are running in tandem with American mink eradication efforts and the reintroduction of plague-resilient European crayfish to suitable habitats by EAZA Members and conservation partners; conservationists are optimistic about the long-term prospects for these populations, and it is hoped that the return of wolves to Germany and Poland in recent years will aid their chances as red fox (a major predator of European mink) numbers start to drop. It is also hoped that introduction of the disease-resistant crayfish in Scandinavia could help to build bridges between wild populations. In the meantime, the kits are delighting visitors to Tallinn Zoo, and are expected to reach full size by the time this article goes to press.

HYENA CUBS MAKE A SPLASH AT AMERSFOORT ZOO

AMERSFOORT ZOO in the Netherlands was thrilled to welcome two new spotted hyena (*Crocuta crocuta*) pups in March. The animals made their public debut in mid-April after venturing out of the den a month after their easy birth. The public reception shows again the value of the EEP goal-setting process and how this can turn around perceptions of species. In 2018, the spotted hyena EEP recognised the need to improve the image of hyenas, and set itself the goal of doing so in 2022. We should remember that in previous decades, hyena were seen as ugly and aggressive, making conservation difficult and failing to attract visitors. Great education by EEP participants, including Amersfoort, have completely turned this perception around. The key to the change was the adoption of education about the species, which underlined the complex social structure and interactions of hyena packs, along with a clear exposition of the environmental services provided by some of Africa's most effective clean-up crews; hyena were of course featured in the EAZA 2030–2032 conservation campaign Habitat Heroes, which focused on the role that scavengers play in maintaining ecosystem health and balance. Visitors have been thrilled to see the pups fitting into the pack hierarchy under the fine care provided by their mother, who came to Amersfoort's pack in 2040.

To encourage a further increase in the public's affection for the species, the zoo has, unusually these days, opened a competition to name the pups – both female – and has placed them front and centre in educational and promotional activities. Meanwhile, wild populations of hyena are recovering gradually thanks to protection measures instituted by range state governments, following a population crash in the early 2020s.

BERNARD DUPONT CC

SPOTTED HYENA HAVE WON A PLACE IN THE AFFECTIONS OF ZOO VISITORS OVER THE PAST FEW YEARS

SAOLA SUCCESS

THE SAOLA BREEDING CENTRE – at a confidential location in Vietnam – has reported the birth of its 15th saola calf, which was delivered naturally after a calm nine-month gestation in January. The calf, a female, is doing well and will be transferred to the Centre's sister location in Laos after weaning. The Vietnamese site was set up in late 2018, where the first animals taken in as a pilot project were large-antlered muntjac (since uplisted to Endangered on the IUCN Red List). The first saola, captured by driven netting with the assistance of local hunters, joined the facility in 2019, a story that made headlines worldwide. Saola produce a single calf every one or two years, and the centres between them hold a total of nine breeding pairs; population management support and analysis supplied by the EAZA Executive Office in association with the Saola Working Group is helping to ensure a healthy population over the long term.

The programme also marked an important turning-point in conservation practice worldwide: until 2019, many conservation programmes involving wild capture of critically endangered species were started too late to save the species; the success of the saola programme, which was in doubt until the first calf was born in 2020, demonstrated that conservationists could not afford to wait for populations to fall so low. The programme also demonstrated another first: European zoos working with conservationists to save species that will never be held in their collections. This combination of factors has also served to greatly improve both the saola's wild habitat and the level of public engagement with conservation across Southeast Asia. While the region still has much to do to reverse decades of degradation and biodiversity loss, strong commitments from governments across the region combined with unconventional techniques for saving species such as those employed by the saola project are gradually stabilising the situation, and prospects, for the first time in many years, look very promising. The new calf will contribute to the further consolidation of the species in anticipation of the reintroduction of animals some time in the next decade.

Altered states

IN 2043, HOW HAVE CHANGES TO THE EU OVER THE LAST FEW DECADES AFFECTED ZOO CONSERVATION?

Daniel Nuijten, EAZA EU Policy Manager, Belgium

2043 Strasbourg France: I am looking at the former European Parliament building (pictured right), which is now the home of the European Research Agency. In the face of public pressure to increase democratic accountability and improve efficiency, the European Parliament has become the most visible EU institution and now meets only in Brussels. With the momentum generated by this public pressure, Members of the European Parliament (MEPs) managed to secure not only this permanent move to Brussels, but also, following their success with the 2014 and 2019 nominations for the president of the European Council, a move to campaigning on European-wide lists in 2024. These steps created a truly European Parliament, and Members were forced to reach out to voters across Member States. A European political identity still doesn't exist, but prominent MEPs are now more widely known to the electorate.

Meanwhile, with the democractic norms of the Union being discussed openly in some Member States in the late 2010s, and the power balance between older and newer Member States causing friction in both, the European Council looked less united than at any time since 1992. And while pressure on some newer Member States to live up to the founding ideals of the Union did little to build public confidence in the Council, it was clear by the mid-2020s that a new relationship would need to be forged between the institutions of the Union (including the Parliament) and the public they served. Despite the convergence of opinions between European countries as successive national elections brought in a more considered view of popular representation – and a less populist approach – it was felt that a lot of damage had been done to the reputation of the Union with the peoples of Europe, and younger MEPs started to discuss ways to improve support for Brussels across Member States. Clearest of all was the need to involve national parliaments (perceived as being closer to the needs of individual countries) in the selection of representatives at the highest levels of the Union. The European Commission (EC) had always been asked to create legislation by the European Council – in essence the heads of government of Member States; but as stronger popular representation across those states came into force, it was felt that national legislative bodies should be the ones responsible for making these requests, rather than heads of government. It seemed that government by concentric layers of coalition was inevitable, and desirable.

The mechanism for this devised by these younger parliamentarians was the Council of National Parliaments (CNP), with 20 members from each Member State. These members are elected by the national parliaments and while their role at first was to bring the voice of national parliaments into European policy processes, the European Parliament is increasingly reliant on the CNP for advice on the direction of the European Project, and how to maintain the high levels of public support that its creation inspired. Currently a new treaty is being proposed formalising this role, with the aim of making the EU a two-chamber system. And while heads of government, in the form of the European Council, still play an important role (as elected leaders, they still hold a veto on legislation requested by the CNP), they tend to delegate European affairs to the CNP, so as to be able to better serve their domestic electorates.

The EC is still there as the guardian of the treaties and is driving processes with great expertise. Many citizens used to distrust these 'eurocrats' in their ivory tower at the end of the 2010s. Their language has always been technocratic and difficult to understand for outsiders. However, an information campaign in the early 2020s helped the public to understand better the role of the EC – as that of a European civil service. This helped to dispel the idea that the EC was somehow 'in charge' of the Union, and allowed the public across Member States to relate to this role more easily – even if they did not necessarily relate better to the Commissioners themselves. Thus, the Union is defined as an upper house (CNP), a lower house (EP) and a civil service (EC), all with accountability both directly to the public and to their nationally elected representatives (the European Council). The Union, then, while still suffering from the tensions implicit in any such diverse gathering of cultures, now enjoys higher levels of public support than it has done for decades.

The position of zoos and aquariums in Brussels has also had its ups and downs. The Zoos Directive REFIT process outcome in 2018 showed that Member States struggled with implementing zoo legislation. A competitively fought tender to provide expert training to national inspectors led to a standoff between some Member States – those who felt that EAZA was ideally placed to provide such training, and those who felt that zoo associations might not be able to provide adequate objectivity during the process. This was not made easier by the fact that MEPs elected in 2019 on an agenda that was strongly led by animal rights militated for the organisations they supported to be included on any such training panel. A compromise position that required an EAZA-led process to be supplemented by oversight from animal rights groups became unworkable in a matter of months; and the EC accepted that an avowed intent to close down the institutions they were supposed to be regulating made the more extreme rights activists unsuited to the process. By 2025, however, a process was devised that required zoos to meet an objectively high standard based on proven success in conservation, research, education and welfare; the welfare standard, which is based on accepted findings of welfare science, is reviewed every 10 years, and zoos and aquariums

must be inspected within five years of any update to ensure that they are in compliance with this welfare standard.

A strong attempt to ban the holding of cetaceans in European institutions nearly succeeded in 2021 – however, public awareness of the pollution of the oceans and its effects on these species abruptly redefined the debate. Cetacean breeding gained urgency in conservation terms, and public support for conservation breeding allowed cetacean holders to invest in ultra-modern facilities that allowed for better integration of wild and aquarium populations. While this came too late for the vaquita – the species whose extinction led to this change of heart – we are glad to report that cetacean populations, and knowledge vital to the conservation of these species, is on the rise. Aquariums are now closely involved in the remapping of shipping lanes, and consultation on shipping industry standards for noise pollution. The world's navies are reportedly also using sonar apparatus with more care.

The impact of Brexit on the work of the zoo community has been less severe than expected. Despite the feared 'Hard Brexit' coming to pass, the UK Prime Minister found it hard to make the public care about continued alignment of veterinary legislation between the EU and the UK.

Zoos and aquariums have also played an active part in the management of European biodiversity strategy. The intervention of EAZA in the listing process of invasive species, following the extinction in the wild of the European mink (EAZA had been making representations to the EC on the subject for many years before this happened, which led to a de facto acceptance of our expertise on invasives) led to a strongly scientific approach to the listing of species. EAZA and IUCN have been key stakeholders in the process since 2026. The European public proved surprisingly accepting of the campaign to eradicate American mink, grey squirrels and other invasive species, thanks to a joint campaign between EAZA Members, national broadcasters and ministries of education across the European Union.

With the biodiversity crisis intensified all over the globe, the role of zoos and aquariums has been key in preventing extinction. In 2043 this is even more evident, but at the same time there are more species that need saving than there are resources. EAZA is heavily involved with the Directorate-General for the Environment to ensure zoos and aquariums can play this role, but unfortunately choices must be made. The extinction of Reeve's Muntjac (*Muntiacus reevesi*) showed the importance of the role of zoos. Invasive Alien Species legislation had the species eradicated in Europe in 2028. Unfortunately hunting and habitat loss made the species disappear from most of its natural range 10 years later. Although zoos tried to save the species it was too late. However, the case did serve to highlight the importance of the roles of zoos and aquariums in conservation, education and research, and, in addition, to prove the importance of science-driven policy-making.

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JAVAN PIED STARLING (*GRACUPICA JALLA*) IS NOW EXTINCT IN THE WILD, AND NOT BECAUSE OF HABITAT LOSS. IN A FUTURE WHERE WILD POPULATIONS ARE PROPERLY APPRECIATED, THEY COULD ONCE AGAIN BECOME A COMMON SIGHT IN THE RICE FIELDS OF JAVA AS THEY WERE JUST 25 YEARS AGO

SAVING OUR SONGBIRDS

HOW THE SILENT FOREST CAMPAIGN SET OUT TO IMPROVE THE PROSPECTS OF SONGBIRDS AROUND THE WORLD

Simon Bruslund, Curator, Heidelberg Zoo, Germany

Back in 2016 the following goals were set for the EAZA conservation campaign 2017–2019; 'Silent Forest – Asian Songbird Crisis'.

- Improve the situation of Asian songbirds in their natural habitat and cultivate increased knowledge and understanding of the threats to these birds and how zoos can contribute to save them.
- Cooperate with partner organisations and work with government agencies in the affected regions.
- Establish and support awareness campaigns in-region and promote birdwatching as an alternative pastime.
- Improve awareness within EAZA through the Passerine TAG and its population management programmes and through EAZA media (newsletters, presentations, magazines, websites). Publish information to improve husbandry and exhibits with Best Practice Guidelines and fact-sheets.
- Establish functioning *ex situ* safety populations of all key species and motivate more EAZA institutions to continue keeping relevant taxa of songbirds after the campaign.

Of course these 'soft' goals were complemented by 'smart goals', which are measurable over the short duration of the campaign, including such things as number of zoos signing up, fund-raising targets and so on. But the one desire shared by everyone involved in the campaign's core group is for Silent Forest to have long-term effects beyond the two years of campaigning. This will be achieved by inspiring not just zoo visitors, but also our fellow zoo professionals around the world to have a lasting appreciation of songbirds.

Songbirds are numerous both in species and individuals. In their relatively short lifespans, they have a large reproduction potential, but their abundance is no reason to take them for granted. Their many amazing feats

SILENT FOREST CAMPAIGN LOGO CREATED BY MICHAEL PETERSEN, STAFF GRAPHIC DESIGNER IN COPENHAGEN ZOO

include some of the longest migrations on earth, achieved thanks to cunning navigation skills. They shape their and our environment by the consumption of insects and distribution of plants. Their songs and colours have long been a source of inspiration for those who care to take a second look. Songbird swarm movements provide clues for pioneering robotics and artificial intelligence programming. Some songbirds are even thought to be among the most sentient of animals, with solution-finding skills that rival those of primates, and their complex social and communication skills, which we are just beginning to understand, may be even more impressive yet.

There really are plenty of reasons *not* to take songbirds for granted, but unfortunately these passerines do not receive the recognition they deserve. As small animals they are easily overlooked and fail to attract the attention that is given to larger birds or mammals.

The general public often fails to make an emotional connection with a particular species unless it is guided in the process. But in order to facilitate a newfound appreciation of these precious birds, the zoo communities themselves first have to forge their own connections with the songbirds of the world. The seed for this has been planted with the Silent Forest campaign, which opens a window on to the plight of the world's songbirds.

The Passerine TAG is responsible for maintaining a strong connection between the EAZA Member institutions and passerines. Frequent publications and active TAG assistance of Members in husbandry issues will lead to more space for passerines in zoos, including urgently needed behind-the-scenes breeding facilities. Creative new solutions for population management and innovative programmes interacting with *in situ* and non-EAZA populations will help to ensure the long-term sustainability of songbird populations and diversity of species exhibited in zoos.

Unfortunately not all passerines have the luxury of time to benefit from this new level of appreciation. In fact a few species are now on the verge of extinction, driven by the fact that they are traded as rare status symbols (e.g. Javan Green Magpie *Cissa thalassina* or Nias Hill Myna *Gracula robusta*) or due to large-scale distribution and exploitation for songbird competitions (e.g. subspecies of white-rumped shama *Kittacincla malabarica ssp.* or Javan pied starling *Gracupica jalla*). Some of these were considered common just 25 years ago, but will surely not survive beyond the next 25 years at the current rate.

As it is not likely that the practice of keeping caged songbirds will be completely regulated or abandoned in the next 25 years, as it is so deeply rooted in cultures around the world, we must develop alternatives. Conservation activities for the coming decades must include advances in the following four fields. These activities will be coordinated and monitored by the newly formed IUCN SSC Asian Songbird Trade Specialist Group (ASTSG), which has close ties to the EAZA Passerine Taxon Advisory Group.

EX SITU MANAGEMENT

For a number of species, the last resort of *ex situ* management is already relevant. During the 2015 Songbird Crisis Summit in Singapore, 12 species were identified as having needs that were sufficiently acute to initiate *ex situ* management programmes. A relative demographically safe population size for smaller passerines is around 200 individuals, which raises the obvious and urgent need for 1200 breeding units just for Sunda region songbirds. Not only is this not achievable in European zoos alone, but also the exportation and transport of the birds would not be feasible, nor would it appreciate the need to involve in-country expertise.

A network of Songbird Arks will be created in Southeast Asia with the support of EAZA zoos and their knowhow. Initiated and run by government organisations or NGOs, these 'Songbird Arks' will work with several species, constantly adjusting their priorities to cater for the most affected populations and working together to improve their management skills. Eventually each species should be managed globally according to a One Plan approach, with some perhaps kept extremely locally but benefiting from global support and shared knowledge.

These Songbird Arks will provide space for *ex situ* populations, which, depending on individual species needs, are either short-term until safe release sites are identified, or long-term, potentially spanning multiple generations demanding advanced population management. European zoos will join and support

ONCE NAMED THE 'WORST ZOO IN THE WORLD' BANDUNG ZOO IS NOW MAKING GREAT PROGRESS AS IT EMBRACES EXTERNAL ADVICE. MEANWHILE, LOCAL PRESS OUTLETS ARE TAKING A KEEN INTEREST IN BANDUNG'S RELEASE OF JAVAN MYNAS (*ACRIDOTHERES JAVANICUS*) IN THE SURROUNDING AREA

THE CONSTRUCTION OF THE PRIGEN SONGBIRD ARK WAS MADE POSSIBLE ONLY BECAUSE OF INTERNATIONAL SUPPORT. HOWEVER, THE LION'S SHARE IS BACKED BY THE KASI FOUNDATION, AN INDONESIAN ZOO-BASED CONSERVATION NGO

the Songbird Arks in these emergency measures by allocating more resources for songbirds in terms of providing space, funding, development of Best Practice Guidelines and sending staff to facilitate knowledge exchange on husbandry and population management within the affected regions.

AWARENESS

Awareness programmes and involvement in community-based conservation efforts are essential to give a purpose to the *ex situ* efforts mentioned above. Without the support and involvement of local communities, future release projects will not stand a chance. Also, awareness programmes are more likely to have a lasting effect in reducing the pressure on remaining bird populations. They sometimes have truly amazing effects, and although an entire industry depends on the songbird trade, in local areas the income from bird-trapping is negligible, and is mostly done simply because it is convenient, or because landowners allow external trappers on their land out of ignorance. Once an understanding is reached that a bird in 'their' forest may not exist anywhere else, a sense of pride and responsibility is often achieved.

Zoos can also play a role in involving local communities in decisions and efforts, guiding them towards appreciating songbirds in a more sustainable fashion. In areas of trapping this includes suggesting alternative livelihoods and helping to initiate pride campaigns, which help to establish safer areas for songbirds. Zoos can provide funding and knowledge of communications, and in some cases can function as an initiator.

In the case of the main consumers, i.e. the bird owners, it is a question of helping them to appreciate songbirds in a more sustainable manner. This could include providing information on *ex situ* breeding as an alternative to trapping wild birds. It could also include providing ideas that help to increase longevity, or developing ranging schemes that in turn also reduce the pressure on wild populations.

Less targeted but more general awareness work on the songbird trade will be done in in-region zoos. Therefore intensified efforts to improve substandard zoos in the region is inevitable and EAZA zoos will play a valuable role in achieving this.

LEGISLATION

As we see in the wild bird trade in Europe in 2018, even the best legislation is not effective when not properly enforced. In Europe, loopholes in the legislation and outright criminal smuggling are bringing thousands of wild Asian songbirds into Europe every year. These are sold openly in markets and on the internet without any repercussions. Perceived to be legal, these birds are often purchased by aviculturists and zoos that should know better.

Some of these birds are locally protected in their countries of origin and yet in some cases are literally stolen right out of Vietnamese National Parks, such as is likely in the case of the endangered collared laughingthrush (*Trochalopteron yersini*). Other individuals arrive within a day and without any quarantine from some of the dirtiest markets imaginable in Bangkok or Jakarta and are offered for sale in public markets in the heart of Europe.

EAZA zoos will provide lawmakers as well as the enforcing organs with expertise on species status and will help to develop functional proposals for entries in international (e.g. CITES) or local legislation.

RESEARCH

Fieldwork and taxonomic and genetics research, which is accumulating data intended and needed for adjusting species and locality priorities, can only be done in an evidence-based manner. More and more EAZA zoos will financially support students' work and even *in situ* science positions working day-to-day to achieve the institutional conservation targets from outside the zoo. One example is the Bali Myna (*Leucopsar rothschildi*), where it is hoped that a partnership of foreign and Indonesian students working on the same project will have the added benefit of providing security for reintroduced birds simply as a result of the ongoing presence of researchers in the field.

A view from the future

A ZOO CONSERVATIONIST TAKES A TRIP INTO THE FUTURE AND IMAGINES WHAT THE WORLD WILL LOOK LIKE A FEW DECADES FROM NOW

Caspar Bijleveld, CEO Papiliorama Foundation, Switzerland

As a young student in the early 1990s, I remember witnessing the first hints of the global changes soon to affect our planet, before they would eventually reach the alarming levels we've seen over the past 25 years. The 1990s were formative years for the young student I was, as it was then that I started to get involved in field conservation in the small country of Belize in Central America, a commitment that has now lasted for more than 50 years.

Today at age 73, long retired from my career as a zoo director, I was asked to reflect on how nature conservation has fared over the past 25 years, to try and give a background picture of today's context to the new generation of zoo directors. This is an honour but also, unfortunately, somewhat painful.

I do remember the winter of 2018, 25 years ago now, rather well: that year, we had only a short but intense period of very cold Arctic weather at the end of February. Many of my friends were happy about 'finally having a winter again'. This short event, however, distracted everyone from the fact that while we were shivering in central Europe, the Arctic region was 30°C above its normal temperature for several days. Climate scientists started to panic. The rest you know – no place on Earth today has the climate it had at the turn of the century. Of course we could have prevented it... but that is not the subject of this article.

The year 2018 and the few years that followed were also a time of contrasting events. Politically, the world started to become more and more unstable due mostly to a congruence of despots, tyrants and populist clowns that governed major countries. This led to a few frightening moments where global war, an idea that scared me as a teenager in the 80s, suddenly became a real possibility again. Fortunately, reason prevailed and democracy managed to survive in most countries. The political system of a well-known global leader, of course, imploded in 2028 – an event that is still shaking world affairs to this day.

But back to the environment. The Unhappy 20s (as you know them now) witnessed the collapse of insect biomass on a worldwide scale, with many other animal taxa affected, and birds in particular. Ironically, the massive breakdown of natural pollination did act as a wake-up call, and fortunately created the much-needed shock that

JOÃO CARVALHO CC

eventually induced the necessary revolution in our food production systems. The world basically went back to the early 20th century, rediscovering what was known all along: nurture your soil, and do not fight Nature, but make it your ally. And, of course, skip the chemical temptations.

In terms of conservation, however, things didn't go that smoothly. What was bound to happen, happened: meat consumption sky-rocketed, as the FAO had predicted, and it has now doubled since the beginning of the 21st century. Although palm oil production finally stopped causing new deforestation, all available wilderness areas were eventually converted into productive lands for fodder and cattle. The seasonal forests south of the Amazon were lost, along with most subtropical forests in Africa, long after all forests had disappeared from Central America. What many had predicted is now reality: nature is confined to small islands scattered over the planet, with hardly any connection between them. The latest reports show that we have officially lost 22 per cent of the world's once known biodiversity.

Interestingly, amidst this rather gloomy portrait of where we stand today, not all is bleak, thanks largely to the work done by conservation organisations over the past decade. The dire situation of the Unhappy 20s acted as a wake-up call for many of us. After almost three decades of what is now regarded as the 'desktop and lobbying years' of conservation, the urgency to act finally set in when it became clear that within protected areas, biodiversity losses were almost as bad as outside. Large conservation organisations shifted their emphasis back into the field. Legally designated protected areas finally started to be efficiently protected, to become the havens they were supposed to be from the start.

Similarly, zoos and zoo organisations also started to change. In the late 2020s, the zoo world came to understand that unity is the only real answer, and what many thought impossible for decades actually happened: in 2030 all zoo associations in the world united under one banner, the One World of Zoos. In parallel, the dramatic level of species extinction triggered political responses worldwide, and the saving of the most emblematic species became a priority for many governments.

This new commitment came with state funding for zoos' population management programmes and facilities, valued for their 150 years of knowledge of husbandry and breeding. Regional branches of the new worldwide zoo association created large-scale breeding facilities in many countries, as well as more specialised facilities at individual zoos. It also became the leader in coordinating *in situ* releases of animals bred in human care, a role that was initiated by the One Plan approach launched in 2015; to us today it is pure common sense, but back then it was, I can assure you, totally visionary.

So, this now being 2043, what are we to expect in the coming years? 2050 was a favourite deadline back when I was young. We were supposed to have phased out oil by then – we aren't there yet, but at least we've stopped using it to move ourselves around, thanks to the new UN-controlled solar energy plants in all major deserts on the planet, which have ensured electricity for all at a fair price. Climate change is upon us, but technological innovation holds up a light at the end of the tunnel. In terms of biodiversity and wilderness, it is true that we have reached the bottom of the pit. Everything that could be saved has been saved, but Edward Wilson's vision of 30 years ago, of 'half the planet for all animals and half for humans', has utterly failed and will eternally remain a beautiful dream.

But hope may come from an unexpected corner: the plan announced last year by *One World of Zoos* with the *United Conservation Organisations of the World* to reconnect conservation areas has kicked off with a surprisingly efficient start, backed by unanimous enthusiasm. This great plan has the advantage of pursuing a very simple and clear goal for the next 50 years: rewilding areas between those we have managed to save. And rewilding works, as some were able to prove as early as the late 20th century. Long-term commitment, however, will be an absolute prerequisite. The idea to have, in parallel, every single zoo adopt one of these many corridors is brilliant. Not only will natural landscapes return thanks to these corridors, but also the pace of the return of wilderness will be helped by a worldwide concerted effort to re-establish animal species that were pushed to the very brink, and kept alive only in zoos.

As I said to my grandchildren this morning: 'Well, maybe there is hope in the end.'

Global campaigning for nature: how it might work

Caspar Bijleveld's article touches on an important theme, unifying conservationists to work together on inescapable issues affecting the whole planet. Achieving such unity will necessarily be a struggle. Every organisation from EAZA to WWF and national governments are coalitions, with their own internal logic, politics and territory. This leads to an atomisation of global efforts in support of nature, and leads to a disconnect: a disconnect between organisations and their public, and a disconnect between individual conservation priorities and the 'Big Picture'.

If EAZA wants to contribute to a more unified approach, we may have to review how we carry out campaigns in the future. While EAZA campaigns have done well to establish partnerships with groups such as TRAFFIC and BirdLife International, it is also true that our most successful campaigns have looked at small snapshots of conservation and biodiversity – apes, for example, or Southeast Asia; the partnerships therefore contribute to a specific campaign issue, and may be limited beyond this mandate. This model may be difficult to change, but might in fact work in our favour, in that campaigning may become a mosaic of efforts under a Big Picture umbrella. For this to happen, EAZA and other conservation organisations may need to map our areas of expertise in campaigning under a single umbrella organisation – so that EAZA may work with TRAFFIC on illegal trade, while WildAid works on Asian medicine with Chinese and Vietnamese NGOs and government bodies. The question would then be: how do we manage to establish such coherence? ***David Williams-Mitchell***

THE BLUE-WINGED PITTA IS NOW HELD ONLY IN EUROPE, AT VIENNA ZOO

Breeding for success

WHY POPULATION MANAGEMENT PROGRAMMES WILL BE VITAL FOR SPECIES SURVIVAL IN THE YEARS TO COME

Dr Mark Pilgrim, CEO Chester Zoo, UK

When asked to predict how our EAZA population management programmes might look in 2043, I drew on my personal experience of being involved with these programmes for 30 years. My early career was spent with birds in a large and dynamic bird collection, where new and exciting species were added to the collection on a regular basis. Many of these came from other zoos, particularly zoos that also had a particular bird focus. Others arrived as customs confiscations or were purchased from dealers. I fondly remember caring for blue-winged pittas (*Pitta moluccensis*), white woodpeckers (*Melanerpes candidus*) and crimson-rumped toucanets (*Aulachorynchus haematopygus*). While we bred many of these examples at Chester Zoo at that time and sent out youngsters to our 'bird-focused' zoo friends, these species have now either disappeared completely from European zoo collections or are present only in ones or twos, according to ZIMS data. The species that we regularly bred at that time and that are still present in our collections are mostly those that were part of a population management programme (ESB or EEP); for example, Luzon bleeding-heart dove (*Gallicolumba luzonica*), blue-crowned laughing thrush (*Garrulax courtoisi*) and Bali starling (*Leucopsar rothschildi*). Of course it is not quite as straightforward as that, as many species that came into our collections and bred regularly became managed programmes later – channel-billed toucans (*Ramphastos vitellinus*) and Fischer's turaco (*Tauraco corythaix fischeri*) for example. Other species that came into our collections weren't bred, unfortunately, such as the wonderful long-tailed broadbills (*Psarisomus dalhousiae*), and a managed programme for these wouldn't have made a difference.

It is this experience, of seeing species that I was so fond of disappear from our collections when unmanaged, that led me to become such a strong supporter of managed species programmes. My hope is that by 2043, all of the species that we wish to continue maintaining will be part of a managed programme. I believe that they will need to be if they are to have any long-term conservation value.

But how realistic is this? As the number of species in our EAZA region collections is currently around 15,000, this is probably an unrealistic goal. Even if we consider only species that show a k-selected breeding strategy – that is, species that produce few offspring and invest in them, typically mammals, birds and reptiles – this is a very big task! Managing species that have an r-selected strategy of producing large numbers of offspring with little parental investment, which is typical of amphibians, fish and invertebrates, will require a new system of population management to be developed.

FUTURE CHALLENGES

There are other challenges looming that need to be addressed over the next 25 years. One issue that we face within our EEPs, particularly with large mammals, is a lack of space for sufficient growth of the populations to meet our genetic goals. Those species with a single male, multi female social system provide the additional challenges of holding the surplus males. This is a particular problem for Asian elephants (*Elephas maximus*), and addressing the issue of surplus young males will become a priority for this species in the near future. Zoos must work ever more collaboratively to address these issues and begin to think much more about the needs of maintaining sustainable populations.

This will require a step change in thinking for many zoo directors and collection managers who are currently too focused on the needs of their own collections.

POPULATION GROWTH

I'm sure that the world will have changed greatly in 25 years, mostly, I suspect, to the detriment of biodiversity, making the populations of animals in our zoos even more important. One predicted change is the growth in human population. It wasn't until the 1800s that the human population reached one billion people living on Earth, but we now see an increase of an additional billion people every 12 to 15 years according to the UN. That means that from a current human population of 7.5 billion, the global population will be more than 9 billion by 2043. Even more worrying is that half of this growth is predicted to be concentrated in just nine countries, most of which are hotspots for biodiversity. More than half of these are in Africa. This population growth will inevitably result in habitats becoming ever more fragmented and animal populations becoming increasingly isolated. If these predictions are correct, we will see more and more wild populations in need of a similar system of intensive population management to maintain genetic diversity as our zoo populations do. With animal populations fragmented into isolated sub-populations, the well-managed EEP populations will become increasingly important, often containing genetically important animals required to bolster the genetic integrity of wild populations. This is the One Plan approach of integrating *in situ* and *ex situ* species conservation. This approach of considering all populations of a species in order to conserve them will, I believe, become vital.

BRIGHT IDEAS

Hopefully it is not all doom and gloom for the future, as technological advances will assist us in many ways. It seems likely that language will no longer be an obstacle, and we will all have digital translators that will allow us to communicate freely with anyone anywhere in the world, making conservation planning much more efficient. Improved cloning techniques will allow us to clone genetically important individuals with low mean kinship. This will allow us a second chance to breed with animals that have not reproduced, or that have produced only a few offspring, allowing us to get their vital genes into the next generation. We will also have a better understanding of re-wilding techniques, restoring degraded areas into havens for wildlife. This will further enhance the important role the mega fauna in our zoos plays to maintain and sculpt these habitats in ways we couldn't have imagined, something that the reintroduction of wolves into Yellowstone National Park in the US has begun to show us.

RISING TO THE CHALLENGE

Collection planning on a regional level is going to be vital if we are to ensure that we focus our efforts, expertise and the limited space in our zoos on those species that have the greatest need for conservation breeding. In addition, effective science is needed to ensure that populations in zoos are suitably equipped for survival in the wild after reintroduction. At the same time, we will still need to balance this with the expectations of our visitors, who, through visiting us, fund the conservation work we do in the zoo and in the field.

Managing healthy populations of animals in our collections has always been at the heart of zoos and will continue to be the key to our success in the future. We need to move on, however, from merely maintaining the species we have to focusing on priority species with the greatest future need. Predicting with which species we can have the greatest conservation impact requires understanding of the potential threats. Perhaps the most obvious major issue we need to consider when prioritising our species selection is the changing climate. With shrinking ice caps, polar species will continue to suffer from limited habitats, seasonal food shortages and many other negative consequences. There will be many species on whose populations climate change will have equally devastating but less obvious effects: for example, the effects of earlier- or later-emerging insects on the timing of breeding birds that are reliant on them, the effects on temperate and dry forests of extended wet or dry seasons, and an imbalance of the number of males or females being hatched from species whose sex is determined by temperature, to mention just a few. Only the most adaptable species will survive.

The zoo world will face many new challenges over the next 25 years. However, whatever challenges come, a new and greatly expanded population management centre within EAZA is something I believe to be of enormous importance. More collaborative thinking by zoo directors and clear goal-setting by EEP co-ordinators will ensure that we no longer haemorrhage those species that we cherish in our collections. This will enable us to maintain populations in a sustainable way far into the future and give them a clear conservation benefit. This structure is, in my opinion, not only important for the future of our animal populations, but also vitally important for the future of zoos.

CHANGES IN RAINY SEASONS MAY LEAD TO THE CREATION OF NEW EEPS FOR NEWLY THREATENED SPECIES

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Welfare state

WHEN IT COMES TO ANIMAL WELFARE, WE NEED TO PRIORITISE THE MEANINGFUL OVER THE MEASURABLE

Dr Jake Veasey, Senior Visiting Fellow, Nottingham Trent University, UK, and CEO Care for the Rare

In the 25 years since *Zooquaria* was first published, the human population has grown by 2 billion, carbon dioxide emissions have risen by 40 per cent and biodiversity has declined by about a third to the point at which wild mammals make up around just two per cent of global terrestrial mammalian biomass.

Extinction is not the only inevitable consequence of these changes; welfare compromise also occurs on a massive scale. The loss of 150,000 Bornean orangutan in just 16 years doesn't happen without immeasurable suffering. Yet despite the shared issues, conservation and animal welfare have remained largely separate; conservationists have focused on population survival into the future, and advocates of animal welfare have focused on the feelings of individuals here and now. Zoos and aquariums are at the interface between conservation and animal welfare, and are therefore in the perfect position to lead the way in improving how we think about species welfare, focusing on the wellbeing of populations in the wild and in human care, both now and into the future. However, in order to do that, I believe that zoos need to reevaluate their approach to welfare and, subsequently, to conservation.

Central to most conceptions of animal welfare are feelings; states such as 'suffering' or 'contentment'. As we can only infer but not measure these states, science uses indirect metrics to provide insights into the feelings of animals and subsequently their welfare. These include factors that might affect the feelings of animals such as malnourishment, confinement and cold, as well as metrics affected by the feelings of animals such as fearfulness, pacing, weight loss, hypertension and disease.

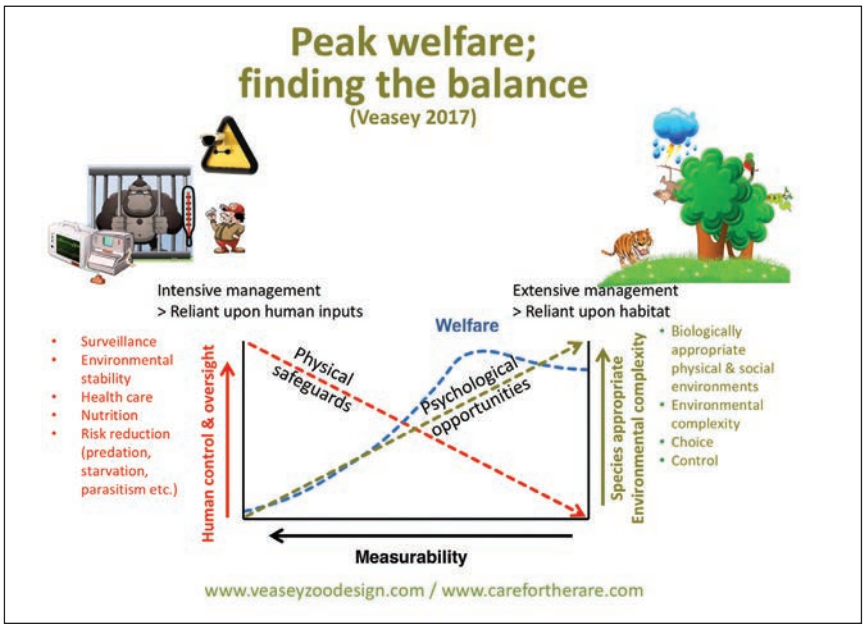
Sadly, no welfare indicator is perfect; even apparently objective indicators can be difficult to interpret. For example, so-called stress hormones can be elevated when animals are excited

and lowered when chronically stressed and stereotypes can actually enhance welfare in stressful situations as well as be expressed in apparently non-stressful situations.

In contrast, welfare indicators relating to physical health such as longevity, body condition and disease benefit from being highly quantifiable and having a deceptively intuitive link to welfare, resulting in the widespread inclusion of health as a defining factor of welfare by many. Whilst this isn't necessarily wrong per se, the inclusion of health in welfare definitions is arguably redundant, because if health doesn't affect the emotional state of an animal, it doesn't affect its welfare, and more significantly, there are potentially negative consequences of its unqualified consideration as a defining factor of animal welfare.

In 2008 a leading veterinary medical association (unsuccessfully) opposed legislation in California requiring farm animals be able to turn around, stand up and lie down on the grounds that such freedoms would negatively impact the capacity of farmers to protect animals from disease and injury, ultimately compromising the welfare of farmed animals. The veterinary association's inclusion of physical health as a factor defining welfare combined with the comparative ease of measuring physical health seems to have resulted in its elevation over the psychological wellbeing of animals to the potential detriment of the welfare of billions of animals.

This example is not a unique one; the first of the five freedoms – from hunger and thirst – requires the provisioning of a 'diet to maintain full health and vigour' on the premise that hunger and thirst are unpleasant mental states and a balanced diet promotes good health and subsequently welfare. Consequently, many zoos, but most notably in North America, favour commercially prepared diets resulting in many big cats being fed daily rations of nutritionally enhanced minced meat. Such diets eliminate natural hunting and food-processing behaviours as well as opportunities for big cats to feel as full as they would do in the wild when feeding on whole large carcasses. Since the motivation for big cats to hunt is regulated by stomach distension, big cats fed such processed rations are likely to be permanently motivated to forage and hunt in environments in which they are permanently prevented from doing so. And so the welfare of some of the most iconic species held in zoos may be systematically and unnecessarily compromised simply because it is easier to quantify micronutrients in a processed diet in support of health than



SCHEMATIC REPRESENTATION OF THE RELATIONSHIP BETWEEN EFFORTS TO SAFEGUARD PHYSICAL HEALTH AND THE AVAILABILITY OF PSYCHOLOGICAL OPPORTUNITIES FOR MANAGED ANIMALS AND HOW THIS MIGHT IMPACT POPULATION LEVEL ANIMAL WELFARE

it is to calculate the psychological harm that may arise as a consequence of that diet.

These examples highlight a tendency to focus on the measurable rather than the meaningful, and that a tension exists between protecting an animal's physical and psychological wellbeing. To illustrate this point further, consider the wellbeing of a frog destined to live in an amphibian ark configured to protect it from chytrid fungus compared to one living loose in an extensive, mixed-species, zoo rainforest building. The extensive rainforest habitat more closely replicates the 'wild', catering well for the frog's psychological expectancies; the animals are more reliant upon their surroundings for survival than on individualised human inputs, but are consequently exposed to risks to their health such as disease, injury and starvation. In contrast, the highly controlled environment of the amphibian ark protects residents well from many risks to their physical health, but probably caters less well for their psychological needs. The tension between these two aspects of care appear to be more or less inevitable; as requirements for observation, supervision and control are increased, freedoms for animals typically diminish, resulting in an increased likelihood of frustration and impoverished welfare, and vice versa. The graphic shown above illustrates how efforts to safeguard the physical wellbeing of animals interact with their psychological opportunities and ultimately combine to influence their welfare, and how the approach of zoos to this balancing act might be influenced by the differential measurability of physical and psychological priorities.

To achieve what I refer to as peak welfare, zoos must better balance the physical and psychological priorities of animals and overcome the tendency to focus on the measurable rather than the meaningful aspects of welfare. To help achieve this, I developed a systematic framework to identify the psychological priorities of animals by examining the evolutionary and motivational characteristics of their behaviours and cognitive processes as well as considering evidence of known welfare impacts.

This methodology is based on the premise that the behaviours and cognitive process of high evolutionary significance are highly motivated to ensure animals express them when needed. Consequently, if animals are frustrated in their attempts to express behaviours or cognitive process, the resulting welfare compromise will be broadly proportional to their evolutionary significance. This relationship is modulated by the nature of the stimulus; behaviours with internal triggers or ones that cannot be eliminated, such as foraging or seasonal reproductive behaviours, are likely to be important regardless of the environment the animal finds itself in, whereas externally stimulated behaviours such as escaping a predator need not be expressed if the trigger is absent. The output of this panel-based process are species-specific welfare priorities, which enable zoos to devise environments and management systems in which species can express those aspects of their life essential for welfare, without unduly compromising the capacity of zoos to protect them from physical harms.

Intriguingly, the development of this framework not only underlines the tension between protecting an animal's physical and psychological wellbeing, but also encourages us to accept that peak welfare is unlikely to be achieved simply by maximising physical and psychological aspects of care, but instead by optimising the relationship between the two. This in turn suggests that peak welfare is more likely to be experienced by animals protected from many natural stressors, whilst still being free to satisfy psychological priorities as might be identified by the framework referred to here. In other words, peak welfare is likely to be attainable in *ex situ* environments formulated around an understanding of the psychological needs of species, challenging a widely held belief that keeping animals in human care is inherently bad for their welfare, which has potentially profound implications for the management of zoos and their role in conservation.

I've always believed that conservation was the mandate of zoos, and animal welfare was our license to operate, but the failure of zoos to conclusively address the welfare concerns felt by many of our stakeholders over the past 25 years has constrained our capacity to deliver our true conservation potential, something future generations may find hard to forgive; despite the widespread acceptance that many species will not persist without well-resourced population management programmes, over the last 25 years the establishment of new breeding programmes has not kept pace with the volume of species that might benefit from them. For that reason, I believe the pursuit of peak welfare is both a welfare and conservation imperative for zoos and I look forward to seeing zoos emerge as champions of species welfare, providing leadership at the interface between animal welfare and species conservation over the course of the next 25 years.

Through the looking-glass

WHAT WILL CONSERVATION LOOK LIKE IN 2043?

Dr Lesley Dickie, CEO, Durrell Wildlife Conservation Trust, Channel Islands

Many zoos have undoubtedly made great strides in conservation effort and application in the past 25 years. This is heartening to see, although I did of course write 'many' not 'all'. However, as a community we are far from reaching our conservation potential today and it's debatable whether we will reach it in the future. The good news is that it's in our hands to reach that potential – we are the commanders of our own mission, we are steering our own ships. However, conservation is not static, it itself is changing – so with our sights set on 2043, 25 years into the future, what will zoo conservation look like?

The first most likely change is that even more zoos will become practitioners in the field, not simply donors. Being a donor is good, helpful, sometimes pivotal, but ultimately we are always handing control and implementation over to others. If we look at the One Plan approach to conservation then a seamless ability of practice in the zoo through to the field will become more commonplace, particularly in a future where reintroductions are to become more likely, not less. This does not mean working as a single institution – for example, all Durrell projects are in partnerships – but it does mean building capacity and an expertise that reaches beyond our own gates, bringing together expertise with much closer interplay between zoo-based and wild disciplines. Zoos are the perfect breeding grounds for such 'hybrid' creatures.

MAKING BOLD DECISIONS

In 25 years, our decisions are going to have to become braver. The downward trajectory for species is ever more alarming and last-gasp efforts are likely to become more rather than less controversial, simply because there will be more of them. The fallout from the unsuccessful vaquita captures demonstrates the dilemma. This is a species that is going to become extinct, we are watching it do so, and it would have been prudent to try coordinated *ex situ* breeding efforts much sooner. There is no doubt that the same voices that decry the recent efforts would have greeted this at an earlier stage as well – but what are the alternatives now? The Saola Working Group of the IUCN (with EAZA Members in the group) has made the bold decision that capture efforts will be made with this terrestrial equivalent of the vaquita. Will this succeed? We do not know. Will there be failures? Yes. Nevertheless, it's also the right thing to do. Failing when trying to do the right thing is better than failing to act at all. We will be more confident in our own abilities in the future.

WORKING THE SYSTEM

Zoos are multi-taxa specialists, which makes them uniquely suitable for a conservation future where the emphasis is not on stand-alone components of systems but on the functioning of the whole system: rewilding. Conservation in the future, unless there is a systematic and global step-change increase in funding, will involve increased species triage. What we save will have to come down to what role it plays in a system, how healthy is the system without the species in question, or what happens when we ensure it remains and the cascade of effects that will result. Our knowledge stretches through nearly all ecosystems when it comes to species, and working with external partners we can become proponents of full system recovery. This brings us to a future where assisted translocations become more commonplace as direct human pressures as well as climate change see species squeezed out of historical ranges. We will have to accept that the planet has been systematically (and irregularly) changed by humanity and what once was will give way to how can we save species in functioning systems, regardless of whether that meets historical range. Our partners, Mauritian Wildlife Foundation, have been leading on Aldabra giant tortoises being introduced to offshore Mauritian islands to fill the vacant ecological niche left by the extinction of the giant Mascarene species that would have roamed there previously – and they are proving to be efficient replacements. We are used to being (rightly) concerned about non-native species invading islands, but in the future it is likely that we will move species around more and more to 'fix' ecosystems, with all the checks and balances and ecological risk assessments that this will require. We will design and create the ecosystems of the future. You may question whether we have the right to do so, but we are already engaged in this activity, haphazardly, as humanity.

If we return to the idea of species triage – we cannot save everything on current available conservation global funds – in the future we may have to abandon subspecies level for the sake of species level in increasing frequency. Advancing technology has led to an ever-more detailed understanding of genetic difference, but does it create further complication in the face of the onslaught facing nature and conservation decision-making? The human population is going to continue to expand, and the wild is going to be ever more squeezed, particularly if we retain our current lifestyles, therefore tough choices will become even more commonplace.

BRAVE NEW WORLDS

Synthetic biology and 'de-extinction' will be part of our conservation future. The use of 'synthbio' is already being explored, despite fears, where it pertains to removing invasive species from islands. Splicing in DNA to invasive species, rapidly spreading new genes through a population that renders it sterile in a few short years, potentially circumvents the protests of animal rights advocates that hinder conservation efforts in large-scale eradication programmes. It is likely that this will happen very soon. In addition, ideas such as transplanting genes that, for example, convey resistance to chytrid in vulnerable frog populations, will become reality. I discussed above the translocation of an analogue tortoise. What happens when there are no healthy numbers of an analogue – is this where in the future de-extinction has its most important application? While

THE PASSENGER PIGEON: COULD DE-EXTINCTION HELP RESTORE ECOSYSTEMS SERVICES?
INSET: ALDABRAN GIANT TORTOISE ARE FILLING VACANT NICHES IN MAURITIUS, HELPING TO FIX ECOSYSTEMS

the media is interested in the recovery of charismatic species such as mammoths, it is more likely that the technology is best applied to more recently extinct key ecological engineer species. With careful, ethically screened advances, it is likely that this technology *will* be put to work. Caution is advised, but the alternatives may be worse. What role do we as zoos want in this? Tissue banking of the species we hold now is one key role that will become more important.

IMPACT INVESTING

Money is a limiting factor for many conservation efforts and will continue to be so. As zoos are often in urban centres, we have many corporate clients. They engage in CSR (Corporate Social Responsibility) activities with us, and some of us discuss ESG planning (Environmental, Social, Governance) with them, but what of corporate TSI – Total Societal Impact, an idea that is receiving more traction in the corporate world? As zoos, we can become more powerful advocates for species and system interests in corporate discussions in the future. The corporations leading the charge today refer to UN Sustainable Development Goals when trying to be mindful of their societal impact, and we have an opportunity to engage with local corporations in a more meaningful way, working with them and looking at their whole investment chains – and corporations are becoming ever more open to these discussions. It is estimated that nearly a quarter of all global investments, $34 trillion, are in so-called sustainable investments. Corporate power has the ability to create a significant positive impact on species, and while some corporations continue with unsustainable practices, the tide may be turning, and we should make sure we are riding the wave.

Turning our attention to the people who visit us every day, the role of the social sciences and behaviour-change applications will become increasingly relevant, and zoos will employ social scientists in their Conservation Knowledge departments (at Durrell this comprises science, training and conservation learning). We will move much further beyond facts-based learning and will augment this with interventions that focus on connections between nature and human wellbeing.

LEADING THE WAY

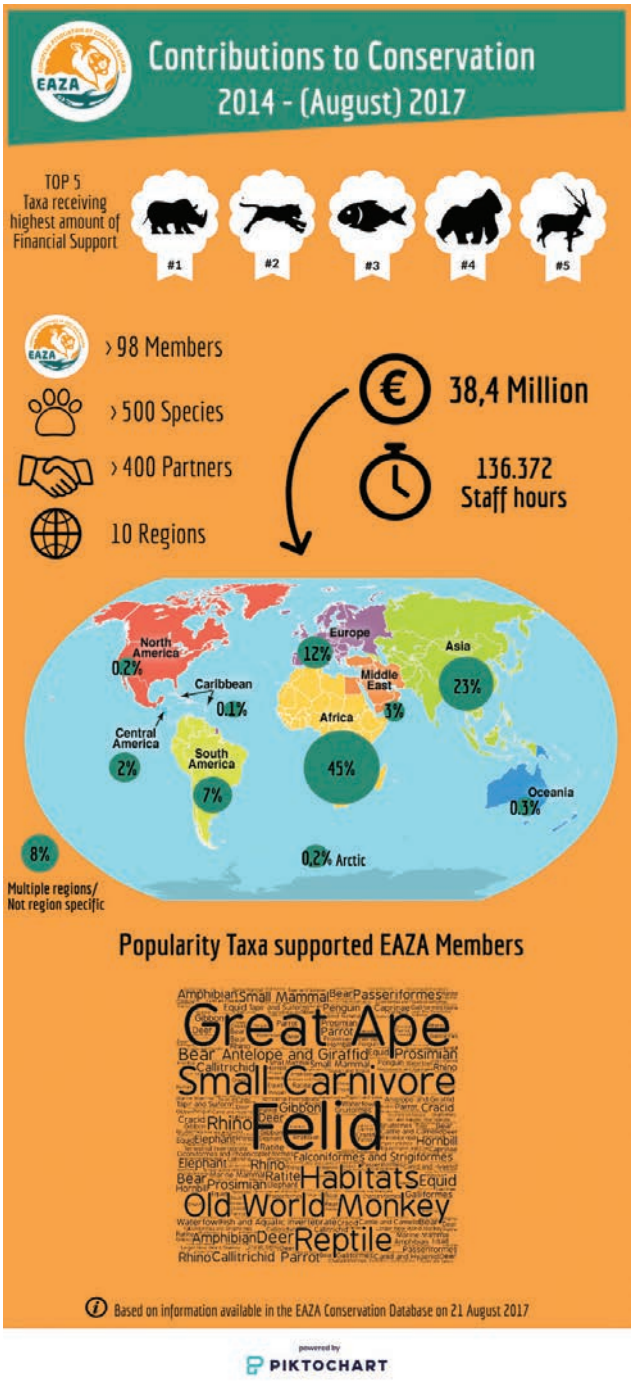
We can only make our best guesses about a conservation future for zoos, but, coming full circle, what we do have control of is our own attitude to conservation as zoos. We have the power to make ourselves even more important advocates and practitioners of conservation. Gone will be the days when we do not measure our impact – it will be expected of us from the public and government, and from donors who are becoming ever-more sophisticated. Spending five per cent of turnover on conservation will be a badge of shame, not something to be celebrated.

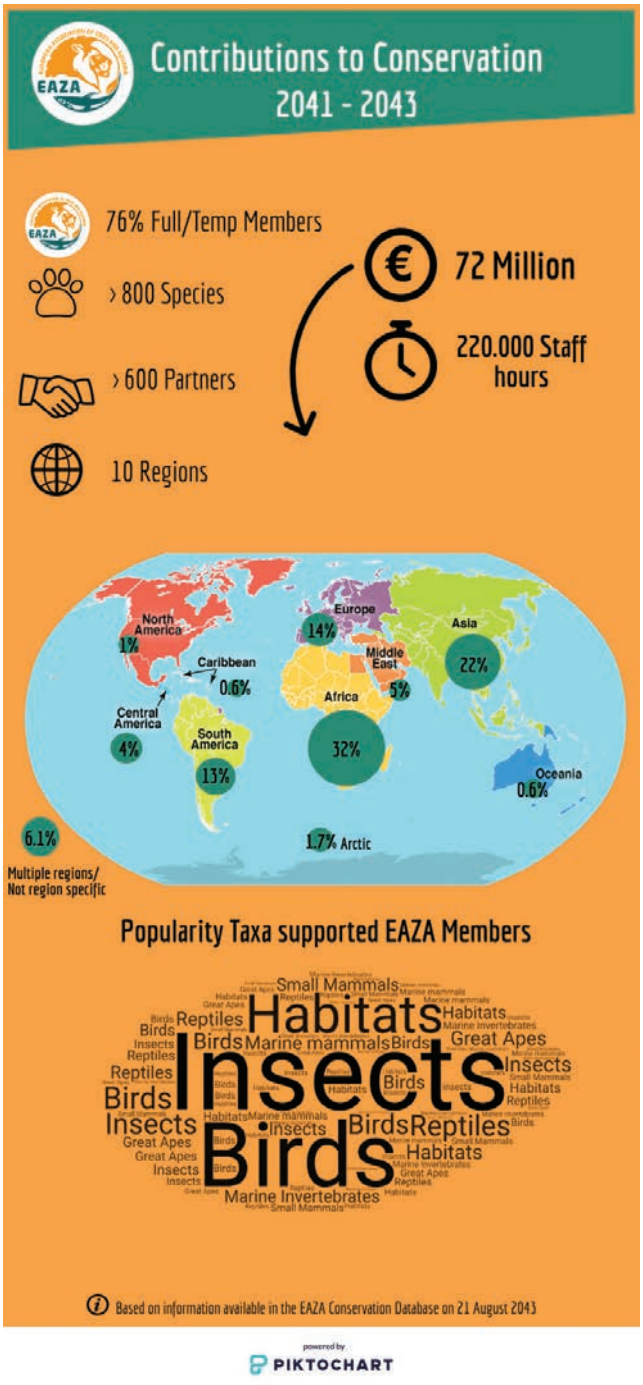
This, of course, comes down to the people who lead zoos and how committed they are to conservation action. Ten years ago when I was interviewed for the role of EAZA Director, the feedback I received was that some members of the governing body of EAZA were unsure that I was right for the role as I was '*too interested in conservation*'. I hope we have moved beyond that attitude in the past decade, and that there should be no such thing in the world of zoos as being 'too interested' in conservation. It is the number one purpose for our existence, and in the future our role, if we wish it to be, will be much larger than it is today.

TORTOISE: PAVAN CC; PIGEON: THOMAS QUINE CC

Contributions to conservation

TO MEET THE NEEDS FOR FUTURE CONSERVATION PROJECTS OVER THE NEXT 25 YEARS, WHAT CHANGES WILL WE HAVE TO MAKE?





THE EAZA CONSERVATION DATABASE ENABLES ONLINE COLLATION OF DATA FROM ALL THE VARIOUS CONSERVATION ACTIVITIES IN WHICH EAZA MEMBERS ARE INVOLVED. THE GRAPHIC ON THE LEFT REPRESENTS OUR CURRENT RECORDED ACTIVITIES; ON THE RIGHT, WE PREDICT AN INCREASE IN THE NUMBERS OF MEMBERS ADDING DATA AS WELL AS HOW THE FOCUS OF CONSERVATION ACTIVITIES WILL HAVE TO CHANGE IF WE ARE TO KEEP UP WITH AN EVER-CHANGING WORLD.

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Genetic potential

DAVID WILLIAMS-MITCHELL, EAZA'S DIRECTOR OF COMMUNICATIONS AND MEMBERSHIP, AND ELMAR FIENIEG, EAZA POPULATION BIOLOGIST, TALK TO PROFESSOR MICHAEL BRUFORD OF CARDIFF UNIVERSITY, UK, ABOUT HIS ROLE AS THE CO-CHAIR OF THE IUCN CONSERVATION GENETICS SPECIALIST GROUP AND DIRECTOR OF THE FROZEN ARK

ZQ: We've seen massive changes in the technology of molecular genetics over the last 25 years, in terms of accessibility and usage. Could you summarise some of the developments we've seen?

MB: I've been privileged to see a huge amount of change during that time. I started at London Zoo in 1990, and at that time there were some major obstacles to using genetic analysis. We were working with karyotyping for taxonomic purposes and allozyme testing for other tasks, although allozyme testing was not useful at the time for testing paternity and confirming lineages. On top of that, we could really only test using quite large blood samples; a lot of our time was spent convincing veterinarians of the health value of genetic work, and making an ethical and moral case for this relatively invasive procedure to extract samples.

In recent years, the big changes have been that we can now accurately test lower-quality samples, such as faecal matter or small tissue samples. Moreover, genetic testing is now routine and cost-effective, rather than the ethical minefield and massive investment it used to be. It's important to look at the rate of change, too: technologically, we can do things now that we couldn't do even a year ago. We've moved on from PCR-based genotyping (although we still do that of course) to SNPs and whole genome sequencing; it's amazing to think that we can now sequence an entire genome for under $400!

ZQ: Looking at where we are now, do you think that the EAZA Biobank is an important tool for the future?

MB: The time spent collecting samples is the bottleneck for most molecular genetic studies, so I think biobanking is already important, and will become ever more essential. By having a bank of samples that is as comprehensive as possible, and combining this with new approaches to conservation genetics, we'll have a very strong basis on which to work. I'm glad to say that the potential of the biobank is already being recognised, and we've just secured significant funding from the BBSRC (Biotechnology and Biological Sciences Research Council) to expand the UK part of the EAZA Biobank. The biobank will also help us face significant challenges now and in the future.

ZQ: You're referring to the Nagoya protocols?

MB: It's the most-raised issue in any discussion of sourcing of genetic samples, and anecdotally has already stopped some DNA transfers for research and conservation. Getting samples from abroad is going to be a headache, and one that involves complex negotiations between lawyers – sometimes, the source countries don't really have lawyers who could take care of these – but I think we'll find a way to share knowledge and work together. In real terms, we'll have to find a solution, and the biobank will definitely be an important part of the solution.

ZQ: Can you give us an idea of the current potential of molecular biology and genetics for conservation?

MB: There are at least three main areas of short-term potential. For some years already now, it has been possible to compare genetic diversity of *ex situ* populations with the genetic diversity in the wild. Sometimes this has shown that an *ex situ* population was not sufficiently capturing the genetic diversity of the wild, and sometimes, conversely, that *ex situ* populations were found to carry genetic variation that was already completely lost in the wild. Such comparisons make it much easier to integrate *ex situ* and *in situ* conservation and as such facilitate a One Plan approach.

An upcoming field that opens new doors for *ex situ/in situ* comparisons is epigenetics. Epigenetics are genomic changes that alter gene-expression that can happen temporarily, within an individual's lifetime, or can even be inherited if the changes occur in the germline, and with current techniques these can already be measured. This could allow valuable insights into how the same genes in an *ex situ* environment could lead to a different phenotype than in the wild.

Each generation, zoo and small wild populations lose genetic diversity. Genomic comparisons between living and museum specimens show that for many species a large amount of genetic variation has already been lost. In the next 25 years, there could be technological possibilities for some well-studied species to bring back some of this lost functional genetic diversity into the population through gene-editing techniques. There are still technological challenges for doing this, and some may object on ethical grounds.

Such techniques are either here or very close. They won't replace demographic management, and there are of course huge moral and ethical issues to address, but the potential is there for genetics to make a big difference to population management and adaptability.

ZQ: So we could, for example, build in climate-change resilience for vulnerable species?

MB: If we isolate the relevant genes and introduce them back into vulnerable populations, then yes, we could certainly make species more adaptable. It's already being looked at in livestock populations, mainly in the context of finding many different genes that each contribute to a wider resilience to climate change. For example, we have recently identified a new candidate gene that has allowed cattle brought to the Americas to develop finer coats

IN THE EARLY DAYS OF GENETIC TESTING, LARGE SAMPLES OF BLOOD NEEDED TO BE TAKEN.

that allow them to better regulate their body temperature in hot, humid conditions. However, if we're going to make a difference to biodiversity conservation in the face of climate change, we're going to need to work very fast!

ZQ: What are the challenges of integrating genetics into the portfolio of zoo and aquarium practice?

MB: Well, of course, it's great to talk about technology, but for the majority of *ex situ* populations, we have to maintain a 'big bang for your buck' approach. There's no appetite for using expensive techniques other than in big, high-profile cases. Zoos can and now do take on projects at low cost, sometimes even involving undergraduate students, but it could be happening much more. We need to make such projects routine, by encouraging zoos to use the tools, through more discussion of the benefits of these projects, and taking advantage of the big increase in conservation biology education – it would be great to see universities and zoos building more connections to allow these projects to become more routine.

Another issue is the prioritisation of work – as things stand, it's hard for everyone to decide which projects should take priority, because we still don't have a strategy in place. That will come as we develop criteria for prioritising work, something that the Biobanks and the Conservation Genetics Specialist Group have been considering. We'll also need to ensure closer collaboration with labs, as any separation between the scientists in the lab and those working to interpret the data for the studbook or management plan makes the task extremely difficult. No study should be started if it is not guaranteed that it will provide useful results that can be easily interpreted and applied by managers. Overall, what we need is a framework and guidelines that can help us streamline all of these processes and get everyone working seamlessly together on relevant projects with reliable data that can be interpreted. This would also help us to navigate the moral and ethical issues that our science faces regularly, especially in the media.

ZQ: Do you think that genetics will be an important part of the One Plan approach in the near future?

MB: Conservation genetics is already an important part of the One Plan approach! In the next 25 years, I expect a lot of progress also on identifying the functional value of specific genes, which will allow us to focus more on maintaining diversity for specific traits of conservation value, rather than focusing on genome-wide diversity alone. This will also facilitate strategic exchange between zoo and wild populations. For example, if we look at black rhinos, it is possible that the European zoo population carries important alleles that have now been lost in the wild; there's huge scope for reinvigorating both populations by managing for the functional diversity of genes, and there is now a collaborative PhD project at Manchester University and Chester Zoo investigating this.

We could also choose to bring animals that have undergone significant hybridisation in the past back to a closer approximation of how they used to be, without compromising on the positive additions that hybridisation may have provided – the example of Przewalski's horse springs to mind (which is an example of work already being carried out); we could potentially work to minimise domestic horse genes from the species. However, this may depend on whether or not the domestic horse alleles are functionally beneficial to the Przewalski's horse ('adaptively introgressed'). Again, a solid framework for us all to work with will be essential in making sure we act according to priorities and within sensible limits. There's also a role for zoos to play in educating the public about conservation genetics – as we get better examples of our successes.

ZQ: What would you most like to see in your field 25 years from now?

MB: I'd love to see a predictive framework in place that helps us understand how genes work to promote adaptation – so that rather than 'fishing', we would be able to look at current conditions and predict adaptive variation in populations. I'd also like to see us have a better understanding of deleterious genes, so that we know which ones we need to keep heterozygous, so we can predictably avoid inbreeding depression. All in all, what I think we will see is scientists having a better feel for the sorts of gene we should be looking at routinely, both for positive and negative effects.

The sustainable zoo

HOW THE ZOOS OF THE FUTURE COULD BECOME THE GREEN HEARTS OF HUMAN SOCIETIES

WITH GOOD DESIGN, INDIVIDUALS CAN CHOOSE THEIR OWN ENCLOSURE CONDITIONS WITHOUT INCREASING ENERGY USE

Nedim Mehmedbregovic, Designer, Deerns Nederland BV

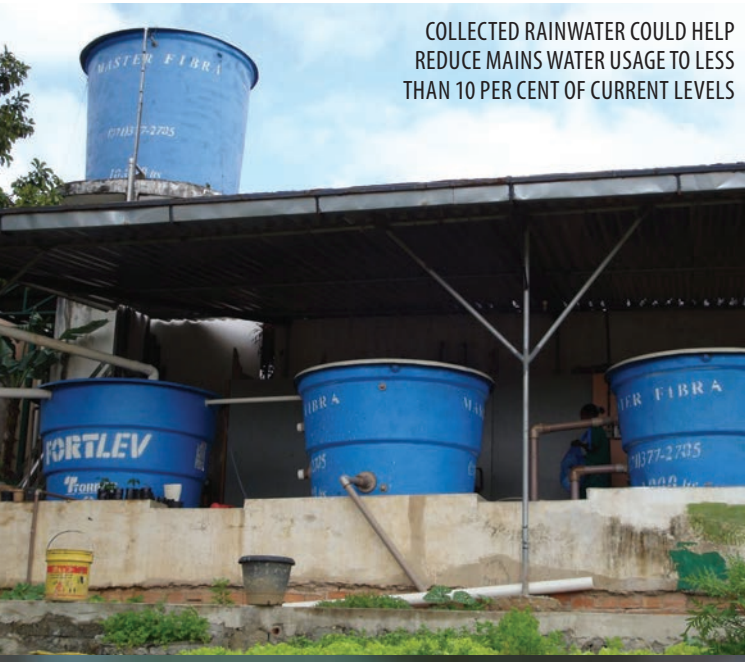
'Mom, may I really touch the baby rhino?!' asks Max. 'Yes, of course!' He gently touches the rhino calf. 'The skin feels much softer than I thought! It's cool that we're allowed to do this! Isn't it, Mom?' 'Yes, my dear, with virtual reality we're able to do much more than when I was your age. And, we don't disturb the animals any more. With the tiny drones that look like small mosquitoes, the animals don't have a clue that we're watching them. The zoos are very different nowadays…'

This could easily be a conversation between a child and his mother in a future zoo. In this zoo, visitors are completely separated from animals, but with the help of virtual reality and tiny drones that record in high-definition video, sound and scent, they can 'walk' between the animals. The animals, on the other hand, live in spacious indoor and outdoor enclosures away from the visitors. Actually, they hardly have any contact with humans – only the keepers are allowed to come close to them. This is important because most of the animals will eventually be released into the wild in order to increase the population in national parks.

In this future world, zoos are now the major institutional players in recovering biodiversity worldwide. By using modern technology, the educational value of the zoo has been multiplied. Now you can experience the animals in the zoo as never before. Education goes far beyond just animals and plants. As a visitor, you learn how the ecosystems work on Earth. The zoo is a perfect place to learn about that, because it is a collection of many different ecosystems: the Earth in miniature. In addition, zoos are now key producers, rather than consumers, of sustainable energy!

Until the first few decades of the 21st century, ecosystems within the zoos were disconnected. Each ecosystem (animal enclosure) had its own stand-alone utility system for heating, cooling, ventilation and water treatment. Many systems were individually designed to be sustainable, but the zoo as a whole still needed a lot of fossil fuel and was not efficient enough. Large amounts of electricity, gas and water were necessary to keep the animals healthy and the zoo running. Besides that, the indoor climate in most of the enclosures was designed to be 'perfect' and as stable and constant as possible. Unfortunately, that was not always perfect from the perspective of animal welfare.

The visitor areas are now designed as passive buildings that do not require additional heating, cooling or ventilation. These buildings are now exclusively designed for humans. The visitors no longer share the same indoor climate as the animals. Therefore, there is no need to design spaces that



COLLECTED RAINWATER COULD HELP REDUCE MAINS WATER USAGE TO LESS THAN 10 PER CENT OF CURRENT LEVELS

HEAT GENERATED FOR TERRARIUMS CAN ALSO WARM OTHER ENCLOSURES FOR LESS SENSITIVE SPECIES

are too hot, too cold, too moist or too 'smelly' for visitors, so it is much easier to achieve maximum energy efficiency and comfort. These buildings meet the highest level of *Trias Energetica*. This three-step principle is based on these design stages: *first, limit energy demand; second, use sustainable energy; third, if necessary, use fossil energy efficiently and as cleanly as possible*. These visitor buildings are designed and built in such a way that only the first two steps of *Trias Energetica* are needed.

Nowadays, zoos are designed and built according to the methodology called *Trias Zoo-Logica*. This design strategy is an extension of *Trias Energetica*, but is developed specifically for zoos. Because zoos are much more than just buildings, there are more design steps developed prior to *Trias Energetica*, and these are:

1. What do animals (really) need?
2. Connect ecosystems within the zoo.
3. Optimise energy use (*Trias Energetica*).

The first step of *Trias Zoo-Logica* begins with the animal's needs as the basis of each enclosure design. Modern enclosures now have a variety of different climatologic layers to mimic the natural habitat of the animals. Indoor enclosures are designed to meet the highest animal welfare standards and, at the same time, to achieve maximum energy efficiency. For example, the great apes enclosures are designed not to have the same indoor climate throughout the space, but instead, as in nature, a climate that varies in different places. In that way, each animal has the freedom to choose for itself the most suitable place within the enclosure, whether that's a cold and windy spot or a cosy and warm one. Because of this, there is much less need for complex and expensive climate systems, and energy consumption is significantly reduced.

The second step of *Trias Zoo-Logica* forces the designers to think outside the box – or, more precisely, outside the enclosure. Because of the fact that the visitors and animals are now completely separated, the zoos are designed in a most efficient way. It is now the energy efficiency and infrastructure that decide the placement of specific enclosures and how they are connected. The storytelling and education are now designed in the visitor areas. The enclosures are built according to the laws of natural habitat, so the animals can live and behave as naturally as possible. Resources such as heat, cold, water and waste are (re)used in different buildings and enclosures, each time on a different quality level, so it is possible to use the heat on the highest level for heating the terrariums or other tropical animals, for example. The rest of the heat from these buildings can then be used to heat the enclosures of less needy animals, such as lions or baboons. In this way, the different ecosystems are connected and act much like ecosystems throughout our planet.

The first two steps of *Trias Zoo-Logica* achieve maximum animal welfare, while improving the energy efficiency and connecting the zoo ecosystems. The last step is to build an enclosure according to the principle of *Trias Energetica*. This last part of the design-and-build process helps to maximise the sustainability of the enclosure and of the entire zoo.

Large roofs on indoor enclosures are now used to collect rainwater and to hold a large number of solar panels and collectors for electricity and hot water. The electricity from solar panels is directly used for processes within the zoo. Surplus electricity is used to make hydrogen from the collected rainwater. Hydrogen is then used to produce electricity for use at night or on days without sun. Hot water from solar collectors is used for heating the buildings in winter. If the capacity of the collector is not enough, heat in the ground collectors stored during the summer months is used. Because of the large capacity of the solar collectors and ground storage, the heat is also used for heating the buildings outside the zoo.

Part of the rainwater, together with filtered groundwater, is used as process water for cleaning, toilets and various purposes other than drinking. In this way, water consumption is greatly reduced to barely 10 per cent of the usage needed at the beginning of the 21st century. The use of fossil fuels is completely banned in zoos. All electricity required is either made sustainably within the zoos, or comes from renewable resources such as sun, wind or water produced elsewhere.

The modern zoo is now a place of high-level nature preservation and is an extended educational institution. The sustainable energy produced by zoos is now powering the surrounding neighbourhoods, villages and even the cities. Zoos have truly become the green hearts of human societies!

RAIN COLLECTING: ALMOSTBRAZILIAN CC

Learning to survive

EDUCATION BY ZOOS AND AQUARIUMS IS KEY TO IMPROVING CONSERVATION OUTCOMES OVER THE NEXT FEW DECADES – BUT THE WORK HAS TO START NOW

Dr Sarah Thomas, Head of Discovery and Learning, ZSL, UK

It is difficult to predict what the world will be like in 25 years' time, but we can make some assumptions about how the world might change over the next few decades. From current estimates we can assume that the human population will increase by 30 per cent by 2043. This in turn will increase the demand for space and put pressure on natural resources, and will sharpen the interface between people and wildlife. We should assume that technology will continue to advance, and we will live our lives much as we do now, inextricably connected to technology. Our assumptions should also include that our climate will have changed, sea levels risen and several well-known species will have gone extinct. Lastly, and importantly, we should assume that zoos and aquariums still exist and that their 'conservation education' role of raising awareness, connecting people to nature and encouraging sustainable behaviours has become one of the most important (and possibly *the* most important) functions of zoos and aquariums of the future.

In 2018, we are in the middle of a paradigm shift concerning how zoos and aquariums view their education purpose. Gone are the days when education in zoos and aquariums happened only in classrooms and was for a purely 'cognitive gain' purpose. Within the EAZA Conservation Education Standards (2016) the following definitions are now used:

> *'…the term "education" is used to mean education and learning in the broadest sense, not confined to schools or education focused on children, but to encompass learning opportunities, experiences and activities for all ages and needs. The term "conservation education" has been used to reflect that biodiversity conservation must be at the core of a programme of educational activities within an EAZA zoo or aquarium. However, EAZA acknowledges that conservation education in its broader sense can include those programmes of activities that make an indirect contribution to biodiversity conservation – such as education for sustainable development, biological, science or environmental education and practical skills-based programmes.'*

This learning ethos moves further away from the traditions of education and will continue to evolve over the next 25 years as zoos and aquariums become more focused on activating and supporting sustainable behaviours in our audiences.

CHANGING BEHAVIOUR

We know that conservation is as much about people as it is about species and ecosystems, and that many of the threats and solutions to biodiversity loss are grounded in human activities. Conservation solutions that focus on influencing human behaviours and the wider 'social dimensions' will be commonplace in zoos and aquariums of the future, but for this to become a reality, a radical change needs to happen right now. At present there is a wide gap in our knowledge, skills and confidence in this area across zoos and aquariums globally. We need to invest now in developing a deeper understanding of human behaviours; what drives them, how to influence them and how to measure the extent to which zoos and aquariums can contribute to how audiences think, feel and act positively towards the natural world. Encouraging changes in human behaviours to benefit biodiversity is difficult, complex, takes time and is

hard to predict, and the potential impacts are even harder to identify and measure. However, I hope zoos and aquariums in 2043 will have spent the previous two decades investing in developing their own capacity and expertise, and will have created close partnerships with others who specialise in human behaviour and change to maximise the potential positive impact that zoos and aquariums can have on their audiences.

EDUCATING THE NEXT GENERATION

The Chinese proverb 'The best time to plant a tree was 20 years ago; the second-best time is now,' rings true when we think about preparing zoo and aquarium audiences for life in the future. The schoolchildren of today will be the decision-makers, conservationists and global citizens of the future. If our assumptions are right, by 2043 there will be a need for more scientists, innovators and creative thinkers to tackle the urgent global issues affecting both people and biodiversity. This means that we need to focus on educating, inspiring and empowering the young people who visit our zoos and aquariums today. By building portfolios of learning programmes that will provide a positive climate of opportunities for young people to follow these career pathways, we can create a future generation of powerful conservation leaders and advocates.

As well as young people, opportunities for all ages to engage in lifelong learning will become the norm in 2043. Zoos and aquariums of the future will understand more about their audiences, their values, cultures and behaviours and develop programmes accordingly. They will embrace the use of technology in all forms to encourage participation from our audiences, deliver elements of learning programmes and connect with audiences globally. However, technology will not and cannot replace the experience of visiting real live animals in zoos and aquariums, but it will enhance and extend these experiences and help to scaffold learning for many of our future audiences, who will probably live their lives highly influenced by technology. In 2043, it will no longer be just 'educators' in an 'education department' that have a conservation education remit, as there will be a shift to a holistic organisational approach to how we deliver learning opportunities. We will have built capacity in all our staff (from keepers to Directors) and volunteers to be able to provide diverse audiences with inclusive and multi-sensory learning experiences throughout their visit to our sites.

TACKLING DIFFICULT SUBJECTS

We will have to become braver in what we discuss with our audiences. We will talk about the challenges of life in 2043 such as human population growth, food security, climate change and over-consumption of resources. We will be open and transparent about our practices such as species population management both *in situ* and *ex situ* to ensure long-term genetic viability. We will acknowledge and encourage conversations about the interface between people and wildlife becoming sharper as areas are urbanised and tensions of coexistence increase, and how we can mobilise individual and collective voices and actions around policies, governance and lobbying for change.

BUILDING OPTIMISM

In the early days of zoos and aquariums, before mass travel and modern technology, people came to zoos just to see animals that they couldn't see anywhere else, and in 25 years' time we could have reverted to this situation for several species that have the real potential to go extinct in the wild. This is a bleak thought indeed, but one of the possible realities of our future. With this in mind, I think it is natural for people to think of the future in two opposing ways, swaying between the ideology of a sustainable utopia and an anthropogenically ruined wasteland. Unfortunately, the latter often pulls conservationists and the public alike into feeling hopeless and powerless about the future security of species and ecosystems. The author Charles Bukowski said, 'What matters most is how we walk through the fire.' This to me means that zoos and aquariums will need shift their narratives to frame conservation messages that include more hopeful and optimistic stories to help people walk through the fire in this era of biodiversity loss. People get turned off by the constant newsfeeds of dwindling numbers of a species and yet another environmental crisis. So I think that an important role that zoos and aquariums will play in the future is that of engaging our audiences with the conservation stories of success, lighting beacons of hope in a world of uncertainty and supporting our audiences' wellbeing to be resilient and optimistic.

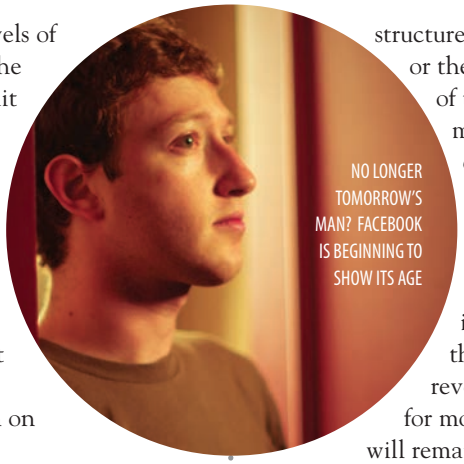
Author Peter Drucker said 'The best way to predict the future is to create it' and I feel that we have a great opportunity to do that with conservation education in zoos and aquariums that aims to raise awareness, connect people to nature and foster sustainable behaviours in our audiences. To meet the assumptions I have made for 25 years' time, much of the groundwork needs to begin now. We need to invest and develop our collective capacity to address the complexity of how to influence people to encourage conservation behaviours. We need to focus on creating programmes and career pathways for young people to support them into future conservation careers. We need to provide an inclusive climate of learning opportunities for all our audiences, involving all our staff and volunteers. Lastly, we need to frame the future as hopeful, and one where we can all take positive actions for a sustainable future for species, ecosystems and human society.

Getting the message

WHY ZOO COMMUNICATORS MUST FOCUS ON UNITY AND TRANSPARENCY IN THE DECADES TO COME

David Williams-Mitchell, EAZA Director of Communications and Membership, The Netherlands

Gordon Moore observed in 1965 that levels of computer processing (more specifically, the number of components in a printed circuit board) would increase at an exponential rate, with a doubling of capacity every 18 months or so. Ray Kurzweil, the prolific inventor, believed not only that this principle would apply to other technologies, but also that artificial intelligence would develop at a rate that would lead to a 'singularity' (the moment when AI machines would take over from humans as the most 'intelligent' life form on the planet) in 2045.



Of course, Moore's law seems to have stopped working around 2012, and many computer scientists believe that Kurzweil's prediction of the singularity is extremely unlikely. In a similar vein, we are constantly being told that new technology is changing the face of communications, and we have certainly seen some of this with the rise in social media; however, just like the disparity between the predictions of Moore and Kurzweil and the current reality, it is hard to be sure of any specific outcomes. Having said this, and without heading into 'Jetsons' territory (for younger readers, the Jetsons was a 60s cartoon from the US, which featured a family zooming about in flying cars), it is possible to predict that the landscape of communications will be significantly different by 2043.

THE FUTURE OF SOCIAL MEDIA

Assuming no singularity, and a gentler pace of change than Moore predicted, we can look at current trends and imagine where they will lead us. Facebook, already in trouble for its cavalier attitude to personal information, and largely ignored by younger social media users, may not be the force it was. Twitter's lack of ability to convey context – and its enthusiastic use by arguably the most unpopular US president in history – may also have crippled its ability to keep up with the times. It may be that consumer protection, of the type being launched in the European Union in 2018 with the General Data Protection Regulation, could lead to a more responsible relationship with technology, in tandem with the coming of age of a generation with a greater understanding of the pros and cons of living online. It is already remarkable to see teens and children appearing to have an innate ability to sift vast quantities of information, discarding easily the information that they assume to be untrue. The concept of 'fake news', so confusing to many of the current generation, will probably soon sink without trace.

The media itself has been undergoing a revolution for some time now, but the leaders of this revolution are already showing their age. A wholesale disruption of the old media structure has not improved global transparency or the social engagement and education of the general public. What started as a movement of 'the geeks shall inherit the earth' now looks increasingly out of touch, and out of the control of those who started the ball rolling. Instead, younger people with a healthier relationship to technology may well be inventing their own systems, subverting those that already exist and, perhaps, reverting to earlier models in a search for more reliable information. Information will remain the source of much power; it will be interesting to see if my children's generation choose to spread this resource, like others, more equally across the world. I would like to think that, conflict and reaction notwithstanding, they will choose to overcome barriers to social and environmental justice, putting technology to work to better the planet rather than just gain an advantage over other people.

Technology then, may not be the defining characteristic of the future of communications. Indeed, sources from Ancient Greece decried the invention of writing, claiming that it would lead to atrophy of the human memory; video was going to kill the radio star; the internet would replace books. The addition of complexity to our lives may complicate matters in the short term, but humans are extraordinarily good at adapting to it, and communications, despite a greater reach and shorter time frame, remain more or less unchanged, certainly since the invention of mass media.

LEADING THE WAY

For zoo and aquarium communicators, the challenges may therefore not be technological in nature, unless the development of technologies fundamentally changes how we communicate; and even if it does, the message of zoos is likely to be similar. With luck, by 2043 denial of human-induced climate change will have been consigned to the past. It is difficult, however, to imagine that decades of abuse of the natural world will have been completely repaired or brought under control. Zoo communicators will continue to cheerlead for endangered species and habitats, and to encourage the public to encounter wild animals. The public may be better informed about sustainable living than it once was, but encouraging it to continue down this virtuous path will be a duty that we as communicators will need to fulfil.

One of the most interesting trends of recent times is the growing integration of communications efforts across organisations. This can be most easily illustrated by the blanket coverage on social and traditional media of the ocean plastic pollution crisis, during which we have seen a remarkable degree of unity in messaging from stakeholders

as diverse as the United Nations Environment Programme and media companies such as Buzzfeed. It is vital that communicators learn to systematise this trend, working together to ensure blanket awareness of environmental issues across all media consumers. I would hope that our legacy as communicators would be to devise a framework for future generations to achieve such a goal, perhaps via a much-strengthened IUCN Commission on Education and Communication, a framework that would need us to abandon our strongly defined territories and work for the common good – in essence, a form of One Plan approach for communications. While it is still early days with the ocean plastic communications drive, we can now see concrete actions beginning to emerge, such as calls for supermarkets to abandon plastic wrapping on many products, and the first few actions to outlaw single-use plastic utensils.

THE POWER OF LEGISLATION

We may also need to act far more politically. Evidence shows that personal actions and commitments on their own are rarely enough to drive meaningful change and that legislation is the single most effective modifier of public behaviour. As a result, many of our communications activities may need to be targeted at legislative bodies, or aimed at building public pressure on legislators to amend laws. Government and Public Affairs (GPA) communicators may well be some of the most important members of the zoo and aquarium Marketing and Communications teams by 2043. There are other reasons why GPA specialists may be key staff members by then; it is clear that, for the moment at least, activists calling for the public to avoid visiting zoos are not making significant headway. Instead, they are beginning to focus far more on legal avenues for the abolition of animal captivity, a profoundly undemocratic development that assumes the public is too irredeemably ignorant to make an informed decision. As a result, activism is moving away from protests at the gates, and towards lobbying and legal challenges. Resisting such moves will entail an assiduous effort to keep politicians and the legal system informed of the challenges facing nature, and the role of zoos in overcoming them. If we assume that information (true, false and indeterminate) will continue to proliferate, we will need to become reliable providers of objective fact. This will involve, as it already does, the idea of balance; faced with the utter destruction of nature in its present form, zoos and aquariums should be doing their best to alter outcomes and minimising compromises. The reasons for these compromises must be clearly articulated, otherwise we may lose the currency of reliability that we currently enjoy with the majority of legislators in Europe. This implies, of course, that zoos and aquariums will need to maintain the highest standards of husbandry, welfare, conservation, research and education – in short, we will need to make sure that we walk the walk as well as talking the talk.

Radical transparency seems like the most likely outcome of the upheavals currently shaking the media and communications sectors. We should embrace this, and work to ensure that zoos and aquariums are truly representative of the environmental aspirations of the communities they serve, and that they maintain a level of creativity and foresight to be able to inform and inspire those aspirations. This will involve every staff member becoming, to some extent, communicators; we'll need to speak clearly with one voice to all who aspire to protect nature, and to ensure that that body of people becomes the clear global majority; no easy task.

JOINING FORCES ON COMMUNICATIONS IS STARTING TO BEAR FRUIT ON THE ISSUE OF OCEAN PLASTIC

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People vs planet

THE RELENTLESS INCREASE IN HUMAN POPULATION IS AN ONGOING THREAT TO GLOBAL BIODIVERSITY

Dr Mark Barone, Senior Scientist, Population Council, USA

It is a stark fact that while the human population continues to grow, other species continue to decline. The natural increase in the world's human population, which takes into account both births and deaths, is approximately 170 people every minute (PRB, 2017). By the time you finish reading this article, the human population will have increased by somewhere between 2,500 to 5,000 people. That translates to around 83 million people per year, the majority born in poorer countries (UN, 2017).

At the same time, other species are becoming extinct. Our activities are causing a massive loss of species that has no precedent in the history of humanity and few precedents in the history of life on earth (Ceballos, 2017). The number lost is difficult to say, especially since many species, perhaps as many as eight million, are undiscovered, but half of all species will likely be extinct by the end of this century (Wilson, 2018). However, the exact numbers aren't relevant to the conclusion that, as the human population continues to increase, other species continue to go extinct.

In one way or another, we humans – our numbers, where we live, and our patterns of consumption – are the primary force responsible for much of the loss of biodiversity; yet zoos, aquariums and, more broadly, the conservation community do not typically discuss human population growth. If we have any hope of passing a viable planet to future generations, this needs to change.

Human population numbers are primarily driven by fertility rates, i.e. the average number of children a woman will have in her lifetime. If women have fewer children, population growth will slow; if they don't, population growth will continue to rise. If average fertility around the world were to stay the same as it is right now, we could be facing a dramatic increase in the world's population from the current 7.5 billion people to numbers reaching perhaps as high as 25 million by 2100 (UN, 2017). Fortunately, this dire projection is an unlikely scenario. Although the world's population continues to increase, growth is slower now than in the past and there is measured hope that this trend will continue.

The latest UN projections suggest that by 2043, the world's population will be somewhere between 8.5 and just over 10 billion. These projections rest on the historically informed premise that fertility will fall fairly drastically in countries where women currently have high fertility rates, primarily due to increased use of effective contraceptives. While it is uncertain whether this will actually happen or not, fertility has generally declined over time. Globally, the average woman today has 2.5 children, down from 5 children in 1950 (UN, 2017). As always, averages can mask underlying deviations and there are indeed dramatic differences in fertility across countries and regions.

Fertility has declined in nearly all regions of the world and even in Africa, where fertility levels are highest, the average woman has 4.7 children today, down from 5.1 in the early 2000s (UN, 2017). Over the next 25 to 30 years, more than half of the world's population growth is expected to occur in only nine countries: India, Nigeria, Democratic Republic of the Congo, Pakistan,

THE EDUCATION OF GIRLS IN DEVELOPING NATIONS NEEDS TO BE A KEY ELEMENT OF CONSERVATION PRACTICE

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RUSH HOUR IN DHAKA SHOWS HOW HUMAN POPULATIONS CONTINUE TO EXPAND

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Ethiopia, Tanzania, the United States, Uganda and Indonesia. At the same time, the population in Europe is likely to shrink (UN, 2017).

Adolescent fertility is an important factor. Not only does it tend to lead to more children per woman over her lifetime, but adolescent fertility also contributes to health risks for both mothers and their children, as well as reduced education and employment opportunities. It is highest in Africa at nearly 100 births per 1,000 girls aged 15–19, compared to approximately 16 per 1,000 in Europe. If current trends continue, adolescent fertility in Africa could fall to under 70 per 1,000 by 2050 (UN, 2017).

Whether or not the fertility declines that are needed to realise the lower or even the middle range of the population projections noted above actually occur is by no means certain. Historically, declines in fertility have primarily been due to the voluntary use of effective, modern contraceptives. Like fertility levels, the global average of 55 per cent of married women aged 15–49 using modern contraception masks dramatic differences around the globe (PRB, 2017). In wealthier countries, use of modern contraception tends to be higher, but in poorer ones, limited availability and affordability, conservative social or religious attitudes, civil unrest and low status of women all conspire to keep use lower – as low as single-digit numbers – which keeps fertility higher.

IN LESS DEVELOPED ECONOMIES, WOMEN HAVE LESS ACCESS TO BIRTH CONTROL DUE TO LIMITED AVAILABILITY, HIGHER RELATIVE COST AND SOCIETAL PRESSURE

The age structure of the world's population is also playing a major role in future growth. There are more young people now than ever before; a little over one-quarter of the world's population is under 15 years of age and the number reaches 41 per cent in Africa (UN, 2017). That's good news and bad news. Bad news because even if they have fewer children than their parents, population growth will accelerate as these large number of young people initiate childbearing.

But it's also good news because children are the potential for the future. In fact, it's the girls that hold the key to this problem. You may not think concerns about girl's education should be prioritised by those interested in conservation, but ensuring that girls stay in school and get a high-quality education may be one of the greatest hopes for the future of our planet. Although there are more girls now than ever, especially in the poorest regions in the world, it is educated girls who grow up to be educated women, and educated women contribute more positively to society, become excellent stewards of their resources and the environment in which they live and, from a population growth perspective, are more likely to choose to have smaller families (Shapiro, 2017). But in 2015, an estimated 131 million girls worldwide were out of school (UNESCO, 2017).

So where do all these facts and figures leave us? Well, there are signs of hope, but there is also cause for concern.

Although fertility has been steadily declining globally, in sub-Saharan Africa declines have been far more modest than had been projected. Whether the declines necessary to achieve reductions in population growth can be achieved in the coming decades is questionable. Adolescent fertility – a touchy subject in much of the world – needs to be addressed, especially given the unprecedented number of girls in the world today.

Contraceptive use is now higher than ever before; however, some 200 million women across the developing world who wish to avoid pregnancy are not using an effective contraceptive. This is referred to as 'unmet need' (Guttmacher, 2017). Last year alone, there were an estimated 89 million unintended pregnancies in developing regions; 75 million of these were among women with an unmet need for modern contraception (Guttmacher, 2017). It is essential to invest in family planning programmes which, if history bears out, will lead to increased use of effective contraceptives, allow women and couples to achieve their desired family size, ensure healthy, educated families and contribute to the substantial reductions in fertility necessary for a more moderate increase in the world's population.

Although significant progress has been made towards improving education for all, particularly girls, we are far from achieving universal education goals. Comprehensive sex education, often a sensitive and controversial subject, has a demonstrated impact on healthy development and overall wellbeing and, crucially, delayed initiation of intercourse and increased use of contraceptives (UNESCO, 2018).

The focus on these issues that are critical to stabilising the world's population has increased with recent global movements, country and international commitments and the work of advocacy groups and multi-stakeholder partnerships such as the Sustainable Development Goals, Family Planning 2020, the United Nations Girls' Education Initiative and the World Education Forum. But unfortunately the success of past initiatives like these has been mixed.

We must hope that we can do better in the future, but that requires significant and sincere political will and leadership, and more sustained financial commitments. Recent events in both high- and low-income countries, with swings towards conservative policies and reduced funding to family planning programmes, is extremely worrying.

There is still much to be done. Now is not the time to rest on our successes as a global community. Investing in women and girls is a non-negotiable component of any strategy to slow human population growth. If we muster the political will to educate girls, and ensure that girls, women and couples can decide when and how many children they want to have, stabilising the world's population will be achievable. Without this turning-point, our way of life will become unsustainable and future generations will look back and ask why we did not do more.

The longer it takes for fertility to decline in places where it remains high, the longer it will take for population levels to stabilise. It is almost certain that the upward trend in the number of people in the world will not have peaked, even with reductions in family size, when the 200th edition of *Zooquaria* is published. The question is, will we be well on the way to stabilising the world's human population, and what role will you and your colleagues have played in getting us there?

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