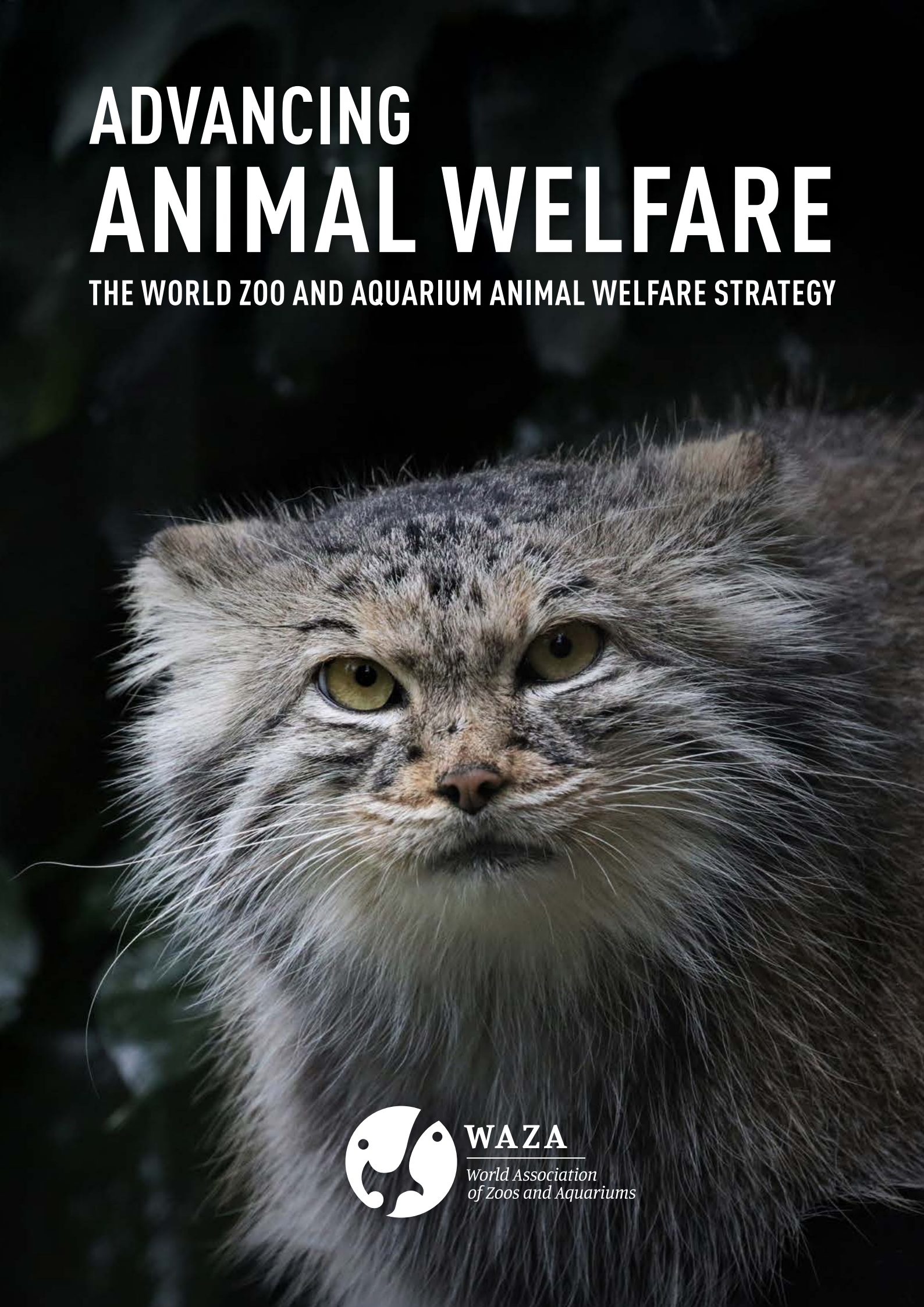
ADVANCING ANIMAL WELFARE

THE WORLD ZOO AND AQUARIUM ANIMAL WELFARE STRATEGY



WAZA

World Association of Zoos and Aquariums

Cover photo: Pallas cat (*Otocolobus manul*) © *Kees Groot*

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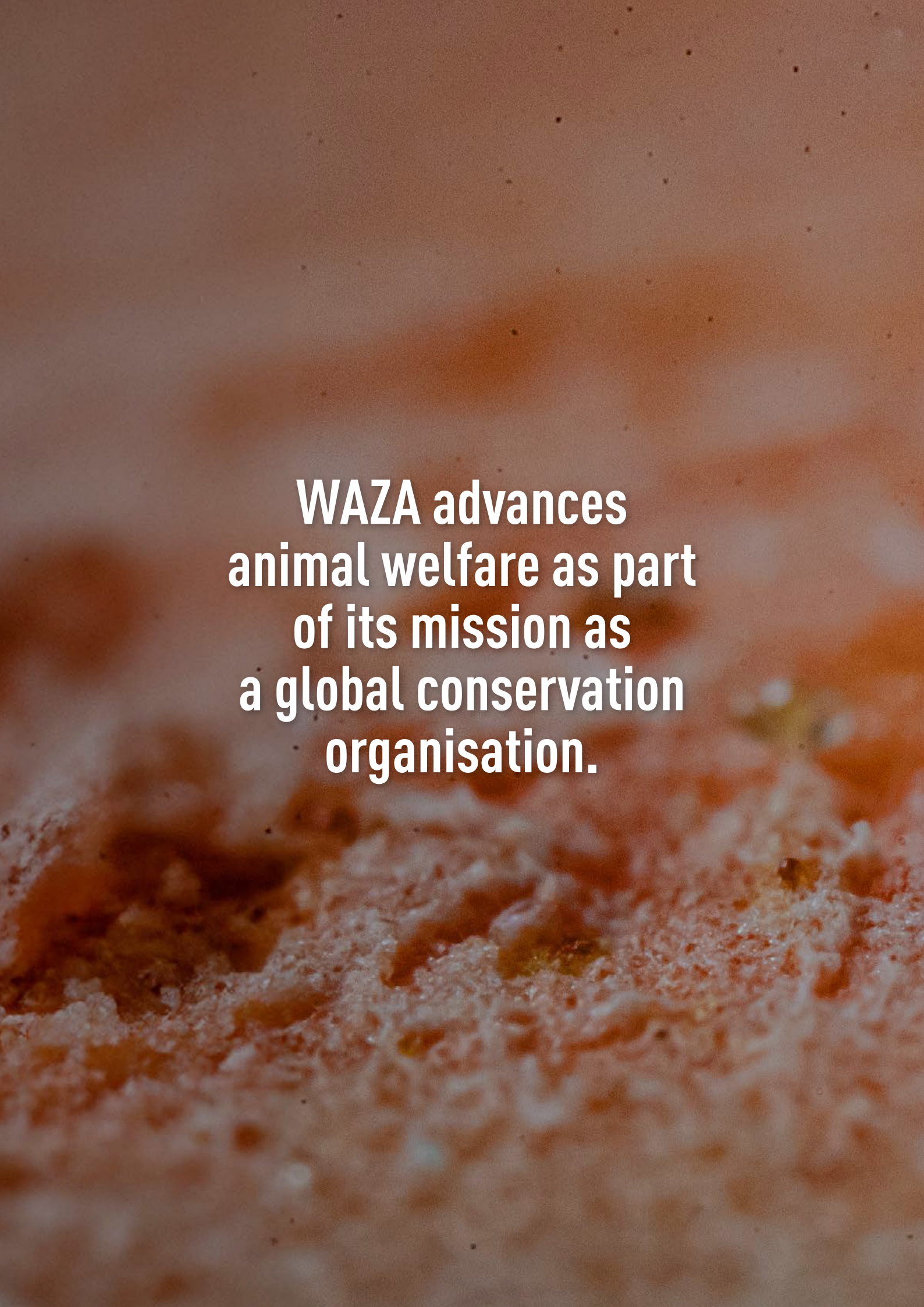
Owl butterfly (*Caligo sp.*) © *Cali Zoo*



WAZA advances animal welfare as part of its mission as a global conservation organisation.

Desertas Island land snail (*Discula lyelliana*) © *Chester Zoo*

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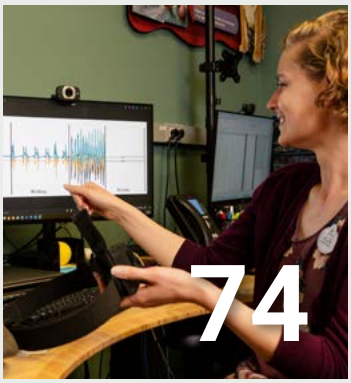

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How to use this Strategy?

NAVIGATE IT!

The purpose of this strategy is to guide zoos and aquariums in strengthening science-based animal welfare across all aspects of their work. Each chapter offers practical recommendations supported by science, as well as examples and tools that can be adapted to different contexts and needs.

The strategy also includes an extensive set of **references** that can provide a more in-depth understanding, inspiration for research, and acts as a practical resource to strengthen evidence-based practice. By linking directly to scientific literature, this strategy ensures that WAZA member organisations can not only apply the recommendations but also engage with the evidence behind them.

Links throughout the document can be used to jump between sections within the strategy, connecting related topics and pointing to additional resources for further detail.

Different parts of the strategy will be most relevant depending on your role and where your institution is on its animal welfare journey. Read it, use it, share it with your colleagues and debate strategies to implement the recommendations provided.

IMPLEMENT IT!

Advancing Animal Welfare: The World Zoo and Aquarium Animal Welfare Strategy acts both as a reference document and a practical tool to help zoos and aquariums embed animal welfare into daily practice and long-term planning. Implementing it effectively means translating its recommendations into concrete actions that fit your organisation's unique animal welfare culture.

1 Start by using the strategy to spark and sustain conversations across your team.

Use it to spark conversations within animal care teams, welfare committee, and the leadership team. Whether you are launching new initiatives or refining existing ones, the chapters provide a common language and shared framework for welfare discussions *Make it happen!*

2 Go through the list of recommendations at the start of each chapter.

These can be treated as a self-assessment approach to the different topics within:

- **Review** them with your team and ask: Are we already doing this? If so, how well? If not, what changes are needed?
- **Identify** areas where your institution is strong, and where further investment, training, or cultural change may be required.
- **Create** action plans based on the recommendations, assign responsibilities, and track progress over time.

3 Identify who the different chapters will be particularly relevant for.

Different roles within an institution can play a role in the implementation of this Strategy.

Carefully reviewing it can support the development or revision of institutional and regional policies and practices, ensuring they align with current science, global standards and community expectations.

4 Foster a culture of open, respectful debate around animal welfare.

Not all welfare questions have simple answers, and teams may face complex trade-offs. Encourage staff at all levels to discuss these challenges openly, valuing different perspectives and experiences. Make welfare conversations a normal, positive part of professional growth and continual improvement.

Magellanic Penguin (*Spheniscus magellanicus*) © *Zoo Wrocław*

Foreword

At a time when animal welfare is being demoted in so many realms, the *2025 World Zoo and Aquarium Animal Welfare Strategy* stands as a firm expectation to put animals first. I have been collaborating with the zoo and aquarium community for fifteen years and they are absolutely my favourite people to work with because there is never a risk of welfare-washing; animal welfare is their genuine priority, and their passion and commitment to improving welfare shines through. The 2025 Strategy exemplifies this passion and commitment throughout. This latest Strategy reinforces some of the key themes of the 2015 version, most importantly the focus on striving for animals to have mostly positive experiences and thus positive welfare overall, and the need for planning, decision-making and practice to be informed by scientific principles and evidence.

In addition to these enduring principles, several other themes consistently emerge. Immediately evident is WAZA's cohesive and holistic approach to supporting and improving wild animal welfare. This is demonstrated by consideration of the broad range of taxa kept in zoos and aquariums, the various stages of these animals' lives, the physical, sensory and social environments in which they normally reside but also their experiences during transport, quarantine, medical care, breeding, research, training, preparation for release, and during interactions with staff and visitors. Also emphasised throughout is the importance of planned, structured and consistent welfare assessment in every aspect of design, routine and extraordinary management, decision-making and to inform internal and external communication.

As humans claim more of the world's space, zoos and aquariums will face difficult choices about which species can be kept well in human care and for which species efforts should be focused mainly on *in situ* conservation. This challenge was highlighted in the excellent Chapter 11 on Social Needs, which pointed to the underappreciated complexity of animal societies and the difficulty in facilitating that complexity in human care. Importantly, zoos and aquariums provide fertile ground to challenge the traditional tensions between welfare and conservation, some of which are explored in Chapter 7. Noteworthy is the zoo and aquarium community's appreciation of the value of animal welfare science expertise as distinct from, but complementary to, veterinary and other animal science expertise. As such, WAZA member organisations are ideally placed to act as honest brokers between animal welfare scientists and field conservationists to break down those traditional barriers and leverage their combined expertise and motivation to optimise outcomes for free-living wild individuals, species, ecosystems and environmental health.

Kea (*Nestor notabilis*) © *Auckland Zoo*

Another consistent theme is the importance to welfare of providing individuals with opportunities for choice, control, agency and constructive challenge so that they can create meaningful positive experiences for themselves as well as avoid those situations that elicit experiences they find unpleasant. We've come a long way from simply ensuring that animals survive and reproduce in human care and even from assuming that all individuals of a species experience the same environments and care the same way. The key link is made between facilitating individual choice/control and promoting resilience. Fostering resilience is important for both survival and welfare and is considered in various chapters in reference to animals remaining in human care as well as those released to boost wild populations. Resilience, not only for animals but also for people and organisations, feels particularly important in this time of global uncertainty.

These emphases speak of WAZA's desire to lead its members in manifesting core values of respect and dignity for all animals in human care and, in fact, those affected by human activities in the wild too. Many of these ideas are aspirational, there's no question. But that is what we expect from WAZA – to lead the leaders. An ongoing challenge for WAZA and its members will be how these leaders can support, encourage or challenge those less able or less willing to prioritise animal welfare to raise their standards. The power of sometimes uneasy relationships between zoos and animal advocacy groups to bring about positive change for animals is clearly illustrated in the case studies shared in Chapter 9.

Specific welfare-related research priorities for the future will include: validating proposed indicators of welfare, particularly for poorly understood affects like boredom; learning more about the behavioural ecology of under-represented taxa, especially those in aquariums; investigating how best to rehabilitate individual animals whose behaviour is abnormal due to impoverished early lives; and understanding how to use artificial intelligence and other technologies to support welfare without losing human knowledge, skills and, importantly, connection and empathy.

Addressing these and other priorities will rely on generous partnerships, collaboration and information sharing, including with academic researchers (call me!). In terms of research, finding partners with complementary expertise and technical skills is mutually beneficial, helping researchers to achieve their educational objectives while addressing priority welfare issues for facilities caring for animals. I also urge regional member organisations to develop and publicise multi-year cross-institution research strategies to identify shared research priorities, maximise access to data, and allow their external partners to effectively match students and funding to priority questions.

Finally, I wholeheartedly endorse the emphasis on investing in staff to ensure good animal welfare and good human welfare. Early and ongoing investment in all staff is key to creating and maintaining a culture that explicitly and consistently prioritises animal welfare and that is proudly displayed to institutional partners and visitors. How lucky would you be to spend your days contributing to a culture that 'encourages curiosity' about animals and their welfare?

PROFESSOR NGAIO BEAUSOLEIL
Animal Welfare Science and Bioethics Centre,
Massey University, New Zealand

Supporting Statements

World Organisation for Animal Health

WORLD ORGANISATION FOR ANIMAL HEALTH (WOAH)

The World Organisation for Animal Health (WOAH) wishes to congratulate WAZA in publishing the World Zoo and Aquarium Animal Welfare Strategy. Putting such a strategy together is an ambitious and arduous task, given the vast diversity of wild species and their distinct needs. It calls for a human-decentric approach, one that objectively recognises and addresses the needs of each wild animal species. Ensuring their welfare during transport and quarantine is important, and this strategy commendably places it at the forefront.

WOAH has been working to improve animal welfare since 2002 and shares WAZA's commitment to ensuring the welfare of animals kept in zoos and aquariums. In 2025, WOAH's World Assembly of Delegates adopted the revision of *Chapter 7.1. Introduction to the recommendations for animal welfare*, which outlines the assessment of the welfare of animals, including those kept in captivity. WOAH is therefore grateful to see the importance of welfare assessments reflected in Chapter 2 of WAZA's strategy. This strategy is an important contribution to the welfare of animals kept in zoos and aquariums and WOAH looks forward to seeing the strategy's impact on animal welfare over the coming years.

ifaw

INTERNATIONAL FUND FOR ANIMAL WELFARE (IFAW)

IFAW was pleased to contribute to WAZA's 2015 Animal Welfare Strategy, and we are delighted to support the 2025 update. We reaffirm our shared commitment with WAZA to augment animal welfare and conservation, recognising that the two are complementary and integral to our missions.

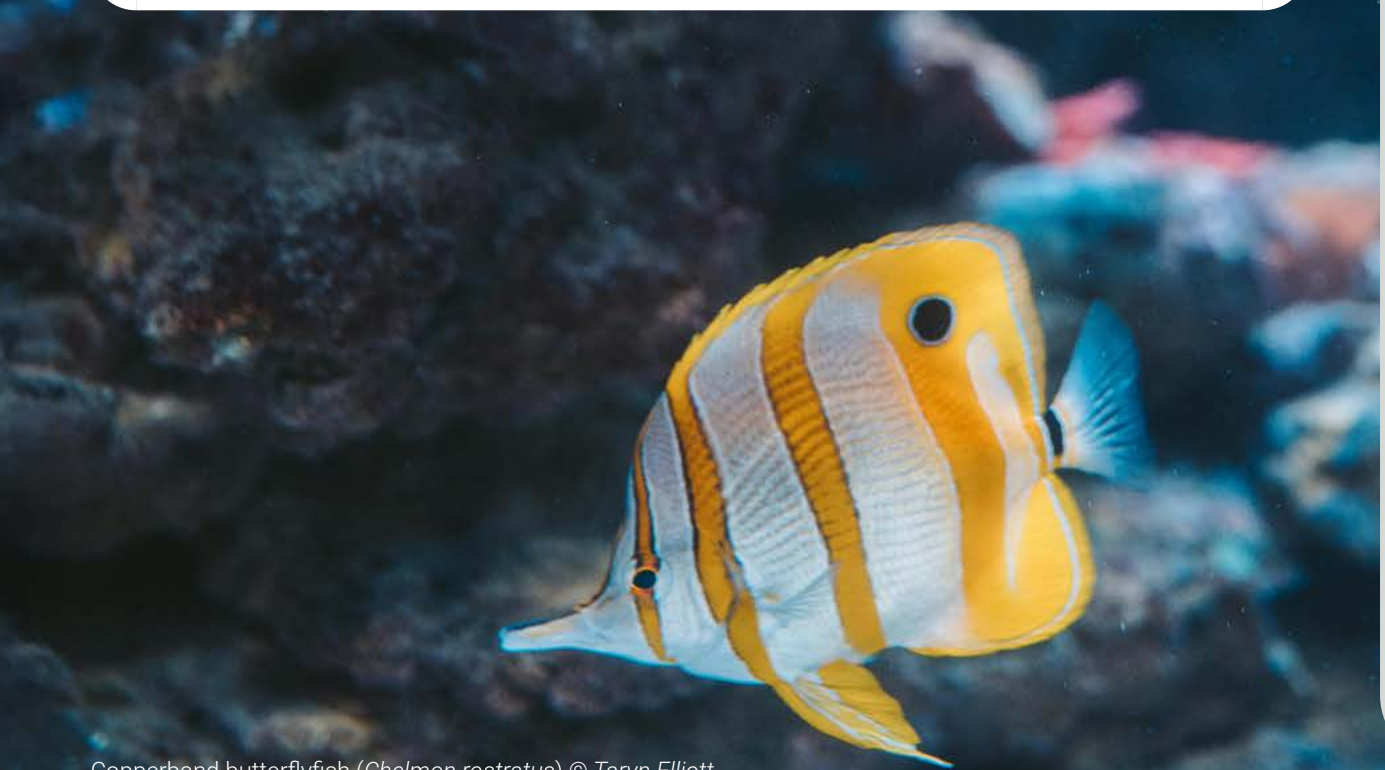
Whilst IFAW believes wild animals should live in the wild, this is not always possible, and providing for their individual needs and ensuring positive welfare is a complex endeavour. Under WAZA's umbrella, zoos and aquaria around the world can share good practices and, working with academic institutes, focus on evidence-based management practices to enhance the well-being of wild animals in care and improve opportunities to contribute to conservation. The 2025 Strategy document clearly demonstrates a commitment to both.

WILD WELFARE

Wild Welfare commends WAZA's comprehensive approach, recognising that animal welfare is a continually evolving journey. Through their partnership, Wild Welfare and WAZA provide zoos and aquariums with invaluable resources and training, encouraging shared learning and a heightened sense of responsibility. Together, the global zoo and aquarium community can raise the bar for animal care. We wholeheartedly endorse *The World Zoo and Aquarium Animal Welfare Strategy* as a guiding framework for positive transformation, striving to ensure that every animal in human care has the opportunity to truly thrive.

GLOBAL SUSTAINABLE TOURISM COUNCIL (GSTC)

The Global Sustainable Tourism Council (GSTC) warmly welcomes *The World Zoo and Aquarium Animal Welfare Strategy*. It is an important step in connecting animal welfare with conservation and sustainable tourism. By bringing the latest science into practice, the Strategy helps ensure that zoos and aquariums provide not only care, but genuine well-being for animals. We value WAZA's leadership and believe this work will encourage many institutions to raise their standards and inspire visitors around the world.



Copperband butterflyfish (*Chelmon rostratus*) © *Taryn Elliott*

Preface

The first edition of WAZA's Animal Welfare Strategy, published in 2015, became a foundational document for the modern zoo and aquarium community. This document has been widely referenced and adopted, not only by WAZA member institutions but also by other organisations and partners seeking science-based, evidence-driven guidance on animal welfare.

Regional associations are hosting regular animal welfare symposia to bring scientists and practitioners together, creating strategic plans for animal welfare, creating animal welfare culture principles for their membership, and meeting WAZA's 2023 Animal Welfare Goal. In animal welfare science, we are seeing expansion of the taxonomic focus of welfare studies, investigation of new welfare metrics, and introduction of new theories. Our professional focus on animal welfare is collectively building and broadening. More work remains but there is much progress to celebrate.

The second edition of the WAZA Animal Welfare Strategy builds on the previous edition and broadens to focus on the promotion of positive animal welfare throughout all aspects of zoo and aquarium operations and for all animals those facilities care for and manage. This edition represents the joint expertise of 45 contributors representing 35 different organisations, both WAZA members and partner organisations – a significant expansion since the last volume.

> 'Rapidly evolving' is perhaps the most appropriate way to describe our understanding of animal welfare today, whether those animals are living in aquariums, zoos, farms, laboratories, in homes as pets, in sanctuaries, or in the wild.

Blue-throated macaw (*Ara glaucogularis*) © *Kees Groot*

We are witnessing a surge in interest about animal welfare from the public, practitioners, governments, and scientists alike, coupled with rapid advancements in technology that are allowing ever more sophisticated ways to identify, validate, and assess indicators of animal welfare. These developments are helping us continually improve how we care for the animals in our institutions.

While a unifying definition of animal welfare remains elusive, the field of animal welfare science has coalesced around the principle of promoting positive animal welfare, not just preventing negative welfare. Thus, positive experiences for animals should outweigh the negative experiences they may have in frequency, duration, and intensity.

Steely-vented hummingbird (*Saucerottia saucerottei*) © *Parque das Aves*

The field of animal welfare has long considered psychological wellbeing alongside physical wellbeing, but what has advanced rapidly since the previous version of this Strategy is the acceptance of affective states explicitly as part of the psychological phenomena that shape an animal's perception of their own welfare. These states range from survival-critical affects like hunger, thirst, or pain to those that likely influence what we might call 'quality of life' like comfort, joy and a sense of safety. They range from negative to positive in terms of how they make the animal feel. We now broadly accept that all vertebrates likely have the capacity to have at least some of these affective experiences. Evidence is accumulating that some invertebrates may as well. Welfare scientists and theorists continue to debate topics like whether 'naturalness' is relevant for welfare and how we understand what role motivation plays, as animals are sometimes highly motivated to do things that may result in reduced welfare. Regardless, we agree that affects are a crucial part of the picture. These advancements have helped shape the content of this new edition of the Strategy.

In preparing the second edition of the Strategy, many of the original chapters were retained, updating and expanding them to reflect the most recent science and practice. New chapters were included on topics that either have matured in the profession or are areas where enhanced focus is needed. Each chapter includes a concise list of recommendations for advancing animal welfare around that chapter topic. The result is a larger strategy, but much of the previous strategy is still valid. I recommend using the two editions together to shape animal welfare at WAZA institutions.

I encourage you to use this strategy to begin or continue discussions, develop or revise institutional and regional policies or practices, to develop new research efforts where more data are needed, and to spark healthy debate. All of these activities eventually contribute to positive animal welfare, which is what we are all here for.

DAVID M. POWELL
Editor
Director of Research
Saint Louis Zoo

The Strategy at a Glance

Building on the short list of recommendations for advancing animal welfare at WAZA member institutions at the start of each chapter in the Strategy, here, we provide brief summaries of the main points from each chapter. These are intended as practical communication tools to inspire conversation between staff, supporters, the media, our visitors and the wider public.

CHAPTER 1

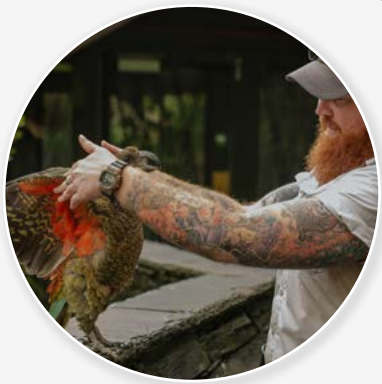
MODELS OF ANIMAL WELFARE

Animal welfare is shaped by individual experiences influenced by physical, psychological, and environmental conditions. Core frameworks like the *Five Domains*, *Opportunities to Thrive*, and the *Three Needs Model* offer evidence-based, adaptable approaches for guiding care. WAZA members are encouraged to adopt context-appropriate models and strive for continuous, science-based improvement to ensure high animal welfare standards.

CHAPTER 2

MONITORING OF ANIMAL WELFARE

Ongoing welfare monitoring is central to quality animal care and the promotion of positive welfare states. A range of tools – from rapid assessments to more in-depth evaluations – can help measure physical, behavioural, and physiological indicators. Effective monitoring depends on staff training, communication, and data sharing, and supports transparent, informed decision-making across the animal's entire life cycle.



CHAPTER 3

ENVIRONMENTAL ENRICHMENT

Enrichment promotes behavioural and psychological well-being by enabling species-specific behaviours and positive experiences. It should be integrated into daily care and tailored across the life stages of individual animals, with a focus on achieving behavioural goals rather than simply providing objects or stimuli. Regular evaluation and knowledge-sharing help foster a culture of welfare within institutions and among visitors.

CHAPTER 4

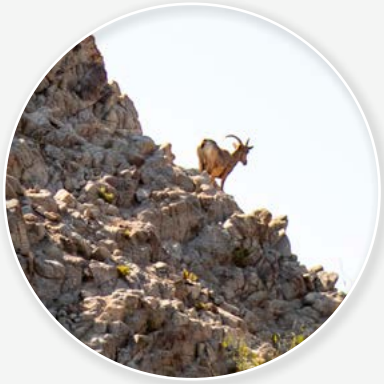
TRAINING FOR ENHANCED ANIMAL WELFARE

Reinforcement-based training can support the voluntary participation in care, promotes natural behaviours, and enhances animals' agency and emotional well-being. Effective programmes rely on clear behavioural goals, progress tracking, and well-trained staff. Training must prioritise animal needs and welfare while respecting individual preferences.

CHAPTER 5

HABITAT DESIGN

Thoughtful habitat design promotes choice, control, comfort, fostering natural behaviours, social interactions and reflecting species needs, life stages, and group compositions – balancing both animal and staff requirements. Animal welfare standards must be consistent across all areas that an animal can experience, and ongoing evaluation ensures that habitats remain enriching, safe, and changing, when needed.



CHAPTER 6

CONSIDERING ANIMAL WELFARE IN SPECIES PLANNING AND BREEDING FOR POPULATION MANAGEMENT

Professional and effective species planning balances conservation goals with individual animal welfare. Successful programmes involve careful coordination, genetic management, and full life-cycle consideration, from sourcing to reintroduction. Regular assessments, integration with welfare models, and high-quality records help institutions ensure science-based, transparent, and responsible outcomes for both individuals and populations.

CHAPTER 7

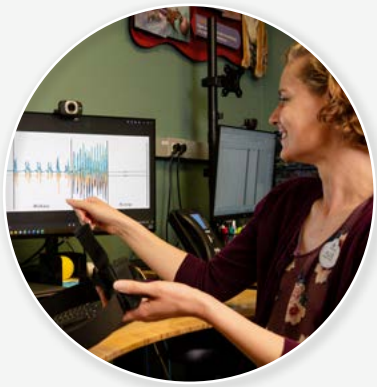
CONSERVATION AND ANIMAL WELFARE

Conservation and animal welfare are interconnected. Zoos and aquariums must integrate animal welfare considerations into all conservation activities, whether on-site or in the field. Addressing trade-offs through ethical review and transparent decision-making helps ensure both objectives are met. Good welfare supports long-term conservation success – and vice versa.

CHAPTER 8

RESEARCH IN ANIMAL WELFARE

Welfare research drives progress and credibility. Institutions are urged to support and apply science, including, and especially for underrepresented species. Key areas include behavioural indicators and affective states. Partnerships, ethical oversight, and staff development all contribute to robust, evidence-based practices that advance animal care and public trust.



CHAPTER 9

PARTNERSHIPS IN ANIMAL WELFARE

Collaboration expands welfare impact. By working with NGOs, academia, governments, and others, zoos and aquariums can influence policy, training, research, and outreach. Purpose-driven partnerships – with clear goals, governance, and mutual respect – build shared solutions, foster accountability, and amplify sector-wide progress in animal welfare.

CHAPTER 10

OPTIMAL WELFARE OF ANIMALS PARTICIPATING IN ANIMAL-VISITOR INTERACTIONS

Animals in visitor interaction programmes require careful welfare monitoring and evaluation. Participation must be voluntary, with options for control, choice, and withdrawal. With thoughtful design, Animal-Visitor Interactions can support education and conservation.

CHAPTER 11

SOCIAL NEEDS OF ANIMALS

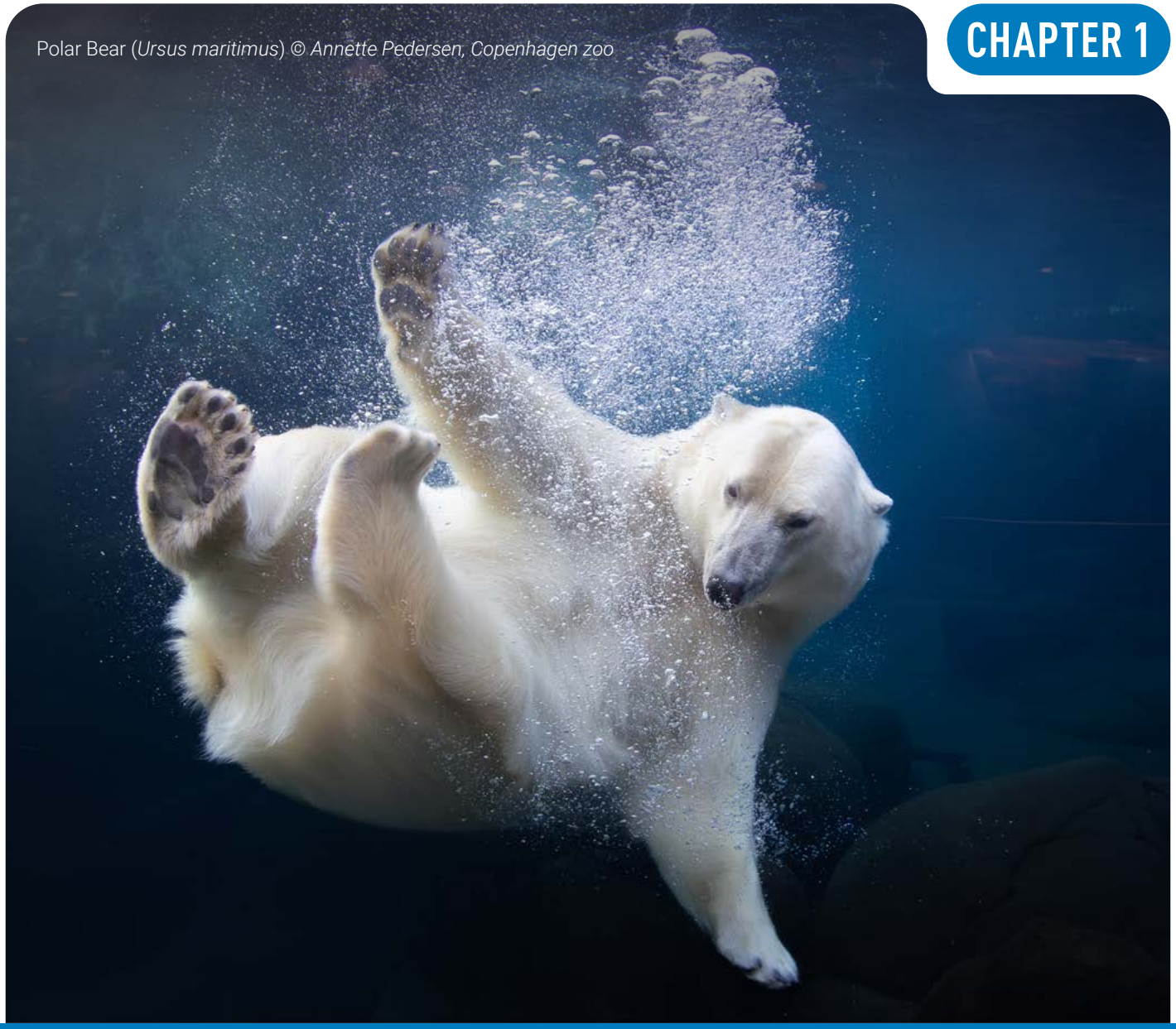
Social environments shape animal welfare. Group structures should reflect species biology, individual preferences, and social dynamics, allowing both interaction and retreat. Behavioural monitoring supports adaptive group management, and institutions must anticipate transitions – such as life stage changes or companion loss – to minimise social stress and support well-being.

CHAPTER 12

TRANSPORT AND ANIMAL WELFARE

Transport may pose challenges but, when carefully and professionally managed, can support welfare and conservation outcomes. Success depends on thorough planning, experienced staff, and compliance with legal and ethical standards. Individual needs guide crate design and environmental controls, with monitoring extending post-journey to ensure animals recover well and adapt safely.

Coquerel's sifaka (*Propithecus coquereli*) © *Kees Groot*



Polar Bear (*Ursus maritimus*) © *Annette Pedersen, Copenhagen zoo*

CHAPTER 1

Lance Miller
Brookfield Zoo Chicago

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Zoo and Aquarium Association Australasia

Sally Sherwen
Melbourne Zoo

Jason Watters
UC Davis

MODELS OF ANIMAL WELFARE

OUR COMMITMENT IS TO EMBRACE CONTINUOUS IMPROVEMENT IN ANIMAL WELFARE AND REMAIN UP TO DATE ON THE LATEST ADVANCEMENTS IN ANIMAL WELFARE SCIENCE CONCEPTS AND SUPPORT IMPLEMENTATION OF THESE ADVANCES INTO PRACTICE ACROSS WAZA MEMBERS.

RECOMMENDED ACTIONS

To realise our commitment to high animal welfare standards, WAZA calls on its member organisations to:

1. Embrace an adaptive, continuous improvement philosophy to ensure animal welfare standards are always improving.
2. Support staff curiosity in animal welfare to ask questions, conduct research and apply new learnings.
3. Dedicate time to explore new findings and stay up to date in the latest animal welfare concepts and thinking.
4. Review existing models in animal welfare and adapt and apply a model that works for the unique challenges and opportunities for your site.
5. Consider the affective states of animals in animal care and management and emphasise opportunities for positive affective states.

INTRODUCTION

WAZA members have a moral and ethical obligation to strive to achieve the highest standards of animal welfare (Mellor et al., 2015). With increasing public concern and interest in the welfare of animals in human care (Moorhouse et al., 2017) as well as increased understanding about the sentience of animals, the broader community also holds an expectation that this obligation be met. As public facing organisations centred around caring for animals (both in zoos and aquariums, and in the wild), it is critical WAZA members deliver on this expectation and moral obligation.

Animal welfare is characteristic of the individual animal. It describes the quality of an animal's life as experienced by the animal (Keeling et al., 2018). Original approaches to animal welfare developed in response to public concern about the poor state of animals in agricultural and laboratory contexts and focused primarily on alleviating suffering. As such, early workers developed tactics with a primary focus to eliminate conditions that led to animal suffering.

An early scientific definition that attempts to capture the complexity of welfare is Broom's (1986) definition that 'animal welfare is the state of an animal as regards their attempts to cope with their environment'. Historically, many have argued that animal health is the most important aspect of welfare and much of the early research in animal welfare focused predominantly on correcting conditions that led to poor health and physical condition in animals. From this approach, a better understanding of the conditions that contribute to physical suffering developed (Mellor & Beausoleil, 2015). This **biological functioning** perspective focuses on ensuring good physical health and functioning in animals and uses a range of criteria to assess their attempt to cope including the behavioural and physiological stress response, as well as any biological costs associated with coping including injury, mortality, growth and reproductive success (Barnett et al., 2001; Fraser, 2009). This is based on the notion that the magnitude of an animal's behavioural and physiological responses to stimuli will affect the animal's fitness, in terms of their ability to grow, breed and remain healthy (Hemsworth & Coleman, 2011). The rationale underpinning this concept is that inadequate adaptation to a particular managed environment will generate welfare problems for animals.

> Each institution should review available models as the science continues to evolve, and either choose a model that has already been developed, or develop a unique model that is based on scientific evidence.

Another perspective that has historically been proposed as a way of conceptualising animal welfare is the **natural living** concept. This view suggests that providing animals with environments and opportunities to express their natural behaviours in a similar way to that of their wild living counterparts will result in positive animal welfare. While the natural living concept has its value in encouraging an in-depth understanding of species-specific requirements and behaviours when designing habitats and care programmes, it has been criticised for the lack of scientific evidence behind the welfare basis of certain behaviours. In other words, simply providing natural environments does not always translate to good welfare outcomes, many other factors need to be assessed and applied including individual needs of an animal, the relative importance of certain behaviours in driving welfare outcomes and consideration of the unique conditions associated with human care in zoos and aquariums (Learmonth, 2019).

Fortunately, the field of animal welfare science is continuously progressing. More recently, there has been movement to suggest an animal's feelings or emotions (**affective state**) should be the central concept (Duncan & Fraser, 1997; Mason & Mendl, 1993). Efforts have shifted focus to emphasise the promotion of positive emotional states in animals (Mellor & Beausoleil, 2015; Yeates & Main, 2008).

In turn, these scientific advancements have raised awareness of the complex desires and requirements each species needs to live a fulfilled life in a zoo or aquarium (Kagan et al., 2015; Maple & Perdue, 2013).

Affective states are mental states with neuronal, physiological, behavioural, and cognitive aspects that equate to basic emotions. Affective states can vary in their degree of valence (from very negative to very positive), in their level of arousal or intensity (low, moderate, high), and in their duration See Figure 1.1 modified from Russell, 1980). With the current prominence of the affective state definition of welfare, there is now a focus on ensuring positive emotional states as a stride towards positive welfare. Animals experience a generally positive state of welfare when their physical and behavioural needs are met and when the environment provides them with rewarding challenges and choices and reasons to be curious over time. Zoos and aquariums can reduce negative states through appropriate management (e.g. analgesics to reduce pain). Animals have better welfare when the cumulative experience of affect is on the whole more positive than negative. A primary goal is not simply that animals avoid negative affective outcomes such as fear and pain but also enjoy positive ones like comfort and satisfaction.

Victorian Grassland Earless Dragon (*Tympanocryptis pinguicolla*) © *Zoos Victoria*

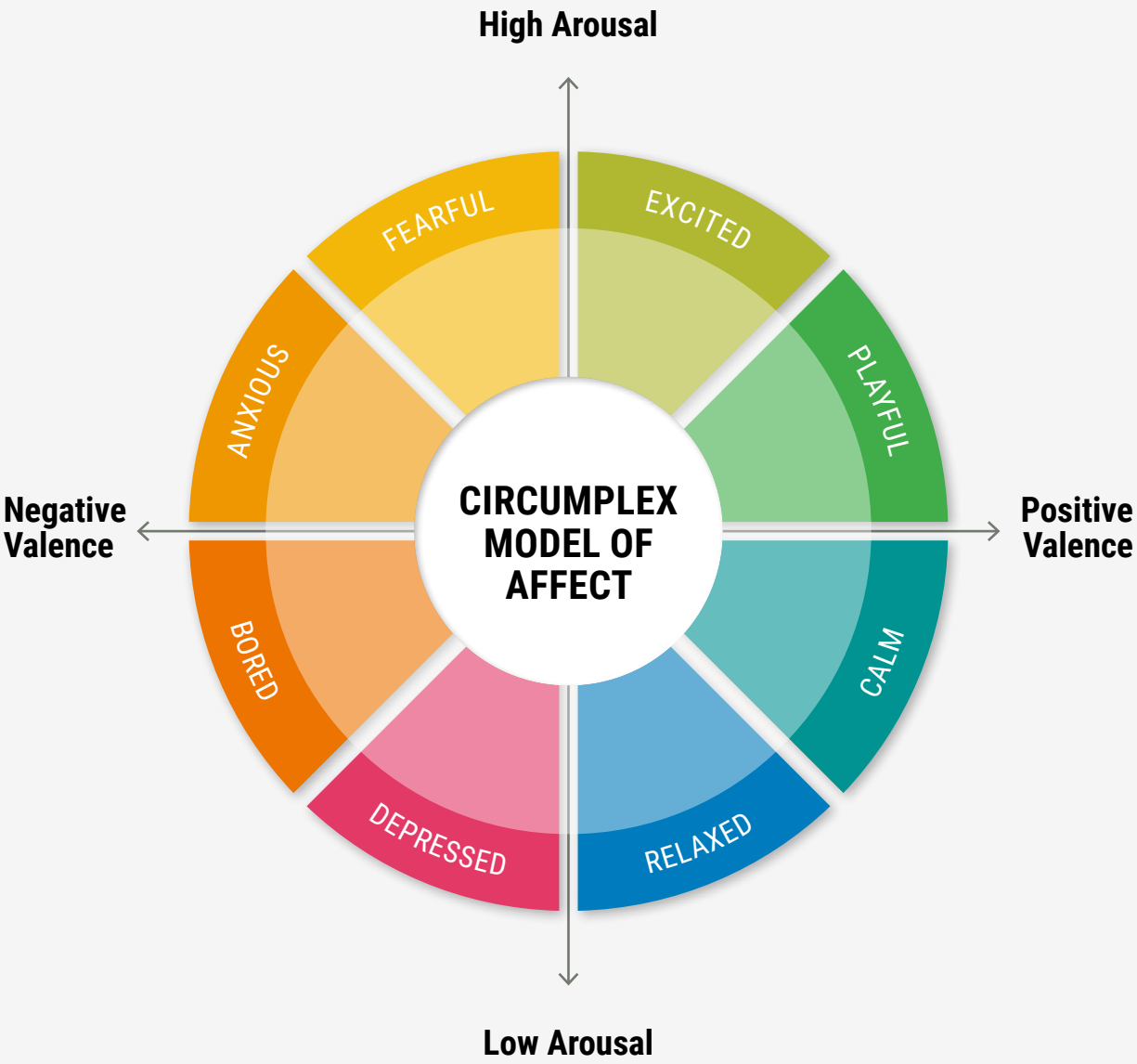


FIGURE 1.1 Circumplex model of affect modified from Russell, 1980.

Currently, there is solid evidence that mammals, and probably most vertebrates, have at least some capacity for experiencing at least some affective states (Mendl & Paul, 2020; Panksepp 2011), though there is growing evidence for affective states in some invertebrate species as well (Crump et al., 2022; Perry & Baciadonna, 2017). Therefore, it is not just the physical or functional needs of animals that require attention in caring for animals in zoos and aquariums, but the integration of these with their potential to have positive and negative affective experiences. Modern zoos and aquariums should work to minimise the occurrence of negative states in their animals and, concurrently, should make efforts to promote positive states.

WAZA's definition of animal welfare acknowledges the contributions of understanding biological functioning, natural living, and affective state concepts in understanding animal welfare and reinforces the linkages between them See Box 1 WAZA, 2020.

Bactrian Camels (*Camelus bactrianus*) © *Brookfield Zoo Chicago*

Box 1

WAZA's definition of Animal Welfare | WAZA, 2020

Animal welfare refers to a state that is specific for every individual animal; it is how the animal experiences its own world and life through its association with pleasant experiences specific for that species such as vitality, affection, safety and excitement, or unpleasant experiences such as pain, hunger, fear, boredom, loneliness and frustration.

Many of these experiences can be generated through features of an animal's diet; environment; physical health and fitness (including injury and disease); social environment (including interactions with humans); and its ability to fulfil the species specific and individual animal's behavioural motivations to have positive physical or social experiences. An animal's welfare state can be influenced both positively and negatively by all parameters of its living environment with husbandry practices (i.e. animal care) being only one of them. The ability to have species specific choices and individual control over their environment are very important contributing factors for positive animal welfare.

Evolution of scientific models

Associated with these shifts in thinking has been an evolution of the scientific models that form the framework for welfare assessment. These conceptual frameworks, originally designed to inform welfare standards to minimise suffering, have now been modified to include additional requirements needed to promote positive animal welfare states (Mellor & Beausoleil, 2015).

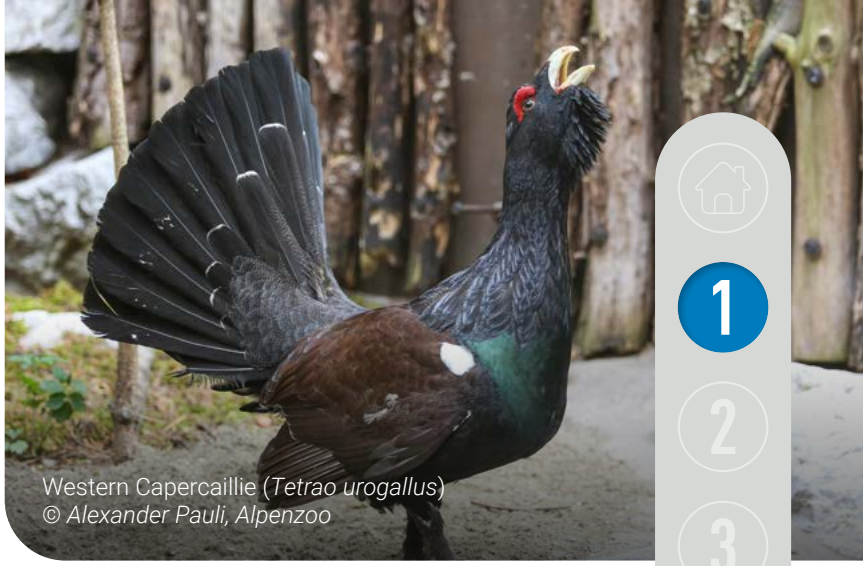
The 'Five Freedoms' concept, originally developed in the 1960s and 70s, provided a beneficial starting point to guide housing and husbandry practices in animal industries. The focus was on reducing suffering and preventing cruelty by suggesting animals in human care should be free from:

i. hunger or thirst
ii. discomfort
iii. pain, injury or disease
iv. fear or distress and
v. free to express normal behaviours.

However, since this time, decades of research have advanced our scientific understanding of the intricacies of animal welfare and the biological processes underpinning its assessment. As such, there are now several models of animal welfare that incorporate the affective state.

Five Domains Model

The Five Domains Model (Mellor et al., 2009) describes four physical domains of welfare, comprising nutrition, health, environment and behaviour and one mental domain, affective state See Figure 1.2.



Western Capercaillie (*Tetrao urogallus*)
© *Alexander Pauli, Alpenzoo*

The Model suggests that if animals' physical domain specific needs are met, they experience positive emotional states and good welfare in the mental domain. The Five Domains Model has been updated several times and one update (Mellor & Beausoleil, 2015) facilitates identification of rewarding experiences that may be associated with positive affective states. It recognises that for animals to have lives worth living, it is necessary to minimise negative experiences, while at the same time providing the animals with opportunities to have positive experiences. These positive experiences can occur when animals are housed in appropriate social groups in stimulus-rich and safe environments that provide opportunities to engage in rewarding behaviours such as exploration, food-acquisition and positive social interactions.

These conditions can generate positive affective experiences such as comfort, pleasure, and interest.

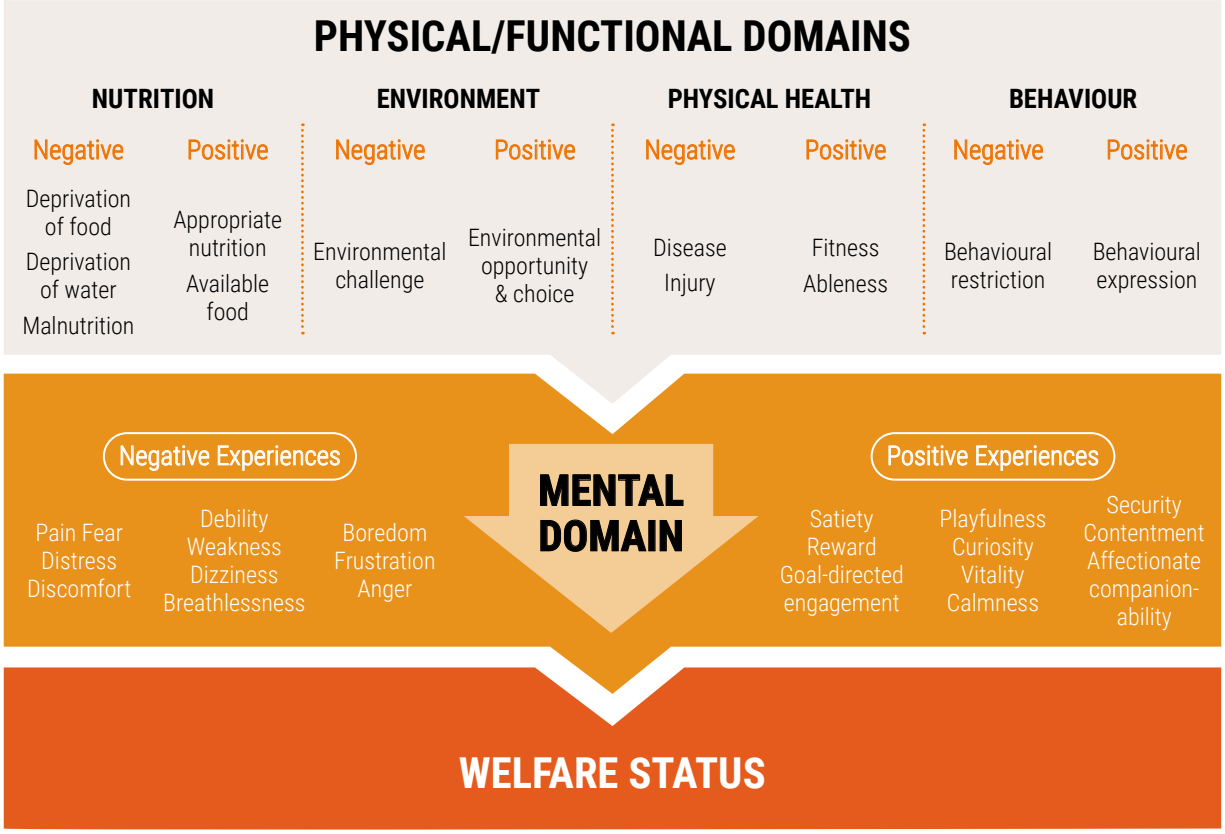


FIGURE 1.2 The Five Domains model for understanding animal welfare, divided into physical/functional and mental components, provides examples of how internal and external conditions give rise to negative (aversive) and positive (pleasant) subjective experiences, the integrated effects of which give rise to an animal's welfare status (modified from Mellor & Beausoleil, 2015).

The Five Domains Model has been widely used and referenced by WAZA in its recent and core animal welfare initiatives, including the WAZA 2023 Animal Welfare Goal and its supporting documents, the Animal-Visitor Interaction Guidelines (2020), and the organisation's Code of Ethics (San Diego, 2023). While WAZA continues to support and embrace this model, it also recognises the validity of other scientific frameworks used within the zoo and aquarium community and provides a brief overview of these alternatives.

Zimmerman's poison frog (*Ranitomeya variabilis*)
© *Zoo Schwerin*

Opportunities to Thrive

Originally developed by Vicino and Miller in 2012, The Opportunities to Thrive were designed to focus on the direct observation of positive indicators of animal welfare (Vicino & Miller, 2015). The Opportunities to Thrive include:

1. **Opportunity for a thoughtfully presented, well-balanced diet:** A suitable, species-specific diet will be provided in a way that ensures full health and vigour, both behaviourally and physically.
2. **Opportunity to self-maintain:** An appropriate environment including shelter and species-specific substrates that encourage opportunities to self-maintain.
3. **Opportunity for optimal health:** Rapid diagnosis and treatment of injury or disease while providing supportive environments that increase the likelihood of healthy individuals.
4. **Opportunity to express species-specific behaviour:** Quality spaces and appropriate social groupings will be provided that encourage species-specific behaviours at natural frequencies and of appropriate diversity while meeting social and developmental needs of each species.
5. **Opportunities for choice and control:** Providing conditions in which animals can exercise control and make choices to avoid suffering and distress, and make behaviour meaningful.

The concept of assessing welfare through the lens of the Opportunities to Thrive should include monitoring of outcome variables specific to each opportunity and provide a model or framework for an animal welfare management programme to optimise welfare for animals under human care.

Three Needs Model of Animal Welfare

Watters and Krebs (2025), developed the Three Needs Model of animal welfare. These authors assert that in addition to having their physical requirements met and being free of fear and discomfort, to achieve a balanced mental state, animals must be able to **Investigate**, **Acquire Rewards**, and **Exert Control** over their daily lives and outcomes. Watters and Krebs describe the Needs as evolutionarily old and their fulfilment as eliciting positive emotions in animals.

These emotions are not the result of reflection or complex thought. They are basic feelings driven by specific motivations and support decision making. Because animals are intrinsically motivated to meet the Needs, not meeting them leads to negative emotional outcomes. Watters and Krebs contend that most behaviours animals express reflect either meeting or not meeting at least one of the needs. Over time, upon repeatedly meeting or not meeting one's needs, a "mood-like" state develops and reflects whether the Needs are mostly met, mostly unmet or in some degree of balance between positive and negative emotional outcomes. It is calculated by repeated observation and expert classification of observed behaviours as reflective of the Needs.

CONCLUSION

It is important to note that there is no one model or framework that needs to guide a programme. However, each institution should review available models as the science continues to evolve, and either choose a model that has already been developed, or develop a unique model that is based on scientific evidence and is justifiable. The three models provided above, are good examples of how the science of animal welfare can be utilised to guide an animal welfare programme at a modern zoo and aquarium. Ultimately, the model or framework chosen should incorporate affective state given the prominence of affective state definition of animal welfare.

Asian elephants (*Elephas maximus*) © *Zoos Victoria*

CHAPTER 2

MONITORING OF ANIMAL WELFARE

A Kea (*Nestor notabilis*) takes part in a routine health check with their care team member © *Auckland Zoo*

OUR COMMITMENT IS TO MONITOR THE WELFARE STATE OF ANIMALS TO SUPPORT ACHIEVEMENT OF HIGH STANDARDS OF CARE.

Marieke Cassia Gartner
Zoo Atlanta

Eli Baskir
Saint Louis Zoo

Miguel Bueno
Dublin Zoo

Lisa Clifforde
Zoological Society of London

Laura Cubides
Cali Zoo

Grace Fuller
Detroit Zoological Society

Claudia Tay
Singapore Oceanarium

Dave Wehdeking
Cali Zoo

RECOMMENDED ACTIONS

To realise our commitment to high animal welfare standards, WAZA calls on its member organisations to:

1. Ensure animal care staff receive ongoing training, stay updated on welfare monitoring practices, and collaborate with professional bodies to share knowledge and best practices, fostering a culture of regular monitoring and reporting.
2. Establish an evidence-based welfare assessment programme with a clear process for addressing findings, reviewing of animal welfare inputs and implementing improvements. Use quality of life assessment tools to support whole-life care, and develop animal behaviour and health plans with provision for 24/7 care where needed.
3. Employ experienced veterinarians, biologists, and welfare experts to ensure high standards of care, preventative health measures, and specialist policies for animals with particular needs.
4. Collaborate with other institutions and share data to establish welfare baselines, using current research and best practices to inform animal care and benchmark welfare indicators.
5. Develop a proactive communication strategy to raise awareness of welfare efforts.

INTRODUCTION

Monitoring animal welfare is critical to effective and humane animal management in zoos and aquariums. A variety of behavioural, physical, and physiological indices may be used to assess welfare and can be measured over time to detect changes in welfare state (Jones et al., 2022). Welfare assessments can take many forms, but all utilise a variety of indices to identify positive and negative experiences and then formulate an action plan to make improvements. They can range from holistic audits conducted every year to provide an overview of animal welfare within the zoo or aquarium, to quality of life assessments which are regularly utilised for a subset of animals, and more specific case studies designed to gather information on specific visitor events or behavioural concerns. Using a combination of welfare assessment types can provide a more complete picture of an animal's welfare state.

The style of an assessment may also vary. Detailed, species specific, individual assessments can provide a robust and objective evaluation of animal welfare but require significant input in terms of staff time and expertise. Given the breadth of species cared for by WAZA members, this can seem overwhelming. Rapid checklist-style assessments allow a wider population to be evaluated on a regular basis, but can miss more subtle animal welfare indicators, particularly in species where less is known about their behaviour. Zoos and aquariums should endeavour to develop a welfare monitoring programme that balances the need for evidence-based scientific practice against efficiency and oversight of the entire animal population in their care (Jones et al., 2022).

CREATING A WELFARE ASSESSMENT PROGRAMME

As welfare is a multidimensional construct – including physical, behavioural, and emotional elements – welfare assessments should holistically measure a variety of inputs and outputs.

The WAZA 2023 Animal Welfare Goal establishes that all WAZA member associations must have an animal welfare evaluation process in place and such a process must include specific elements approved by WAZA. WAZA member zoos and aquariums need to successfully go through these processes. As part of these national or regional animal welfare evaluation processes, the Associations require their member facilities to show evidence that animal welfare is monitored systematically and ongoing in between the Association's on-site visits and/or re-evaluation. Additionally, WAZA requires for these assessments happening in member zoos and aquariums to include a combination of input- and output – based measures to assess animal welfare. The criteria discussed here should serve as a guide for developing a welfare assessment programme. Programme development includes decisions about when and how welfare will be measured and how the process will be implemented. Staff knowledge, time investment and financial resources to support an animal welfare monitoring programme must be considered in the development of a comprehensive welfare assessment programme that considers all stages and likely events in animals' lives.

More information about WAZA's 2023 Animal Welfare Goal here.

> Monitoring programmes may take various forms but should incorporate a range of measures that prioritise the animal's lived experience, alongside the inputs provided to support welfare.

The number of species housed by zoos and aquariums presents significant challenges to welfare monitoring. Developing strong staff knowledge and expertise to understand behavioural traits and changes in individual animals, and how these affect other aspects of care, must remain a priority. This can be achieved through training, Continuing Professional Development (CPD), and by inviting external partners (e.g. faculty at research institutions) to assist. Collaboration with research institutes to develop species-specific knowledge is also vital – especially for understudied taxa See Case Study 2.1 (Benn et al., 2019). Progress is being made through regional zoo and aquarium associations' accreditation programmes.

Case Study 2.1

Assessing the welfare of live invertebrate prey | Zoological Society of London (UK)

The Zoological Society of London (ZSL), which runs London and Whipsnade Zoos, developed the Live Food Project and Ethical Guidance for Use of Invertebrate Prey as part of its commitment to provide the best care for all animals. By breeding invertebrate prey in-house, ZSL can assess and manage their environment as with any other species – optimising temperature, humidity, and diet, and enriching habitats to support natural behaviours. Enhancing positive experiences while minimising negative ones improves health, weight, body size, and breeding rates in colonies.

Although invertebrate sentience remains under study, applying the principles of replacement, reduction, and refinement (3Rs) allows a precautionary approach to care and welfare assessment (Fischer, 2025). During feeding events, predator-prey interactions are monitored for prey injury without consumption, predator difficulties, and consumption rates. These observations may prompt the removal or replacement of certain prey species, or changes in quantity and presentation methods.

A giant katydid (*Arachnacris corporalis*) is weighed at London Zoo's annual weigh in © *ZSL London Zoo*

National and regional associations are developing accreditation standards, professional development opportunities, conferences, and other educational resources to strengthen staff capacity to monitor and manage animal welfare. Associations that are members of WAZA are also meeting WAZA's 2023 Animal Welfare Goal, which ensures a science-based animal welfare evaluation process is in place, including cyclical audits for member institutions.

An eagle ray (*Aetomylaeus sp.*) gets examined by the care team © *Seattle Aquarium*

Many animals in zoos and aquariums live their entire lives in managed environments. Welfare-focused monitoring and management procedures must be tailored to address varying levels of robustness or vulnerability at different life stages. These procedures should be proactive, anticipating potential changes and adjusting care in advance where possible. Enrichment and training See Chapter 3 and 4 should be based on the needs of the individual animal and adapted as necessary using objective welfare assessment tools. While the quality of care should be consistent throughout life, its characteristics may change – e.g. increased comfort, dietary adjustments, or screening for age-related disease or infirmity. Decision trees that consider these and other factors – such as species longevity and frequency of veterinary intervention – may be needed. The welfare of aged animals should be regularly assessed to determine whether euthanasia may be preferable to continued treatment See Case Study 2.2.

Case Study 2.2

Quality of Life Assessments | BIAZA (UK)

Quality of Life assessment should be used to improve quality of life through changes to habitats, care routines, and medical treatments, not just end of life decision making. The British and Irish Association of Zoos and Aquariums (BIAZA) has published a Quality of Life Assessment Tool which emphasises the need for evidence-based decision making in quality of life cases. The tool is designed to be collaboratively completed by the animal care team including veterinarians. This tool emphasises gathering objective data on the animal's current welfare state with regards to its medical history, nutrition, physical condition and behaviour and using this information to identify specific mitigation strategies for concerns.

At a BIAZA member institution, the QoL tool was used to track the progression of osteoarthritis in a male Bengal tiger, allowing his QoL indicators to be tracked as medication type and dosage were adjusted to achieve a reasonable QoL. This monitoring allowed him to be kept comfortable in his final years.

Approaches to care – and therefore welfare assessment – may vary depending on the setting. Quarantine areas, propagation facilities, and rescue centres serve different purposes and represent distinct models of care. Their specific goals must be considered alongside animal welfare when designing care programmes. As there is no single formula for good welfare, care and husbandry may differ between settings. However, positive animal welfare must remain a defining feature of all animal care settings.

Designing a welfare assessment

Welfare evaluation is an ongoing and variable process. It may involve daily observations by animal care staff, event-based assessments in response to risks, or proactive audits examining welfare-related factors. Designing assessments requires knowledge of species' natural history, history in human care, individual characteristics, and institutional practices.

Decisions must be made about how many animals are assessed, and whether the focus is on individuals or groups where individuals may not be identifiable. Group-level approaches include sampling, rating percentages meeting specific criteria, or identifying outliers for follow-up.

Comprehensive welfare audits often use survey-based tools where knowledgeable staff rate input and output criteria. Though qualitative, these ratings should be based on evidence such as behavioural observations, animal condition, and medical findings. Detailed records of physical, functional, and behavioural observations support ongoing welfare monitoring, help track changes, and assess the impact of management or veterinary interventions. This information enables review of current practices and guides new approaches to enhance welfare See Case Study 2.3. Where such data are lacking, research should be encouraged to build a knowledge base (Benn et al., 2019).

Case Study 2.3

Technology for assessing the welfare of animals with avoidant or nocturnal behaviour | Cali Zoo (Colombia)

A behavioural study of three owl species (*Asio clamator, Asio stigyus* and *Pulsatrix perspicillata*) was carried out at the Cali Zoo. Nocturnal remote observation was done with camera traps and behavioural analysis software BORIS. This study made it possible to observe and quantify the behaviour of nocturnal species, overcoming the limitations of conventional observation. The results provide a valuable contribution to the understanding of the nocturnal life of these animals, identifying how the animals interact with their environment in their usual schedule of activities and behavioural repertoire not normally observed: grooming, feeding dominance, feeding patterns, and dietary preferences. The use of these technological tools helped to develop management strategies in their habitats, as well as identify the challenges faced by the animals, thereby providing key information to improve their welfare.

Different models of welfare assessment See Chapter 1 use different criteria, but it is important to recognise individual variation. Incorporating personality into welfare tools can improve interpretation and predict individual responses to major life events, aiding management (Powell & Gartner, 2010; Watters et al., 2017). Personality also influences morbidity, mortality, and well-being, making it a valuable welfare indicator.

Some models assess both inputs (e.g. enrichment, nutrition programmes) and outputs (e.g. behaviour, body condition). Outputs – animal-based measures are often more insightful. Institutions may choose to evaluate inputs and outputs separately or at different frequencies, depending on need. Accrediting bodies may offer example tools or question libraries to support institutional assessment design. Scientific literature, care manuals, and expert input also help identify meaningful welfare indicators. Examples of published tools are listed at the end of this chapter (Justice et al., 2017; Kim et al., 2024; Maher et al., 2021; O'Brien & Cronin, 2023; Racciatti et al., 2022; Sherwen et al., 2018).

Specific monitoring tools should also be developed for cases needing special attention, such as when an animal's social needs are unmet or in situations of isolation, rejection, or death of a social partner.

Assessment processes and questions are not universal. They should be developed with input from all relevant stakeholders – animal care staff, veterinarians, and welfare scientists. Staff engagement is essential; the process must be meaningful and practical to ensure buy-in and successful implementation.

Implementing an animal welfare assessment

Commitment to an animal welfare assessment programme requires developing staff in positions that will be responsible for animal welfare discussions and process (Kagan et al., 2015). It is recommended to designate a knowledgeable point person to introduce welfare assessments. This should be someone who understands the assessment process and is able to provide guidance on its completion, utilisation, and the development of action plans. The point person should train all potential assessors, with managers facilitating training for new staff. Ideally, during initial assessments, the point person should be present to facilitate the process. Additionally, retraining by the point person every few years is also recommended.

The frequency of animal welfare assessments will vary with staff time, number of species housed and other considerations, but ideally should occur at least once per year. Assessments may be scheduled around events, breeding seasons, visitor flow, and other relevant factors. It is recommended that multiple, knowledgeable individuals replicate and complete the assessments to ensure objectivity.

Managers should review welfare assessments promptly, to allow for the creation of timely action items if needed. Action plans, along with a timeline for completion, should be implemented for animals whose assessment reveals concerns. To ensure compliance, either the original point person, a manager, or a departmental point person should assume the role of project manager for the action plan.

Rockhopper penguin (*Eudyptes chrysocome*) gets a veterinary check © *RZSS Edinburgh Zoo*

If faced with multiple items of concern, it is recommended to prioritise immediate harm cases for action. Then, prioritise welfare concerns on a case-by-case basis, taking into consideration how other departments can help, likelihood of positive impact, approaches to address other aspects of the animal's welfare to increase their overall positive experiences, and resources that must be shared with other animals (e.g. staff time, funds, materials). If the animal's welfare is poor and cannot be made positive, facilities should consider transfer of the animal to another institution which can meet the welfare needs of the animal or euthanasia.

Sound monitoring
© Annika Sorjonen, Korkeasaari Zoo,

TECHNOLOGIES FOR ASSESSING ANIMAL WELFARE

Modern welfare researchers have a wealth of technological options for data collection to support animal welfare assessment. There are many considerations in selecting technologies for monitoring. A few common approaches are discussed here.

Videography

Video is useful when live observation isn't practical due to location, time, or duration. Key considerations include power, memory, durability, weather resistance, lighting, camera controls, zoom, recording, format, and data management. Camera traps, best for faster-moving animals, should be placed where animals frequent or to check resource use. Drones allow aerial observation but must be assessed for animal impact and legal compliance.

Biotelemetry and biologging devices

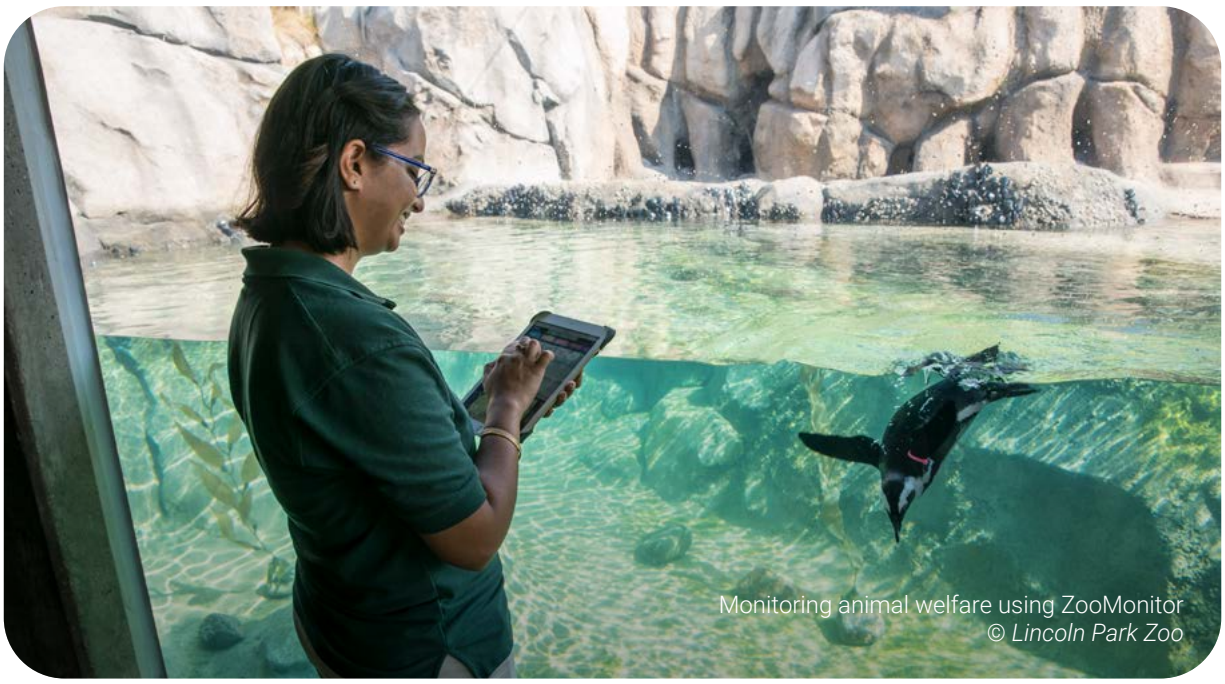
Worn and implanted devices monitor behaviour, physiology, body posture or movement without cameras, and either store or transmit these data. They may impact behaviour and require animal handling for deployment, monitoring or replacement. Welfare impacts must be weighed against the value of data collected.

Environmental loggers

Handheld loggers can measure light (lumens), temperature (°C), humidity (%), and sound (dB). Thermal imagers can identify health concerns. Field-ready models offer wireless transmission and increased storage and battery life.

Software and AI

Software can track behaviour, movement, and individual identification. AI tools may require species-specific training data and technical expertise.



Monitoring animal welfare using ZooMonitor
© Lincoln Park Zoo

COLLABORATION IMPROVES MONITORING

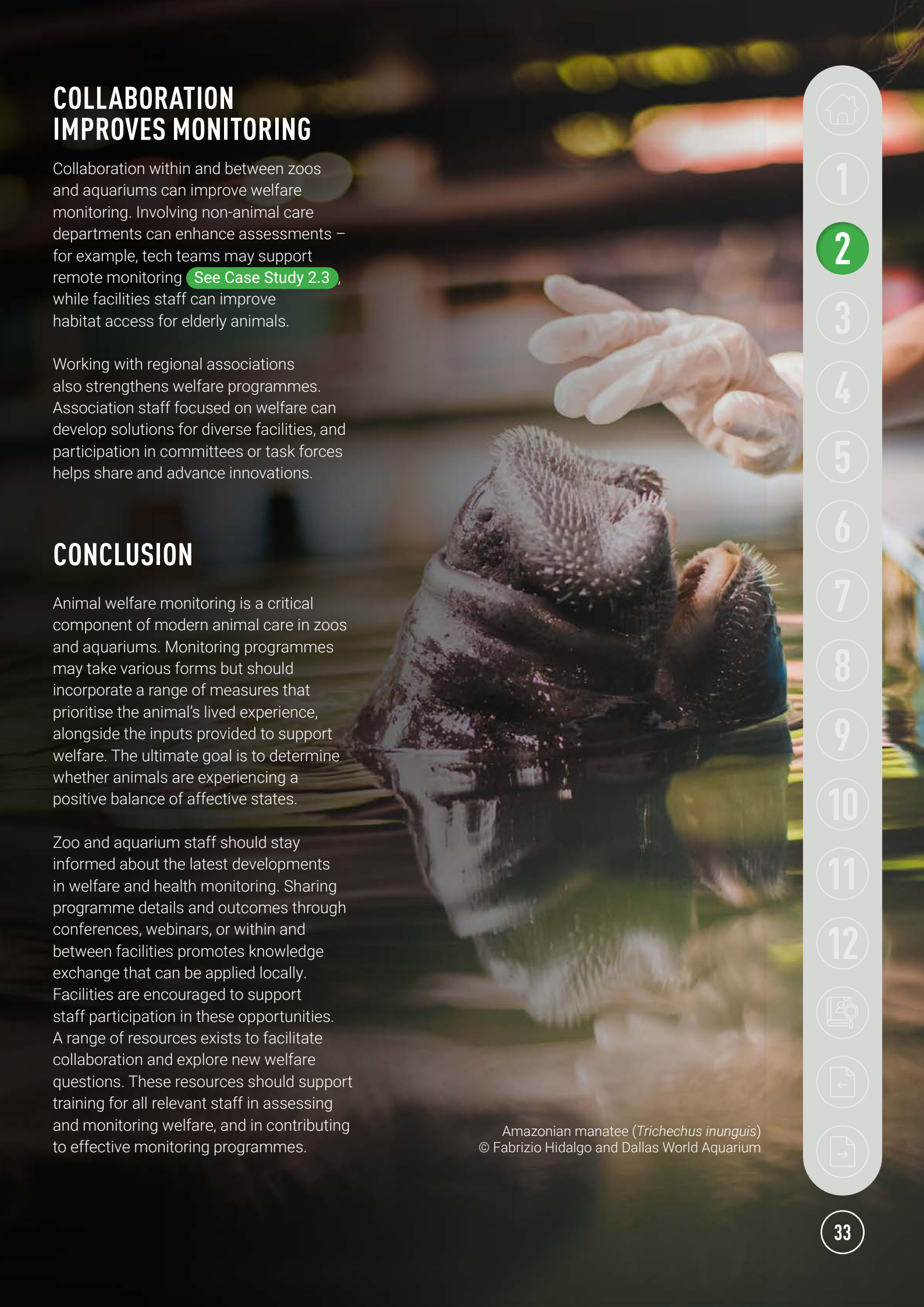
Collaboration within and between zoos and aquariums can improve welfare monitoring. Involving non-animal care departments can enhance assessments – for example, tech teams may support remote monitoring See Case Study 2.3, while facilities staff can improve habitat access for elderly animals.

Working with regional associations also strengthens welfare programmes. Association staff focused on welfare can develop solutions for diverse facilities, and participation in committees or task forces helps share and advance innovations.

CONCLUSION

Animal welfare monitoring is a critical component of modern animal care in zoos and aquariums. Monitoring programmes may take various forms but should incorporate a range of measures that prioritise the animal's lived experience, alongside the inputs provided to support welfare. The ultimate goal is to determine whether animals are experiencing a positive balance of affective states.

Zoo and aquarium staff should stay informed about the latest developments in welfare and health monitoring. Sharing programme details and outcomes through conferences, webinars, or within and between facilities promotes knowledge exchange that can be applied locally. Facilities are encouraged to support staff participation in these opportunities. A range of resources exists to facilitate collaboration and explore new welfare questions. These resources should support training for all relevant staff in assessing and monitoring welfare, and in contributing to effective monitoring programmes.



Amazonian manatee (*Trichechus inunguis*)
© Fabrizio Hidalgo and Dallas World Aquarium

Red Panda (*Ailurus fulgens*)
© *Colin Dabbs, St Louis Zoo*

CHAPTER 3

Kelly Trotto
Zoo Tampa at Lowry Park

Jim Mackie
Zoological Society of London

Beth Posta
Toledo Zoo and Aquarium

Catalina Rodríguez Álvarez
Fundación Parque
Jaime Duque

ENVIRONMENTAL ENRICHMENT

OUR COMMITMENT IS TO PROVIDE ANIMALS WITH THE MEANS TO ACHIEVE BEHAVIOURAL AND PSYCHOLOGICAL HEALTH THROUGH OPPORTUNITIES FOR CHALLENGE AND CHOICE IN PURSUIT OF POSITIVE WELFARE STATES.

RECOMMENDED ACTIONS

To realise our commitment to high animal welfare standards, WAZA calls on its member organisations to:

1. Build staff skills, internal culture, and commitment to embed enrichment into daily animal care, providing training and regularly reviewing strategies and activities to ensure continual improvement.
2. Design species-specific enrichment that promotes natural behaviours, facilitates highly-motivated behaviours, varies to provide challenge, choice, and comfort, and supports psychological health throughout life and across the day.
3. Use a strategic, goal-driven approach to enrichment planning, including health and safety evaluations before and after implementation, and systems to evaluate success and inform future planning.
4. Incorporate environmental enrichment into habitat design and upgrades to meet behavioural and psychological needs.
5. Share enrichment successes, failures, and stories with other zoos and aquariums to support collective learning, and with visitors to broaden public understanding of animal biology and welfare.

> Enrichment should address the animal's full life cycle – 24 hours a day, seven days a week, from birth to death.

INTRODUCTION

Environmental enrichment, also known as behavioural enrichment, promotes both psychological and physical health by encouraging species-typical behaviours that result in positive experiences. These behaviours may include feeding, play, space use, social interactions, activities like swimming, dust-bathing, hiding, flying, climbing and running. In this way, environmental enrichment provides animals in zoos and aquariums with species-appropriate challenges, opportunities and stimulation.

Animals raised in enriched environments exhibit higher cognitive abilities, improved problem-solving skills, and even differences in brain anatomy. For example, rats reared in enriched settings outperform laboratory-reared rats in cognitive tests (Harris et al., 2009; Lambert et al., 2016; Simpson & Kelly, 2011), while pigs raised in stimulating environments demonstrate greater optimism and a heightened willingness to explore novel stimuli (Douglas et al., 2012). Research in zoos and aquariums further supports these findings, showing that innovative enrichment strategies lead to improved welfare. Animals in enriched environments display a broader range of natural behaviours, fewer abnormal behaviours, and better social interactions, while also developing greater adaptability and resilience in response to change. Enriched environments also improve reproductive success (Meagher et al., 2014).

The practice of enrichment has now been integrated as a basic principle in the daily care of zoo and aquarium animals of all taxonomic groups. However, in recent years, the term enrichment has largely lost its meaning, defined by most animal caregivers as any object inserted into an animal's habitat that produces some form of activity, with little or no relevance to the natural history of the species (Vicino et al., 2022).

Furthermore, we now accept that animals have a biological need to engage in highly motivated natural behaviours, linked to neurobiological reward systems. Enrichment programmes should be designed to meet these behavioural needs rather than simply relying on the provision of variety and novelty (Bacon, 2018).

With this in mind, a re-evaluation of enrichment as a concept is underway in the zoo and aquarium community and is now evolving from being primarily based on objects and other stimuli (e.g. scents) added to the animals' habitat to a more holistic and dynamic behavioural husbandry-based model. The first step in any environmental enrichment programme should be in the research of species-typical wild behaviours. This information can then be used to design and build enriched environments which promote behavioural diversity and provide a habitat where animals have opportunities to make choices to control a variety of outcomes (Hester & Friedman, 2024). This habitat provision can be augmented with changes and modifications to daily care and the environment, the implementation of a varied feeding and foraging presentation plan, and addition of inputs that provide physical and cognitive challenges.

Wellington Zoo animal care team member prepares enrichment items © *Te Nukuao Wellington Zoo*

FRAMEWORKS FOR ENRICHMENT PROGRAMMES

Successful enrichment programme frameworks integrate several key components: individualised behaviour-based goal setting, strategic planning, consistent implementation, thorough documentation, and continuous evaluation. Structured frameworks like the widely used S.P.I.D.E.R. Model (Barber, 2014) includes these components and provides a structured approach to managing enrichment programmes. While institution-wide enrichment programmes benefit from being guided by a clear framework and philosophy, goals and plans should remain species-specific and tailored to the individual needs of every animal.

Effective institution-wide enrichment programmes require clear oversight. In many zoos and aquariums, this falls to animal care leadership, for example curators or supervisors, but balancing it with other duties can affect consistency. Some facilities form enrichment committees, with representatives from each area to promote ownership and staff buy-in. While helpful, this still needs managerial oversight for consistency.

Increasingly, zoos are creating dedicated roles to manage enrichment or broader behavioural programmes. This ensures institution-wide coordination by staff with behavioural expertise. Regardless of structure, those overseeing enrichment must be knowledgeable, understand expectations, and have clearly defined roles to support a cohesive and effective programme.

Goal Setting and Implementation

Instead of simply providing objects to stimulate animals, zoos and aquariums now aim to encourage highly motivated behaviours. These goals are tailored to be species-specific and can be broken down into their component behaviours. For example, foraging behaviour might be expanded to include mechanisms for looking for and identifying the food source, approaching the food source, catching the food, consuming the food, and so on. Goal setting should involve an around-the clock (24 hour), seven days per week approach to enrichment, ensuring that animals remain

engaged with activities that support their behavioural health and well-being throughout their circadian rhythm and their daily lives.

Once the goals are defined, planning and implementing of enrichment activities that will support these objectives should occur. This should include a development and approval process that assesses the safety, species appropriateness, and potential efficacy of the activities to achieve the desired behavioural outcome. Once approved, items and experiences can be incorporated into the planning process. Many facilities use calendars or other tracking systems to assist with implementation in daily husbandry.

Documentation and Evaluating Effectiveness

Accurate documentation is essential for evaluating enrichment activities. Facilities often use record-keeping software or custom databases to track enrichment, ensuring it is effective yet manageable for staff. Evaluating both short-term activities and long-term strategies helps assess effectiveness in achieving specific behavioural goals and the overarching goal of optimising welfare. Observation of animal behaviour helps refine enrichment, with time budgets and indicators like behavioural diversity and social interactions offering insights. A species-appropriate time budget should reflect a successful enrichment programme, showing that behavioural needs are being met.

Tools like ZooMonitor can track time budgets and space use, but collecting data can be labour-intensive. Some facilities address this by using volunteer programmes, internships, or academic partnerships, and may supplement long-term tracking with subjective scoring assessments. While scoring can help, it should be used cautiously due to keeper bias; validated metrics like engagement duration provide more reliable evaluation. This process ensures enrichment continues to support animal well-being and drives improvements in care. An evidence-based approach enables facilities to build dynamic, responsive programmes that truly enrich animals' lives.

PROVIDING 'CHALLENGES' AND 'CHOICES'

A key aspect of enrichment programmes is providing animals with the ability to make choices. Giving animals the opportunity to make decisions allows them to influence the outcomes of their actions, reinforcing their sense of control over their environment and overall well-being. The need for control is biologically motivated, supporting both individual welfare and the species' evolutionary survival by ensuring reproductive success.

In the wild, animals constantly make decisions related to food procurement, shelter, social interactions, and self-protection. Animals make choices to obtain outcomes they are motivated to achieve, for example, whether to engage with a competitor over access to a potential mate. In zoos or aquariums, while some of these decisions are made by caregivers, offering choices in these environments can stimulate problem-solving behaviours and improve the animals' well-being. Providing options which might include what and when to eat, when to go in or out, temperature and humidity to live in, which animals to live with and with whom to breed, may influence welfare indicators (Ross, 2006).

Chimpanzee (*Pan troglodytes*) © *Wrocław Zoo*

Andean bear (*Tremarctos ornatus*) enjoys an enrichment item © *Fundación Jaime Duque/ Bioparque Wakatá*

Enrichment programming should offer diverse opportunities tailored to the natural history, individual history, social dynamics, and personality of each animal. Activities should target specific behaviours – such as offering arboreal animals food on branches alongside puzzle feeders – and include opportunities to choose from multiple options among numerous behavioural categories daily. This might include planning a day's worth of enrichment that incorporates multiple options for sensory experience, obtaining different types of food, and exploring elements of the habitat that lead to additional experiences such as areas to scent mark or different thermal gradients. These options might include platforms from which to view different areas of the environment or offering multiple layers of perching that provide choice of canopy level for animals who strongly rely upon vision. For animals with a strong sense of smell, natural scents placed throughout the day can encourage exploration and natural behaviours.

One must also consider that when an animal makes a choice it may not always be the option they want. For example, an animal may retreat indoors to avoid visitors, only to face aggression from a dominant group member – choosing the lesser of two negative options rather than what it truly prefers. An animal might choose an area of their environment that provides thermal comfort, but offers little in regards to activity options or exposes the animal to some other challenge. Animals may also make poor choices and face the consequences, but those accustomed to dynamic environments are often more resilient. Thus, it is important to offer a variety of opportunities for animals to choose from to truly have a positive impact on an animal's physical health as well as their affective state.

ENRICHMENT FOR FEEDING AND OTHER HIGHLY MOTIVATED BEHAVIOURS

Food search and acquisition are among the most highly motivated behaviours for animals to display. In addition to the rewarding experience of obtaining food a substantial amount of literature on 'contra-freeloading' develops the case that many animals prefer to work to acquire food rewards rather than to simply have easy access to such rewards provided by animal keepers (Sasson-Yenor & Powell, 2019). The strong motivation to engage in behaviour such as foraging, hunting, stalking, and fishing, makes food delivery a common tool in an effective enrichment strategy.

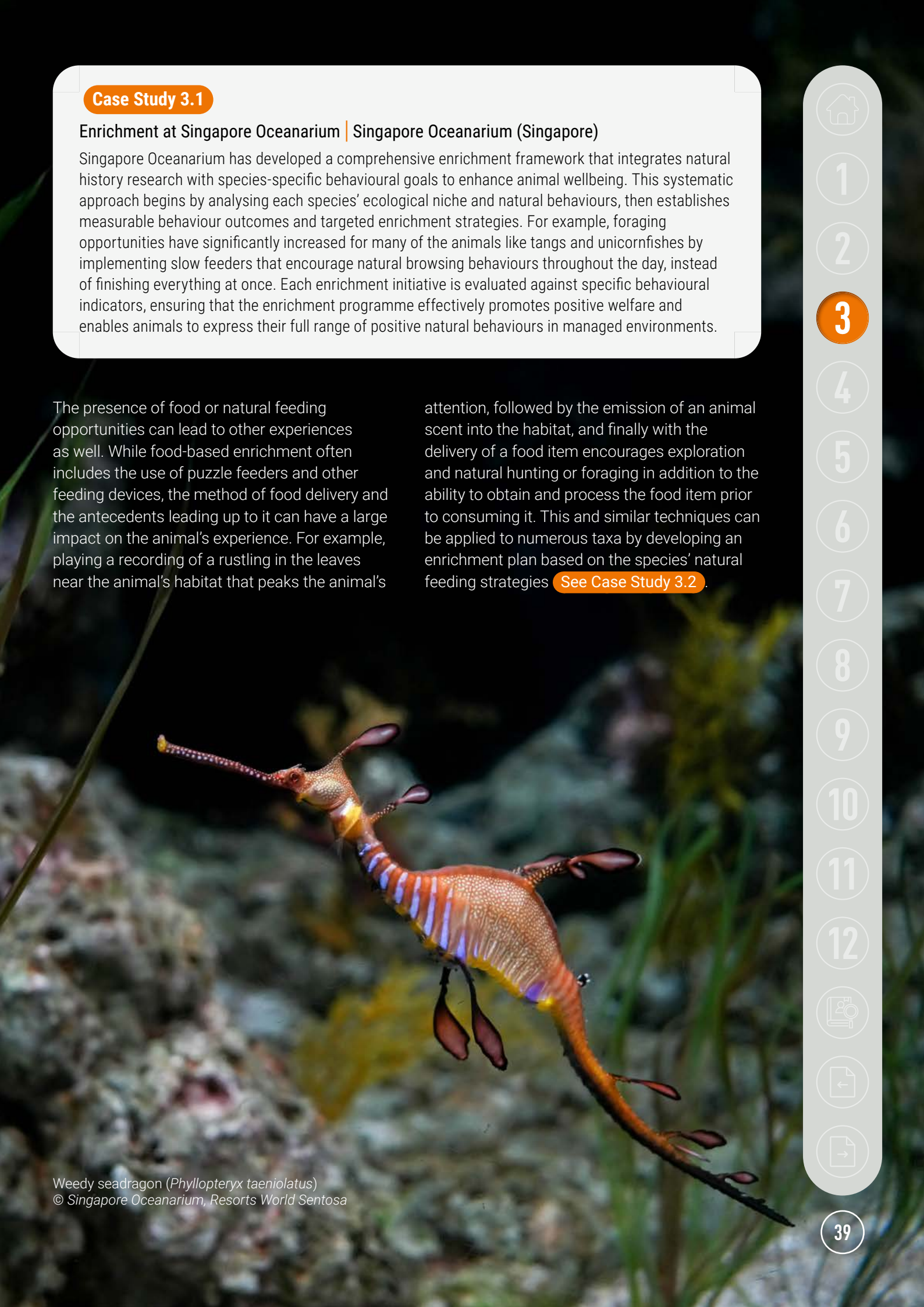
When targeting feeding behaviour, it is recommended that natural feeding patterns are reviewed and specific components of the behaviour are identified. Offering opportunities for animals to mimic natural feeding behaviour has been linked to other behavioural indicators of positive welfare and can provide the animal with more appropriate behavioural expression (Fernandez et al., 2008). Varying how and when enrichment is delivered is also a widely used technique to mimic natural variance in feeding behaviour. The time of feedings can be varied, as can the number and location of feeds or activities offered Case Study 3.1.

Case Study 3.1

Enrichment at Singapore Oceanarium | Singapore Oceanarium (Singapore)

Singapore Oceanarium has developed a comprehensive enrichment framework that integrates natural history research with species-specific behavioural goals to enhance animal wellbeing. This systematic approach begins by analysing each species' ecological niche and natural behaviours, then establishes measurable behaviour outcomes and targeted enrichment strategies. For example, foraging opportunities have significantly increased for many of the animals like tangs and unicornfishes by implementing slow feeders that encourage natural browsing behaviours throughout the day, instead of finishing everything at once. Each enrichment initiative is evaluated against specific behavioural indicators, ensuring that the enrichment programme effectively promotes positive welfare and enables animals to express their full range of positive natural behaviours in managed environments.

The presence of food or natural feeding opportunities can lead to other experiences as well. While food-based enrichment often includes the use of puzzle feeders and other feeding devices, the method of food delivery and the antecedents leading up to it can have a large impact on the animal's experience. For example, playing a recording of a rustling in the leaves near the animal's habitat that peaks the animal's attention, followed by the emission of an animal scent into the habitat, and finally with the delivery of a food item encourages exploration and natural hunting or foraging in addition to the ability to obtain and process the food item prior to consuming it. This and similar techniques can be applied to numerous taxa by developing an enrichment plan based on the species' natural feeding strategies See Case Study 3.2.



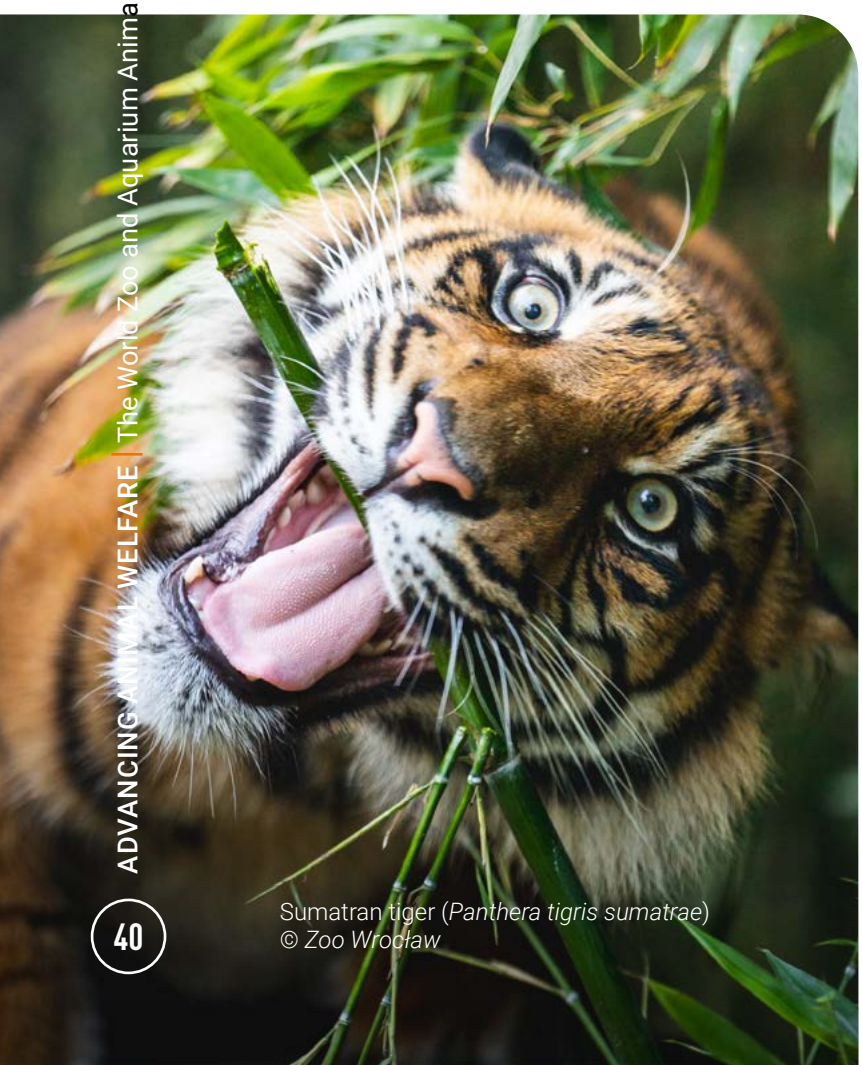
Weedy seadragon (*Phyllopteryx taeniolatus*)
© *Singapore Oceanarium, Resorts World Sentosa*

Case Study 3.2

Enriched Experiences at SDZWA | San Diego Zoo Wildlife Alliance (US)

The Enriched Experiences programme, developed by San Diego Zoo Wildlife Alliance (SDZWA), shifts enrichment from object-based inputs to behavioural outputs for lasting impacts. Instead of asking, "What object do I give my animal today?" caregivers focus on promoting specific natural behaviours. This approach integrates environmental cues, mimicking wild occurrences. One example was a Sumatran tiger (*Panthera tigris sumatrae*) floating carcass feed being preceded over several days by environmental changes such as the disturbance of live planting, followed by the addition of tapir tracks and urine near a water source, stimulating a suite of behaviours prior to the feeding event. Central to this programme is the behaviour workflow, identifying species-typical behaviours, components and contexts, methods to evaluate enrichment impacts, and inputs to evoke these behaviours.

Feeding live prey to predatory animals occurs in some zoos and aquariums. Feeding live prey provides opportunities for promoting species-typical feeding, foraging and hunting behaviours, prolonging feeding and increasing behavioural variety before and after feeding events. Various international zoological governing and advisory bodies have different regulations with some allowing feeding of live vertebrates as food and others not. In all cases, the welfare of the prey animal should be considered See Chapter 2.



Sumatran tiger (*Panthera tigris sumatrae*)
© *Zoo Wrocław*

While feeding is a common focus of enrichment, motivated behavioural repertoires are diverse. Providing varied enrichment is essential to support the expression of all behavioural needs. Social behaviour is highly motivated for many species and can be broken down into chemical signalling, visual and auditory displays, as well as physical contact. These behaviours can be elicited with targeted scent enrichment, visual or auditory cues when appropriate, offering opportunities for animals to cooperate, or by changing social management strategies. Exploration is also strongly motivated in many species and includes various forms of locomotion and navigation. This can be encouraged by creating dynamic habitats with elements like perching and substrates that change in order to encourage exploration and increase space use.

When designing habitats, it is important to consider how the environment will enrich the lives of animals living within See Chapter 5. Habitats can be designed with enrichment delivery tools in mind, such as feeding poles for big cats, or the ability to create access to dynamic spaces. It is essential that animals be engaged by components of the environment that they can come to understand and over which they can exert some control.

VISITORS AND ENRICHMENT

As expectations of zoos and aquariums have risen in society, zoos and aquariums must commit to further promoting positive perceptions. In that sense, they should connect visitors – including those engaged through social media and websites- to the principles of animal care and show how they achieve high animal welfare standards for the animals in their care.

Although visitors' expectations may not have a direct impact on animal welfare, they have the potential to increase zoo and aquarium commitment to environmental enrichment. As visitors' expectations about animal welfare have risen sharply, many now anticipate or demand that zoos and aquariums will actively work to keep animals healthy and engaged. Thus, it may be beneficial to tell visitors about enrichment activities and how they make important contributions to positive animal welfare.

Enrichment provides opportunities for animals to develop natural behaviours, which is interesting to visitors and allows them to learn about the species and the ways they interact with their surroundings. Additionally, behind an enrichment activity is a programme with particular goals, and it is important to show visitors the science that supports each enrichment; this can be accomplished through sharing animal stories that help connect visitors with individual animals and their needs. These efforts enrich the visitor experience and create opportunities to engage with animals, which in turn increase the opportunity to learn about the species and to get involved in biodiversity conservation.

CONCLUSION

Environmental enrichment is a proven approach to supporting animals' physical and psychological health with the goal of creating a dynamic, engaging environment that offers meaningful opportunities for animals. A well-designed programme is guided by species behaviour and should go beyond discrete events, integrating enrichment into habitat design and daily care to promote behavioural diversity. More focus is needed for underrepresented taxonomic groups, and overall programmes and individual techniques should be regularly evaluated.

Enrichment should address the animal's full life cycle – 24 hours a day, seven days a week, from birth to death. Sharing this work with visitors and media helps demonstrate how evidence-based, welfare-focused enrichment benefits animals and encourages other organisations to develop and assess their own programmes.

Grey Seal (*Halichoerus grypus*) © *Zoo Wrocław*

Training of a Golden lion tamarin (*Leontopithecus rosalia*)
© Annette Pedersen, Copenhagen Zoo

CHAPTER 4

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TRAINING FOR ENHANCED ANIMAL WELFARE

OUR COMMITMENT IS TO IMPLEMENT EVIDENCE-BASED, REINFORCEMENT-FOCUSED TRAINING PROGRAMMES TO ENHANCE THE PHYSICAL, BEHAVIOURAL, AND PSYCHOLOGICAL WELL-BEING OF THE ANIMALS WITHIN OUR ORGANISATIONS.

RECOMMENDED ACTIONS

To realise our commitment to high animal welfare standards, WAZA calls on its member organisations to:

1. Develop an institution-wide animal training framework that prioritises evidence-based positive welfare outcomes, incorporates contemporary behavioural science, and establishes clear goals and evaluation methods.
2. Implement training programmes that provide animals with choice and multiple ways to achieve reinforcement, acknowledging their emotional states as valuable feedback.
3. Utilise training to facilitate daily care, health monitoring, and veterinary procedures through voluntary participation, reducing the need for physical or chemical restraint.
4. Establish regular monitoring and evaluation systems for training programmes to track progress, ensure consistency, and allow for continuous improvement.
5. Invest in staff development to ensure caregivers possess the necessary skills to effectively implement reinforcement-based training techniques and respond appropriately to animal behaviour.

> With animal well-being at the heart of any animal training programme, training can facilitate and support daily care, veterinary needs, physical fitness, and overall behavioural, physical, and emotional well-being.

INTRODUCTION

The promotion of positive animal welfare is multi-faceted, combining elements of physical, emotional and behavioural health, all of which can be supported by a formalised animal training programme. The European Association of Zoos and Aquariums defines animal training as "intentionally changing behaviour with an awareness and understanding of the principles of behaviour analysis and applying these principles with individuals or groups of animals in managed care" (Heidenreich et al., 2023).

Training is teaching – teaching animals to emit a specific behaviour or perhaps to replace an undesired behaviour, using a variety of techniques. Most formalised training programmes are based on principles of behaviour analysis, including operant conditioning, where animals learn through reinforcement, repetition, and observation, amongst other strategies.

Building an effective animal training programme with sentient animals relies on a strong foundation of trust between the animal and its trainer. This is often accomplished through the repetition of brief, positive interactions, which build in scope until a strong, positive human-animal relationship is established. The trusting relationship is strengthened through clear and honest communication, where the trainer is clear in what they are asking of the animal and is respectful and understanding of the animal's response.

The importance of training for enhanced animal welfare

Historically, animal training often relied on aversive means and was primarily carried out for human entertainment (Mellor et al., 2015). Today's zoos and aquariums rely on reinforcement-based methodologies to effectively impact animal behaviour with the primary purpose of enhancing animal welfare.

Behavioural management involves the synergistic application of environmental enrichment, reinforcement-based training, assessments, and problem solving (Desmond & Laule, 1994). Learning itself is an enriching experience; throughout the learning process, animals develop problem-solving skills, mental flexibility, and acuity. It is important to note that simply performing learned behaviours does not provide the same enrichment benefits as the process of learning something new (Melfi, 2013).

This requires staff involvement from multiple levels and departments across an institution, with managers recognising and supporting the importance of animal training in supporting daily care.

Integrating Training into Daily Care and Management

A robust training programme enhances care by promoting voluntary animal participation in daily routines. Training can begin at any life stage or upon arrival at an institution. Introducing training during the quarantine period helps build a trusted relationship and sets the foundation for integrating training into daily management.

Behaviours that facilitate daily animal care and management, such as voluntary shifting between habitat spaces, can enable staff to offer additional enrichment opportunities and increase safety for both staff and animals, especially in emergency situations requiring immediate animal movement (Veeder et al., 2009). Crate training, including lock-ins for transport, can also reduce stress during intra- or inter-institutional transfers.

The same training concepts can also be used to enhance sociality and promote harmony within a group. Socialisation techniques help achieve group housing goals by teaching socially inexperienced individuals appropriate behaviours, such as grooming. Training strategies like cooperative feeding may reduce resource-related aggression and support positive social behaviour (Bloomsmith et al., 1994; Cox, 1987; Desmond & Laule, 1994).

Training for Veterinary Care

Incorporating veterinary goals into training allows animals to voluntarily participate in their own health care, reducing fear, stress, and anaesthesia risks during routine and non-routine procedures. Training supports medical exams, improves body part presentation for evaluation and treatment, and simplifies medication administration. It can also enable collection of key health metrics – such as weight, body measurements, growth rate, and temperature – while reducing the need for restraint or sedation.

Juvenile male Black rhino (*Diceros bicornis*) training on habitat for voluntary hoof care and blood draw
© The Living Desert Zoo & Gardens

Complex training methods are often used in training both invasive and non-invasive medical techniques. These procedures are helpful for obtaining diagnostic information and providing treatment, as well as providing follow up treatment. Invasive techniques, such as injections and blood collection, require specialised training to ensure animal safety and comfort. Non-invasive procedures may include ultrasound imaging, radiographs, and biological sampling. Both types of techniques, along with proper wound or injury treatment, contribute significantly to effective healthcare by aiding in diagnosis and treatment.

Although restraint or anaesthesia can sometimes be necessary, well-designed training can reduce their use. Teaching animals to voluntarily enter a crate or squeeze area, combined with reinforcement, can minimise stress and improve the overall experience for the animal and care team.

Training for Rewilding, Research, and Rehabilitation

Operant conditioning can enhance research and rewilding projects by training animals to voluntarily participate in behaviours that support their long-term success in the wild. This approach reduces stress, enabling more accurate health assessments and a better understanding of species biology. In rewilding and reintroduction efforts, training helps animals adapt to new environments by improving physical fitness, building essential survival skills, and reducing dependency on humans.

Animals who have experienced significant stress or trauma will require help to recover and adjust to a new environment. Operant conditioning methods can address fear of people, procedures, situations, and other animals. As described previously, training can also support the development of social behaviours critical for rehabilitation and integration into a group of conspecifics.

Advanced concepts in animal training to enhance animal welfare

Like husbandry, environment enrichment, veterinary science and other animal care practices, animal training is constantly evolving to take into account new research findings and learnings from practitioners as well as adapting existing frameworks for modern practice. Some recent enhancements to the field of animal training are outlined below.

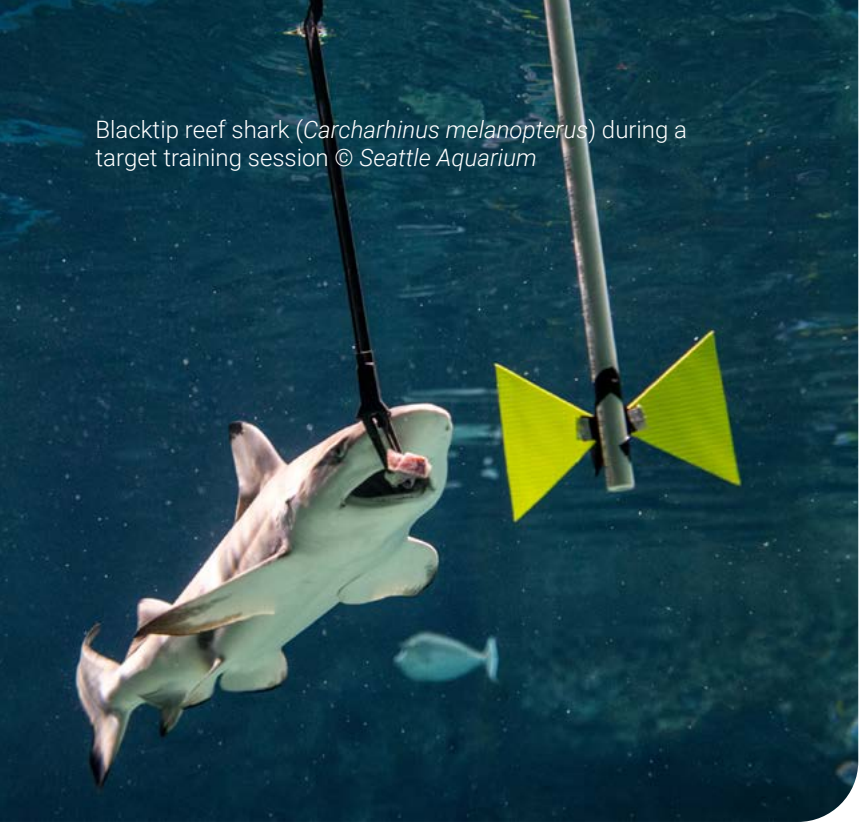
The Constructional Approach to Fear and Aggression

A constructional approach, rooted in Goldiamond's (1974) framework, focuses on building behaviour rather than eliminating it. By identifying and reinforcing behaviours that serve the same function as undesired behaviours, caregivers address the underlying contingencies maintaining fear or aggression. Over time, this reinforcement strategy builds new behaviours, like calmly observing the caretaker, that serve the same function of achieving distance, as the aggressive response See Case Study 4.1.

Case Study 4.1

Constructional Approach with an Amur Tiger | Copenhagen Zoo (Denmark)

A male Amur tiger (*Panthera tigris altaica*) at Copenhagen Zoo never accepted a particular caretaker's presence and always showed extremely aggressive behaviour towards them. When a desensitisation approach failed, the caretakers tried a constructional approach using a negative reinforcement procedure of shaping calm behaviour by removing the aversive stimulus, the caretaker. When the tiger tolerated proximity to the caretaker, the caretaker could then also start offering food, switching from negative to positive reinforcement, resulting in calm and relaxed behaviour (Pedersen, 2023).



Blacktip reef shark (*Carcharhinus melanopterus*) during a target training session © *Seattle Aquarium*

Nonlinear Contingency Analysis: A Holistic View

Traditional behavioural analysis often approaches behaviour as linear sequences: a stimulus leads to a response, which produces a consequence. However, animals in managed environments face multiple, simultaneous contingencies. For example, a tiger might be reinforced for approaching a caretaker with food (positive reinforcement) while simultaneously experiencing relief when maintaining distance from that same caretaker (negative reinforcement). Nonlinear contingency analysis acknowledges these complex interactions and helps trainers design interventions that address the full range of influences on an animal's behaviour, rather than addressing single behaviours in isolation.

Providing Genuine Choice Through Increased Degrees of Freedom

Genuine choice involves offering multiple ways for animals to achieve the same reinforcing outcome, a process called increasing degrees of freedom (Goldiamond, 1974; Heidenreich & Layng, 2024). For example, a fearful animal could gain distance by retreating, turning its head, or yawning – all behaviours reinforced by the removal of the aversive stimulus. This approach contrasts sharply with traditional training that offers animals only one path to reinforcement, which can become coercive regardless of whether positive or negative reinforcement is used See Case Study 4.2.

Case Study 4.2

Degrees of Freedom with an Okapi | Dublin Zoo (Ireland)

Staff wished for two people to be able to stand close to an Okapi (*Okapia johnstoni*) for a future medical procedure at the Dublin Zoo. Achieving these goals involved the first person observing the animal from far enough away that the animal showed relaxed behaviour. Next, the person slowly approached the okapi from the front and moved away for various responses (e.g. continuing to eat, attending to other environmental stimuli, and more). Criteria were adjusted throughout the shaping process until two people stood beside the Okapi while she comfortably ate leaves. By allowing the Okapi to offer numerous behaviours (degrees of freedom) to produce the same critical consequence of distance from the people, the Okapi did not choose to walk away from people. The goal of having two people stand next to the Okapi was achieved in a single session.

Emotions as Contingency Descriptors

Emotional behaviour, such as fear or aggression, reflects the contingencies influencing an animal's environment. For instance, yawning or grooming during training can signify a calm state, providing valuable feedback to the trainer. Lunging or moving away can indicate a need for distance. These behavioural "tells" can be even more subtle, such as skin twitching or nostrils flaring, but by learning to recognise them, trainers can increase the likelihood of continued motivation and participation in training.

A more nuanced approach to positive and negative reinforcement

Traditionally, positive reinforcement has been central to animal training. However, evidence reveals that under certain conditions, positive reinforcement can become coercive in situations; where degrees of freedom are lacking, competing contingencies are present, or caregivers withhold desired consequences to potentiate reinforcers.

For example, if an animal that fears a person is offered food to encourage it to approach, the combination of positive reinforcement (the food) and negative reinforcement (the ability to maintain a desired distance from the person) can create conflict, leading to emotional distress. Withholding food to heighten the animal's hunger and address its fear response may be seen as a coercive use of positive reinforcement to promote the animal's approach, particularly as its hunger intensifies.

The ethical application of reinforcement depends not necessarily on the type, positive or negative, but on how it is used in a procedure. By focusing on genuine choice through increased degrees of freedom and eliminating coercion, trainers can use both positive and negative reinforcement to create a compassionate and effective training environment. This nuanced approach moves beyond the oversimplified view that positive reinforcement is always ethical and negative reinforcement is always aversive. Instead, it focuses on the application of the processes involved and the options available to the animal throughout the training interaction.

Trainer's Toolkit: Practical Applications

While the theoretical foundations provide valuable guidance, implementing training programmes in real-world settings presents unique challenges. This section addresses practical considerations that trainers commonly encounter when applying behavioural science principles.

Alternative Reinforcement Strategies

Identifying which reinforcers maintain behaviour is key to selecting effective strategies. Food is often convenient and effective, but not always available or appropriate – such as for pre-anaesthesia procedures or for animals with low appetite. Trainers should develop a diverse reinforcement history using meaningful alternatives like preferred environments, tactile interactions, social access, or control over stimuli. This approach ensures training programmes remain adaptable to changing circumstances while maintaining positive welfare for the animal.

Veterinary Partnerships

Veterinary training succeeds through collaboration between animal care and veterinary teams. Involving veterinary staff early in training plans, addressing fear responses to staff or equipment, and conducting mock procedures help animals build comfort in neutral contexts, reducing stress during actual procedures.

Capybara (*Hydrochoerus hydrochaeris*) during a training session © *Fundación Temaikèn*

Training Environment Considerations
The physical setup and approach to animal interactions greatly impacts training success. When choosing between shared space and protected contact, consider the individual's welfare. Ensure habitats include "human-free zones" where animals can retreat if desired, and consider barrier training for fearful animals until confidence is established. Recognise that fear responses can inhibit learning and must be addressed before effective training can proceed. Respecting spatial preferences often accelerates progress and supports better welfare. By creating training environments that prioritise animal comfort, trainers may improve welfare and achieve faster, more sustainable results.

Programmatic Framework
A robust behaviour management programme should be standardised across the institution to ensure consistency in goals and practices. This may include hiring or assigning a staff member to oversee the programme, lead staff in positive training practices, and ensure alignment with programme objectives. It's essential that relevant staff participate and feel their input is valued, so all departments see themselves reflected in the programme's goals and successes.

With a clear vision established, a strong framework provides a roadmap to success. While there is no "one size fits all" model, the S.P.I.D.E.R framework (MacPhee & Mellen, 2001) or similar derivatives offer a solid starting point. This cyclical process promotes continuous improvement through regular assessment and adjustment. Its structure makes it accessible to staff with varying experience levels, while its scientific basis supports evidence-based practice.

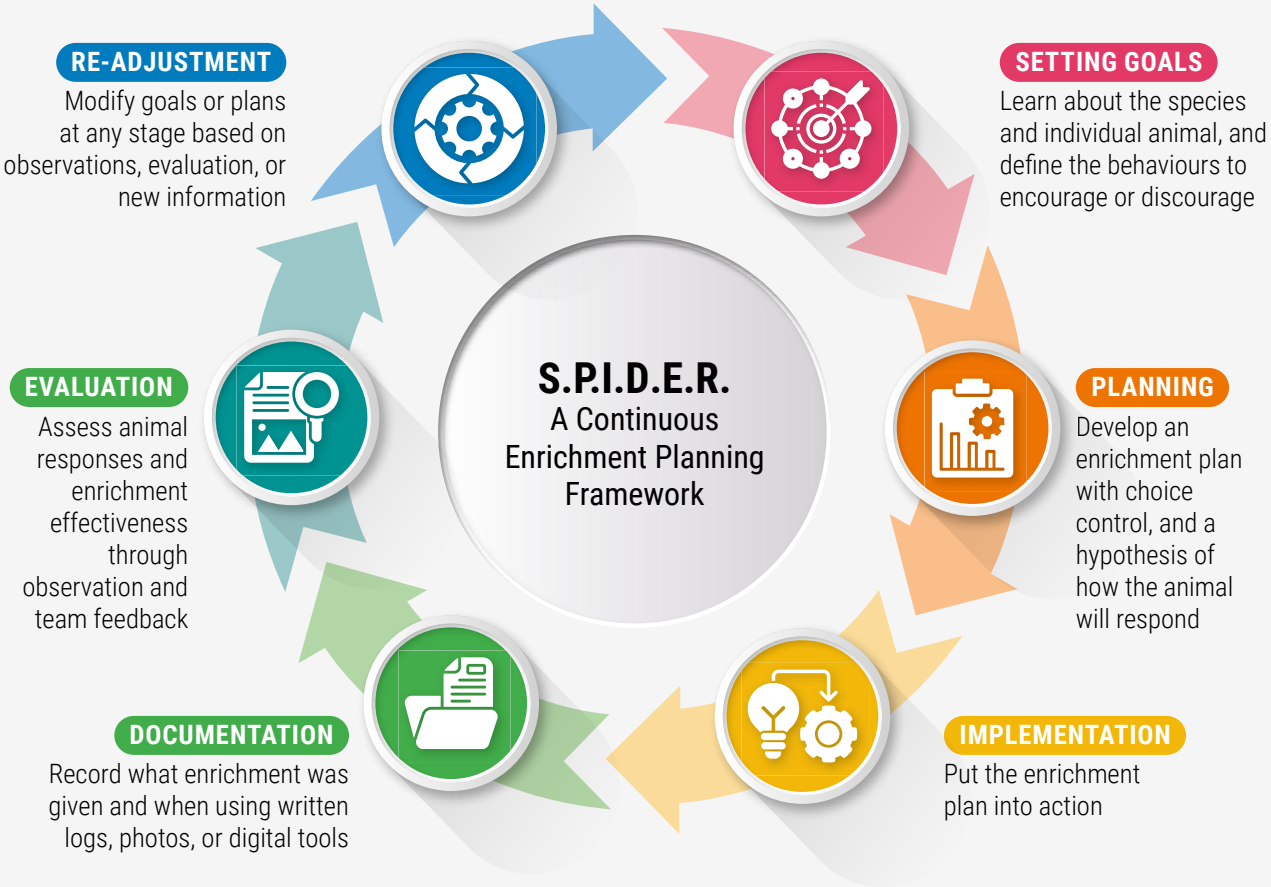


FIGURE 4.1 The S.P.I.D.E.R. Framework, modified from MacPhee & Mellen 2001.

Elephant care team member during a training session to support veterinary procedures © *Seoul Zoo*

Even with a strong framework, behavioural challenges will arise. In such cases, a strategic problem-solving approach can help identify motivating operations influencing behaviour and guide logical action steps. Several models from behavioural science and psychology literature can assist in addressing these challenges systematically.

A comprehensive onboarding programme should outline daily and programmatic goals, standard procedures, and structured problem-solving methods. Educating and involving new staff help to build a welfare-focused culture, encourage constructive feedback, define expectations around animal training, and ensure consistent use of operant conditioning across the team.

Monitoring and Evaluating Training Programmes

Before beginning any training project, it is beneficial to create a written plan outlining the individual behavioural steps toward the final goal. This helps ensure a logical progression and allows the trainer to set a clear focus for each session based on the animal's current approximation.

Tracking training progress is essential to ensure the programme promotes positive welfare and meets its goals. Documentation supports evaluation of effectiveness, consistency in terminology, and alignment across staff. Records should capture both progress and setbacks so that all trainers can review and build on previous sessions.

Electronic systems, such as spreadsheets, can be used to analyse trends in progress, animal attitude, food consumption, and variation among staff. Graphing these data allows for visual analysis and informed adjustments.

A strong monitoring system ensures that training remains a positive experience and does not compromise welfare. It supports continuity between trainers, early identification of challenges, and continuous improvement of both individual learning and overall programme outcomes.

CONCLUSION

Modern understanding of animal welfare in zoos and aquariums emphasises the importance of a comprehensive behaviour management and training programme. Such programmes, rooted in scientific principles, focus on building desired behaviours rather than just eliminating undesired behaviour. A strong leadership structure is crucial for integrating science into the institution's culture, and providing consistency within the training programme. Evidence-based training strategies are essential for improving animal welfare, and thoughtful programmes should be implemented across all zoos and aquariums, regardless of their size, species diversity, or staff expertise.

Bighorn sheep (*Ovis canadensis*) on top of their natural mountain habitat
© *The Living Desert Zoo & Gardens*

CHAPTER 5

HABITAT DESIGN

OUR COMMITMENT IS TO PROVIDE HABITATS THAT CREATE OPPORTUNITIES FOR ANIMALS TO FEEL COMFORTABLE, ENGAGE IN SPECIES-SPECIFIC BEHAVIOURS, EXERCISE CHOICE AND CONTROL, BUILD RESILIENCE, AND EXPERIENCE POSITIVE WELFARE.

Thalia Pelegrin
WAZA

David M. Powell
Saint Louis Zoo

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RECOMMENDED ACTIONS

To realise our commitment to high animal welfare standards, WAZA calls on its member organisations to:

1. Define and prioritise environmental features that promote species-specific positive welfare in all habitat designs and upgrades.
2. Meet animals' physical, behavioural, and psychological needs by offering challenges that encourage curiosity, engagement, and choice, while enabling separation when needed for welfare or social management.
3. Design both visitor-facing and behind-the-scenes areas with the same goal of promoting positive welfare.
4. Ensure staff can safely and efficiently conduct care, training, maintenance, and behavioural monitoring to support ongoing animal well-being.
5. Monitor habitat and off-view area quality, share best practices across the community, and, where appropriate, support multi-generational or mixed-species groupings to enhance welfare and sustainability.

INTRODUCTION

The quality of life of any animal is determined by a series of variables, including genetics, previous experiences, environmental quality, and the ability to exercise choice in seeking comfort, sustenance, and social engagement. While animals cannot control their genetic makeup or all aspects of their environment, an individual in the wild or in a zoo or aquarium can exercise a degree of control over its well-being through behavioural opportunities, choices, and an ability to express individual preferences.

On any one day, an animal might find itself being more or less comfortable, more or less hungry, or under stress from a variety of external factors. An important aim of habitat design is to provide animals with opportunities to keep mentally, emotionally and physically fit, ensuring they have access to choices that can lead to having positive experiences.

As research in zoos and aquariums continues to expand our understanding of the species in our care, habitat design should evolve to integrate this knowledge. Spaces should be designed holistically, considering the whole-of-life needs of animals, expanding space allocations as necessary, incorporating diverse environmental enrichment features, and enhancing opportunities for social interactions as appropriate.

> A holistic approach to habitat design simultaneously addresses the creation of environments that cater to the well-being of animals, facilitates management and care of them, and provides meaningful experiences for visitors.

Grey wolf (*Canis lupus*) habitat, visitor viewing area © *Assiniboine Park Zoo*

THE ROLE AND STYLE OF HABITAT DESIGN

In modern zoos and aquariums, habitat design serves two fundamental roles. First, to create a flexible and enriching environment where animals have opportunities to engage in natural behaviours, and express choice and control, while caregivers can support and care for the animals safely. Second, to provide a space that promotes visitor education regarding species biology, threats to their survival, and how visitors can take action and support conservation.

Whether a zoo or aquarium pursues a design philosophy that seeks to replicate the natural habitat of the animals using similar vegetation or environmental features (e.g. streams) or one that re-creates essential features of that habitat using non-naturalistic substrates (e.g. climbing structures made of posts or metal bars), a holistic approach to habitat design that simultaneously addresses the creation of environments that cater to the well-being of animals, facilitates management and care of them, and provides meaningful experiences for visitors is the overarching standard. Therefore, successful, animal welfare-based habitat design involves collaboration among animal care professionals, veterinarians, welfare scientists, designers and architects, horticulturalists, and other important partners to balance these priorities.

Habitat for the African Penguin (*Spheniscus demersus*)
© Michał Ciechanowicz, Zoo Wrocław

PROMOTING POSITIVE ANIMAL WELFARE OUTCOMES IN HABITAT DESIGNS

Designing for species

Regardless of style, the critical element in creating a new habitat design is ensuring that habitats are species-specific for the species housed, thereby providing suitable environmental complexity, choice, and opportunities to express natural behaviours that support positive welfare outcomes. Once these elements have been well defined and the physical, behavioural and psychological needs of the species have been established within the design criteria, the wider scope of the new design project may be outlined by understanding what this habitat is trying to accomplish, in terms of relevance to the community, awareness raising for the welfare and conservation of the species.

Each habitat should be designed to meet the species-specific needs, ensuring the species selected are well-adapted to the habitat's climate or that environmental conditions maintain their well-being. The complexity of the habitat itself can affect the animals' behaviour and physiology. Considerations for the suitability of habitat must be taken to both support and engage natural behaviours and avoid unnatural ones that may lead to negative affective states.

HABITAT COMPLEXITY AND VARIETY

Habitat complexity and variety are driven by habitat size, features intentionally incorporated into the habitat, and environmental features within or surrounding the habitat, including topography, weather, visitors, native wildlife, and other sensory stimuli. Part of habitat complexity is also the ability to use multi-dimensional space to express natural behaviours fully and meet behavioural needs See Case Study 5.1. Therefore, when designing habitats, facilities should maximise access to vertical, horizontal, and subterranean spaces essential for different species, while ensuring that the choice to use these different dimensions remains open to the animals.

These elements influence the biological interactions that occur within the habitat in a species-dependent way (de Azevedo et al., 2023). Complexity and variety in the social environment are also important for welfare in some species See Chapter 11. Habitat complexity and variety should change frequently across days, seasons and over the species lifetime to encourage natural behaviours such as foraging, climbing, or swimming and by offering diverse spaces that cater to exploration, social interaction, and sensory engagement (Rose & Lewton, 2024). Continually evaluating and changing elements within the space when appropriate can ensure curiosity and a positive affective state in animals See Chapter 3.

Edinburgh Zoo's Linnaeus's two-toed sloth (*Choloepus didactylus*) habitat
© RZSS Edinburgh Zoo

Case Study 5.1

Mandai's Bird Paradise, designing to meet birds' needs | Bird Paradise (Singapore)

Bird Paradise, part of Singapore's Mandai Wildlife Group, features eight large walkthrough aviaries (0.24–1.5 hectares) housing over 4,000 birds from 380 species. Designed with input from architects, animal care specialists, and visitor experience experts, each aviary replicates a biogeographical region, with species selected for ecological compatibility and behavioural needs.

Mandai's multi-dimensional habitat at Bird Paradise
© Mandai Wildlife Group – Bird Paradise, Singapore

Microhabitats – such as thickets, clearings, streams, and clay cliffs – encourage natural behaviours. Immersive design, including cryptic mesh and open space, enhances both welfare and visitor experience. Each aviary includes conditioning facilities and operates as a separate epidemiological unit.

The scale supports social species living in natural group sizes. For example, the Crimson Wetlands aviary hosts over 240 Scarlet Ibises (*Eudocimus ruber*) and several macaw species, allowing rich social interactions. Landscaping is maintained for nesting, privacy, and seclusion, while open areas and a 2-metre clearance between canopy and mesh support flight. Fruiting trees promote natural foraging in species such as hornbills. These environments uphold high welfare standards and offer engaging visitor experiences. However, they also require adaptive management to address breeding competition, dominant individuals, and colonial dynamics.

Privacy and Retreat Areas

Zoos and aquariums should seek to provide the best habitat design to maximise animal welfare while providing for the needs of visitors. Whether 'visitor effects' on animal behaviour and welfare are positive, negative, neutral (Hosey, 2000) or more complex (Krebs et al., 2023) depends on many different factors related to the animals, their habitat, and visitor behaviours and characteristics (Edes & Powell, 2024). Despite wide variability in the results of research on visitor effects on animals (Fernandez & Sherwen, 2024), habitat design that includes privacy or retreat areas for animals is important (Sherwen & Hemsworth, 2019). Animals should be able to remove or distance themselves from visitors when desired, and still have opportunities for positive experiences wherever they choose to be See Case Study 5.2. These retreat and/or hiding areas can also be important in mixed-species habitats where the possibility of hiding and having comfortable niches for the various species is present to minimise the frequency of aggressive behaviours or competition for resources. Techniques can also be applied when needed to minimise the impact of potentially stressful stimuli (e.g. sounds, sights, and vibrations).

Case Study 5.2

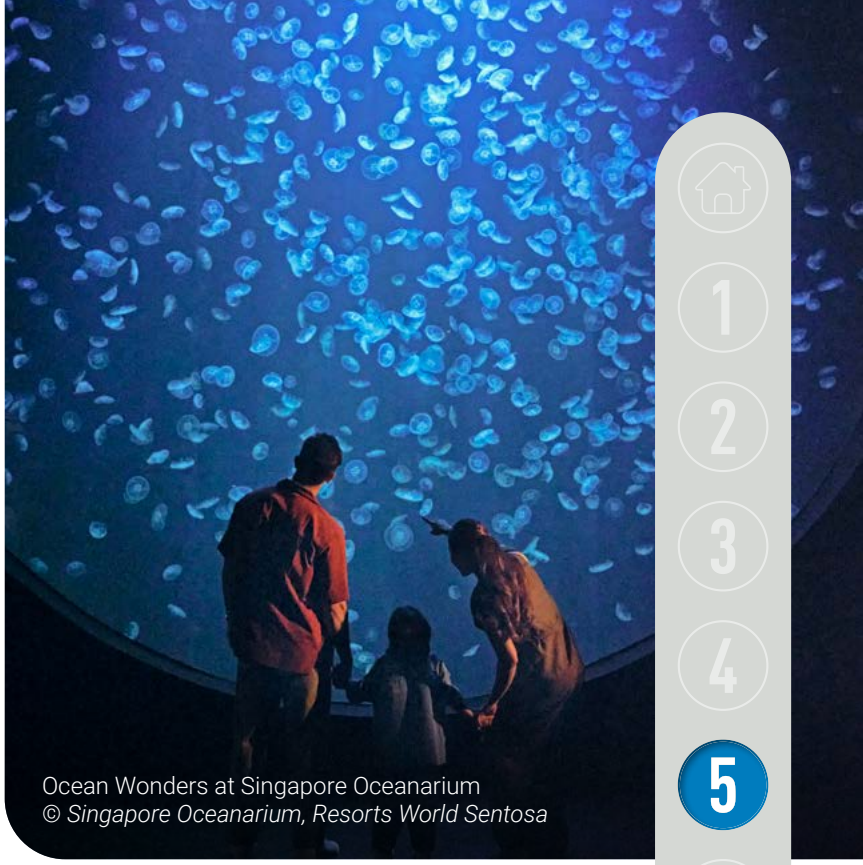
Monitoring behavioural changes in a mixed species fish habitat after increasing privacy areas and reducing exposure to visitors | Melbourne Zoo (Australia)

Across Melbourne Zoo, understanding the needs of individual animals in their habitats is fundamental to achieving good welfare, particularly related to mixed-species habitats as there are a range of stimuli created by inter- and intra-species behavioural interactions. To increase knowledge on best practices for habitat design, the Zoo observed four fish species (two elasmobranch and two teleost species) in their original habitat, and then in a newly constructed habitat that more closely represented the species' natural habitat, through reduced direct visitor interaction, substrate changes and the addition of structures that created microhabitats and niches, to enhance retreat options. The behaviours such as space use, resting, swimming and abnormal behaviours including surface 'hopping', and perimeter swimming in elasmobranchs were recorded before and after the renovation. The habitat changes had a positive effect on the fish, with all animals spending more time throughout the day exhibiting natural behaviours such as resting, greater space use towards the front of the habitat, and significantly less time spent engaged in stereotypical behaviours (Lawrence et al., 2021).

Northern elk (*Cervus canadiensis*) habitat © *Zoo Sauvage de St-Félicien*

Off-view and breeding areas

Off-view areas are often required for social management, propagation, or veterinary care. However, these areas should be designed with similar welfare considerations in mind. Animals in these spaces must have sufficient opportunities to meet their behavioural needs while engaging in pleasurable experiences and thus experiencing positive welfare. Rotating animals between off-view and visitor-facing areas also provides variety for animals and may help build resilience. At times, animals may need to be temporarily confined to less stimulus-rich environments, for example when recovering from sickness or injury. While attempts should be made to still meet the animals' needs during these times so that they experience positive welfare overall, it should also be a goal that these periods are temporary and short compared to the animals' lifespan.



Ocean Wonders at Singapore Oceanarium
© Singapore Oceanarium, Resorts World Sentosa

MONITORING AND EVALUATING HABITAT DESIGN

Like in all aspects of animal care and welfare, it is essential to establish systems for regular assessment, continuous monitoring, and evaluation of habitat design successes and challenges. Such assessment programmes can uncover aspects of the habitat design that promote positive welfare across the lifespan of individuals and across different generations of habitat occupants. When habitats are not able to meet the needs of an individual and this cannot be remedied, alternative housing should be sought for the animal. One such method for habitat design assessment is post-occupancy evaluations, which considers habitat suitability from the perspectives of zoo and aquarium staff, visitors, and the animals (Snyder & Barrett, 2022). Observations of and interviews with staff and visitors are combined with observations of animals (e.g. including space use) in this process.

CONCLUSION

A well-designed zoo or aquarium habitat, combined with high quality animal care, can significantly enhance the fitness, health, and welfare of the animals. It also allows their caregivers to safely care for them, and the visitors to understand, connect and care for the species. Providing choice and control through a number of considerations, including but not limited to environmental complexity, multi-dimensional space use, and access to areas for rest and retreat from visitors and other animals can greatly support the promotion of positive animal welfare outcomes. Off-view spaces should be designed with the same attention to species needs and welfare as visitor-facing areas, ensuring a holistic and ethical approach to animal welfare. By considering all aspects of habitat design, embracing new science, and conducting ongoing habitat evaluations, zoos and aquariums can ensure the habitats they build for animals promote positive welfare over the long-term while meeting conservation and education objectives.

Silvery gibbon (*Hylobates moloch*)
© *Chester Zoo*

CHAPTER 6

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CONSIDERING ANIMAL WELFARE IN SPECIES PLANNING AND BREEDING FOR POPULATION MANAGEMENT

OUR COMMITMENT IS TO CONDUCT SPECIES PLANNING AND BREEDING FOR POPULATION MANAGEMENT, THAT ACHIEVES CONSERVATION OUTCOMES, SUSTAINS VIABLE ANIMAL POPULATIONS, AND PROMOTES POSITIVE ANIMAL WELFARE STATES.

RECOMMENDED ACTIONS

To realise our commitment to high animal welfare standards, WAZA calls on its member organisations to:

1. Create and follow breeding plans and species management recommendations that consider species conservation, population viability, and positive animal welfare.
2. Support animal welfare during breeding events through skilled observation, staff training, use of external specialists where needed, and careful consideration of animals' needs.
3. When breeding for reintroduction, give specific attention to balancing animal welfare with survival in the wild and population restoration.
4. Develop a clear population management strategy for each managed species, that includes considerations of management euthanasia, contraception, single sex groups, and disposition of offspring, to support whole-of-life care across generations.
5. Ensure that sourcing and placement of animals to or from all sources is legal, ethical, and sustainable, the latter one meaning that it does not lead to the long-term decline of biological diversity in the wild and minimises adverse effects on animal welfare.

INTRODUCTION

Breeding is a highly motivated behaviour involving positive, enriching forms of natural behaviour and positive affective states for animals in zoos and aquariums. However, it can also raise complex ethical and welfare issues if not properly managed. An overarching principle in considering any breeding event in zoos or aquariums should be the balance between animal welfare and the needs of population management, informed by expertise in species-specific biology and welfare.

While a central objective of modern zoos and aquariums is maintaining viable populations, interpretation of how we might achieve this through breeding programmes varies. However, there are common themes emerging that include species-specific expertise and knowledge underpinned by a strong cooperative planning approach.

ANIMAL SPECIES MANAGEMENT

Modern zoos and aquariums should strive to have a species plan outlining why each species is housed and for what purpose. The plan should include the number of individuals, planned breeding, animal movements in or out, and future directions. It should consider available facilities, habitat types, species requirements for welfare and management, and the institution's overall purpose and mandate. Species planning should address not only the needs of species and individuals but also the institution's capacity to house multiple groups or generations and provide positive welfare – whether animals are housed on-view or off-view.

Leading institutions align their species planning with principles and policies endorsed by their governing authority and with regional species plans provided by their zoo and aquarium associations, when possible. This alignment supports the management of viable populations with positive welfare.

> Breeding programmes based on science and species' natural history benefit welfare by avoiding inbreeding, reducing overcrowding, supporting natural dispersal, and promoting social skill development.

Breeding should be managed through species management programmes at the institutional and/or regional level and involve careful planning. Even when breeding occurs outside formal cooperative programmes, collaboration among facilities is often beneficial and necessary for effective population and welfare management.

High-quality record keeping is essential to species management. Population management depends on understanding individual relatedness and welfare outcomes. Beyond the data required by WAZA's Committee for Population Management (WAZA CPM, 2025), institutions should track both successful and unsuccessful breeding attempts. For example, studbooks may only record births, but data on copulation, egg-laying, or failed reproduction can provide insights into pair compatibility. Species360's Zoological Information Management System (ZIMS) is a key platform for global population sustainability. It helps share data that builds knowledge on successful breeding and supports welfare at both individual and population levels.

In many parts of the world, it is the role of the regional and/or national zoo and aquarium association to coordinate and assist with managing certain animal populations, by supporting species planning, ensuring good species management practices, and overseeing and advising on how to promote positive animal welfare states within that framework. In some cases, breeding programmes may be managed in a formal global programme, such as through WAZA's Global Population Management Frameworks, involving the management of a particular species with a globally agreed set of goals, while building upon and respecting existing regional processes. Zoos and aquariums should continue to use these programmes and, where possible, collaborate to further enhance the active management of regional and global breeding programmes with population management frameworks that comply with WAZA's 2027 Population Management Goal, which defines key elements for effective and professional population management.

Hamadryas baboon (*Papio hamadryas*)
© *Oakland Zoo*

ANIMAL WELFARE CONSIDERATIONS IN BREEDING PROGRAMMES

Breeding programmes in zoos and aquariums commonly strive to maximise genetic and demographic diversity to ensure population viability. Ensuring genetic diversity is also important for animal welfare as it contributes to individual animal health and its possible conservation potential. Well-managed breeding programmes must consider animal welfare, with regional associations, zoos, and aquariums making every effort to balance the ethical and welfare issues with the need to sustainably manage populations. The success of these programmes also relies on individual facilities prioritising the needs of the population over institutional needs whenever possible. The assistance of animal ethics and welfare committees, or other such entities, can help to address the complexities of decision-making in these areas.

A variety of approaches can be incorporated into animal welfare management in breeding programmes. For example, careful consideration and planning of animal transports can lessen the stress of transfers on animal welfare See Chapter 12. Positive reinforcement training can also be used to acclimate animals to transport containers See Chapter 4. Detailed observations of behaviour by skilled individuals with species expertise is critical in planning breeding introductions and creating appropriate environments for parental care and offspring development. Hormone monitoring may be useful to appropriately time breeding introductions to maximise compatibility or to monitor stress. Though currently limited to a small number of species, assisted reproductive technology (ART) may offer the ability to minimise animal transfers while promoting genetic diversity, but these advantages should be weighed against any welfare impacts on animals as a result of associated procedures as well as the impacts of allowing natural breeding to occur.

Bearded vultures (*Gypaetus barbatus*)
© *Alpenzoo*

Species biology and breeding considerations

Providing mate choice

Breeding programmes generally strive to mimic natural processes during courtship, breeding, and parental care. This increasingly includes consideration of mate choice as it is prevalent in animals and is associated with improved reproductive success. Research across taxa, demonstrates that allowing animals mate choice enhances reproductive success by increasing the likelihood of producing offspring, expanding litter sizes, improving parental care and offspring viability, and altering offspring sex ratios – factors that collectively shape population demographics and support long-term sustainability See Box 6.1, Martin-Wintle et al., 2019). Allowing animals to exercise control over mate selection aligns breeding practices with their natural behaviours, reducing stress and improving their overall well-being (Norman & Brando, 2024). When free mate choice is limited or impossible, efforts should focus on monitoring and maximising pair compatibility to achieve successful breeding outcomes through observations by experienced staff. Pair compatibility might be improved through alteration of housing and husbandry programmes, pharmacological assistance, consideration of animal personality, or other means. All phases of the reproductive cycle (i.e. pre-courtship, courtship and copulation stages) should be considered when providing mate choice.

Population management programmes may designate a larger or specialised institution as a breeding centre, where compatible pairs can be selected through controlled mate choice trials with guidance on genetic suitability from population biologists. Mate preferences may be assessed via a variety of techniques (Martin-Wintle et al., 2019). Compatible pairs can be bred on-site or sent to partner facilities. Breeding centres may also positively impact welfare through minimising animal transports and associated veterinary testing and quarantine. Still, there are times when a pair is not compatible and unlikely to breed. Managers should explore re-pairing animals or adjusting housing, husbandry, or even pharmacological approaches to improve behavioural compatibility.

Rearing of offspring

Animals should ideally be parent-reared so they learn the appropriate species-specific behavioural skills needed to breed, such as the social and courtship behaviours appropriate for their species. Hand-rearing should only be utilised in instances of species threatened with extinction where every individual counts; however even then, imprinting onto humans should be avoided at all costs. Furthermore, both parent- and hand-reared individuals should be given the opportunity to socialise in juvenile groups, if this aligns with the species' natural ecology. Within these groups, juveniles also learn the appropriate species-specific behaviour that could increase their chances of breeding in the future.

Box 6.1 Mate choice in breeding programmes

Successful population management programmes incorporating mate choice realise significant benefits in reproductive success, population viability, and animal welfare. Columbia Basin pygmy rabbit (*Brachylagus idahoensis*) females allowed to choose their mates had increased breeding success (Martin & Shepherdson, 2012), and when both sexes were allowed to choose their mates in naturalistic, large habitats, there was a dramatic surge in successful pairings and offspring production. Another example is the Oregon Zoo's "love tent" for the Taylor's checkerspot butterflies (*Euphydryas editha taylori*), which allows butterflies to choose their mates in a controlled environment (personal communication, Martin, 2025), resulting in higher mating success. When housing breeding pairs of pink-headed fruit doves (*Ptilinopus porphyreus*) at different zoos was not resulting in sufficient offspring, the Toledo Zoo and Aquarium brought multiple breeding pairs together in a breeding centre programme, resulting in quickly and dramatically increasing reproduction. In marsupials, studies of Eastern barred bandicoot (*Perameles gunnii*, Hartnett et al., 2018) and stripe-faced dunnarts (*Sminthopsis macroura*, Parrott et al., 2019) revealed that providing mate choice increased reproductive success and reduced aggression. These examples underscore the critical role of incorporating mate preferences into conservation strategies to improve genetic health, behavioural robustness, animal welfare, and population growth for endangered species.

All breeding programmes should consider whole-of-life care and the welfare of parents and subsequent generations of offspring. Many zoos and aquariums actively manage reproduction to avoid unwanted breeding events and to minimise the production of surplus individuals. Reproductive management, whether by controlling or promoting breeding, is also essential for population health. The effective use of contraception is one of many aspects of managing breeding, and as such, the expertise of veterinary staff members, curators, and reproductive biologists is vital to successful reproductive management. Alternatively, management euthanasia (also known as "culling" in some regions) may be used by facilities in countries or regions where it is allowed by law and culturally appropriate.

USE OF EUTHANASIA

Euthanasia is the act of providing a humane death and may be used to alleviate suffering in medical cases or as a population management tool (i.e. culling). Animals should be treated with respect throughout their lives and, when necessary, given a humane death. All zoos and aquariums should have clear policies to deal with the euthanasia of animals. Euthanasia policies should clearly outline the circumstances of how and why euthanasia will be used. Euthanasia should be overseen and approved by an experienced veterinarian or senior animal management staff member briefed by a veterinarian. Decisions on euthanasia should be based on context-dependent evaluation of all alternatives. Some institutions find it beneficial to involve an animal ethics and welfare committee, or other such entity that has external members, in such evaluations. While regional differences exist, several regional zoo and aquarium associations recognise that euthanasia may be an appropriate tool in managing the demographics, genetics, and diversity of animal populations when done in consultation with facilities and programme managers, and adhering to relevant veterinary guidelines.

The death of an animal in a zoo or aquarium can evoke public interest as well as emotion from staff members and volunteers. This may particularly be the case when the animal has been euthanised. In some circumstances, zoo and aquarium visitors, the community, staff members and volunteers may need an explanation of the rationale of the euthanasia decision and it may be beneficial and necessary to take time to explain the reasons.

MANAGING AGGRESSION

Certain natural behaviours, such as aggression, can temporarily challenge animal welfare. Aggression can be a highly motivated behaviour used for achieving rewards or critical for behavioural development to avoid welfare compromise later in life (Powell et al., 2023). In species characterised by dominance hierarchies, periodic aggression stabilises the group and prevents prolonged conflict. Aggression may also be a necessary part of the normal behavioural repertoire of animals engaged in courtship and breeding (Lemm & Martin, 2023; Martin-Wintle et al., 2017). In these instances, zoos and aquariums should seek to minimise serious harm, while allowing animals to use their evolutionarily-derived behaviour to achieve their goals and build resiliency and social skills.

Guatemalan palm viper
(*Bothriechis aurifer*) © *Zoo Atlanta*

Endangered White's Seahorses (*Hippocampus whitei*) bred at SEA Life Sydney, ahead of release © *SEA Life Sydney*

Well-designed habitats can help decrease aggression See Chapter 5 or mitigate aggressive encounters (e.g. by providing multiple access points, vertical structures, and obstacles to allow animals to separate from one another). When preparing for animal introductions, staff should be well trained and have detailed knowledge of the species natural history and behavioural repertoire and expertise regarding managing animal introductions to ensure that any aggression is species-typical, and animal injury is minimised, while achieving successful social integration and breeding.

BREEDING FOR RELEASE

In some instances, animals used in breeding-for-release programmes may be housed in facilities specifically designed for the propagation of the species rather than visitor viewing. Animal habitats in these facilities may be smaller or less complex than habitats visible to visitors but are often necessary for successful breeding and can still achieve required welfare outcomes.

Beyond providing what is needed for breeding and rearing of offspring, propagation facilities should support animals' physical and psychological well-being, offering choice, control, and opportunities to achieve relevant behavioural and management goals. Regular welfare assessments should apply equally to these animals as to those in visitor-facing areas See Chapter 2.

Many breed-for-release programmes undertake pre-release training that may lead to a transient and/or repeated reduction in animal welfare, for example, adapting an individual's diet to mimic more closely the diet in the wild, such as: limiting food resources (e.g. gorge-and-starve diet), introducing live prey items, or introducing predator avoidance training. During these processes, staff should remember that animals are generally adapted to and should be able to cope with these challenges if they are part of the species' natural history, and while animal welfare may be reduced during these interventions, it does not necessarily mean that overall animal welfare state is compromised.

Animals that are being trained for release should be part of regular welfare assessment programmes See Chapter 2. The efficacy of pre-release training programmes, whether they have positive or negative animal welfare impacts, should be evaluated for potential impact on reintroduction outcomes. When training that involves temporary negative impacts of animal welfare does not result in positive reintroduction outcome(s), these practices should be modified or ended. The input of an animal ethics and welfare committee, or other such entity, in addition to the input of conservation authorities and species experts, are important in these situations.

SOURCING FROM THE WILD, RESCUES AND FARMING

Sourcing animals from the wild remains necessary in some cases to maintain genetic diversity, establish conservation breeding programmes, or rescue threatened populations. When done responsibly, it supports species survival and conservation while upholding high welfare standards See Case Study 6.1. All wild sourcing must comply with relevant authorities. Facilities must act in accordance with local, state, national, and international laws, conventions, treaties, and regulations, as well as conservation bodies such as the International Union for Conservation of Nature (IUCN). In modern zoos and aquariums, wild sourcing must serve a clear conservation purpose or, in collaboration with responsible authorities, support education, research, welfare, or the sustainability of populations (e.g. breed-for-release), and be reflected in the institution's species plan.

Case Study 6.1

Responsible Species Planning and Ethical Release of Ragged-Tooth Sharks | Two Oceans Aquarium (South Africa)

The Two Oceans Aquarium has pioneered a responsible, full-cycle approach to the care and management of ragged-tooth sharks (*Carcharias taurus*) enabling it to ethically collect juvenile sharks from the wild, ensuring complete traceability and alignment with conservation priorities. This approach allows the team to select individuals best suited to a temporary stay in human care, reducing stress and supporting better welfare outcomes.

An important feature of this programme is its planned-release model. Sharks are returned to the wild after a designated period, typically between two and four years. Carefully selected release sites ensure the animals are returned to appropriate and familiar habitats. Post-release monitoring, through external and acoustic tagging, validates the Aquarium's model as not only ethical but also effective in preparing animals for life back in the wild.

Ragged-tooth shark (*Carcharias taurus*) about to be released © *Two Oceans Aquarium*

A caretaker practices puppeting to prevent imprinting and support chicks through a critical stage of conservation breeding © *Fundación Temaikèn*

Many zoos and aquariums receive rescued animals at the request of governments – such as orphans, victims of illegal wildlife trade, or animals from closed facilities. While sanctuaries exist, modern zoos and aquariums are well-equipped for long-term care, though this must be balanced with species plans and breeding programme sustainability. Rescued animals also offer educational value, raise conservation awareness, and may contribute to sustainable populations. However, space, resources, and long-term care commitments must be carefully considered.

Working with commercial or private breeders can be complex. Breeding must not incentivise unsustainable or illegal wild sourcing, which would undermine conservation goals. However, in some cases, ethical commercial breeding may benefit local communities and ecosystems, and welfare can be acceptable or even good. Acceptability varies by region and species, but facilities must assess impacts on welfare and wild populations across the full supply chain. Only sources that provide positive welfare, avoid biodiversity harm, and ideally support local communities should be used. Commercial breeders can also offer valuable insights into husbandry, welfare, and reproductive management.

USE OF ADVANCED BIOTECHNOLOGIES

Modern zoos and aquariums are using more technological advances to assist with breeding programmes, from using molecular genetics and genomics to identify genetically important individuals to applying assisted reproductive technologies, including artificial insemination, embryo transplantation, intracytoplasmic sperm injection and *in vitro* fertilisation. Zoos and aquariums also have a growing role in biobanking, the collection and preservation of biological samples from animals for future applications See Case Study 6.2.

Natural breeding should be prioritised in zoo and aquarium animals to align with behavioural needs and welfare, but assisted reproductive technologies (ART) and biobanking play essential roles in supporting population sustainability, animal welfare, and conservation, especially for small or fragmented populations where natural breeding may be harder to achieve. ART enhances genetic diversity and may reduce the need for stressful animal transfers, while biobanking offers a minimally invasive way to preserve genetic material. Whenever possible, biobanking procedures should be integrated into routine medical exams to minimise additional handling. More invasive ART methods, like hormone treatments or surgical insemination, should only be used after carefully assessing animal welfare risks, benefits, and outcomes at the individual and population level. Evaluating barriers to natural reproduction and prioritising less invasive options ensures both ethical animal management and long-term population health.

Case Study 6.2

Biobanking to support breeding programmes and conservation | Saint Louis Zoo (US)

Biobanking is growing in the global zoo and aquarium community due to its demonstrated utility in *in situ* and *ex situ* conservation. The CryoZoo of Saint Louis Zoo is designed to archive genetic material from animals of high genetic value in the Zoo on an opportunistic basis. It further serves as the official United States Fish and Wildlife Service repository of gametes for the Mexican wolf (*Canis lupus baileyi*), an endangered subspecies of grey wolf. Each year, genetic analyses of the population of wolves in the wild, in human care, and in the CryoZoo using a special module in the population management programme PMx dictate which individuals should be paired for breeding in *ex situ* facilities, bred by artificial insemination, and which individuals should be targeted for semen banking or gamete rescue should the animal pass away or be sterilised.

CONCLUSION

Whether institution-based or coordinated through regional zoo and aquarium associations, breeding programmes that are based on scientific management principles can benefit animal welfare, as well as other objectives of modern zoos and aquariums. Zoo and aquarium species planning also benefits animal welfare by careful consideration of the institution's ability to provide good care for the species through all life stages and across multiple generations of individuals. Thus, in combination, breeding programmes and careful species planning at the institution and regional scale can promote animal welfare.

High-quality zoo and aquarium species planning and species management must be based on a commitment to considering wildlife conservation, animal welfare, and zoo and aquarium operations collectively. This ensures that the genetic and demographic viability of zoo and aquarium populations is maintained, which supports positive animal welfare, and the successful delivery of conservation, education, recreation, and research outcomes. Zoo and aquarium staff members undertaking species management should be fully aware of regional and global priorities in relation to the species in their care, understand the benefits and limitations of current management methods, and ensure high-quality record keeping.

Mexican wolf (*Canis lupus baileyi*) semen samples being deposited into storage at the Saint Louis Zoo's CryoZoo © Saint Louis Zoo

Chester Zoo conservationists in Madagascar surveying critically endangered amphibian species © *Chester Zoo*

CHAPTER 7

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CONSERVATION AND ANIMAL WELFARE

OUR COMMITMENT IS TO ENSURE THAT OUR WILDLIFE CONSERVATION ACTIVITIES CONSIDER ANIMAL WELFARE ALONGSIDE CONSERVATION GOALS.

RECOMMENDED ACTIONS

To realise our commitment to high animal welfare standards, WAZA calls on its member organisations to:

1. Establish animal welfare as a component in all conservation activities and projects supported by your institution.
2. In conservation work involving animals, ensure that the review of the individual animals' needs and the promotion of positive animal welfare is considered at all times and supported through appropriate staff training and facilities.
3. Work with partner field conservation organisations, collaborating to enhance collective animal welfare knowledge and skills.
4. Evaluate whether the animal welfare implications of management interventions are outweighed by their conservation benefits.
5. Build understanding of the importance of integrated species conservation frameworks that include assessing animal welfare.

Partula snails (*Partula sp.*) release to their native habitat in the French Polynesian Islands © *Akron Zoo*

INTRODUCTION

Animal welfare and conservation are intrinsically bound together. Sound animal welfare principles and practices must be embedded in conservation activities and be integrated into how modern zoos and aquariums operate from day to day. Indeed, animal welfare should be considered as a priority when field conservation efforts are planned and conducted.

While life in the wild is characterised by challenges to welfare, human activity can impact animals in their natural environments as well and has the potential to compromise animal welfare. Many species´ conservation efforts focus on the long-term survival of populations or species, however, in carrying out potentially invasive practices to achieve population sustainability, it is important that we do not inadvertently undermine individual animal welfare, especially as diminished welfare may threaten the ability of animals to thrive and reproduce. Notably, individual animal welfare can influence the success of head-start and reintroduction programmes, with implications on the spectrum from individual to population (IUCN/SSC, 2013; Teixeira et al., 2007).

Given rising conservation urgency, it is becoming increasingly necessary to intervene in the lives of wildlife and their environments in order to mitigate threats. The impetus for such interventions may be to mitigate animal welfare problems, manage disease outbreaks or meet a conservation priority to undertake animal translocations. Also, it is likely that some species will not survive without human intervention. However, interventions may themselves compromise the welfare of individual animals and this must always be considered in light of the anticipated contribution to species conservation.

Wild Ural owl chick (*Strix uralensis*) monitoring
© *Alpenzoo*

INTEGRATING SPECIES CONSERVATION AND ANIMAL WELFARE – NOT A DICHOTOMY

Declining animal populations could be considered conservation problems, animal welfare problems, or both.

Because wild animals are part of social groups, populations, and ecosystems, actions affecting individual welfare can also shape broader conservation outcomes – and vice versa.

> Aligning animal welfare principles with conservation strategies strengthens both welfare and conservation, fostering a more holistic and sustainable approach.

Even though conservation and animal welfare both focus on how animals survive and thrive in their environments, their orientations differ. Conservation prioritises the survival of populations, species, and/or ecosystems, whereas animal welfare considers the wellbeing and quality of life of individual animals. Recognising these distinctions while integrating both perspectives is important.

CONSERVATION AND ANIMAL WELFARE IN ZOOS, AQUARIUMS, AND THE WILD

A holistic concept of animal welfare must be considered alongside conservation interests in wildlife management, wildlife research and ecotourism. Many zoos and aquariums are involved in diverse conservation activities in their local area and also further afield. The science of animal welfare must be applied to these broader activities.

Good zoo or aquarium-based conservation practice seeks to promote positive animal welfare. Advances in caring for wildlife species can improve their welfare See Chapter 1 as well as the success of population management See Chapter 6. Building on this expertise, zoos and aquariums can help partner conservation organisations working in the field to aim for good animal welfare standards relevant to the wild context.

Potential conflict between animal welfare and conservation objectives may arise in cases where species are not able to successfully adapt to being housed in zoos or aquariums. Conversely, adaptation to managed environments may reduce an animal's capacity to adjust to the wild. Thus, many zoos and aquariums involved in reintroduction programmes adopt strategies aimed at mitigating such potential problems. It is important that these efforts are science-based, tailored to the individual species and situation, evaluated and adjusted appropriately, and consider both conservation and animal welfare impacts.

The management of animals involves a range of activities that often include the capture, restraint and transport of animals, where minimising animal welfare compromise and providing opportunities for positive animal welfare experiences become key issues See Case Study 7.1. Thus, field conservation activities focused solely on free-ranging wildlife must also be considered through an animal welfare lens.

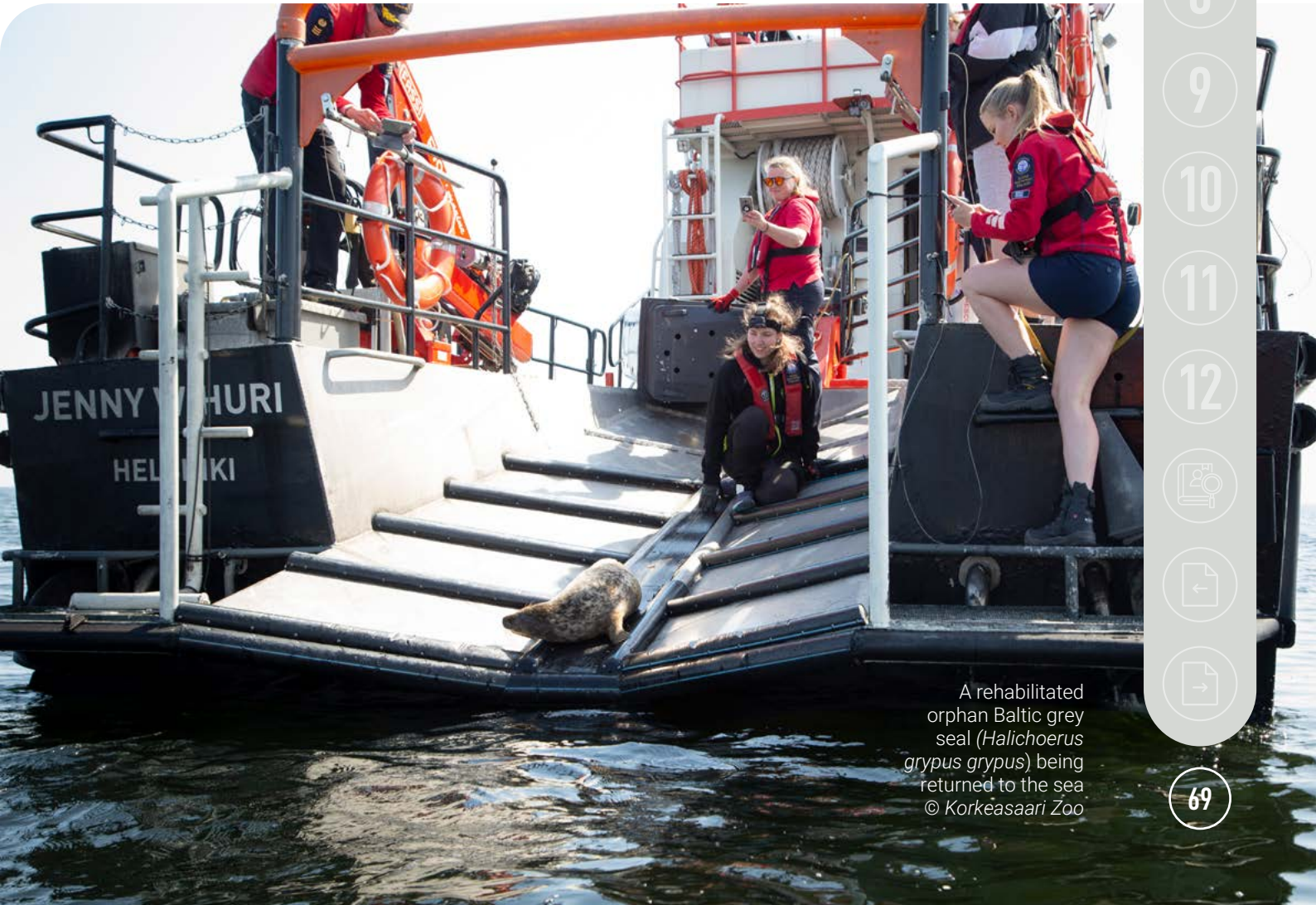
The knowledge within zoos and aquariums of animal welfare and care can benefit conservation efforts See Case Study 7.2 in areas such as the recovery and management of small populations, translocation biology, animal handling and transport, and conservation medicine. Their expertise should be considered when a OnePlan approach (Barongi et al., 2015) to species conservation is adopted.

Case Study 7.1

Non-invasive swabbing methods to support amphibian conservation | Lincoln Park Zoo (US)

Lincoln Park Zoo has long invested in the welfare of the animals in its care and scientists wanted to similarly prioritise the welfare of animals in the field. Lincoln Park Zoo researchers developed a non-invasive method by swabbing amphibians' skin to analyse cortisol levels, rather than the traditional invasive methods. This addressed a critical challenge of assessing stress-related physiological changes in amphibians affected by the often-deadly pathogen, chytrid fungus.

Dubbed "frog swabs," this technique allowed simultaneous stress and pathogen testing without harming the animals, which led to the discovery of a significant link: heightened stress levels suppressed immune responses, thereby increasing susceptibility to the deadly fungus. This innovative method provides a scalable, non-invasive model for stress monitoring.



A rehabilitated orphan Baltic grey seal (*Halichoerus grypus grypus*) being returned to the sea © *Korkeasaari Zoo*

Case Study 7.2

Bridging welfare science and conservation in the wild | Oklahoma City Zoo (US)

The Sri Lanka Elephant Project (SLEP) was established by the Oklahoma City Zoo and Botanical Garden to enhance the sustainability of the endangered Asian elephant and address the challenges of human–elephant coexistence in Sri Lanka. To reduce reliance on farming activities that can lead to human–elephant conflict, SLEP is working with local partners to explore wildlife tourism as an alternative livelihood that also supports elephant conservation.

As tourism expands in Sri Lanka's protected areas, it is increasingly important to monitor and prioritise the welfare of free-ranging elephants. SLEP researchers are using a combination of behavioural and physiological indicators to assess the impact of tourism. Behavioural observations focus on activity budgets, social interactions, and vigilance, while other non-invasive methods such as faecal glucocorticoid analysis offer insights into stress physiology.

Many of these field techniques were first validated through studies of zoo elephants at WAZA member institutions, demonstrating a direct application of welfare science pioneered by *ex situ* facilities to *in situ* contexts. This approach fosters data-driven tourism practices that minimise negative impacts on elephants while promoting sustainable conservation efforts.

Animal welfare and conservation can be represented as axes on a graph See Figure 7.1, each ranging from negative to positive. Practices that combine positive animal welfare with good conservation outcomes are preferred, and the combination of poor animal welfare and poor conservation is unacceptable. Activities involving trade-offs between conservation and welfare require further evaluation.

Asian elephants (*Elephas maximus*) gather in Minneriya National Park, Sri Lanka a key site where researchers study wild elephant behaviour and welfare © *Chase LaDue*

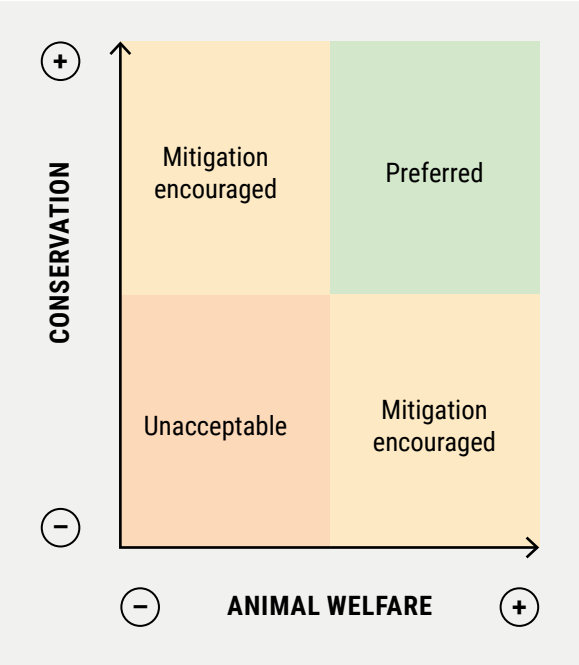


FIGURE 7.1 A framework to support the evaluation of animal welfare and conservation outcomes.

Canid Coyote team
© *Saint Louis Zoo*

Placing conservation activities in such a framework assists with providing transparency about how conservation and welfare goals and compromises were acknowledged and can encourage creative brainstorming to help lessen the undesired impact(s) of a given course of action, including impacts on non-target species. Animal welfare monitoring throughout conservation activities provides a practical means for assessing these practices See Chapter 2.

ETHICAL CONSIDERATIONS OF ANIMAL WELFARE IN CONSERVATION

While animal welfare is measured through objective, scientific methods, decisions about how to utilise information about animal welfare may differ depending on one's ethical framework. These situations are inherently complex, and decision making needs to be supported by appropriate review from an ethical and animal welfare perspective and include the viewpoints of diverse partners. Core principles in this process include respecting and promoting animal welfare and dignity, promoting conservation excellence, proportionality (balancing benefits and costs), and ensuring appropriate expertise is available.

Animal ethics boards or committees, or other such entities, exist to enable the open discussion of these complexities. A well-balanced ethical review board or other such entity will enable critical reflection, based on open, respectful debate of people with very different backgrounds and experiences, ultimately leading to improved, ethically justifiable outcomes. While animal ethics approval might or might not be required by law, an ethical review board or the equivalent should be engaged to attenuate welfare compromise.

Wellington green gecko (*Naultinus punctatus*)
© *Te Nukuao Wellington Zoo*

The widely used 3Rs (Sneddon et al., 2017), can provide a practical starting point:

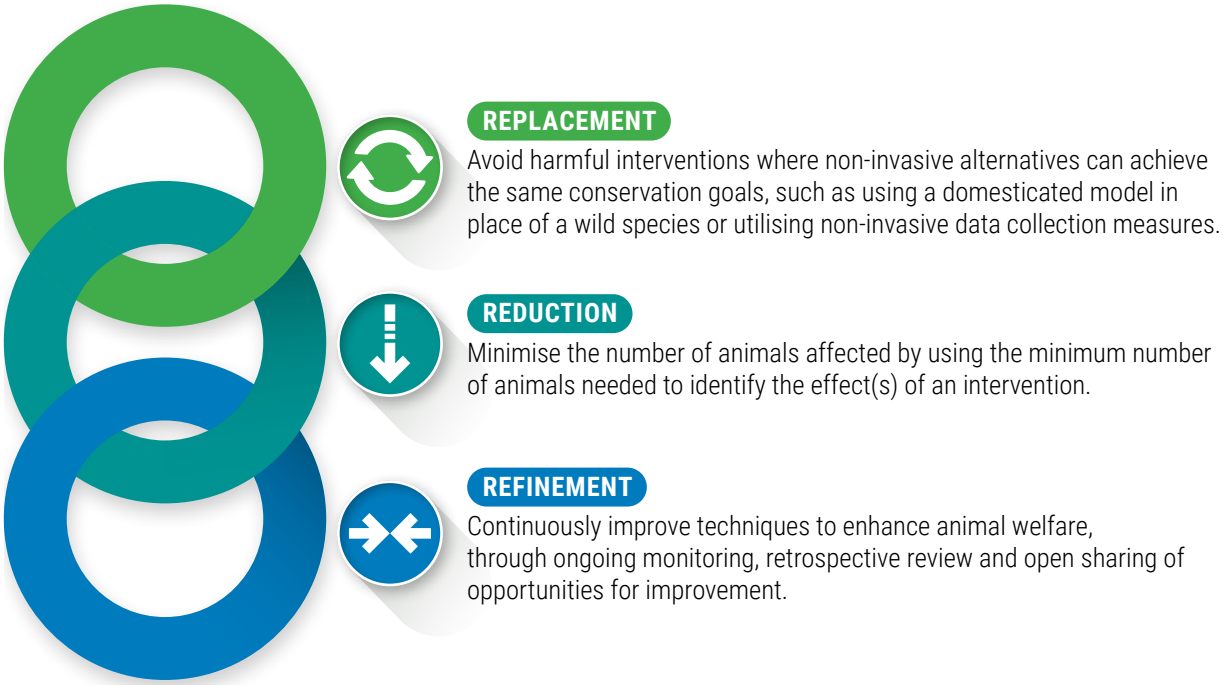


FIGURE 7.2 The 3Rs model (adapted from Sneddon et al., 2017).

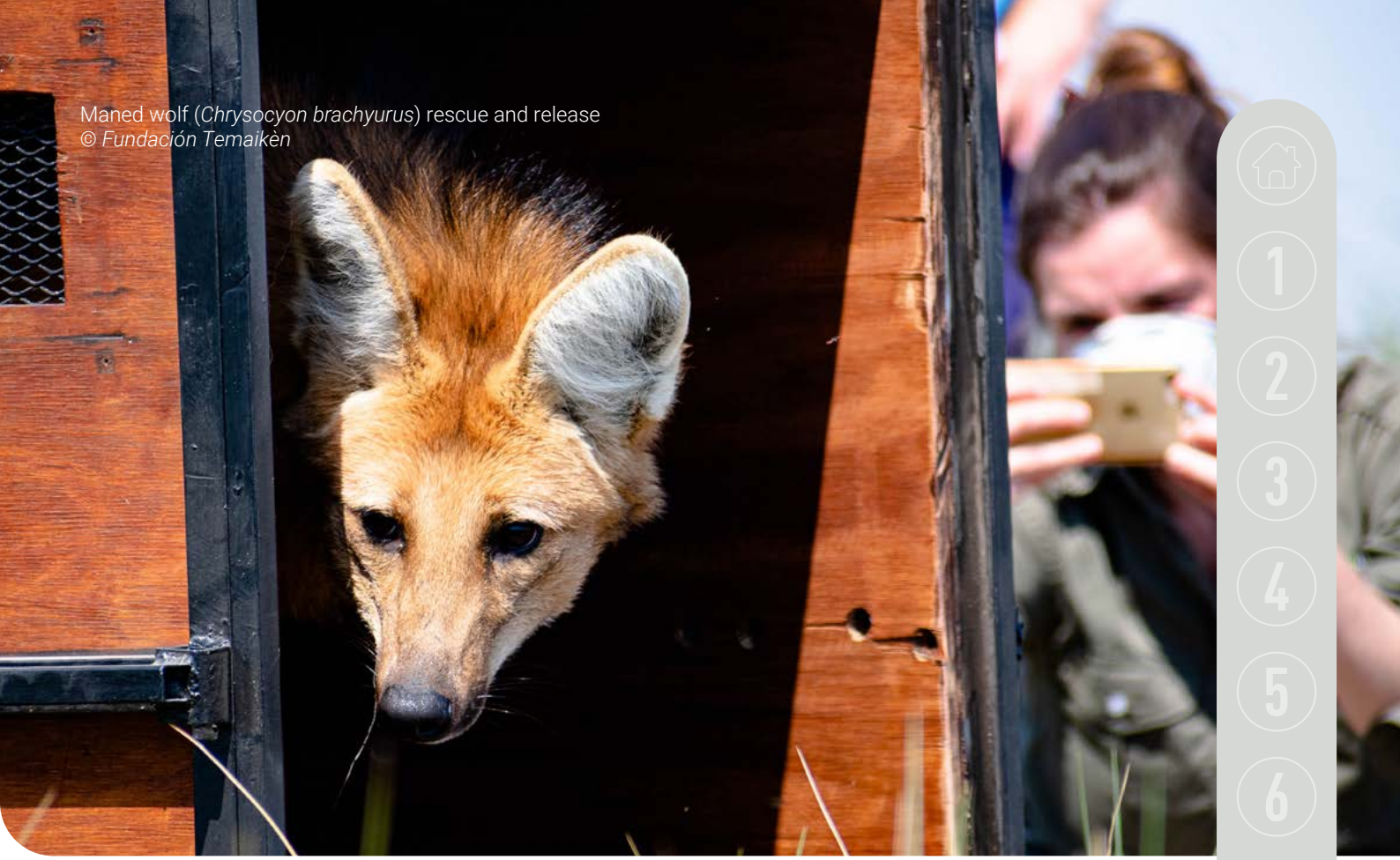
Some advocates suggest that the 3Rs provide minimum standards that can be expanded. More recently, the Concordat on Openness in Animal Research (2014) provides valuable lessons that reflect modern thinking, particularly on transparency and public accountability. Conservation efforts should clearly communicate the ethical basis, methods, and outcomes of interventions, engaging partners to foster trust. Sharing successes, failures, and lessons learned demonstrates commitment to ethical standards and encourages informed dialogue, but also contributes to ongoing refinement of techniques See Case Study 7.3, reducing potential future harm.

Case Study 7.3

White's Seahorse Recovery Programme | SEA LIFE Sydney Aquarium (Australia)

In 2019, SEA LIFE Sydney Aquarium (SLSA), in partnership with NSW DPI Fisheries and the Sydney Institute of Marine Science, launched a recovery programme for the endangered White's seahorse (*Hippocampus whitei*), aligned with the New South Wales Department of Primary Industries' Priority Action Statement. As aquatic husbandry specialists, SLSA was tasked with developing and implementing "an *ex situ* breeding programme to produce and release animals reared under human care back into the wild to assist recovery of White's seahorse populations."

To support this, SLSA established a purpose-built Conservation Lab with facilities tailored to the species' husbandry needs, from broodstock to juvenile development. As a welfare-accredited member of the Zoo and Aquarium Association of Australasia (ZAA), SLSA applies the Five Domains Model and uses the ZAA Welfare Assessment Tool (WAT) to evaluate and promote positive welfare. The lab includes aquaria of varying sizes and shapes, with interchangeable theming, perches, and manipulable flow, temperature, and lighting to simulate natural conditions and offer animals experiences such as foraging, choice, novelty, and seasonality. The programme's ongoing commitment to animal welfare has informed continuous improvements, culminating in the production of a dedicated White's seahorse husbandry manual based on insights gained throughout the project.



Maned wolf (*Chrysocyon brachyurus*) rescue and release
© *Fundación Temaikèn*

There are no universally agreed-upon principles guiding those who work with wildlife welfare and conservation. However, a useful framework, slightly modified here, has been provided by principles suggested in a consensus statement arising from a 2009 Conservation and Animal Welfare Science Workshop (2010) held at the University of British Columbia:

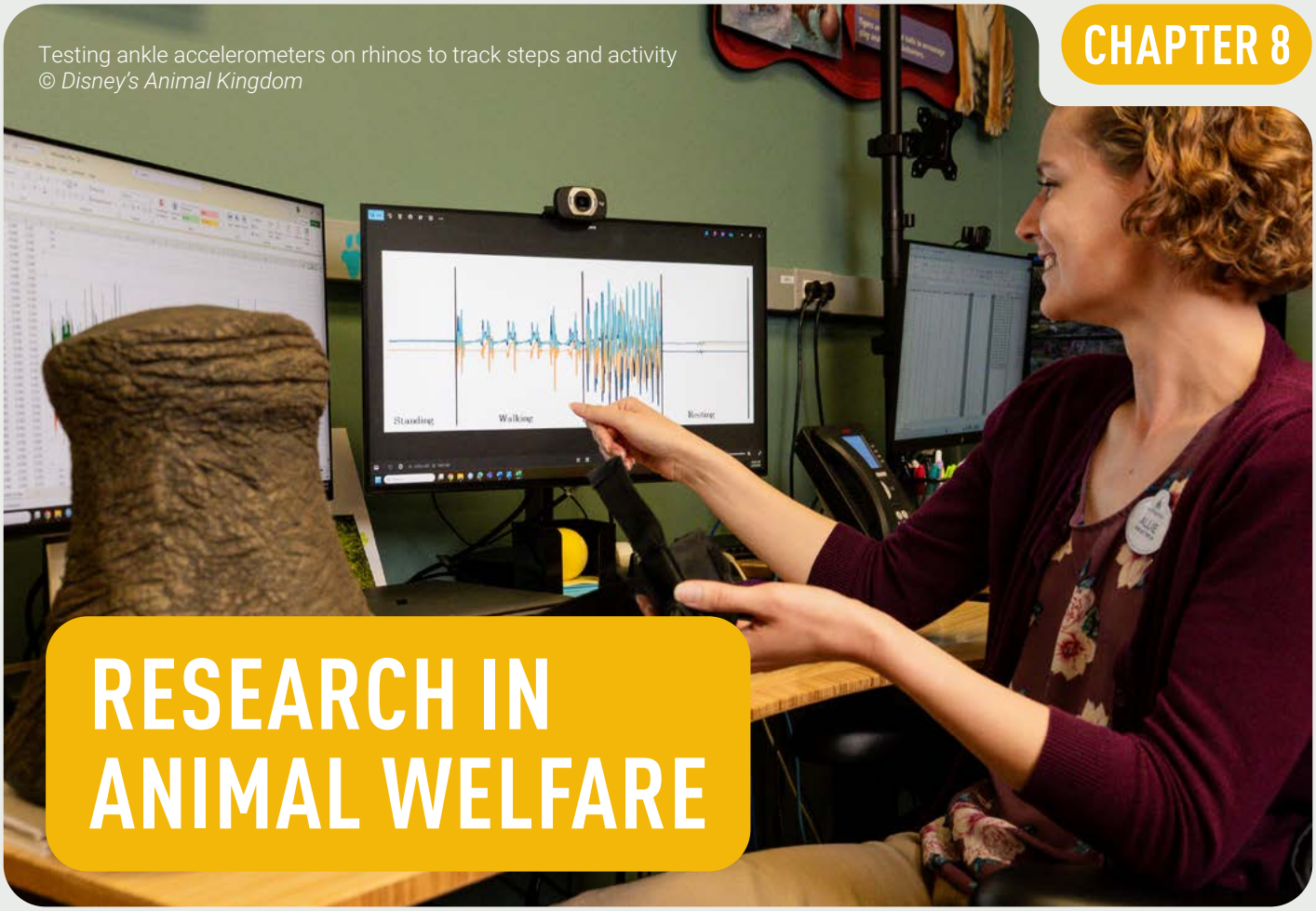
- The welfare of all individual wildlife species is of equal moral concern. This does not mean that all such animals must be treated equally, just that their well-being should be given equal consideration.
- Actions that affect animals are of moral concern whether they exert their effects directly or indirectly.
- Actions that might harm the welfare or conservation status of wildlife should not be undertaken without careful consideration of the necessity of the action.
- The severity and scale of harm (in terms of the number of animals affected and the duration of the harm compared to the lifespan of the animal) should be minimised.
- Actions with irreversible impacts should be considered to be more serious than those with transient impacts.

CONCLUSION

It is increasingly important to recognise the relevance of animal welfare when planning wildlife conservation efforts. The same human activities driving the current biodiversity crisis often compromise animal welfare, and these interlinked concerns directly apply to the work of zoos and aquariums on saving wildlife.

The welfare of wildlife species can be directly and indirectly assessed in increasingly sophisticated, scientifically validated ways. The fact that animal welfare is assessed on an individual basis, whereas some wider goals of wildlife conservation are measured on populations or species, does not make them incompatible.

Animal welfare and conservation scientists and advocates are increasingly recognising each other's work as complementary. Zoos and aquariums need to ensure that their conservation work with threatened wildlife populations, and the work of their conservation partners, include strategies aimed at achieving positive animal welfare outcomes.Ligendandae perum harum, et



Testing ankle accelerometers on rhinos to track steps and activity
© *Disney's Animal Kingdom*

CHAPTER 8

RESEARCH IN ANIMAL WELFARE

OUR COMMITMENT IS TO CONSIDER ANIMAL WELFARE IN RESEARCH ACTIVITIES AND ADOPT A SCIENTIFIC, EVIDENCE-BASED APPROACH TO ANIMAL WELFARE IN ANIMAL CARE.

Paul Rose
University of Exeter/
BIAZA Research Committee

Ashley Edes
Saint Louis Zoo

Marina Salas
Antwerp Zoo Centre for
Research and Conservation

RECOMMENDED ACTIONS

To realise our commitment to high animal welfare standards, WAZA calls on its member organisations to:

1. Prioritise research that identifies factors contributing to animal welfare states and that advances welfare monitoring techniques when collaborating with universities, research bodies and other zoo and aquarium institutions.
2. Share research findings and apply the outputs from valid scientific research to welfare assessment and welfare-focused husbandry and management practices.
3. Form a committee or similar entity to review proposed research activities prior to implementation to ensure the institution's ability to complete the study and ensure scientific rigour.
4. Develop a research policy and protocols to ensure that any potential animal welfare concerns are clearly identified. Negative impacts on animal welfare should be minimised, transient, and justified in terms of the objectives of the research.
5. Encourage research focused on medicine and conservation to enhance animal welfare both *in situ* and *ex situ* with conservation partners and other collaborations.

INTRODUCTION

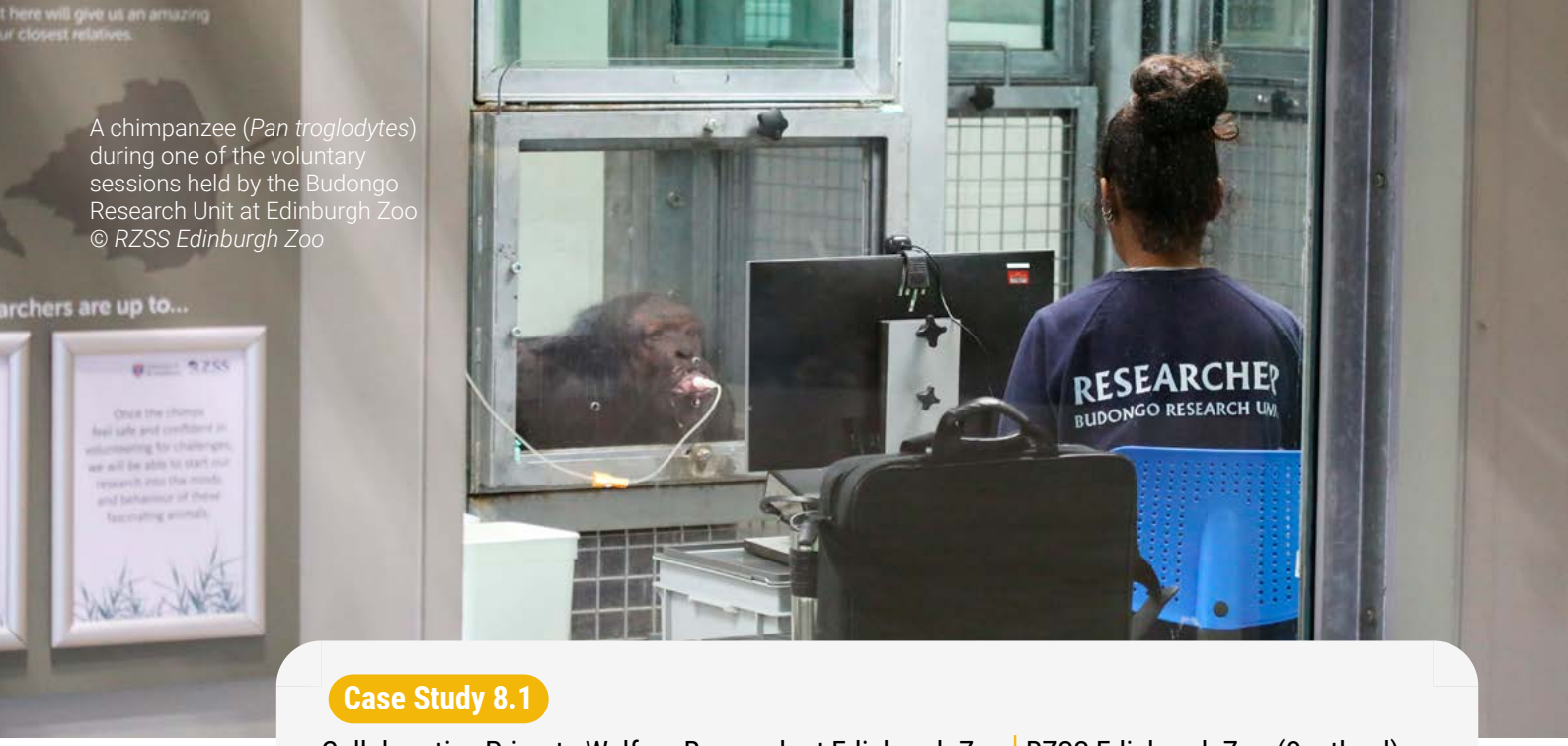
Zoos and aquariums have the potential to offer multiple opportunities for scientific research, including research on both basic (e.g. gaining of fundamental knowledge) and applied (e.g. with direct influence over zoo and aquarium operations) questions, for scientists seeking to learn more about key elements of the natural world and our human relationships with it.

> It is therefore critical to understand the importance of research on defining, understanding and assessing zoo and aquarium animal welfare states, and showcase the value of the evidence-based approach to animal husbandry and management protocols as the foundation for positive welfare outputs.

With this, zoos and aquariums should develop a list of research priorities or identify research areas that they wish staff, students, external researchers, or collaborative partners to focus on. These lists may be informed by national or regional zoo and aquarium associations or WAZA committees, as appropriate. In this way, research efforts and outputs are directed to areas of zoo and aquarium operations that require the most scrutiny and ultimately have the biggest impact.

Research collaborations between zoos or aquariums and academic institutions can have the advantage of furthering knowledge gain in many areas of zoo and aquarium operations (Fisken, 2011). Sharing expertise also greatly extends the scope and value of scientific study and can result in investigations being undertaken that would otherwise not have been possible. Such collaborations can help develop and refine methods and approaches for zoo and aquarium animal welfare assessment by utilising the expertise in scientific research embedded at universities with the knowledge of the animals and their care from the zoo and aquarium See Case Study 8.1. Even small-scale case studies have value in advancing our understanding of animal welfare assessment, and well-run undergraduate projects should not be dismissed as low impact or low value. Relationships between a zoo or aquarium and a university, when well managed and with clear dialogue, can benefit both parties See Chapter 9.

Endocrinology Lab
© *Detroit Zoo*



A chimpanzee (*Pan troglodytes*) during one of the voluntary sessions held by the Budongo Research Unit at Edinburgh Zoo © *RZSS Edinburgh Zoo*

Case Study 8.1

Collaborative Primate Welfare Research at Edinburgh Zoo | RZSS Edinburgh Zoo (Scotland)

The Royal Zoological Society of Scotland (RZSS), the University of St Andrews, and the Scottish Primate Research Group partnered to create the "Living Links" and "Budongo Research Unit" at Edinburgh Zoo – highlighting the value of multidisciplinary collaboration in advancing welfare and behaviour research.

Living Links (est. 2008) houses squirrel and capuchin monkeys with access to indoor/outdoor habitats and purpose-built testing rooms, where they can voluntarily participate in research. Budongo (est. 2018) supports a community of chimpanzees in an award-winning habitat designed to promote natural behaviours and offers optional research-based activities.

Both centres allow scientists to study primates while educating visitors about the role of research in enhancing welfare. Real-time observation helps make science accessible and transparent (MacDonald & Whiten, 2011). This partnership shows how strong welfare enables rigorous science and how zoos can be effective platforms for education, research, and care.

Multiple studies have examined trends in zoo and aquarium research outputs (Hvilsom et al., 2020; Rose et al., 2019). Unsurprisingly – given its accessibility, usefulness and flexibility – behavioural research tops these lists, with mammalian studies predominating. While it is important to study mammal behaviour, zoos and aquariums should also use research priority lists to direct researchers to other questions or less studied taxa (e.g. fish, reptiles, invertebrates, amphibians) where there is a need to gather evidence for husbandry and management. The available scientific literature is a good starting place for determining what question(s) to ask and why. Methods can be taken from papers on well-studied species and adapted for ones less studied. This saves time and effort, and removes the potentially daunting aspect of starting a research project from scratch.

It is important to remember that science is cumulative (what we do now builds on what has occurred in the past), so by using and acknowledging such past papers, we continually add to our knowledge. In animal welfare science, for example, we know that behaviour can be a useful first identifier in helping us understand what animals need to do and what happens when they are thwarted in their efforts. We can then build on this by looking at body language and behavioural expression linked to internal welfare states. This integration of quantitative and qualitative data helps build a more complete pattern of animal welfare outputs. As science moves forward, we have also validated certain physiological measures of hormonal change linked to stress, pleasure, excitement or reproductive state that can be further integrated into an animal welfare research project. But without looking at what has been done before, we cannot develop our methods, experimental designs, research plans and study systems accordingly.

Key tips for building a successful and long-running research project with a focus on animal welfare include:

1. Where financially and logistically possible, welfare-focussed staff (e.g. animal care staff with a welfare-specific role, or the recruitment of welfare specialist scientists) within the zoo or aquarium can spearhead research and its application to operations.

2. Develop links with academic institutions that possess the expertise and knowledge in how to design and implement data collection methodologies.

3. Decide on what key areas of animal welfare need to be researched in your zoo and aquarium, and ensure all personnel collecting data are trained in the same methods.

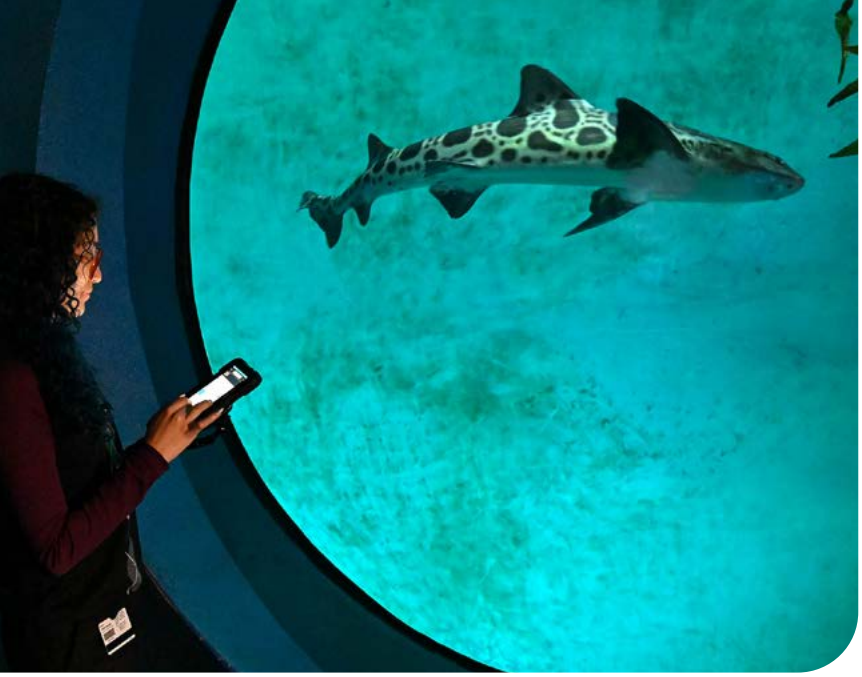
4. Publish, or have readily available, lists of priority projects with critical details including a title, focal species or system, and aims and objectives that can be passed on to students or external researchers that contact the zoo or aquarium.

5. Ensure all personnel who collect data (e.g. internal staff members or external students) provide their raw data in an accessible format for review and analysis by the scientists or researchers who are running the study.

6. Disseminate findings of any animal welfare-focused study, no matter how small, through conference presentations and peer-reviewed scientific publications so that new questions and predictions can be generated.

7. Foster collaboration, not competition. Work with others who are also interested in answering a specific question to promote positive animal welfare states. Build a professional network of scientists, species experts, and animal health professionals that can assist with implementing and executing research.

American flamingos (*Phoenicopterus ruber*)
© *Cali Zoo*



Animal Welfare Intern doing research on sharks
© *Brookfield Zoo Chicago*

A research focus in zoos and aquariums can benefit from long-term commitment to close cooperation with the academic community, especially when the zoo or aquarium does not have on-site research expertise. A decision-making process on academic partnerships and research at both policy and operational level can be developed to support improved animal welfare, encourage high-quality scientific research, facilitate research to answer questions of great relevance to improving animal welfare, and strengthen the scientific credibility of the zoo or aquarium involved See Chapter 9.

Research is only as valuable as the audience it reaches. Once permissions have been acquired, findings should be shared with all vested parties. Publishing in peer-reviewed journals and presenting at conferences is recommended, as such events foster collaboration and can spark new ways of "doing science at the zoo and aquarium", and help shape future research.

INCLUDING ANIMALS IN RESEARCH

Not all research in zoos and aquariums is focused on animal welfare. However, no matter the research focus, prior to undertaking any research that involves animals, potential or actual impacts on their welfare must be discussed and a cost-benefit evaluation of any negative impacts be undertaken. It is important to consider the regulatory context regarding the conduct of scientific research on animals. The details of laws and regulations may vary but the key principles are often common.

Even for observational research, the "The 3Rs" of Refinement, Reduction and Replacement should always be considered See Figure 7.2.

The 180 member countries of the World Organisation for Animal Health (OIE) unanimously accepted OIE standards for the 'Use of Animals in Research and Education' (World Organisation for Animal Health, 2010). These standards are not intended to supersede existing statutes, which may include more detailed and exacting requirements; rather, they provide guidance to those countries seeking to update old statutes or to introduce them for the first time. These standards emphasise compliance with national laws, the importance of having institutional policies for animals in research, external oversight by ethics committees or other such entities, and a balance between research benefits and animal welfare, as well as minimising welfare impacts. These principles are a useful guide for zoos and aquariums and their research partners for zoo- or aquarium-based research but also in the conduct of field conservation activities See Chapter 7.

Invasive research involving significant surgical interference to an animal is often unacceptable to zoos and aquariums, though there are some research projects where such approaches may be acceptable from the institution's perspective. Decisions about such research require careful balancing of management, conservation, scientific and ethical perspectives, and will have the best support if they are done within the context of a formal consultation and decision framework. When research involving animal restraint or anaesthesia is approved, staff should also take the opportunity to collect samples for biobanking.

Observational research in zoos or aquariums faces similar challenges to those of wild field studies. For example, animals may move out of sight, limiting the amount of data that can be collected within an observation period. Animals in zoos or aquariums and in the wild will respond to stimuli beyond the observer's control (e.g. weather, presence of other biotic factors) that can disrupt observation sessions. Ensuring due review and evaluation of the impacts of such events enables valid and replicable outputs from observational studies.

Being an "ethical scientist" relies on having research methods reviewed in order to protect animal welfare to the extent possible and ensure integrity of the science performed. For those wishing to know more on ethical practices and upholding good academic practices in research involving animals, published guidelines on ethical methods for observational research are readily available (ASAB Ethical Committee/ ABS Animal Care Committee, 2024).

CONDUCTING RESEARCH TO SUPPORT POSITIVE WELFARE IN ZOOS AND AQUARIUMS

Research in zoos and aquariums is not always straightforward, often facing criticism for small sample sizes and lack of repeatability and replication. Institutional differences in animal life histories, housing, and husbandry can affect results and limit broader application. Researchers must account for these factors when generalising findings. Multi-institutional studies are strongly encouraged, using variations in care as biological data to identify welfare-husbandry associations. If a broader study isn't possible, a well-designed single-institution study can still provide an impactful case study. In combination with simple experimental setups based on positive reward systems (e.g. preference testing, cognitive bias testing or choice of environmental enrichment interaction), observational studies have a substantial potential to contribute to improvements in animal welfare.

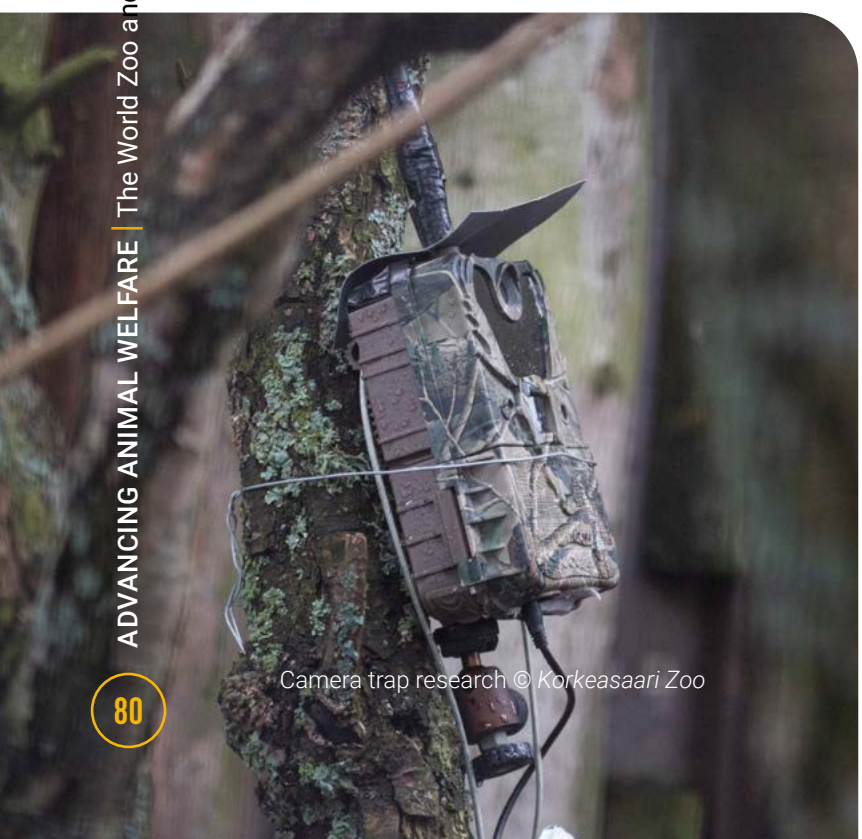
The use of validated and species appropriate methods when assessing welfare in zoos and aquariums is necessary See Chapter 2. Scientific research can be used to develop and refine welfare assessment methods. A species-specific focus to welfare assessment means case studies that, collectively, develop a better way to infer welfare for a particular species, can be grouped to eventually produce a standardised welfare tool for that species, that can be more insightful than generic welfare assessments.

The Five Domains Model See Chapter 1, was originally developed specifically to minimise harm from research, teaching and testing procedures involving sentient animals (Mellor & Reid, 1994). Its wider use for assessing welfare was a later development. The principles of the Model are potentially useful in developing welfare assessment methods but lack of objectivity, repeatability and reliability in scoring welfare indicators could still result in different conclusions being drawn. A mixed methods approach that investigates the relevance of inputs and their impact on measurable and valid welfare outputs (e.g. time-activity patterns, behavioural expression/body language, physical health measures) may be more appropriate for species that lack current, validated and tested means of assessing mental states.

Nitsche's bush viper (*Atheris nitschei*) © *Kees Groot*

As such, a welfare research question should focus on animal responses to inputs that are provided (e.g. housing, husbandry, nutrition) and reactions to stimuli from the wider environment (e.g. presence of zoo or aquarium visitors, personnel, weather/climate). Therefore, observational studies could construct time-activity budgets or evaluate space utilisation and resource usage. Understanding how an animal responds to a change requires starting observations prior to when those changes are made. Too often, the desire to understand the impact of a change is expressed too late, with insufficient time to collect baseline/pre-change data or even after the change has occurred.

Alongside such observational research, personality scoring by the animal care professionals can provide context for individual animal differences in responses to the zoo or aquarium environment and their care. Physical records (e.g. body condition score, plumage, pelage, or scale condition) and health status (e.g. morbidity) provide measurable data on how animal care and the animal's environment impact welfare and biological function. Finally, non-invasive measures of physiological responses (where validated for that species) may help contextualise changes in behavioural patterns and provide potential explanations for acute and chronic changes to homeostasis that can impact welfare states.



Camera trap research © *Korkeasaari Zoo*

Whenever welfare research is undertaken for the purpose of promoting positive welfare, a benchmark is required. Documentation of welfare states (behavioural, psychological and/or physical) should be maintained and new data then used as a comparison. When attempting to identify improvements to welfare, one can only say with confidence that welfare has improved if methods are comparable so that data can be reviewed with certainty.

CURRENT AND PRIORITY AREAS OF ZOO AND AQUARIUM RESEARCH

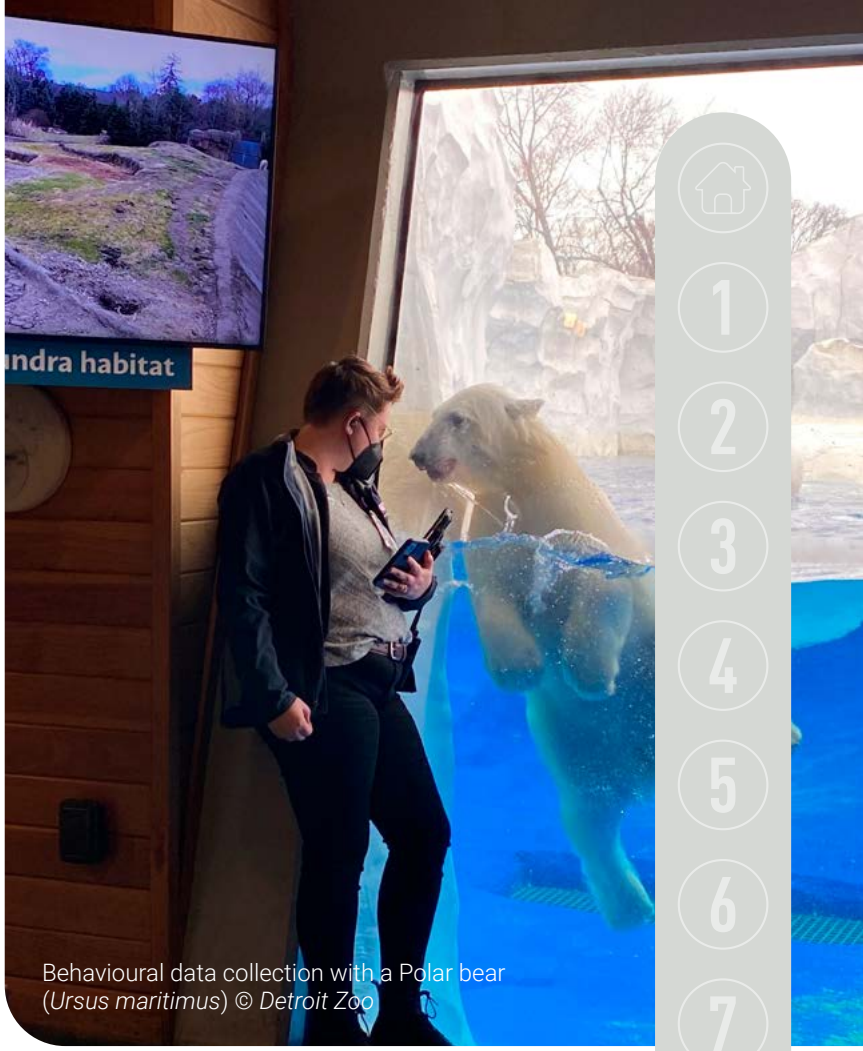
There are numerous research questions that can have a strong welfare component when conducted in zoos and aquariums. A non-exhaustive list includes:

- Increase our understanding of both positive and negative stressors in the zoo and aquarium environment and the extent to which these compromise or enhance welfare.
- Validate and define our understanding of indices of negative and positive animal welfare states, including stereotypies and other behavioural cues across taxa See Case Study 8.2 as well as physiological data such as hormone levels or heart rate.
- Design and evaluate innovative environmental enrichment approaches across species that involve species-specific challenges that promote problem solving, learning, and resilience.
- Detection of infertility and associated health compromises.
- Analyse the impact of contraceptive control of reproduction on behaviour and welfare.
- Optimise nutrition for all life stages.
- Enhance assessment of health status and pathogen detection in all managed individuals and wild individuals that may come in contact with them.
- Develop techniques to enhance *ex situ* population viability and reintroduction efforts that consider individual and population-level welfare.

Case Study 8.2

Research that enhances animal welfare and evolves evidence for husbandry | Detroit Zoo (US)

Research by Detroit Zoo explored the behavioural development of two polar bear cubs, one hand-reared and the other parent-reared (Gartland et al., 2024). Both cubs displayed similar developmental patterns, such as time spent inactive and playing, consistent with data on wild polar bear cub development. Parent-rearing promoted independence from the cub's mother (measured as a reduction in time in proximity with age), while hand-rearing corresponded with the performance of stereotypic pacing. This research suggests that hand-reared cubs require enriched environments to prevent stereotypic behaviours. Zoo and aquarium-based studies offer valuable insights into behavioural development and demonstrate that management practices impact welfare.



Behavioural data collection with a Polar bear (*Ursus maritimus*) © *Detroit Zoo*

CONCLUSION

Zoos and aquariums offer valuable opportunities for high-quality research that can, for example, evaluate the inputs that we provide and validate the outputs that we can infer on welfare experience, thereby improving welfare assessment protocols. Zoos and aquariums have yet to fully realise their potential in conducting research that enhances animal welfare. Strategic planning and collaboration, particularly with academic institutions, can overcome concerns about costs or other challenges associated with research. Collaboration with academic institutions also ensures rigorous data collection aligned with the needs of animals and staff.

Being strategic, expending modest additional effort to support scientific research on animal welfare can significantly advance scientific knowledge while enhancing institutional credibility. Reliance on anecdotal evidence is insufficient. Transparency, validity, and objectivity are essential components of the research process. Reliable research outputs, especially peer-reviewed studies, provide the foundation for welfare-focused animal management. Ultimately, zoos and aquariums can drive improvements in animal welfare standards by embracing research methodologies that promote an evidence-based approach to housing, husbandry and management.

Following rehabilitation from a poaching-related injury, this Amazonian manatee (*Trichechus inunguis*) was released into the Amazon rainforest through a partnership between the Centro de Rescate Amazónico and the Dallas World Aquarium © *Dallas World Aquarium*

PARTNERSHIPS IN ANIMAL WELFARE

OUR COMMITMENT IS TO WORK COLLABORATIVELY WITH OUR PARTNERS, LEVERAGING OUR COLLECTIVE STRENGTHS AND EXPERTISE FOR THE BENEFIT OF THE ANIMALS IN OUR CARE AND BEYOND.

Paula Cerdán
WAZA

Darren Minier
Oakland Zoo

RECOMMENDED ACTIONS

To realise our commitment to high animal welfare standards, WAZA calls on its member organisations to:

1. Align all partnerships with your organisation's strategic goals, prioritising animal welfare and broader objectives. Partner with organisations whose resources, expertise, and strengths complement yours and enhance animal welfare initiatives.
2. Establish clear agreements outlining shared goals, timelines, roles, responsibilities, and decision-making processes to ensure mutual benefit, accountability, and transparency.
3. Foster long-term partnerships that support capacity building, knowledge transfer, and lasting benefits, rather than short-term projects.
4. Proactively collaborate with a wide range of partners and colleagues to broaden the reach and impact of your animal welfare efforts.
5. Maintain regular, transparent communication, track progress, and evaluate success to ensure continuous improvement and alignment.

> Partnerships provide a powerful mechanism for combining the strengths of each party, enabling both parties to achieve their respective goals while advancing animal welfare on a broader scale.

INTRODUCTION

Knowledge of animal welfare is increasing across the globe, but resource constraints and operational challenges that limit or hinder animal welfare are disproportionate. Though animal welfare science is providing clearer definitions, models, and metrics for the welfare of many species, applying such measures to enhance or change traditional animal care methodologies and the spaces in which animals live can be challenging logistically, cost prohibitive, or both. This creates massive potential for zoo and aquarium partnerships to leverage shared resources, expand reach, and amplify impact.

As part of a collaborative community, WAZA members are encouraged to share their expertise and support one another to advance animal welfare through meaningful partnerships. These partnerships can take many forms and may involve collaborations between zoos and aquariums, associations, non-profits, for-profit entities, academic institutions, government agencies, and other interested parties who share animal welfare goals and bring complementary strengths See Case Study 9.1. This is particularly valuable for institutions with more limited access to resources or expertise.

Case Study 9.1

Zoo and Aquarium Associations collaborate with Wild Welfare to meet WAZA's Animal Welfare Goal

In 2024 three zoo and aquarium associations met WAZA's Animal Welfare Goal supported by long-term partnerships with Wild Welfare. Since 2014, Wild Welfare has worked alongside Associação de Zoológicos e Aquários do Brasil (AZAB), Japanese Association of Zoos and Aquariums (JAZA), and Southeast Asian Zoo and Aquarium Association (SEAZA) to develop comprehensive animal welfare certification programmes.

These partnerships facilitated several successes, such as 10 WAZA members in Japan undertaking full animal welfare audits, 12 AZAB members achieving certification in 2024, Wild Welfare supporting SEAZA in conducting their audits, and all three associations completing auditor and advanced auditor training which was delivered by Wild Welfare and Wild Welfare US.

In 2024, JAZA met WAZA's 2023 Animal Welfare Goal, supported by long-term partnerships with Wild Welfare © *Wild Welfare*

To highlight the strength of these partnerships, in 2023, AZAB adopted the *Wild Welfare Core Standard of Welfare Practice for Captive Animals* as its official welfare standard, a significant step in improving animal care and welfare across member facilities.

Houston Zoo and Taipei Zoo signed an agreement to advance wildlife conservation, animal welfare, education, and cultural exchange through 2026 © *Taipei Zoo*

Partnerships can range from simple initiatives, such as funding specific welfare enhancements, to long-term collaborations built on mutual trust, respect, and a shared vision. Collaborating with animal welfare and rescue organisations, local and government agencies, and other like-minded organisations is critical to increasing animal welfare for both animals in our care and others who can benefit from our knowledge and skill.

PARTNERING TO EXPAND CAPACITY, KNOWLEDGE, AND IMPACT

Animal welfare partnerships bring together diverse stakeholders with complementary strengths to achieve shared goals. These collaborations may serve a wide range of purposes – from sharing expertise between zoos and aquariums, to conducting research, or working with governments to shape policy and legislation See Case Study 9.2.

Wild Welfare's Auditor training for the *Associação de Zoológicos e Aquários do Brasil (AZAB)* © *Wild Welfare*

Case Study 9.2

Partnering for Big Cats: AZA's Role in Passing US's Big Cat Public Safety Act | AZA

In 2022, the U.S. passed the Big Cat Public Safety Act (BCPSA), addressing the widespread private ownership of big cats – an issue that may have left more tigers in captivity in the U.S. than in the wild.

The Association of Zoos and Aquariums (AZA), alongside partners like WWF, WCS, and Humane World for Animals, supported legislation to close regulatory gaps that allowed untracked private ownership outside the scope of the Endangered Species Act.

AZA worked to ensure accredited zoos could continue to hold and breed big cats. Though first introduced in 2012, the bill gained traction after the 2020 Tiger King docuseries raised public concern. It passed the House in 2020 and the Senate in 2022 and was signed into law.

Sumatran tiger (*Panthera tigris sumatrae*)
© *Chester Zoo*

Collaborations with academic institutions enhance understanding of key welfare topics, such as pain perception, sentience, and positive behavioural states across species. Veterinary teams in zoos or aquariums may work with conservation bodies to improve the health and welfare of free-ranging wildlife. Partnerships with local and national governments help ensure compliance with legislation while supporting policies aligned with zoos' and aquariums' welfare and conservation missions.

National and regional associations play a key role in coordinating multi-institutional initiatives. NGOs may provide specialised expertise, advocacy, or independent oversight, while corporate partners can sponsor welfare improvements.

Collaborations with conservation organisations ensure that the welfare needs of free-ranging wildlife are integrated into broader strategies. For example, *ex situ* efforts like propagation for reintroduction and headstarting for release require welfare expertise to care for animals in zoos and aquariums. Likewise, welfare considerations extend to free-ranging animals when zoo and aquarium staff participate in field conservation. These partnerships collectively enhance the impact of zoos, aquariums, and their collaborators on animal welfare and conservation.

Partnerships may also involve organisations with opposing views or concerns about animals in human care See Case Study 9.3. While such relationships involve risks, transparent and honest dialogue with advocacy groups – despite fundamental differences – can help achieve shared goals, build trust, foster compassion, and lay the foundation for long-term collaboration. These engagements promote mutual respect and may lead to alignment on key issues, while acknowledging areas of disagreement.

Case Study 9.3

Sometimes controversial partnerships to combat animal cruelty and neglect | Oakland Zoo (US)

Oakland Zoo's commitment to animal welfare extends beyond its own residents, supporting animals in need locally, nationally, and internationally. For decades, its staff have advised on cases of cruelty, exploitation, and wildlife crime, have helped shape regulations, and assist investigations alongside organisations like the Humane World for Animals (formerly Humane Society of the United States) and People for the Ethical Treatment of Animals (PETA).

These partnerships can be controversial, as groups like PETA often criticise zoos and aquariums. However, prosecuting animal abuse cases requires expertise beyond law enforcement and legal teams. Zoo and aquarium professionals assess animal welfare, provide expert testimony, and ensure proper care for confiscated animals – critical steps in building strong cases against neglect and exploitation.

Since 1999, Oakland Zoo has helped remove thousands of animals from abusive conditions. As Brittany Peet of the PETA Foundation stated, "The Oakland Zoo has long prioritised common sense and welfare, and PETA looks forward to continued collaboration on improving the welfare of captive wildlife across the U.S."

A scuba diver from the Seattle Aquarium interacts with young visitors
© Seattle Aquarium

CONSIDERATIONS AROUND ESTABLISHING PARTNERSHIPS

The success of a partnership relies on thorough planning, clear communication, and ongoing evaluation to ensure accountability and mutual benefit See Figure 9.1. When forming partnerships, it is essential to define goals, priorities, and specific outcomes. A successful collaboration identifies mutual benefits and what each party hopes to gain. Organisations should assess whether their strengths and resources are complementary, while recognising limitations such as staffing, funding, or legal constraints. Mapping out challenges – real or perceived, legal, strategic, or logistical – helps prevent misunderstandings and prepares the partnership to address difficulties.

Partnerships are encouraged to formalise collaboration through agreements (e.g. memorandum of understanding) that detail the partnership's scope, duration, implementation, communications, and dispute resolution. Clear timelines and deliverables should be established early. Thoughtful coordination helps minimise duplication and ensures contributions are aligned for maximum impact. The process should also include how success will be monitored and evaluated, using both qualitative and quantitative indicators – such as Key Performance Indicators (KPIs), Return on Investment (ROI), financial data, programme outcomes, and feedback on satisfaction and engagement.

Strong governance is essential. Roles, responsibilities, and expectations should be clearly defined – including decision-making processes and communication norms. Clarity on who does what and when helps avoid ambiguity. Establishing expectations for communication supports transparency and alignment. Agreement on deliverables and shared expectations fosters trust and collaboration throughout the partnership's duration.

FIGURE 9.1 Primary considerations in navigating benefits, challenges, and impacts in a typical partnership.

MAXIMISING THE VALUE OF PARTNERSHIPS

Effective partnerships focus on shared goals and outcomes rather than simply measuring outputs or the metrics of the work produced. There is great value in deepening connection and agency between the organisations and in sharing perspectives, ideas, expertise, and purpose. The value generated in terms of social, economic, or welfare and conservation benefits must be compared to the resources invested by each partner in analysing the effectiveness of the partnership. However, the intangible value generally outweighs the metrics of a partnership's effectiveness, particularly regarding enhancing animal welfare, credibility and institutional growth.

To position themselves as centres of expertise, zoos and aquariums must maintain transparent and proactive relationships with their partners.

The focus of the partnerships that a zoo and aquarium establishes should be aligned with the organisation's strategic direction and priorities, as well as the capacity to provide resources to support the success of the partnership.

Successful partnerships rely on leveraging complementary strengths from the organisations involved. This includes capacity building, knowledge transfer, organisational learning, and the development of sustainable solutions that extend beyond the partnership's duration. By focusing on these principles, partnerships can achieve lasting impacts for animal welfare and conservation.

All partners are encouraged to communicate proactively about the successes of the partnerships they are part of. Communication objectives, methods and channels as well as partners' responsibilities should be an integral part of partnership agreements.

São Paulo Zoo works closely with the Brazilian government and other organisations to advance shared goals in animal welfare and conservation © *São Paulo Zoo*

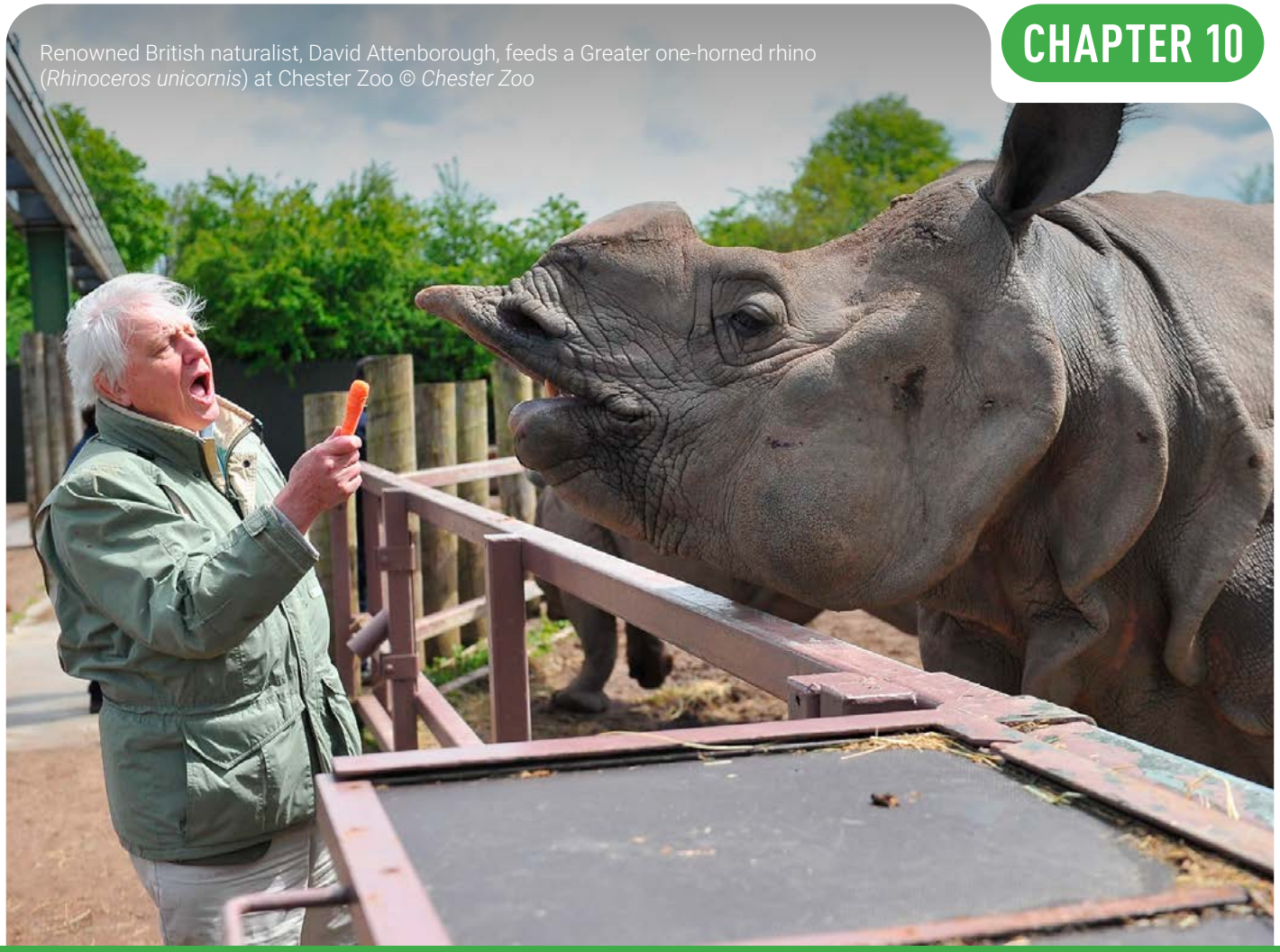
The Latin American Association of Zoos and Aquariums (ALPZA) and the Zoo and Aquarium Association Australasia, partnered to share, learn and strengthen their accreditation systems © *ALPZA*

CONCLUSION

Partnerships offer zoos, aquariums, and their collaborators a powerful way to expand their impact on animal welfare and conservation. These relationships can range from simple collaborations to complex, multi-partner initiatives involving non-profits, academic institutions, government agencies, and private entities. Each partner brings unique strengths that, when combined, can address welfare challenges more effectively than any organisation alone. Strong partnerships require clear goals, transparent communication, and regular evaluation to maximise both tangible and intangible benefits.

Success depends on mutual respect, well-defined roles, and decision-making processes that foster trust. Key considerations include assessing partner strengths, setting timelines and deliverables, and monitoring impact through qualitative and quantitative measures. By engaging a broad range of partners or collaborators – from advocacy groups to corporate sponsors – zoos and aquariums can build diverse, lasting collaborations that support animal welfare, strengthen institutional capacity, and advance conservation. With aligned goals and shared resources, partnerships can deliver enduring positive outcomes for animals, people, and the environment.

Sea otter survey led by the Seattle Aquarium © *Seattle Aquarium*



Renowned British naturalist, David Attenborough, feeds a Greater one-horned rhino (*Rhinoceros unicornis*) at Chester Zoo © *Chester Zoo*

CHAPTER 10

Mark James Learmonth
Bristol Zoological Society

Paula Cerdán
WAZA

Mandi Wilder Schook
Disney's Animal Kingdom

OPTIMAL WELFARE OF ANIMALS PARTICIPATING IN ANIMAL-VISITOR INTERACTIONS

OUR COMMITMENT IS TO PROTECT AND ENHANCE THE WELFARE OF OUR ANIMALS IN ALL OF THEIR INTERACTIONS WITH VISITORS WHILE WE INSPIRE EMPATHY AND CONNECT PEOPLE TO ANIMALS, AND ENGAGE VISITORS IN WILDLIFE CONSERVATION.

RECOMMENDED ACTIONS

To realise our commitment to high animal welfare standards, WAZA calls on its member organisations to:

1. Ensure that all animal-visitor interactions adhere to the WAZA Guidelines for Animal-Visitor Interactions (AVI's) (WAZA 2020).
2. Provide all 'experience' animals with the opportunity to express agency and control, including the ability to choose whether or not to participate in each experience.
3. Conduct ongoing welfare evaluations and monitoring of animals in AVIs and avoid using animals in AVIs that result in negative welfare outcomes.
4. Ensure respectful treatment and representation of animals, both in practice and in how they are portrayed to the visitors and explain how welfare has been optimised for the animals involved.
5. Leverage expertise in environmental education and AVI animal welfare literature to develop interactions that maximise benefits and ensure animal welfare.

INTRODUCTION

In recent decades, zoos and aquariums have seen rapid growth in a new model of animal husbandry, presentation, and visitor experience. This includes adapting traditional models of housing 'ambassador animals' and offering animal-visitor interactions (AVIs). When conducted appropriately, these experiences leverage human-animal connectedness to inspire conservation, reduce harmful behaviours, enhance zoo knowledge, and foster empathy (Howell et al., 2019; Learmonth et al., 2021; Minarchek et al., 2021). They also aim to build positive attitudes towards the broader work of zoos and aquariums – both for animals in their care and species conservation in the wild. For children and adults alike, the thrill of being close to a wild animal can spark lifelong interest in animals, ecosystems, and importantly, conservation.

The 'modern zoo' movement, which promotes naturalistic habitats and a respectful understanding of animals' natural history, has gained significant momentum (Gray, 2017). Many facilities now embrace an ethical, measured approach to husbandry, housing, and presentation – often moving away from direct-contact experiences and performance-based shows. Instead, they prioritise observational encounters and immersive settings beyond traditional habitats. This marks a shift from sensationalised, interactive models of past decades toward institutions focused on research, conservation, education, and animal welfare. Central to this evolution is the integration of conservation messaging, helping visitors understand both the organisation's role and their own in protecting wildlife.

AVIs vary widely. Some involve minimal interaction, such as visitor access to secure behind-the-scenes areas (e.g. animal care team zones or training yards) or guided staff tours. Others include closer proximity, such as walk-through habitats or direct contact – hand-feeding, petting, or even holding animals.

The Association of Zoos and Aquariums (AZA) defines an ambassador animal as one "presented to visitors AND the animal leaves its primary habitat or is being presented to visitors (inside or outside of its habitat) and visitors are intended to have direct contact (i.e. feeding, touching, swim with, etc.)" (AZA, 2023). While ambassador animals are often those used in AVIs, some facilities also use the term more broadly (e.g. as species representatives or conservation icons), even without visitor interaction. For this chapter, ambassador animals and animals participating in AVIs are considered equivalent despite these semantic differences. All recommendations for AVI animals apply equally to ambassador animals. This also includes animals used in educational activities or as 'roving animals' (explained later in the chapter).

Visitors receive guidance from an educator during an interpretive activity about the Atlantic Rainforest and its species at Parque das Aves © *Parque das Aves*

Docent with a Hermann's Tortoise (*Testudo hermanii*) part of the education animal team at Oakland Zoo © *Oakland Zoo*

ANIMAL-VISITOR INTERACTIONS (AVIs)

Many zoos and aquariums, worldwide, offer diverse AVI opportunities, with varying human-animal proximity (D'Cruze et al., 2019; D'Cruze & Groves, 2024; Learmonth et al., 2021). These AVI opportunities are believed to engage visitors more effectively than traditional animal viewing or talks, and thereby provide the institution with better opportunities to educate visitors about the animals, their welfare, and the importance of the conservation of nature (Doodson et al., 2024; Gray 2017; Learmonth et al., 2021; McLeod et al., 2024, Spooner et al., 2021). However, research has shown mixed results, with demographic factors influencing learning outcomes, even when messaging and engagement are strong (Learmonth et al., 2021; Spooner et al., 2021). As more institutions adopt the 'Connect, Understand, Act' model developed by Zoos Victoria, a tool which focuses on shaping wildlife-friendly behaviour through best-practice conservation, education and social science, opportunities to evaluate the impact on conservation learning and animal welfare will increase (Clifford-Clarke et al., 2021; Collins 2024).

Monitoring AVIs is crucial to assess their impact and maintain welfare standards, requiring a solid understanding of animal welfare science. Ongoing monitoring should be paired with staff training on animal welfare principles at all levels. Animals involved in AVIs should be closely monitored for any negative impacts, with evidence collected to justify continued management practices. Zoos and aquariums must end AVIs if distress occurs that cannot be successfully addressed. Many individual zoos and aquariums, national and regional associations, and WAZA have all developed guidelines for the use of animals in interactive or visitor demonstrations, close-contact encounters, or other AVIs. These are useful guides that should be utilised when considering, creating, or undertaking interactive experiences or presentations. The WAZA Guidelines for Animal-Visitor Interactions (WAZA 2020) should be adhered to by all WAZA members, as well as any institution that shares the values of modern zoos and aquariums and/or offer AVIs or encounters with ambassador animals.

THE EFFECTS OF AVIs ON ANIMAL WELFARE

Our understanding of the impacts of AVIs on animal welfare remains limited and highly context-dependent, often based on non-experimental, observational studies (Fernandez & Chiew, 2021). However, research on the effects of AVIs on both animals and visitors is steadily increasing See Case Studies 10.1 and 10.2. To date, studies have primarily focused on primates and mammalian carnivores, with less attention given to birds, reptiles, fish, and invertebrates (Williams et al., 2023; Williams et al., 2024).

Some evidence suggests that AVIs can be distressing, stressful, or uncomfortable for certain animals (Edes & Hall, 2023; Learmonth et al., 2021; Sherwen & Hemsworth, 2019). When given a choice, some individuals consistently avoid interactions. In other cases, AVIs appear to have a neutral effect on welfare See Case Study 10.1. Increasingly, studies show that some individual animals benefit from AVIs, demonstrating positive welfare responses and actively choosing or soliciting human interaction (Edes & Hall, 2023; Learmonth, 2020; Learmonth et al., 2020; Learmonth et al., 2021; Sherwen & Hemsworth, 2019). For these individuals,

Case Study 10.1

Impact of animal role and/or handling on behavioural and physiological indicators of welfare | Cleveland Metroparks Zoo (US)

The Cleveland Metroparks Zoo conducted a multi-institutional study of animal welfare indicators (abnormal behaviour, faecal glucocorticoids) in several species (Baird et al., 2016). Welfare indicators of armadillos (*Dasypodidae*) did not differ between those housed in visitor-facing habitats or used as ambassador animals.

However, there was a positive relationship between the amount of animal handling (for routine husbandry or ambassador programmes) and measures of abnormal behaviour and/or faecal glucocorticoids for armadillos (*Dasypodidae*), African hedgehogs (*Atelerix albiventris*) and red-tailed hawks (*Buteo jamaicensis*). The study also revealed that providing adequate deep substrate positively impacted measures of welfare. Research conducted at the Saint Louis Zoo on AVI's involving Magellanic penguins (*Spheniscus magellanicus*) and guinea pigs (*Cavia porcellus*) found no behavioural or physiological effects of AVIs on the animals (Hartell-DeNardo et al., 2023; Powell et al., 2020). Combined, this research suggests that AVI's can occur with no negative impacts to welfare, but all studies highlighted that there were individual animal differences, underscoring the need to monitor welfare in all AVI's for all animals.

Barn owl (*Tyto alba*) free flying with no traditional falconry equipment
© The Living Desert Zoo & Gardens

Guests and Zoo staff share a memorable moment feeding a giraffe (*Giraffa camelopardalis*)
© Omaha's Henry Doorly Zoo & Aquarium

Case Study 10.2

Impact of guest feeding interactions on welfare in giraffes (*Giraffa camelopardalis*)

Multi-institutional studies can provide a good foundation for comparing and understanding the effect of AVI's. A study on guest interactions in a feeding based AVI looking at nine different AZA accredited institutions demonstrated that the amount of time that giraffes (*Giraffa camelopardalis*) spent participating in guest feeding programmes was associated with increased time spent idle and reduced time spent ruminating (Orban et al., 2016). However, the amount of time spent participating in guest feeding programmes had no correlation to the performance of stereotypic behaviours in giraffes. Nevertheless, individuals that spent more total time engaged in foraging/feeding behaviour in a day (both during and outside of AVI feedings) tended to perform less oral stereotypic behaviours such as object-licking and tongue-rolling than giraffes that had shorter total feeding behaviour per day. The authors proposed that by extending foraging time and complexity, guest feeding programme participation may be environmental enrichment and alleviate unfulfilled foraging motivations that underlie oral stereotypic behaviours. However, as with all AVI programmes, it was suggested that ongoing evaluation of the AVI is critical, and management strategies may need to be adjusted to mitigate increased idleness and other programme participation consequences.

AVIs may offer valuable opportunities for positive affective engagement and the expression of agency, choice, and control.

However, many current AVIs lack true voluntary participation. In some cases, animals face a false or forced choice – participate to receive a reward or miss out entirely. This may prompt participation driven by resource access rather than enjoyment of the interaction itself. Animals should be able to choose whether to participate, and both options – engaging or abstaining – should be associated with positive outcomes.

Careful selection of participating animals is essential. Decisions should consider species-typical and individual characteristics such as life history, personality, sex, age, and natural behaviour (e.g. foraging strategy, activity cycle). More research is needed to evaluate AVI impacts at the individual level. Zoos and aquariums offering AVIs must ensure welfare assessments are made for each animal and each interaction type, with ongoing monitoring to detect changes in personality, behaviour, or willingness to participate over time.

ASSESSING AND EVALUATING THE WELFARE IMPACTS OF AVIs

The WAZA/IZE Conservation Education Strategy introduced the term "education welfare" as a framework that supports positive animal welfare states while achieving conservation education goals (Thomas, 2020). While *The World Zoo and Aquarium Animal Welfare Strategy* does not endorse categorising welfare by programmatic focus (e.g. education welfare, conservation welfare), it emphasises that conservation education activities must embed appropriate animal welfare assessment frameworks into their planning, implementation, and evaluation. Published risk assessment processes for AVIs and general zoo and aquarium welfare (de Mori et al., 2019; Sherwen et al., 2018) should be consulted when designing new AVI opportunities.

All AVIs must be assessed for both potential and actual impacts on animal welfare – positive, neutral, or negative – through structured assessments and regular monitoring See Chapter 2. Monitoring should consider the frequency, duration, and timing (e.g. time of day) of interactions; whether physical contact with visitors is allowed and, if so, how many visitors interact daily; and the behaviours of both animals and visitors during encounters. These assessments should be used to evaluate whether the welfare impacts and visitor learning outcomes justify continuation of the AVI.

Differences in habitat, housing, and husbandry between ambassador animals and conspecifics not involved in AVIs must be carefully evaluated. Housing and care standards must remain consistent regardless of an animal's involvement in visitor experiences. Potential impacts on other group members should also be considered, especially if individuals are removed for AVI participation. All animals involved should have equal access to positive welfare outcomes, including suitable housing and effective mitigation of any handling, relocation, or transport See Chapter 12.

Many AVIs involve domesticated animals, which may generally tolerate human interactions well. However, the same standard of rigorous welfare assessment and monitoring applies. This also extends to walk-through habitats where animals and visitors share space; 'on-grounds animal encounters' or 'roving animals' (staff holding or walking animals through visitor-accessible areas); drive-through safari habitats; facilities with free-roaming animals (not confined to traditional enclosures but not free-living wildlife); and aquariums offering interactive experiences such as touch pools or swim-throughs (often involving rays, sharks, or large fish).

Young visitor with a goat (*Capra aegagrus hircus*) during a close encounter experience © *Oakland Zoo*

PRACTICAL AND ETHICAL CONSIDERATIONS FOR AVI OPPORTUNITIES

Zoos and aquariums should base decisions about offering interactive experiences on evidence that they achieve desired guest outcomes (e.g. empathy, conservation-mindedness) and benefit the participating animals. It is recommended that an internal animal ethics and welfare committee – or other such entity, ideally including some external experts or partners – conduct an initial assessment of whether proposed AVIs are appropriate.

Final decisions should be informed by welfare assessments of the animals involved and measures of the programmes educational or conservation impact. In some regions, establishing such a committee may be a legal requirement. Organisations must also ensure that AVIs comply with relevant legislation, which may override recommendations in this document or in the WAZA AVI Guidelines.

When visitors enter animal habitats, activities should occur in a dedicated 'encounter space' largely separate from the main habitat. Animals must be monitored during interactions and given full choice about whether to participate, with continuous access to retreat or refuge spaces. Undesirable behaviours may indicate the animal lacks means to leave the interaction or faces resource restrictions if it chooses not to participate (e.g. food-stealing by petting zoo animals may reflect limited food availability in non-interaction areas).

Aquatic 'touch tanks' should align with evolving guidelines or laws that prohibit placing slow or immobile invertebrates (e.g. sea stars, sand dollars, sea cucumbers) within visitor reach, as they cannot avoid interactions. Roving animals must never be forcibly restrained (e.g. taping limbs or jaws) and must only be handled by trained staff who recognise and respond to signs that the animal wishes to end the interaction (e.g. squirming, wriggling, escape attempts). These animals must always have immediate access to a safe refuge, such as a trained carry container, during interactions and transport.

A Wētāpunga (*Deinacrida heteracantha*) participates in the Hidden New Zealand talk © *Auckland Zoo*

Wildlife on Wheels spokesperson engaging visitors with a Tarantula (*Theraphosidae*) ambassador animal © *Brookfield Zoo Chicago*

Hand-rearing animals solely to serve as ambassador animals is ethically unsupported. Separating offspring from parents or conspecifics at birth for visitor interaction or photo opportunities contradicts modern ethical standards in animal care.

Hand-rearing should only occur in specific conservation contexts See Chapter 6 or when parental or alternative care is unsuitable. While some human-reared animals may become suitable for AVIs, this should never justify removing young animals from conspecific care.

One study found that hand-reared cheetahs, commonly used as ambassadors, were more likely to display 'Alert' behaviours and undesirable behaviours like pacing (Baird, 2018).

Close contact between animals and visitors can pose health risks to both, including zoonotic disease transmission or spread within the animals housed at the zoo or aquarium. AVIs must prioritise safety for animals and visitors.

Additionally, inadequate or misinterpreted educational messaging may lead visitors to perceive wild animals as suitable pets, potentially fuelling the illegal wildlife trade or supporting practices that may be legal but compromise animal welfare.

CONCLUSION

Many zoos and aquariums offer AVIs and ambassador animal encounters to support conservation, research and education goals. To ensure these experiences prioritise positive animal welfare, institutions must adopt evidence-based management practices, implement a robust animal welfare assessment and monitoring programme, undertake ethical decision-making, and ensure that each interactive experience has been informed by systematic and objective animal welfare research.

Interactive experiences should be non-invasive, safe and non-aversive for animals. An animal's overall welfare state should not be compromised. The suitability of each animal for participation should be carefully evaluated, considering their species-specific needs, life history, temperament, and individual preferences.

Finally, interactive experiences should provide animals with the appropriate choice of whether to participate or not; should represent the animal(s) with respect; and should have an overriding conservation or welfare message that is consistent with the purpose of modern zoos and aquariums.

Taipei Frogs (*Hylarana taipehensis*) © *Taipei Zoo*

CHAPTER 11

SOCIAL NEEDS OF ANIMALS

OUR COMMITMENT IS TO IMPROVE ANIMAL WELFARE BY OPTIMISING SPECIES-APPROPRIATE SOCIAL OPPORTUNITIES IN ZOOS AND AQUARIUMS.

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Ricardo Lemos de Figueiredo
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Jessica Moody
Wildlife Conservation Society, Bronx Zoo

RECOMMENDED ACTIONS

To realise our commitment to high animal welfare standards, WAZA calls on its member organisations to:

1. Ensure knowledge of the species' natural history and social behaviour, and consult relevant species management groups (e.g. Taxon Advisory Groups, regional plans) to guide decisions on social needs.
2. Consider welfare at both group and individual levels, taking into account each animal's life history and potential impacts of changes like births or deaths.
3. Develop long-term management plans for social groups, supported by a physical environment that meets all individuals' social needs.
4. Implement a health management plan that supports proper access to food and nutrition for all animals in the habitat, while minimising disease transmission.
5. Conduct regular assessments of social dynamics and their impact on welfare through behavioural monitoring by trained staff.

INTRODUCTION

Social management in zoos and aquariums can be challenging and requires careful consideration of several factors. The umbrella of social management covers the continuum of sociality from highly social species that live in large, complex groups to non-social species that have more limited conspecific associations (Heeres et al., 2024). Therefore, it is important to have an informed decision-making process to ensure the institution is able to meet the management and welfare needs of the species being considered. This process should include a review of the natural history and social ecology of the species, consultation with the appropriate management group (e.g. Taxon Advisory Group (TAG) or regional management plans like ALPZA Population Management Programmes, AZA Species Survival Plans, EAZA *Ex situ* Programmes, JAZA Species Management Programmes or ZAA Species Management Plans, etc.) for husbandry requirements, and a thorough understanding of the space requirements necessary to manage the potential complexities of a social species in a zoo or aquarium.

Buffy-tufted marmoset (*Callithrix aurita*)
© *Leandro Amaral, São Paulo Zoo*

Management of social groups in human care: unnatural social settings, challenges and considerations

Solitary species

A species is considered solitary when the majority of adult individuals predominantly forage and sleep alone, meeting mostly for courtship and mating (Makuya & Schradin, 2024). Solitary species in zoos and aquariums may be housed with conspecifics due to a variety of reasons. However, the social housing of naturally solitary animals may compromise their welfare and needs to be carefully considered. Social housing of solitary species may be associated with positive welfare indicators in some situations (e.g. De Rouck et al., 2005), but managers should be aware that these individuals may have reduced control and opportunities to avoid conspecifics, which could be associated with reduced welfare outcomes. For example, previous research has shown that keeping solitary species such as black rhinoceroses (*Diceros bicornis*; Carlstead & Brown, 2005) and brown brocket deer (*Mazama gouazoubira*; Christofoletti et al., 2010) regularly housed with conspecifics resulted in an increase in stress-related agonistic behaviours and hormones.

On the other hand, solitary does not mean asocial, and despite spending most of their time alone in the wild, solitary animals still encounter and engage with conspecifics via direct (e.g. courtship, mating) and indirect interactions (e.g. scent marking, vocalisations) (Makuya & Schradin, 2024). Therefore, keeping solitary species in long-term isolation from conspecifics may have negative impacts on their welfare. Research across taxa has shown that the presence of conspecifics can be enriching and have positive welfare impacts on solitary species in human care. For example, tigers (*Panthera tigris*) housed in pairs exhibited higher behavioural diversity and reduced pacing in comparison to singly-housed conspecifics (De Rouck et al., 2005), and garter snakes

(*Thamnophis sirtalis*) sought social interactions and developed associations with conspecifics (Skinner & Miller, 2020). Furthermore, data on the natural social behaviour of wild animals are often lacking, in particular for cryptic taxa. Therefore, it is possible that some species considered solitary spend more time engaged in social behaviours in the wild than what is currently assumed (Alejandro et al., 2021). Even if species are confirmed to be naturally solitary, long-term management plans for singly-housed animals should consider the potential impacts of long-term isolation on animal welfare and include plans to provide the animals with opportunities for social interaction, even if indirectly. Consequently, the social management of solitary species requires careful consideration, and animals should be given, as much as possible, control and choice over when to engage in, or retreat from, social interactions with conspecifics.

Unnatural social groupings

Many zoo and aquarium-housed species are naturally social in the wild. Wild social groupings not only improve individual fitness but also support welfare in human care by promoting behavioural diversity, including positive social interactions like allogrooming and play.

However, social species in zoos and aquariums are sometimes housed in groupings that do not reflect wild compositions. This may be due to population management (e.g. single-sex groups or non-monogamous breeding pairings), limited space, or temporary needs such as quarantine or veterinary care, which may result in individuals being housed alone.

While conservation outcomes and breeding success are vital, it is equally important to house animals in species-appropriate social groupings to support welfare. Complementary strategies can address both aims – such as the use of contraceptives to prevent unintended breeding while allowing appropriate group sizes and compositions. This supports behavioural diversity, including sexual behaviours, and may foster more stable social hierarchies in non-breeding groups.

When welfare best practices and breeding or conservation goals do not align, decisions should follow an ethical process that weighs both carefully See Chapter 7. Where substandard or unnatural groupings occur, it remains critical to follow the recommendations in this chapter and regularly review possibilities for improvement – such as consulting species management groups.

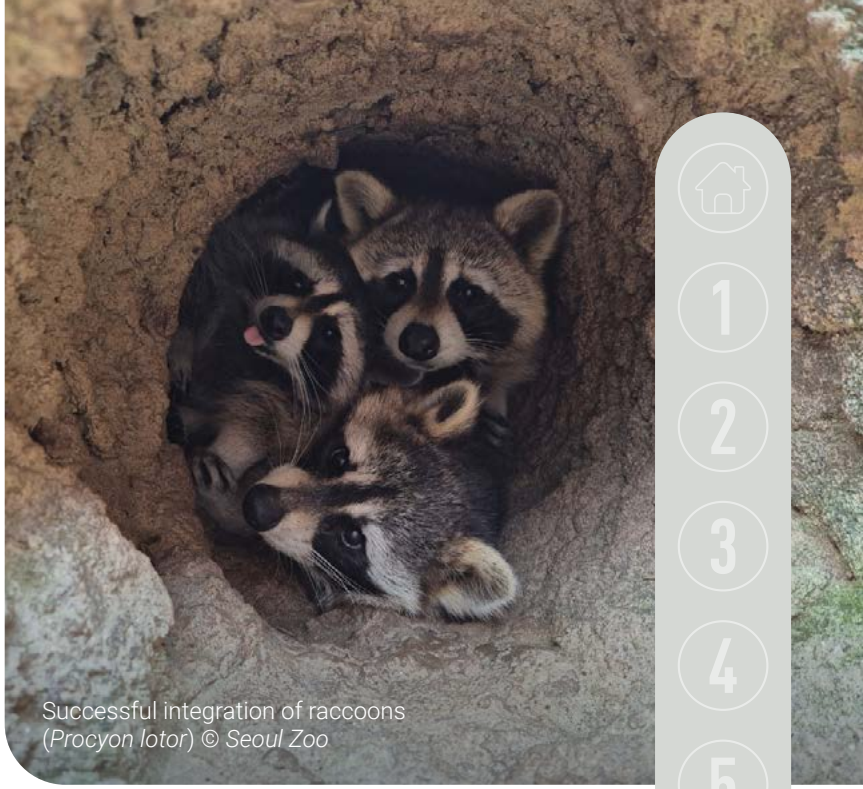
Reef manta rays (*Mobula alfredi*) © *Singapore Oceanarium, Resorts World Sentosa*

Housing social individuals alone can have a larger negative impact on their welfare than denying solitary individuals some limited forms of biologically-appropriate social interaction with conspecifics. Hetero-specific interactions, whether with humans or other animals, may benefit the welfare of animals in either situation and may be potentially useful in certain situations, such as short- term housing. Still, every effort should be made to provide social animals with a suitably compatible conspecific(s). This should be considered throughout different stages of animal housing and transport, for example, if an animal is in quarantine, try to import and quarantine multiple individuals together or keep the quarantine process as short as possible to limit social isolation.

Social group complexity

As noted above, natural social groups in some species are large and can be difficult, or impossible, to replicate in zoos and aquariums. This is especially true for species with multilevel societies – more common among vertebrates than often realised (e.g. primates, elephants, prairie dogs, vulturine guineafowl). These are among the most complex social systems, characterised by social stratification with multiple tiers or units (Grueter et al., 2012), shaped by kinship, social bonds, reproduction, and conspecific threat, among other factors.

While animals in zoos and aquariums do not experience many of the environmental/social pressures that can explain the development of multilevel societies, individual or group stress can be exacerbated by sub-optimal group complexity that does not allow for the expression of certain social behaviours (such as conflict management and reconciliation) that are innate to these societies. For instance, in many such species, males leave their natal group to compete for access to a harem or social unit, while females may form matrilineal hierarchies marked by intense competition for resources and mates (Clutton-Brock & Huchard, 2013). In these groups, aggressive and competitive behaviours are not only expected but are essential for appropriate social development and, therefore, for welfare See Chapter 6.



Successful integration of raccoons (*Procyon lotor*) © *Seoul Zoo*

> Positive welfare in social groups is not defined by a lack of conflict or stress, but rather opportunities to successfully cope with challenges and adapt to changing social situations (Ohl & Putman, 2014).

If opportunities for choice and control are provided, there will inevitably be conflict and ultimately resolution, even if the outcome benefits one individual over another (Mason & Mendoza, 1993). Animals are sometimes highly motivated to do things in social situations that may temporarily reduce individual welfare (e.g. wounding) but are goal-directed behaviours that may have longer-term benefits (e.g. social stability, Powell et al., 2023). It is important for animal managers to distinguish between the two and understand how group size and composition can influence the expression of these behaviours, while striving to have animals experience more instances of positive experiences than negative ones.

A giraffe (*Giraffa camelopardalis*) and a plains zebra (*Equus quagga*) at the African savanna habitat at Zoo Atlanta © *Zoo Atlanta*

Multi-species groupings

Creating a successful mixed-species habitat in a zoo or aquarium requires a thoughtful approach to ensure the wellbeing of all animals involved. These habitats, which bring together different species in shared environments, aim to mimic natural ecosystems where animals coexist. Potential benefits include enrichment through the presence of other species, but disadvantages – such as aggression and competition – can also occur, as they do in the wild. Mixed-species habitats therefore require careful planning to minimise conflict, stress, and discomfort.

Key wellbeing factors must be considered to support the health, safety, and comfort of all species. These ensure animals can thrive in an enriched environment, promote natural behaviours, and reduce stress. Foremost among these is species compatibility. Not all animals are suited to cohabitation – each species has unique behavioural and social needs. Some are territorial, solitary, or aggressive, while others are social and group-living. Understanding these differences is crucial to prevent conflict and stress.

Feeding habits are another important consideration. Co-housing species with different diets may require exclusion of some animals to specific food types, while still providing these specific foods as species-appropriate foraging opportunities. Co-housing species with similar diets may lead to competition and resource guarding, so ample foraging opportunities must be provided for all species and individuals. Predator-prey relationships must also be carefully managed – even natural cohabitants may experience stress or injury in confined environments.

Attention to social hierarchies is essential. Some species form strict dominance structures, and dominant individuals can overwhelm others of the same or different species, leading to stress or injury. When designing mixed-species habitats, it is important to consider how these dynamics will play out and ensure that dominant species and/or individuals do not disrupt the wellbeing of others. Breeding behaviours also need to be managed carefully. While some species may breed more readily in mixed settings, others may find the presence of other species stressful. Managers must also ensure that mixed species exhibits are safe for offspring of the species housed. Control over breeding is necessary to prevent overpopulation and maintain the wellbeing of all species within the habitat. Special consideration should be paid to prevent hybridisation between closely related species.

Finally, integrating ecological considerations into mixed-species habitats can help build more balanced, dynamic environments. Allowing animals to fulfil roles such as seed dispersal, pest control, or soil aeration supports more self-sustaining ecosystems within zoos and aquariums.

The physical environment in relation to social management

The physical environment should give animals control and opportunities to retreat, avoid, and hide from others in the habitat See Chapter 5. Habitat design must consider the needs of each species and individual, ensuring sufficient space to establish territories and express natural behaviours. Overcrowding can lead to aggression, chronic stress, and poor welfare.

Escape routes, hiding spots, microhabitats, and visual barriers help animals avoid habitat mates, reducing aggression and competition for resources.

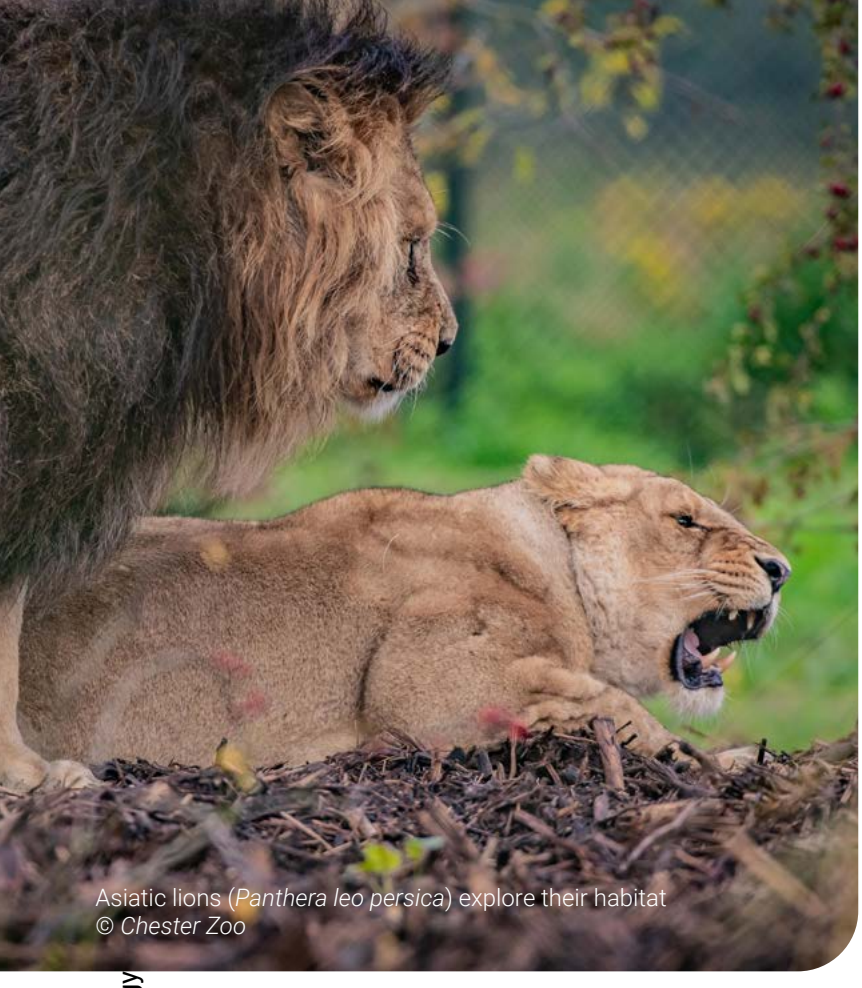
These considerations also apply to socially bonded animals or those that rarely show aggression, as they may still seek solitude or privacy at times See Case Study 11.1. This is especially important in family groups, including those with young offspring or individuals nearing dispersal. Offspring preparing to disperse may show signs such as lingering on group peripheries and should be monitored accordingly. Species-appropriate social opportunities should be provided after separation from the group. Additional holding space should be available to accommodate social changes – such as aggression requiring separation, group size shifts due to breeding, or acute social stress. Potential stressors should be addressed during facility design.

Case Study 11.1

The importance of providing socially-housed animals with opportunities for concealment

The lesser mouse deer (*Tragulus javanicus*) is a forest-dwelling solitary species. Despite their solitary nature, mouse deer are commonly housed socially in human care, usually as male-female pairs which often have overlapping territories in the wild. Lemos de Figueiredo et al., (2021) investigated the husbandry, behaviour and breeding success of this species in 15 European zoos. Although they rarely observed agonistic interactions, pairs that spent less time in close proximity to each other were more successful at breeding. Furthermore, pairs in habitats with enhanced vegetation cover spent less time near each other, suggesting they benefit from increased opportunities to conceal themselves and/or retreat from their conspecifics. This study highlights the importance of assessing the impact of the social environment on the behaviour and welfare of zoo or aquarium-housed animals, even if agonistic social interactions appear rare. It also demonstrates how socially-housed animals can benefit from improved opportunities to avoid and retreat from other animals in their shared habitat.

Sea otters (*Enhydra lutris*) © *Oceanário de Lisboa*



Asiatic lions (*Panthera leo persica*) explore their habitat
© *Chester Zoo*

Planning for social management

Long-term management plans should consider all potential changes in the social environment of the animals, including potential social stressors, that may compromise their welfare in the future. For example, when keeping social animals in pairs, one of them is likely to die first, leaving the other animal alone. As it can take some time to acquire another companion for the remaining animal due to the logistics of breeding programmes and animal transfers across institutions, that animal may find itself in a less optimal social situation for an extended period of time, likely compromising its welfare. Animal deaths may occur unexpectedly, and therefore it can be difficult to plan for such events, but the risks and mitigations for situations such as those should be assessed and developed accordingly (e.g. animals may be kept with more conspecifics or in mixed-species habitats to avoid living alone when unexpected deaths happen, or a plan can be drawn proactively to ensure additional animals can be quickly transferred if needed).

Oftentimes, individual and group welfare – the aggregated welfare of all individual group members – can conflict with each other, complicating our ability to provide optimal individual welfare while maintaining positive welfare overall in the group. Balancing these sometimes competing priorities can be extremely challenging, particularly for species that have a complex social organisation. In fact, the welfare of a group may be enhanced through an individual of the group performing a behaviour that strengthens the functioning of the group as a unit, even if that individual experiences a (temporarily) reduced welfare state as a result (Ohl & Putman 2014). The life history of individual animals should also be considered, as the social environment the animal developed in, as well as any social associations and bonds it developed over time, can help inform the most suitable social environment for the animal. Furthermore, social housing of animals should consider both their genetic and behavioural compatibility.

The personality of individual animals is likely to influence the hierarchy and stability of groups, and the behavioural ecology of the/all species in the habitat, impacting the ability of the animals to share the space with both conspecifics and other species. It is also important to recognise that while the welfare of some group members may be reduced, this does not mean it is necessarily poor. It may just be less good, or it may be equivalent if welfare is being addressed in other domains. This is where effective welfare monitoring See Chapter 2 can provide data to inform practice.

Health considerations

The health and hygiene of each animal and species in the habitat should be considered when managing social groups. Efficient waste management is necessary to reduce chances of disease transmission and contamination across animals and species. Animal care and veterinary teams must be able to monitor and have access to the different animals and species in the habitat, to avoid overlooking sick or injured animals. Also, diets and feeding practices must be carefully planned to ensure that all animals and species receive the correct nutrition without competing for food. Special attention should be given to avoid food poisoning from shared or incompatible diets.

Behavioural monitoring

Behavioural monitoring can help determine the impact of the social environment on the welfare of the animals in the habitat and inform mitigation strategies. Regular assessments of social interactions and proximity can reveal how the welfare of individual animals is affected by the presence of conspecifics and/or other species in the habitat. Monitoring the formation of new social groupings is particularly important, as it is an especially volatile period, with animals being introduced and the potential for heightened aggression. Documenting the formation of new social groupings is also important as it provides opportunities for review of the process and adaptive management for future social introductions.

Established and stable groups should also be regularly monitored, as social dynamics and their impact on welfare can change over time. Animal care staff should be trained to understand the behaviour and needs of each animal and species in the habitat, and have the necessary skills and knowledge to manage any emerging conflicts or issues.

CONCLUSION

Successful social management that supports positive welfare is the result of extensive planning, monitoring, and consideration of many factors See Figure 11.1. The social environment of animals in human care requires careful planning and management to ensure it provides them with choice and control to engage in, or retreat from, social behaviours and interactions that provide positive welfare outcomes. Factors such as the natural history of the species and the life history of individual animals must be considered, and long-term social management plans should be developed that account for changes in the social structure and dynamics over time. Adequate physical environments and health management practices will improve the odds of successful co-existence of multiple animals and/or species. Additionally, the impact of the social environment on the welfare of the individual animals should be regularly assessed with behavioural monitoring by trained staff.

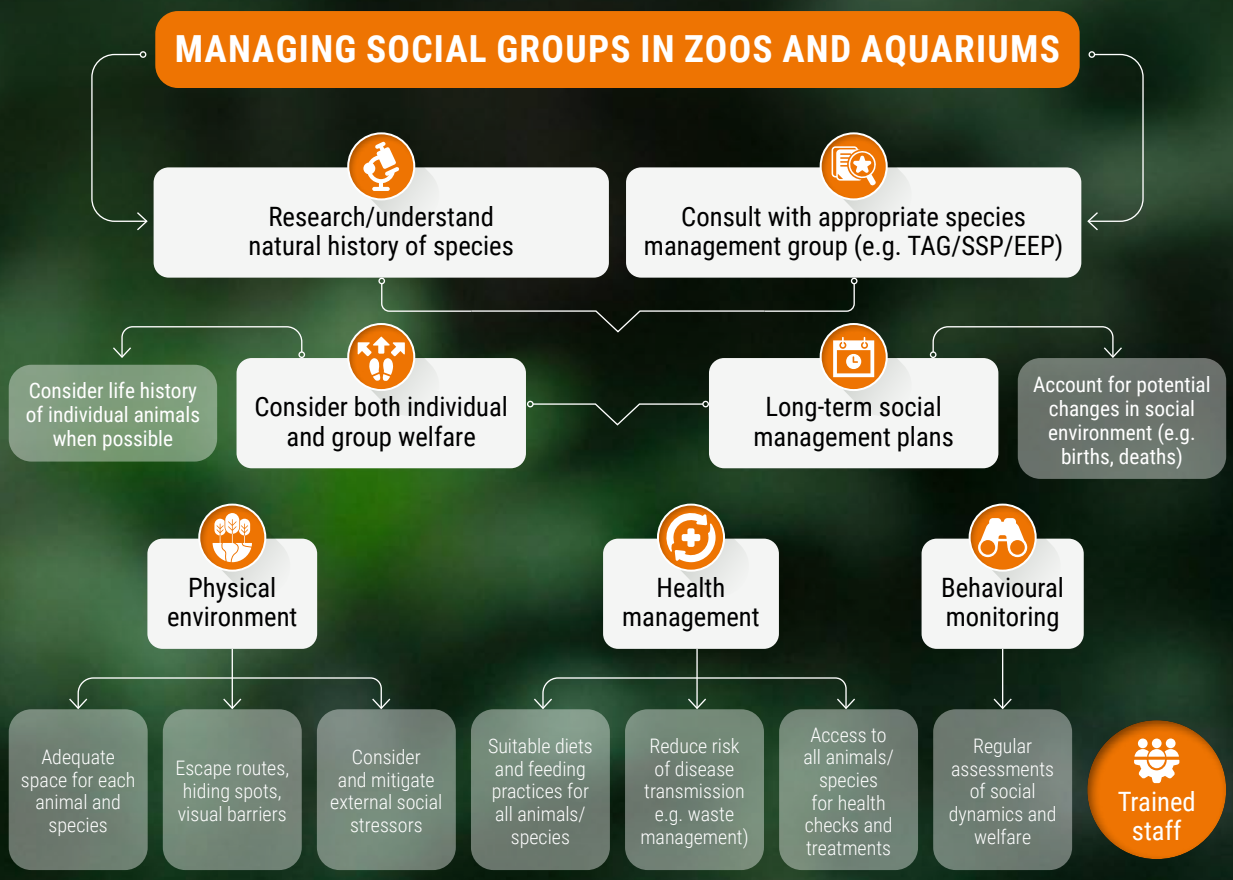


FIGURE 11.1 Diagram of main considerations when managing social groups in zoos and aquariums.

CHAPTER 12

Eastern bristlebird (*Dasyornis brachypterus*) rescued from the 2019 Australian wildfires released back into the wild © *Zoos Victoria*

Adam Felts
Columbus Zoo

Narinda Beukes
Cango Wildlife Ranch

Csaba Harsányi
Sosto Zoo

Liz Wilson
Audubon Zoo

TRANSPORT AND ANIMAL WELFARE

OUR COMMITMENT IS TO PLAN AND EXECUTE ANIMAL TRANSPORTS WITH WELFARE AS A PRIORITY BEFORE, DURING, AND AFTER TRANSIT, ENSURING GOOD WELFARE WHENEVER POSSIBLE AND MINIMISING NEGATIVE EXPERIENCES THROUGHOUT THE PROCESS.

European mink (*Mustela lutreola*) discovering his new home from transport box
© *Annika Sorjonen, Korkeasaari Zoo*

> Welfare does not begin or end at the habitat – it travels with the animal.

RECOMMENDED ACTIONS

To realise our commitment to high animal welfare standards, WAZA calls on its member organisations to:

1. Plan and prepare in advance any animal transport to ensure that any potential animal welfare issues are identified and properly managed before and during the process.
2. Consider and seek advice and input from competent staff with different expertise when planning and implementing animal transport.
3. Set up a risk assessment for possible problems and emergencies that may occur during transport (e.g. stopover en route, or necessary medical care)
4. Ensure compliance with all legal and ethical requirements to avoid any delays or complications that may negatively affect welfare.
5. Consult and collaborate with external partners including organisations transporting, receiving or placing the animals in your care.

INTRODUCTION

Zoos and aquariums transport animals within and between institutions to support population management, conservation, animal welfare, and even rescue and rehabilitation efforts See Case Study 12.1**. However, transport and its preparation or acclimation can cause stress. Therefore, animal welfare must be considered at all stages – before, during, and after transport – whether by air, boat, train, or automobile. Each species and individual may have specific needs, making careful planning essential. Institutions must comply with international, national, and local requirements and prioritise understanding the species and individual characteristics. With this knowledge, the transport environment can be planned accordingly and shared with all involved parties, including transporters and cargo staff. Efforts should be made to minimise stress and injury risks, and pre-transfer planning is vital to ensure animals are prepared and all parameters are followed throughout the process** See Case Study 12.2**.**

Case Study 12.1

Two Oceans Aquarium Foundation Turtle Conservation Centre | Two Oceans Aquarium (South Africa)

The Two Oceans Aquarium Turtle Conservation Centre created two solutions to decrease stress and increase comfort during travel in sea turtles.

Turtle Rescue Boxes: The majority of stranded turtles admitted to the Turtle Conservation Centre are post-hatchling loggerheads suffering from cold shock. These young turtles are especially vulnerable to stress and injury during handling and transport. To address stress in post-hatchling, cold-shocked loggerhead turtles arriving at the Centres, awareness campaigns have been paired with the distribution of purpose-built turtle rescue boxes which provide a dark, room-temperature environment with a soft towel insert. This initiative has significantly improved the safety, comfort, and welfare of turtles during transit to the centre, enabling faster recovery and more consistent rescue outcomes.

To address challenges in transporting large sea turtles, the Centre has developed custom turtle stretchers designed to securely restrain the turtle's body and front flippers, reducing the risk of self-injury or harm to handlers. Turtles transported in these stretchers display significantly calmer behaviour, improving welfare outcomes and ensuring safer handling for all involved.

Large turtle stretcher facilitating transport of Loggerhead turtle (*Caretta caretta*) © *Two Oceans Aquarium*

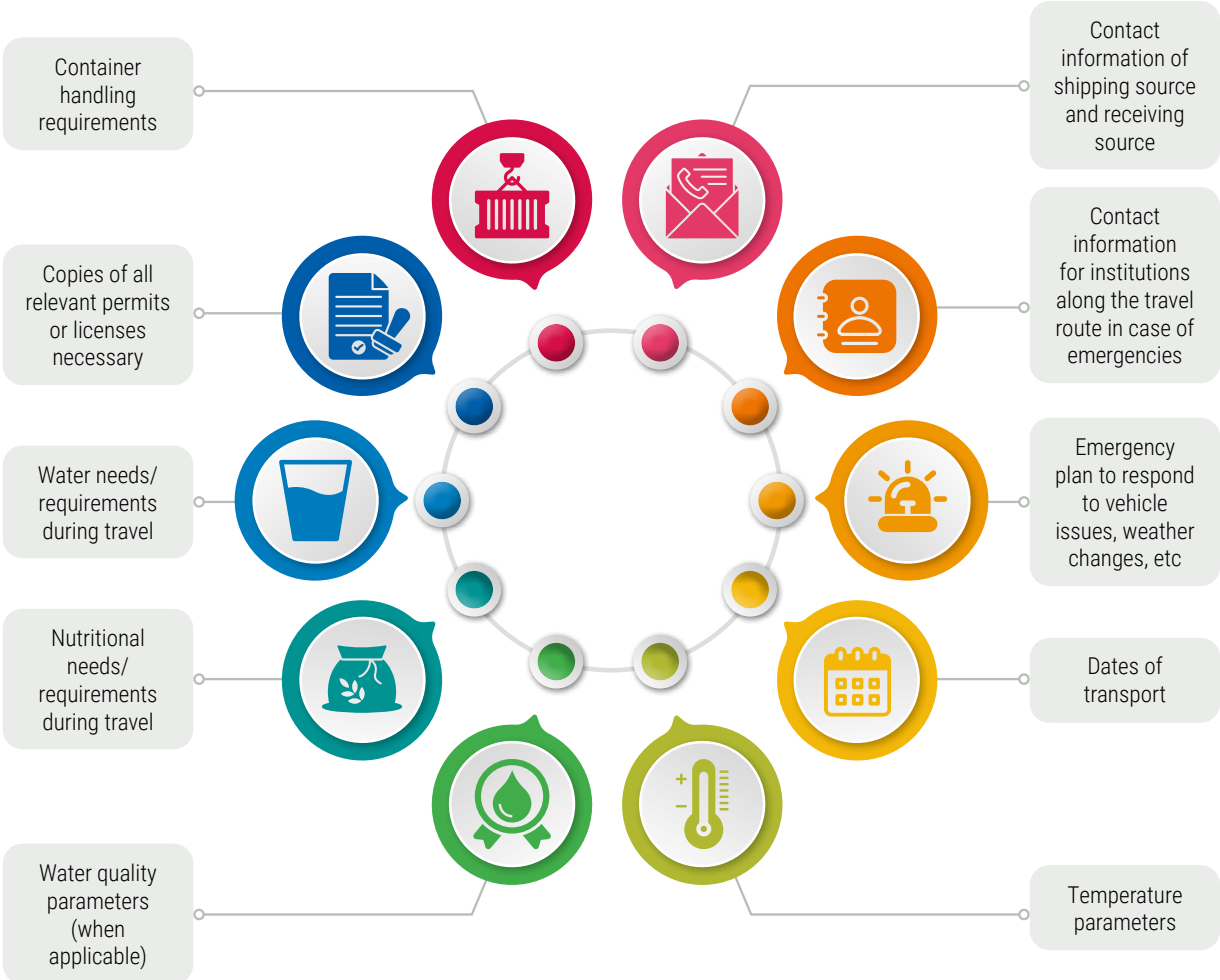


FIGURE 12.1 Critical elements to include in a transport plan

Case Study 12.2

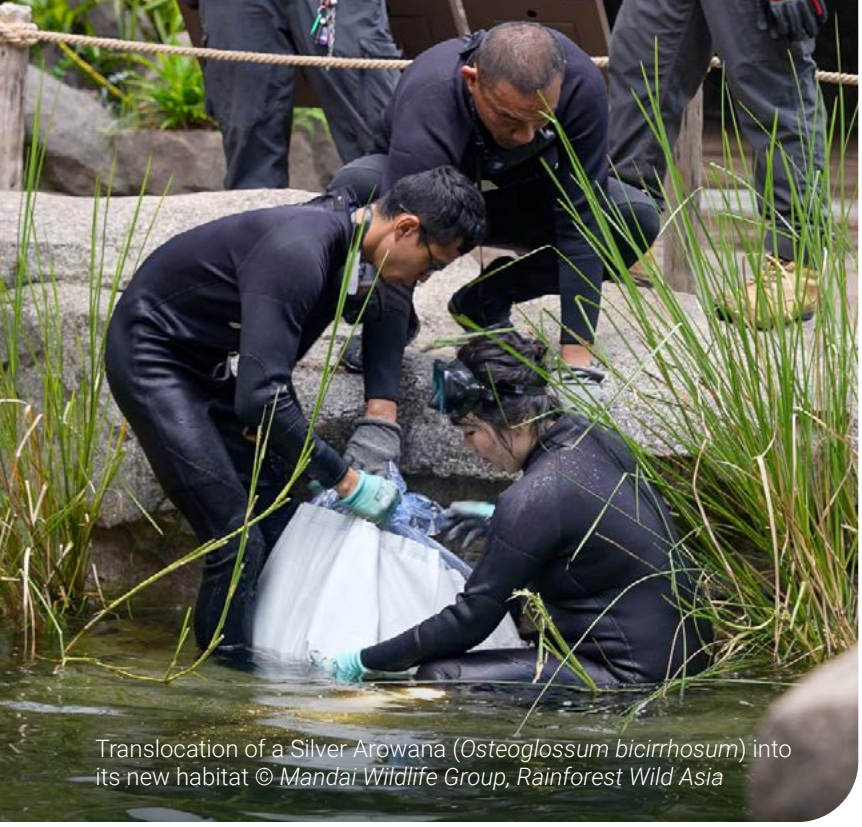
International transport: The importance of planning and inter-institutional collaboration | Dublin Zoo (Ireland) and Cincinnati Zoo and Botanical Gardens (US)

In November 2023, four Asian elephants (*Elephas maximus*) were flown from Dublin Zoo to the Cincinnati Zoo and Botanical Garden.

This move followed a 2021 joint recommendation from the Endangered Ex-situ Programme (EEP) of the European Association of Zoos and Aquaria (EAZA) and the Asian Elephant Species Survival Plan (SSP) of the Association of Zoos and Aquariums (AZA). These programmes coordinate breeding and transfers to maintain a genetically diverse, demographically stable, and biologically healthy population.

The relocation was over two years in the making, involving extensive coordination between both zoos. It was the largest and most complex animal transport in Dublin Zoo's history. Over 18 months, the elephants were trained to participate voluntarily in the process, minimising stress. Transport by plane presented significant logistical challenges, but a multidisciplinary team – including caregivers, veterinarians, and curators – accompanied the elephants on the eight-hour direct flight, providing continuous care and monitoring environmental conditions to ensure their comfort. Upon arrival in Cincinnati, the elephants quickly adapted to their new environment, exploring their habitat with curiosity, resuming feeding, and later resting from the journey.

Asian elephant (*Elephas maximus*) © Dublin Zoo



Translocation of a Silver Arowana (*Osteoglossum bicirrhosum*) into its new habitat © *Mandai Wildlife Group, Rainforest Wild Asia*

Considerations

To ensure the health and wellbeing of all animals before, during and after transport, the following considerations should be addressed:

Container

Institutions should follow the International Air Transport Association (IATA, 2025) Live Animal Regulations, even for ground transport. Containers must meet the animal's specific needs, including appropriate size for the individual or group, allowing animals to perform species-appropriate behaviours such as standing comfortably, turning around or lying down and accessing water. As the animal will be housed in a much smaller space than usual, containers must be strong and secure, and allow for safe feeding, drinking, and medical care without endangering the animal, staff, or accompanying persons.

Environmental factors – humidity, temperature, ventilation, and for aquatic species, oxygen levels, pH, and water temperature – must also be considered and monitored, ideally inside the shipping container and/or the shipping vessel (e.g. truck or cargo area), as appropriate. Containers should be large enough or equipped with substrate to minimise contact with urine and faeces; in some cases, secondary pans can collect fluids. In many cases, using substrate or litter is recommended or required to help maintain appropriate temperature and to maximise sanitation.

To reduce stress, providing a familiar environment is helpful, such as using familiar odours. Animals should be given the opportunity to become accustomed to containers through passive or active acclimation See Chapter 4. While mimicking travel time is not always feasible, acclimation – whether passive (exposure for a set time) or active (training to enter, exit, and be secured) – can reduce stress.

Animals often become less active once transport begins, so planning how often to inspect them is important. In some cases, visual checks can increase stress; where available, cameras are a useful, non-disruptive monitoring tool.

Seasonal variations

Long distance travel often means that an animal may pass from one climatic zone to another. The changes in climatic zones can be detrimental for an animal's welfare and therefore careful considerations and measures should be placed in advance and a well organised plan should be followed to acclimatise the animal appropriately. To assist any animal with acclimatising, it is commonly recommended to move the animal into a controlled environment and then acclimatise them slowly. The sending and receiving facilities should decide which institution (receiving/sending) would be best suited to acclimatise the animal. Alternatively, the participating facilities may agree to transport the animal when climatic conditions are mild.

Environment

Transport plans must define temperature parameters to be maintained by trained staff during travel. This includes choosing appropriate travel seasons, using heating or cooling systems, and allowing the animal to thermoregulate. If extreme conditions can't be avoided, travel timing may be adjusted. Some airlines and shipping companies restrict animal transport during certain months or temperatures. Institutions must be aware of airline and carrier requirements when planning transport.

For road transport, vehicles must provide environmental control. Preplanned stops should include welfare checks to ensure temperature is within range and systems are functioning. These stops must be risk assessed to reduce stress. Adequate ventilation is essential for both temperature and welfare. Containers and vehicles must allow proper airflow, with approved perimeter spacers. If ventilation holes are covered for comfort or privacy, porous materials must be used to maintain airflow. During road transport, air quality should be monitored to ensure carbon monoxide levels remain safe.

Behavioural needs

Meeting species-specific behavioural needs during transport is essential to minimise stress and ensure animal welfare. This includes pre- and in-transport handling, social interactions (if relevant), and rest and recovery after arrival. Transport can negatively impact welfare by placing animals in confined, unfamiliar environments, increasing stress and the risk of illness. Gentle handling techniques are critical throughout. Pharmacological treatments (e.g. calming medications) may also be useful in helping animals load or unload more readily as well as remain calm during transport.

For ground transport, journeys over eight hours should include rest periods, allowing animals to adjust position, eat, and drink. Upon arrival, animals should be placed in a quiet environment with food, water, and minimal noise to support recovery.

Decisions to transport animals together must consider species biology, social systems, risk of injury or isolation stress, container size, environmental needs, IATA regulations, and more. The welfare benefits of group transport must clearly outweigh the risks. Institutions without experience in transporting a species should consult regional associations, taxon advisory groups, or experienced colleagues.

On April 2021, four Przewalski's horses (*Equus przewalskii*) were moved from Prague Zoo's Dolní Dobřejov breeding and acclimatization station to their new 20-hectare home on the Dívčí hrady plain © *Petr Hamerník, Prague Zoo*

Pre-transport environments

In some cases an animal may be loaded into a shipping vehicle from a location that is not its original habitat. When possible, it is advantageous to transport the animal from its usual and well-known habitat. Regardless of what space the animal is loaded from, consideration of crating technique should be discussed in advance and a plan formed as crating may involve anaesthesia or tranquilisation, luring, guiding or using training to move the animal into a crate. Whenever possible, the least stressful method should be chosen.

Transport of aquatic animals and other ectotherms

Transporting terrestrial, aquatic, or marine ectotherms requires careful, species-appropriate planning. Most require a stable, highly controlled environment throughout the transport process, which may include custom-built containers, life support systems, and environmental monitoring equipment, depending on travel time, distance and animal size.

Small fish are usually moved in strong-walled, multi-layered nylon bags filled with water from their original habitat and supplemented with oxygen. Larger fish are commonly transported in tanks or pools. These must be equipped with instruments to rapidly or continually measure and monitor temperature, pH, oxygen, and other parameters, as water quality can deteriorate quickly, compromising welfare and risking death. Spare water should be available in case of emergency.

Upon arrival, animal condition should be evaluated to determine the most appropriate unloading method. Water or other environmental parameters – especially temperature – should be gradually balanced between transport and receiving environments. However, immediate release may be appropriate in some cases, depending on risk.

Some ectothermic taxa may also need modified feeding protocols before, during, or after transport to minimise health risks. This may also apply to some endothermic species.

Cheetah (*Acinonyx jubatus*) arriving at Edinburgh Zoo © *RZSS Edinburgh Zoo*

Transport of a rescued and rehabilitated Andean bear (*Tremarctos ornatus*) to the Colombian Andes
© Fundación Parque Jaime Duque/Bioparque Wakatá

Similarity of shipping and receiving facilities
Facilities should consider the similarities and differences between the shipping and receiving environments that may impact the animal's welfare. This does not mean that transfers should only occur between identical facilities, but that transitions should be planned with the animal's experience in mind.

Familiar elements – such as training routines, opportunities for human interaction, enrichment items, or environmental features like water sources – may ease the transition. Dietary consistency is especially important. Ideally, animals should have access to the same food items for at least the first month after arrival, while their diet is gradually adjusted.

CONCLUSION

Animal transports can be stressful for animals, but animals can be assisted in coping with this challenge and minimising the stress associated with transport and acclimation. Institutions involved in transporting or receiving animals should take appropriate time to carefully plan transports, consult relevant experts or skilled individuals, discuss logistics of loading, handling and unloading with all relevant personnel, prepare animals for shipment (including acclimation and/or training), and create contingency plans in case of unforeseen circumstances. Animal welfare should figure more prominently in these discussions than shipment time, cost, or other considerations to maximise the likelihood of successful transports.

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