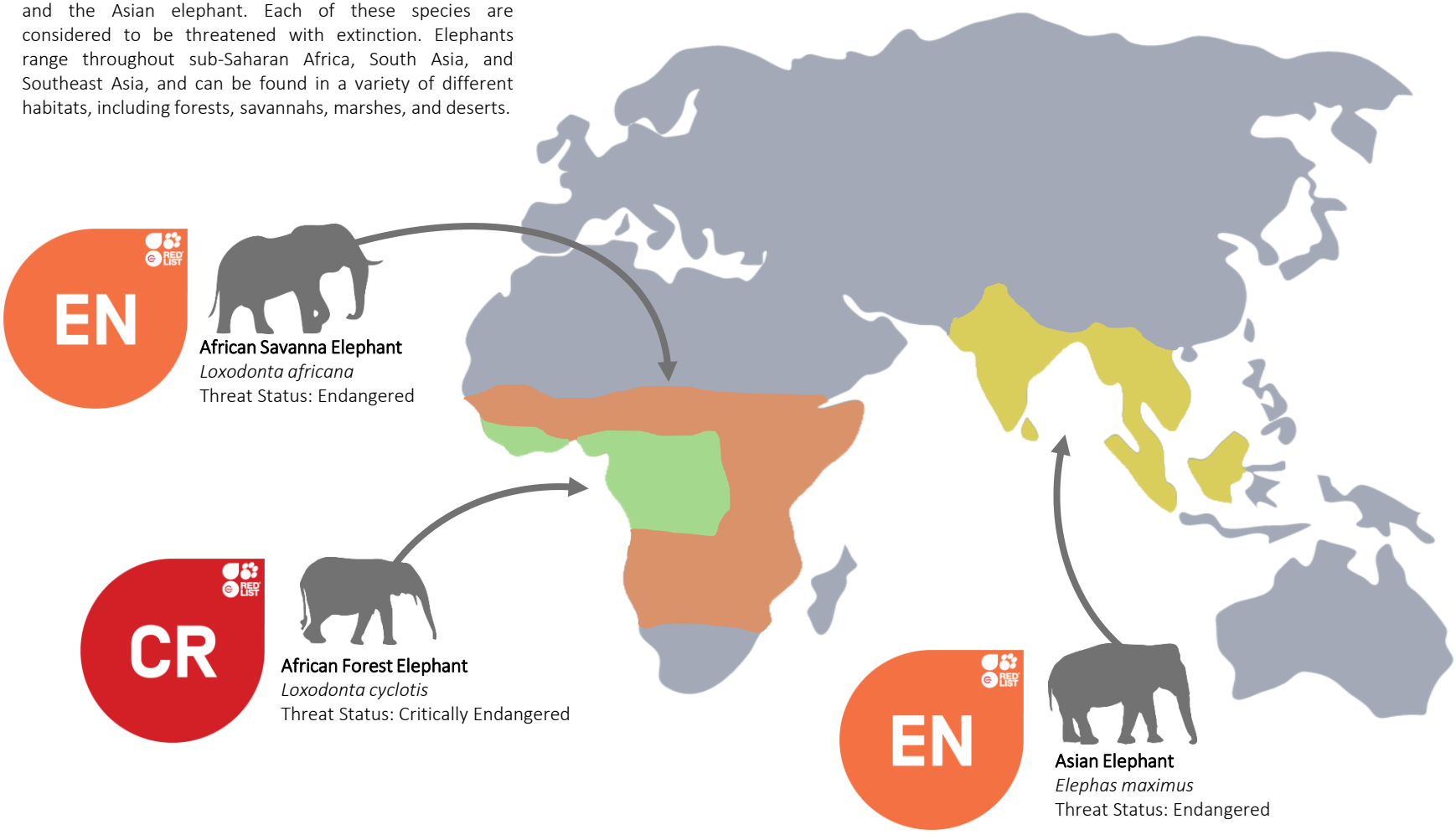
Elephants at Dublin Zoo

Conservation, Research and Management

Elephants

Elephants are threatened by habitat loss and fragmentation, illegal poaching for their ivory, and human-elephant conflict.

There are currently three recognised species of elephant: the African forest elephant, the African savanna elephant, and the Asian elephant. Each of these species are considered to be threatened with extinction. Elephants range throughout sub-Saharan Africa, South Asia, and Southeast Asia, and can be found in a variety of different habitats, including forests, savannahs, marshes, and deserts.



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Introduction

Elephants are some of the most inspiring species on the planet, and for centuries have helped to create emotional connections between people and the natural world. However, all three species of elephant are now threatened with extinction, with their populations decreasing globally due to habitat loss, poaching and human-wildlife conflict. Dublin Zoo is extremely privileged to care for a family of Asian elephants, and together with our partners in the British and Irish Association of Zoos and Aquariums (BIAZA), and the European Association of Zoos and Aquaria (EAZA), we are contributing directly to elephant conservation, both in zoos and in the wild.

Caring for elephants is a constantly evolving process, and we continually strive to push the boundaries of elephant husbandry, providing the very highest standards of care possible for the elephants at Dublin Zoo. We participate in, and instigate, innovative research to help us better understand the elephants in our care and their needs, allowing us to underpin all of our management practices and conservation actions with evidence and science. Working with the Asian elephant EAZA Ex Situ Programme (EEP), we are helping to create a healthy and sustainable population of Asian elephants in European zoos, while also contributing to the conservation of elephants in the wild.

Through our conservation partners, the Wildlife Trust of India and the Asian Nature Conservation Foundation, Dublin Zoo is helping to secure habitats for Asian elephants in the wild, directly conserving and improving the lives of wild elephants. These projects ensure that the local communities who live alongside elephants are included as part of the solution, creating a sustainable future for both people and elephants in India. In this way each time you visit Dublin Zoo you are not only getting the chance to watch a herd of Asian elephants living together as a family group and displaying natural behaviours, but you are also directly helping to conserve elephants in the wild.

Dublin Zoo's elephant programme has attracted the interest of zoo professionals from all over the world, and has allowed us to successfully breed Asian elephants for the first time in Ireland. We have now successfully bred two generations of Asian elephants at Dublin Zoo, making a substantial contribution to the conservation of this iconic species. Simultaneously, we have created a truly immersive experience for our visitors, delivering conservation messages and education programmes focussing on elephants in the wild and the actions we can all take to conserve them. We couldn't do any of this without our visitors, and we thank you for your continued support and dedication. Dublin Zoo is committed to ensuring that Asian elephants have a sustainable future, both in zoos and the in the wild, and we look forward to continuing to connect our visitors with elephants and the natural world.

Dr. Andrew Mooney
Conservation and Research Officer

Dublin Zoo works in partnership with:

BIAZA British & Irish Association of Zoos & Aquariums

EAZA European Association of Zoos and Aquaria

WAZA World Association of Zoos and Aquariums

Dublin Zoo is home to a successful breeding herd of Asian elephants, and actively participates in the EAZA Asian elephant Ex Situ Programme (EEP). The elephants at Dublin Zoo regularly contribute to scientific research on a huge variety of topics which have helped inform animal management practices and conservation actions. Dublin Zoo also proudly supports *in situ* efforts to conserve elephants in the wild through our conservation partners in India, helping to secure critical elephant habitats and reducing human-elephant conflict.

History

Dublin Zoo was opened by the Zoological Society of Ireland in 1831 on four acres of land in the Phoenix Park. In 1835, the Zoo rented its first elephant for the summer months, and the following year, in 1836, London Zoo gave Dublin Zoo its first resident elephant. During these early days enclosures were rudimentary, designed for containment and to provide visitors with good views of the animals. Over the coming decades many elephants came to Dublin Zoo, including notable figures like Prince Tom in 1871 (a gift from the Duke of Edinburgh) and Sara in 1936 (a gift from the Governor of Madras). Like many other zoos at the time, visitors were given the opportunity to ride the elephants, and many Irish people have fond memories of these times. However, as our understanding of the needs of elephants changed, so did our practices in caring for them.

Beginning in the 1970s the international zoo community started evolving, shifting away from just the display of animals and focussing more on conservation and education. During this period zoos started establishing animal care and husbandry standards, and began working together to manage populations of a species across multiple zoos and countries.

In the early 2000s, Dublin Zoo made the big decision to expand our elephant habitat and begin actively participating in the EAZA Ex Situ Programme (EEP) for Asian elephants, helping to create a healthy population of elephants in European zoos. In 2007, Dublin Zoo opened the world-class Kaziranga Forest Trail and welcomed three new Asian elephants from Rotterdam Zoo. This same year saw the first birth of an elephant in Ireland, a female calf named Asha. This was the start of Dublin Zoo's participation in the European Asian elephant breeding programme, and between 2007 and 2019 nine calves were born at the Zoo, bringing the total number of elephants at Dublin Zoo to a record 12.

Komali, an Asian elephant calf at Dublin Zoo (1950)

Male Asian elephant Rama and his keepers (1900)

Kaziranga Forest Trail

In 2007, Dublin Zoo opened the innovative and immersive Kaziranga Forest Trail habitat for Asian elephants. This expansive habitat was designed by the American architectural firm Jones and Jones, and was inspired by the Kaziranga Forest region in Assam, India, which supports a rich biodiversity including elephants, tigers and Indian rhinoceros. The aim of this new habitat was to provide a breeding herd of Asian elephants with the space they needed to live in a natural social group setting, as they would in the wild, while also encouraging them to display natural behaviours.

This new habitat was one of the first facilities in the world designed to allow elephants to live together day and night (a radical decision for the time), and provides 24 hour access to outdoor areas. Important features of this habitat include a night house for elephant cows and calves, which has a ceiling window to allow natural light to enter, and a two-metre deep sand substrate, which allows the elephants to lie down and sleep together. The night house also contains elevated feeders, rough surfaces for rubbing, and food timers for overnight feeding, all of which encourage searching, curiosity and muscle building behaviours.

The complex outdoor habitat includes two deep pools, a sand substrate, hanging feeders for elevated feeding, artificial rocks for rubbing, and hidden feeders to encourage and prolong the amount of time the elephants engage in natural foraging behaviours. The outdoor habitat is where the elephants at Dublin Zoo spend most of their day, so it is important that this environment is enriching for them. Each day our dedicated elephant care team carefully plan out and enhance the habitat, by adding tree stumps and rocks, and even changing the contour of the surface by moving the sand into small hills for the elephants to climb and lie on. In this way the elephants have ever changing visual and tactile stimulation, as well as edible stimulation, adding variety to their daily lives and encouraging natural behaviours.

Kaziranga Forest Trail at Dublin Zoo

A separate night house and outdoor area were also built just for a bull elephant, giving space to separate the elephant herd if needed. Although Asian elephants normally live peacefully together, sometimes separation can be necessary, specifically when the bull is in musth.

What is musth?

Musth is a natural annual hormonal cycle that occurs in adult male elephants. During musth, testosterone levels increase significantly, which can change the behaviour of bull elephants, sometimes resulting in aggression.

As well as being home to Asian elephants, the Kaziranga Forest Trail is also home to a small group of blackbucks (*Antilope cervicapra*), a small antelope species which shares the same habitat as Asian elephants in the wild. Although the elephants and blackbuck live together harmoniously in the Kaziranga Forest Trail, the blackbuck also have a separate night house and outdoor area which the elephants cannot access.

This progressive habitat has attracted the interest of zoo professionals from all over the world, and has allowed us to breed Asian elephants for the first time in Ireland. We have now successfully bred two generations of elephants at Dublin Zoo, making a substantial contribution to the conservation of this species. Simultaneously, the extensive use of plants, and a trail with unique viewing areas, has helped to create a truly immersive experience for our visitors, and gives us the chance to deliver conservation messages about elephants in the wild. Most importantly, the Kaziranga Forest Trail gives our visitors the opportunity to watch elephants displaying a wide variety of natural behaviours – bathing, feeding, moving, digging, playing, interacting or simply relaxing together as a herd, as they would in the wild.

Blackbuck at Dublin Zoo

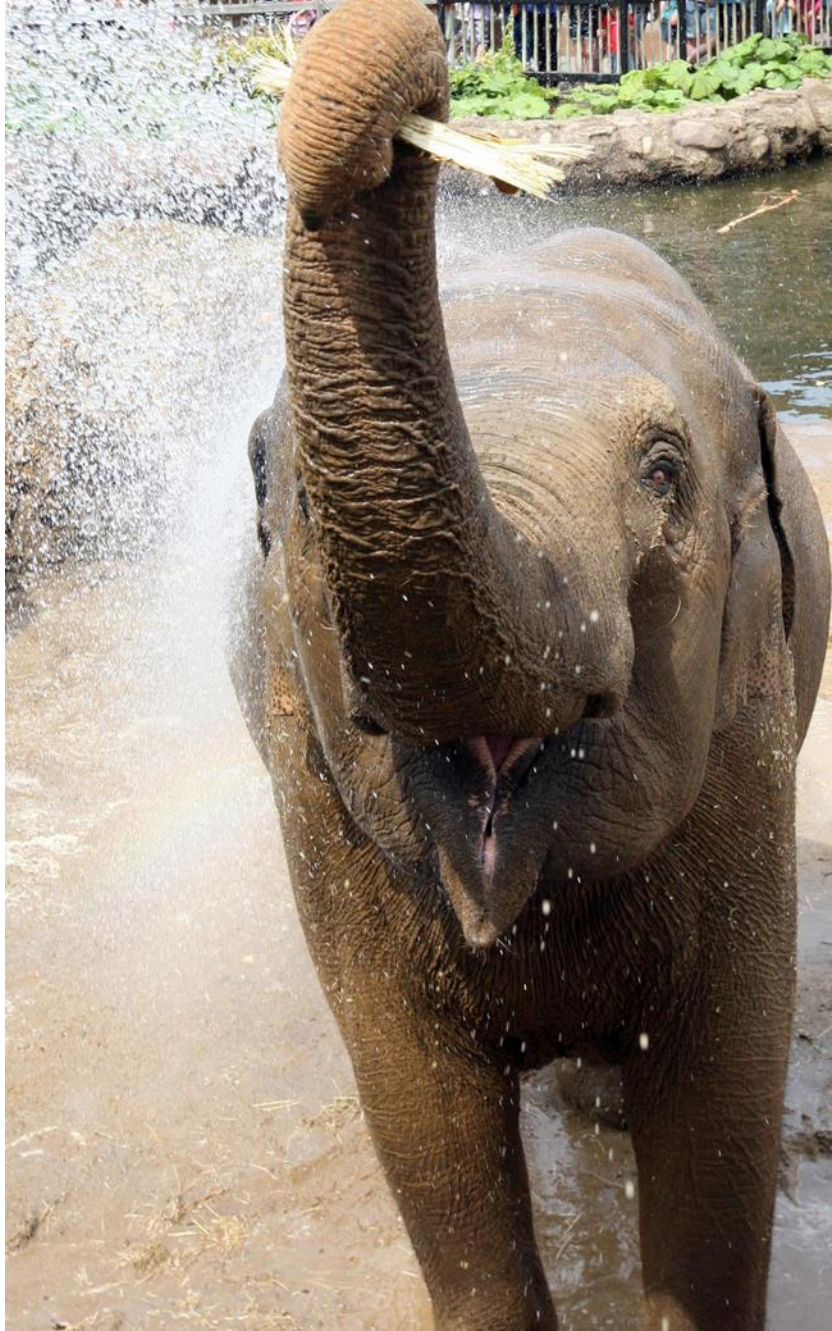
Caring for Elephants

Caring for elephants is a complex and constantly evolving process. We are committed to providing the elephants at Dublin Zoo with the highest possible standards of care, and we strive to lead the way in progressive animal husbandry. Everything we do is guided by the natural history of elephants, and is grounded in evidence-based research, ensuring that all of our actions can continually be monitored and improved to provide the best possible life for the elephants in our care.

What is animal husbandry?

Animal husbandry is the science of breeding and caring for animals, and covers all aspects of how we manage our animals on a daily basis. At Dublin Zoo, our world-class husbandry practices help to support the growth and development of the animals in our care. Our practices are based on years of experience and collaboration with other zoos, researchers, and from studying the behaviour of animals in the wild.

In the wild, elephants can spend up to 18 hours a day foraging and feeding, so we take every opportunity to replicate this and stimulate the elephants during their waking hours. For example, the elevated feed nets throughout the Kaziranga Forest Trail are filled regularly with hay, maize, and browse. These feed nets can be automatically lowered and raised out of the elephant's reach by hand-held remote controls. This mimics natural foraging behaviours and encourages movement and searching behaviours in the elephants, while also prolonging the amount of time that a single net of food can be used by the elephants. Since we started providing elevated feeding opportunities we have seen a remarkable increase in the neck and shoulder strength, and overall body condition, of the elephants in our care, and this has now been replicated in many other zoos.



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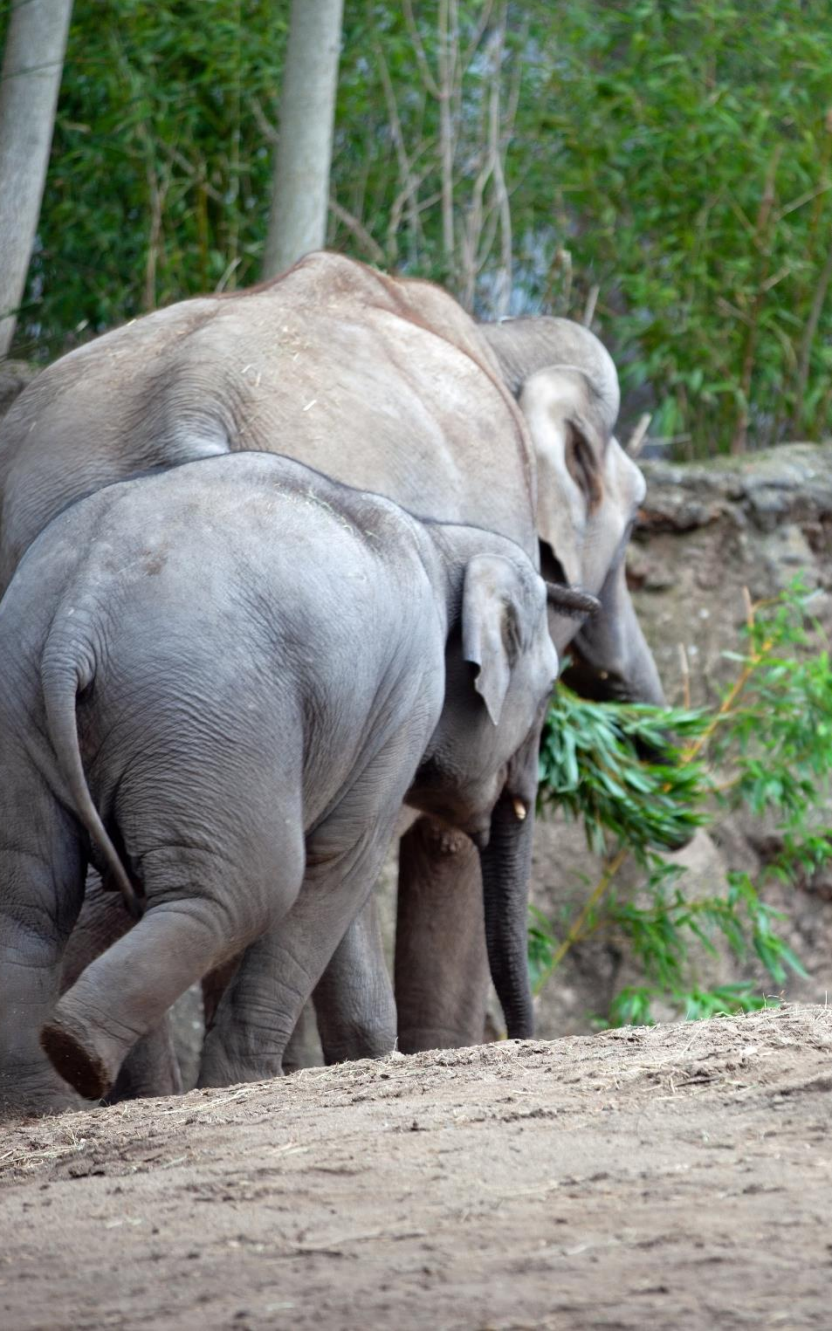
As elephants only sleep for approximately three hours a day, we have also designed the indoor area of the elephant habitat to offer the elephants feeding opportunities throughout the night. A large feed wall uses timed doors to provide access to hay and feed balls at different times throughout the night. These activities can be monitored by the elephant care team remotely through the use of CCTV cameras throughout the habitat. The use of cameras has also allowed the elephant care team to follow and record sleeping and behavioural patterns in the elephants at Dublin Zoo over time, and they play a crucial role during the birthing process. The cameras allow our team to observe and monitor the birthing process without disturbing the elephants with their physical presence. However, if an emergency situation arises during a birth then the team are only seconds away, watching the situation unfold on screens in the elevated staff viewing area.

Elephant Care Team at Dublin Zoo

The elephants at Dublin Zoo receive world-class care, including daily enrichment and stimulation. This is provided by our dedicated elephant care team, who have been trained according to the latest and most progressive husbandry standards, and are equipped with the skills necessary to provide the complex care required. Members of our elephant care team regularly attend training workshops and conferences to receive the most recent information on elephant conservation, research, management, and veterinary matters. Dublin Zoo also receives regular expert advice from specialist elephant care consultants, helping us to continually develop our elephant care team and improve our management practices.

Routine elephant foot care at Dublin Zoo



Historically, many zoos kept elephants on hard concrete surfaces because they were easier to clean. However, when designing the Kaziranga Forest Trail Dublin Zoo made the decision to use sand instead. The two-metre deep natural sand found throughout the Kaziranga Forest Trail provides opportunities for the elephants to engage in natural behaviours such as throwing and dusting 24 hours a day, while also providing an uneven surface that strengthens leg tendons and muscles. At Dublin Zoo, the young elephants can often be seen playing with the sand, while the adults take the opportunity to lie down and sleep on sand mounds, something very rarely seen on concrete surfaces.

The sand also has the added benefit of assisting the elephants when giving birth, and throughout the post-birthing process. The sand substrate quickly absorbs the fluids produced during the birthing process and allows calves to gain a much quicker grip on the surface when trying to stand. Deep sand also cushions their fall and drastically reduces the need for any kind of human intervention, with elephant calves born onto natural surfaces often on their feet within six minutes. This was an important consideration when designing the Kaziranga Forest Trail, and has allowed our elephants to give birth in as natural a setting as possible, surrounded by other herd members for support. Witnessing the birth of a calf is an important experience for other members of the herd, and allows younger females to become familiar with the sights and sounds of the birthing process before they themselves give birth.

Research Highlight: Elephant Movement

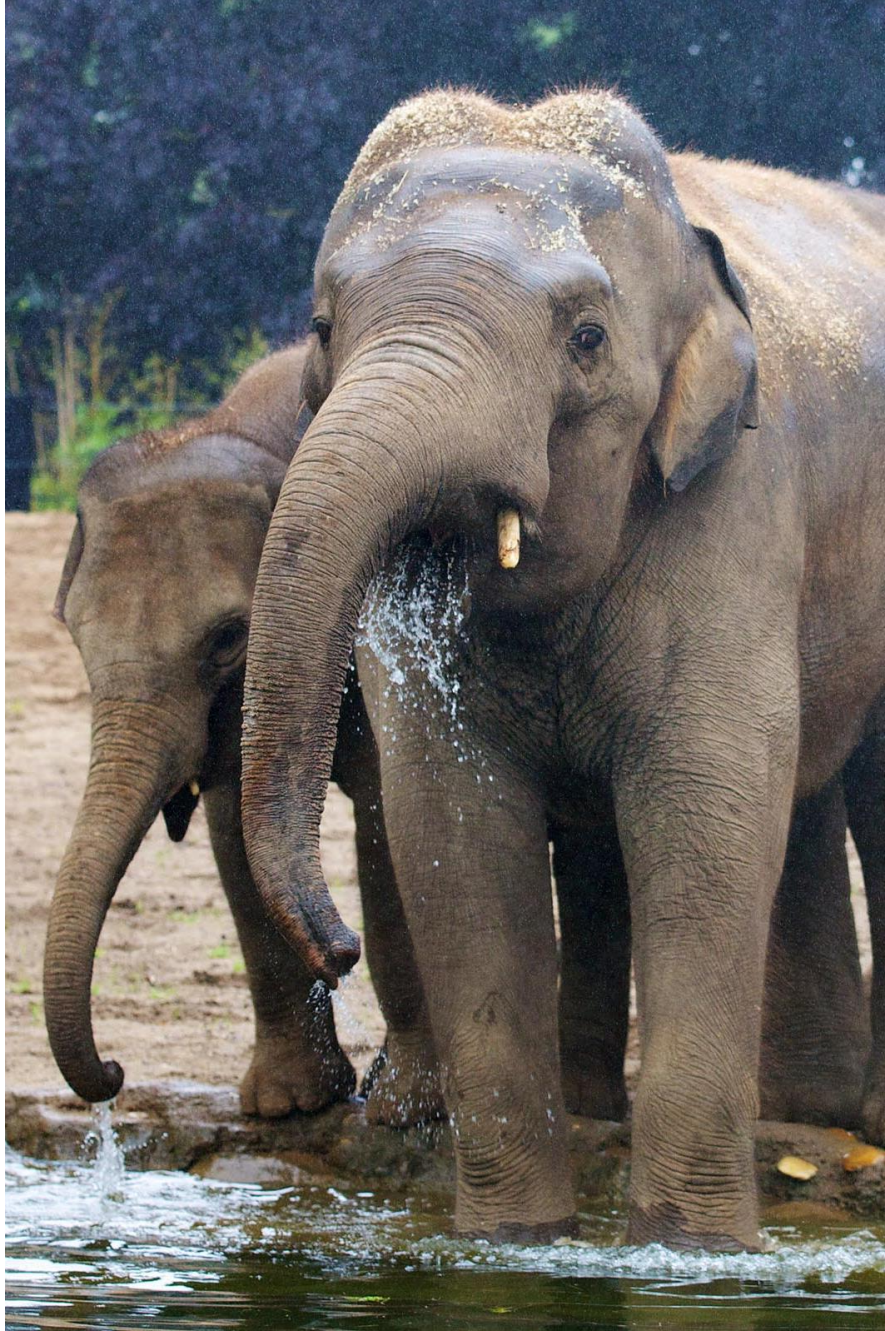
Research has shown that the elephants at Dublin Zoo travel nearly 10 km a day. This is similar to Asian elephant herds in the wild, which normally travel distances of 5-10 km a day. This research, in collaboration with University College Dublin, found that the elephants at Dublin Zoo display walking and behavioural patterns more similar to elephants in the wild than to elephants in other zoos (Brady *et al*., 2021)

Protected Contact

At Dublin Zoo we never share space with the elephants, instead the elephant care team manage them through a system known as protected contact. This means that our keepers are always separated from the elephants by a purpose built protective barrier and never enter the habitat with the elephants. Specialised protocols are in place which are designed to help the team work with the elephants in this way, all of which are based on the voluntary participation of the elephants. The elephant care team manage and train the elephants at Dublin Zoo using positive reinforcement techniques, which are conducted through a specially designed protective wall. This is not only safer for our keepers, but it also allows the elephants to maintain their own social group with minimal human interaction, and lets them choose what training they want to participate in and when. Protected contact is now being adopted by the EAZA Elephant Taxon Advisory Group (TAG) as the only management system for elephants in EAZA zoos.

To help us manage the elephants through protected contact, the night house for the cows and calves has three adjoining training stalls, which are used during voluntary positive reinforcement training sessions. These stalls mean we can separate the elephants, gaining essential husbandry access to each animal individually, while also ensuring that the individual elephant stays in close contact with the rest of the herd. The stalls are large enough to accommodate a cow and calf, so that they are always in close proximity. Additionally, a specially designed calf training area is also available, where we can get individual calves to engage in voluntary training sessions, whilst they remain in close contact with their mothers.

Each stall has both foot and ear access ports, which are used regularly for health checks and minor medical procedures. This allows us to safely check and care for the elephant's feet, trimming the foot pads, nails and cuticles as needed. Dublin Zoo also actively participates in research looking at the foot health of elephants in European zoos. Results from this collaborative research has further emphasised the importance of a natural sand surface, and has allowed us to improve our husbandry practices.



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The Herd

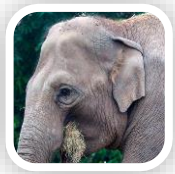
In 2007, Dublin Zoo welcomed three Asian elephants from Rotterdam Zoo – Bernhardine, Yasmin and Anak. Both Bernhardine and Yasmin were pregnant when they arrived, and in 2007 we welcomed the first elephant ever born in Ireland, a female named Asha, followed by the first male calf named Budi in 2008. Upali, a bull elephant arrived in 2012 from Chester Zoo, and between 2012 and 2019 Dublin Zoo welcomed a further seven calves – Samiya, Ashoka, Kavi, Zinda, Avani, Sanjay and Kabir, representing a significant contribution to the Asian elephant breeding programme, which is called an EEP.

What is an EEP?

EAZA Ex Situ Programmes (EEPs) are population management programmes for species which are managed by EAZA zoos and aquariums. The aim of these programmes is to maintain a healthy population of animals within the EAZA community, considering both the demography and genetics of the population. Each programme is managed by an EEP Coordinator, who is responsible for carrying out analyses on the population to help create breeding and transfer recommendations for the population. The EEP Coordinator is supported by an EEP Committee, who provide technical guidance and expertise when managing the programme. In this way we are part of a much bigger conservation goal, and this is why some animals move between zoos once they reach sexual maturity. For example, in 2019 the decision was made to move Upali to Le Pal Zoo in France as part of a breeding recommendation to maintain the genetic diversity of the elephants in European zoos.

EEP

Meet the elephants



Bernhardine ♀
Born 16/06/1984

Asha ♀
Born 07/05/2007

Samiya ♀
Born 17/09/2014

Avani ♀
Born 13/03/2017

Upali ♂
Born 14/11/1994
Current Location:
Le Pal Zoo

Yasmin ♀
Born 25/11/1990

Zinda ♀
Born 19/09/2016

Anak ♀
Born 26/07/2003

Budi ♂
Born 17/02/2008
Current Location:
Denver Zoo

Kavi ♂
Born 17/07/2014
Current Location:
Sydney Zoo

Kabir ♂
Born 15/05/2017

Ashoka ♂
Born 19/08/2014
Current Location:
Sydney Zoo

Sanjay ♂
Born 10/02/2018

Conservation Action

Between 2015 and 2019, Dublin Zoo provided over €50,000 in financial support to a project focussed on conservation planning for elephants in the Kaziranga-Karbi Anglong landscape in Assam, India. This project is run by the Asian Nature Conservation Foundation (ANCF), who are also collaborating with the state forest department in Assam, the Wildlife Trust of India and Cincinnati Zoo. The project is coordinated by Professor Raman Sukumar and is endorsed by the Asian elephant EEP. Prof. Raman Sukumar is one of the leading authorities on Asian elephant conservation in India, and represents India on the Intergovernmental Panel on Climate Change. Dublin Zoo's support has allowed the ANCF to further our understanding of the Kaziranga-Karbi Anglong landscape, and they are now looking to expand their work by deploying radio-collars and camera traps to track elephant movements in the region.

Dublin Zoo has supported the Jana Robeyst Trust Fund, which provides small grants to allow researchers to conduct studies on wild elephants. The Trust Fund supports small-scale research projects up to a maximum of €1,500, financially supporting biologists to carry out their research. The Trust Fund is in memory of Jana Robeyst, who dedicated her life to furthering our understanding of the natural world.

ANCF
ASIAN NATURE CONSERVATION FOUNDATION

JANA ROBEYST TRUST FUND

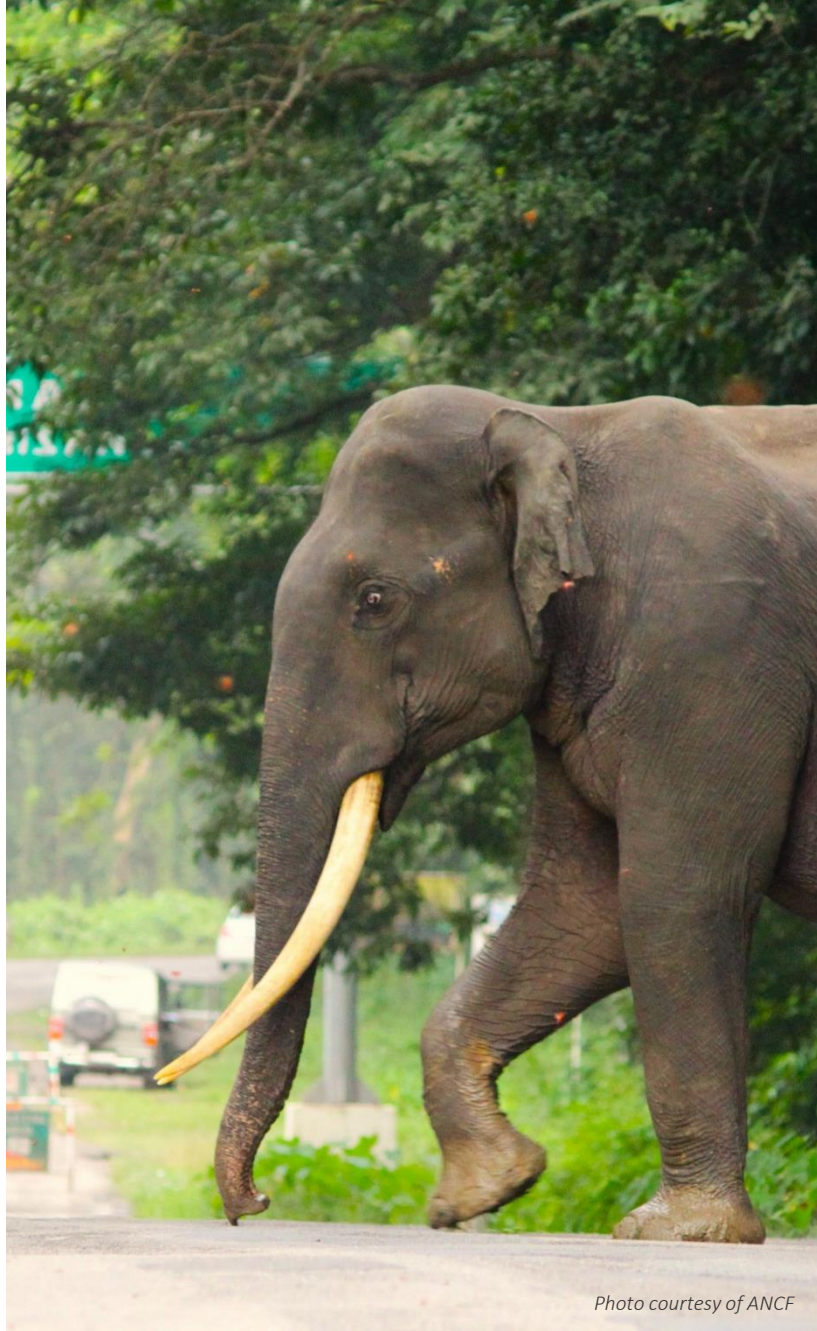


Photo courtesy of ANCF

Through our conservation partners, the Wildlife Trust of India and the Asian Nature Conservation Foundation, Dublin Zoo is helping to secure habitats for Asian elephants in the wild, directly conserving and improving the lives of wild elephants.

Asian elephants outside Kaziranga National Park. Photo courtesy of ANCF.

Elephants at Manas National Park. Photo courtesy of Dr. Bhaskar Choudhury - WTI-IFAW.

Tippi corridor in Arunachal Pradesh, Northeast India. Photo courtesy of WTI.

Conservation Partners

In 2022, Dublin Zoo began partnering with the Wildlife Trust of India (WTI) to help conserve and protect Asian elephants in the wild. WTI is a registered charity and works to conserve wildlife and its habitat in partnership with the Government of India, state governments, and the local communities most impacted by wildlife.

Dublin Zoo supports WTI as part of their National Elephant Corridors project, called Right of Passage. Unfortunately most elephants in India today live in small, isolated habitat fragments. These fragments are often surrounded by, or even include, local human communities and areas of human use, which can result in human-wildlife conflict. In the wild elephants need to be able to move freely between different habitats as the availability of food and water changes seasonally, and to maintain genetic flow in the population. Some of these existing habitat fragments are connected to each other by narrow natural habitat linkages, called corridors. These corridors allow elephants to move between secure habitats without encroaching upon human populations and neighbouring communities.

These corridors are crucial for the future of elephants in India, but they are often not protected and are vulnerable to human encroachment. In response to this, WTI has been working for over two decades to identify and protect elephant corridors all over India, while simultaneously working with local communities to improve their livelihoods and promote sustainable human-wildlife co-existence. As part of this project, WTI has identified 101 elephant corridors, six of which have already been secured for elephants. WTI is committed to securing more elephant corridors and are involved in political advocacy with national and state governments to allocate resources for further corridor securement.

WTI has also developed a network of Green Corridor Champions across India. Green Corridor Champions are local community stakeholders who ensure that every corridor is continually monitored, and that local communities are educated on the importance of elephants and the corridors. This engagement helps to create a sense of ownership and responsibility among local communities and is helping to secure a sustainable future for elephants in India.

Education

Elephant Exploration

The Asian elephant herd at Dublin Zoo have been a key species to support conservation education programmes and sustainability messaging at Dublin Zoo. Following the development of the Kaziranga Forest Trail, an interactive elephant-themed Learning and Discovery Centre was developed to educate the public about the ecology, habitat, diet and physiology of Asian elephants. This self-guided interpretation centre is home to a full size skeleton of an Asian elephant, which faces a full size human skeleton for scale. Visitors have the opportunity to hear the heartbeat of an elephant, feel the surfaces of their teeth and learn about the threats elephants face via videos and written interpretation. The centre, now called 'Elephant Exploration', has received millions of visitors since it opened its doors in 2008 and is near the entrance to the Kaziranga Forest Trail.

Kaziranga Forest Trail – an immersive learning journey

The design of the Kaziranga Forest Trail lends itself to the ethos of our learning programmes: to provide an opportunity of discovery and learning about all aspects of the Asian elephant's ecology and natural habitat. Learners are taken on an immersive journey through a bamboo forest trail, passing waterfalls and crossing creeks, feeling the vibrations of elephant rumbles and occasionally hearing them trumpet in the distance. As they approach viewing areas, a vast habitat is presented with a family herd of elephants playing in pools or mud wallows. It is an exciting and popular experience which replicates encountering these incredible animals as you would in the wild.

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Public Engagement

The multisensory experience along the Kaziranga Forest Trail is supported by public engagement activities from the highly skilled volunteer team at Dublin Zoo. Along the trail, the team engage visitors with educational displays and learning props such as an elephant tooth and foot parings. These activities support further learning about the herd, and the work Dublin Zoo and our conservation partners do to support elephants in the wild. Regular keeper talks also take place to give further insights into Asian elephants and the herd at Dublin Zoo. Within the indoor viewing area, a screen shows the birthing process and the early stages of an elephant calf's life, as well as the extensive indoor habitat, which supports the sleeping and foraging needs of the elephants.

Learning Programmes

The range of learning programmes that feature Asian elephants is extensive, and takes the form of in-person programmes at Dublin Zoo, outreach in schools, and virtual learning opportunities. Topics include; adaptations, habitats and ecosystems, elephant behaviour, herd dynamics, elephant care and communication. Asian elephants feature on formal programmes for primary, secondary and tertiary learners as well as informal programmes, such as parent and toddler sessions, school holiday workshops and camps. For over a decade, lectures on the Asian elephants, and the science behind elephant care at Dublin Zoo, have been presented as part of the Department of Education and Skills Primary Teachers Course, which provides a richer understanding of the care, research and conservation work dedicated to the Asian elephants in our care. The objective of the programme is also to encourage primary school teachers to engage with teaching and learning about Asian elephants with their students. Bespoke programmes for Science Week and Engineers Week have also explored Asian elephant habitat design, and have reached large audiences through both Dublin Zoo and Science Foundation Ireland's media channels.

Volunteer at Dublin Zoo


DUBLIN ZOO
ADVENTURE

Research

In line with the World Zoo and Aquarium Conservation Strategy, Dublin Zoo is committed to the instigation of, and participation with, quality research in various disciplines, both in zoos and in the wild. Research undertaken at Dublin Zoo directly impacts the conservation of species in the wild, informs the management and welfare of the animals in our care, and contributes to the overall scientific body of knowledge on species and their habitats. The undertaking of such quality research is emphasised by the EU Zoos Directive, the European Association of Zoos and Aquaria (EAZA) and the World Association of Zoos and Aquariums (WAZA). The elephants at Dublin Zoo have provided critical insights and have contributed to multi-institution research on a huge variety of topics, ranging from veterinary care, to animal behaviour and animal physiology, all of which have helped inform animal management practices and conservation actions.

Examples of research which has involved the elephants at Dublin Zoo can be found on the following pages.

EEHV

The Elephant Endotheliotropic Herpesvirus (EEHV) is a life-threatening virus that affects elephants in human care and in the wild, threatening the survival of these endangered species globally. Although EEHV can be found in both African and Asian elephants, Asian elephant calves between one and five years old appear to be the most vulnerable to the virus. Since its discovery in the 1990s, zoos around the world have been working together to find an effective treatment and vaccine for this virus.

EEHV causes damage to blood vessels and results in internal bleeding, which can lead to vascular shock in elephant calves, causing sudden death. Many elephants in zoos and the wild actually carry EEHV, but only some elephants develop clinical symptoms and become unwell. The reasons why some elephants become sick and not others is still not well understood, and on-going collaborative research is trying to explain and predict EEHV susceptibility. This means that it is difficult to fight the virus, as calves often do not appear to be unwell until days or hours before their death, at which point interventions are not as effective. Therefore early detection is key, and Dublin Zoo has participated in peer-reviewed research with the Cummings School of Veterinary Medicine at Tufts University and the National Elephant Herpesvirus Laboratory at the Smithsonian National Zoological Park, to assess the efficacy of oral swabs and trunk washes for the detection of EEHV.

Thankfully no Asian elephant calves born at Dublin Zoo have succumbed to the virus, but we are aware of the devastating potential of this infectious disease and the threat it poses to the long-term conservation of Asian elephants. Since 2014, Dublin Zoo has supported critical research efforts to help us better understand EEHV, in collaboration with Rotterdam Zoo, Erasmus University and Houston University (USA). This work is supported by the EAZA Elephant Taxon Advisory Group (TAG), and has provided critical insights into how the virus works, and how it can be detected.

The dedicated Conservation and Science Team at Chester Zoo, in collaboration with the University of Surrey, are now developing the first EEHV vaccine. This vaccine is currently undergoing a pilot study. Together, the global zoo community is committed to saving Asian elephants from this deadly virus.

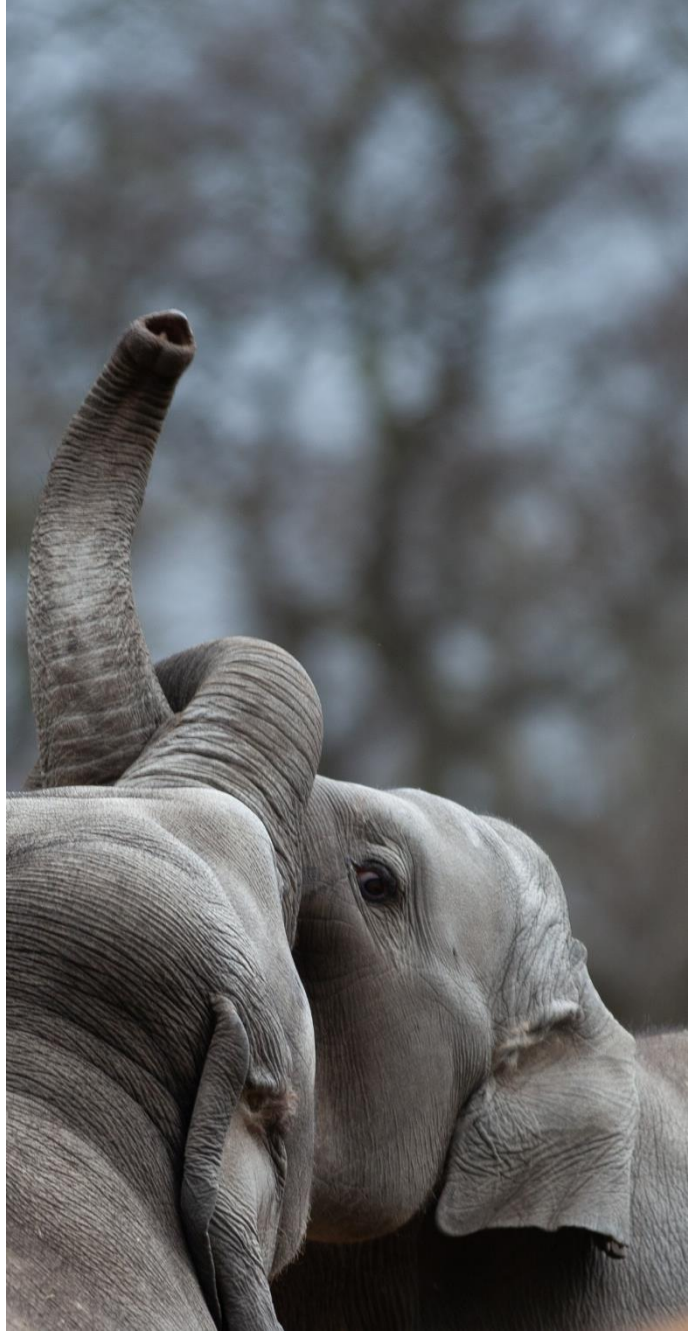
Veterinary Research

Rose, J. B., Leeds, A., Yang, L. M., LeMont, R., Fayette, M. A., Proudfoot, J. S., Bowman, M. R., Woody, A., Oosterhuis, J., & Fagan, D. A. (2022). Treatment and Outcomes of Tusk Fractures in Managed African Savanna and Asian Elephants (*Loxodonta africana* and *Elephas maximus*) across Five Continents. *Animals*, *12*(9), 1125. https://doi.org/10.3390/ani12091125

Excerpt: When tusk fractures occur in elephants under managed care, they can expose the soft tissues and substantial blood supply of the tusk's pulp. The management strategies and clinical consequences of those fractures vary immensely in both the literature and the collective experiences of elephant managers and clinicians. Outcomes have ranged from self-healing with conservative management to life-threatening systemic infection. A detailed survey requesting tusk fracture characteristics and subsequent management and outcomes was completed by elephant veterinarians globally. A larger pulp canal diameter at the time of fracture and the use of tap water in the course of treatment were associated with an increased risk of the development of an infected and inflamed pulp, meriting further investigation. Endodontic treatment of fractured tusks with pulp exposure was associated with a reduced risk of tusk extraction. These guidelines can aid elephant managers and clinicians in their clinical decision-making surrounding these challenging events. Data from the elephants at Dublin Zoo were included in this study, with expertise provided by our veterinary team.

Grenus, B. G., Latimer, E., Cullinane, A., Lyons, P., Creighton, G., & Nutter, F. B. (2020). Evaluation of the efficacy of two different sampling sites for the detection of Elephant Endotheliotropic Herpesvirus (EEHV) in three Asian elephants (*Elephas maximus*) in Ireland. *Journal of Zoo and Wildlife Medicine*, *51*(2), 303–307. https://doi.org/10.1638/2018-0193

Excerpt: Elephant endotheliotropic herpesvirus (EEHV) causes a disease that primarily affects juvenile Asian (*Elephas maximus*) elephants, causing acute haemorrhage and death. Due to the severity of the disease, many zoos have developed EEHV active surveillance programs. Currently, trunk washes are the standard for testing elephants for shedding of EEHV, but it has also been detected from other mucosal surfaces. This study compared the efficacy of oral swabs and trunk washes for the detection of EEHV shedding using previously validated quantitative polymerase chain reaction (qPCR) methods. Oral swab and trunk wash samples from three juvenile elephants at Dublin Zoo were collected in tandem and tested from April to September 2017. Of the 51 paired samples, 21 trunk wash samples were positive for EEHV1, while only 2 of the oral swab samples were positive for EEHV1, suggesting that trunk wash samples are more effective for detecting shedding of EEHV in Asian elephants compared with oral swabs.



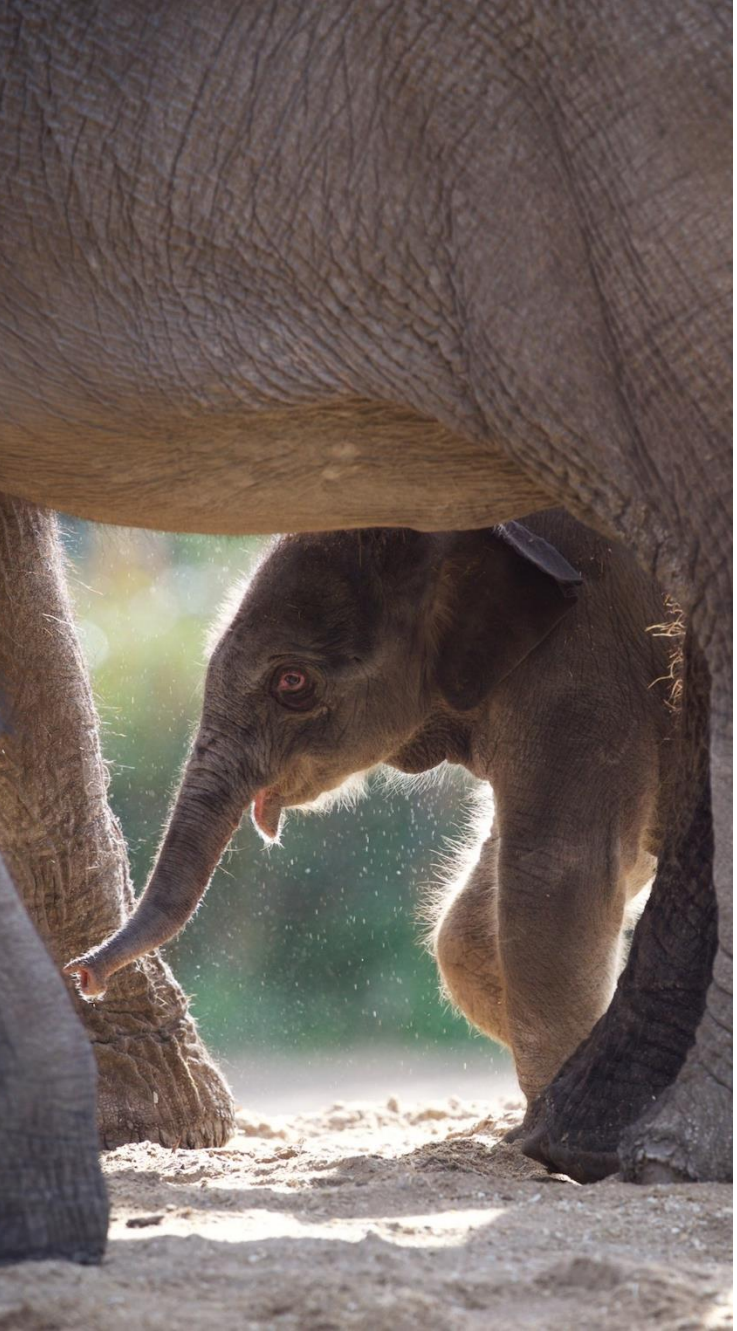
Elephant Behaviour

Williams, E., Bremner-Harrison, S., Hall, C., & Carter, A. (2020). Understanding Temporal Social Dynamics in Zoo Animal Management: An Elephant Case Study. *Animals*, *10*(5), 882. https://doi.org/10.3390/ani10050882

Excerpt: Here we used elephants as a case study to enhance the understanding of potential group dynamics in zoo animal social groups. Data were collected over 12 months to investigate temporal dynamics in social networks. Positive social interaction networks were more interlinked than negative interaction networks. Social networks were fluid, but they did not follow a seasonal pattern. The results demonstrate the importance of understanding social networks and social behaviour over extended periods of time. Consideration of temporal changes in social relationships will enable and support evidence-based management. Such management will lead to the improved welfare of socially housed zoo species, through increased understanding and recognition of the impact of management actions on welfare. The elephants at Dublin Zoo participated in this study through direct behavioural observations and monitoring of their interactions over time.

Williams, E., Carter, A., Hall, C., & Bremner-Harrison, S. (2019). Social Interactions in Zoo-Housed Elephants: Factors Affecting Social Relationships. *Animals*, *9*(10), E747. https://doi.org/10.3390/ani9100747

Excerpt: Here we investigated whether a number of factors at the individual (e.g. personality, age or relatedness to others) and zoo (e.g. herd size, presence of calves in the group) level affected the frequency of social interactions in zoo elephant herds. Social interactions were found to be related to age, personality, presence of calves in the herd, relatedness to other elephants in the herd and species (African or Asian). Calves engaged in the greatest amount of positive interactions but no extreme aggression was observed between any individuals, which was considered indicative of good social management. These findings support the recommendations that elephants should be housed in related herds with multiple ages wherever possible, but they also highlight that unrelated elephants can still form compatible and successful social groups. The elephants at Dublin Zoo participated in this study through direct behavioural observations and monitoring of their interactions.



Elephant Reproduction

Dale, R. H. I. (2010). Birth statistics for African (*Loxodonta africana*) and Asian (*Elephas maximus*) elephants in human care: History and implications for elephant welfare. *Zoo Biology*, *29*(2), 87–103. https://doi.org/10.1002/zoo.20234

Excerpt: African (*Loxodonta africana*) and Asian elephants (*Elephas maximus*) have lived in the care of humans for many years, yet there is no consensus concerning some basic parameters describing their newborn calves. This study provides a broad empirical basis for generalisations about the birth heights, birth weights, birth times and gestation periods of elephant calves born in captivity. I obtained data concerning at least one of these four characteristics for 218 new-borns calves from 74 institutions. Over the past 30 years, newborn Asian elephants have been taller and heavier than newborn African elephants. Neonatal African elephants exhibited sex differences in both weight and height, whereas neonatal Asian elephants have exhibited sex differences only in height. Primiparous dams *ex situ* are at least as old as their *in situ* counterparts, whereas *ex situ* sires appear to be younger than sires in range countries. Birth statistics from the elephants at Dublin Zoo were included in this study.

Whilde, J., & Marples, N. (2012). Effect of a birth on the behavior of a family group of Asian elephants (*Elephas maximus*) at Dublin Zoo. *Zoo Biology*, *31*(4), 442–452. https://doi.org/10.1002/zoo.20408

Excerpt: Elephants in the wild live in herds of related females from several generations. Zoos, therefore, tend to house elephants in female groups, consisting where possible of related individuals. This type of group structure is very beneficial as it allows group members to experience events such as births in the group, and means that natural social interactions can take place between the group members. The behavior of four related female Asian elephants at Dublin Zoo was recorded before and after the birth of a calf, to examine what effects it would have on the behavior and associations in the elephant group. The mother of the calf significantly decreased the amount of time she spent walking after the birth and the aunt of the calf showed significant decreases in both walking and standing. The mother spent the majority of her time closest to her calf after the birth, but the proportion of time she spent with each of the other individuals in the group did not change. The older sister of the newborn calf increased the proportion of time she spent nearest to her mother after the calf was born, and reduced the time she spent close to another young elephant in the group.

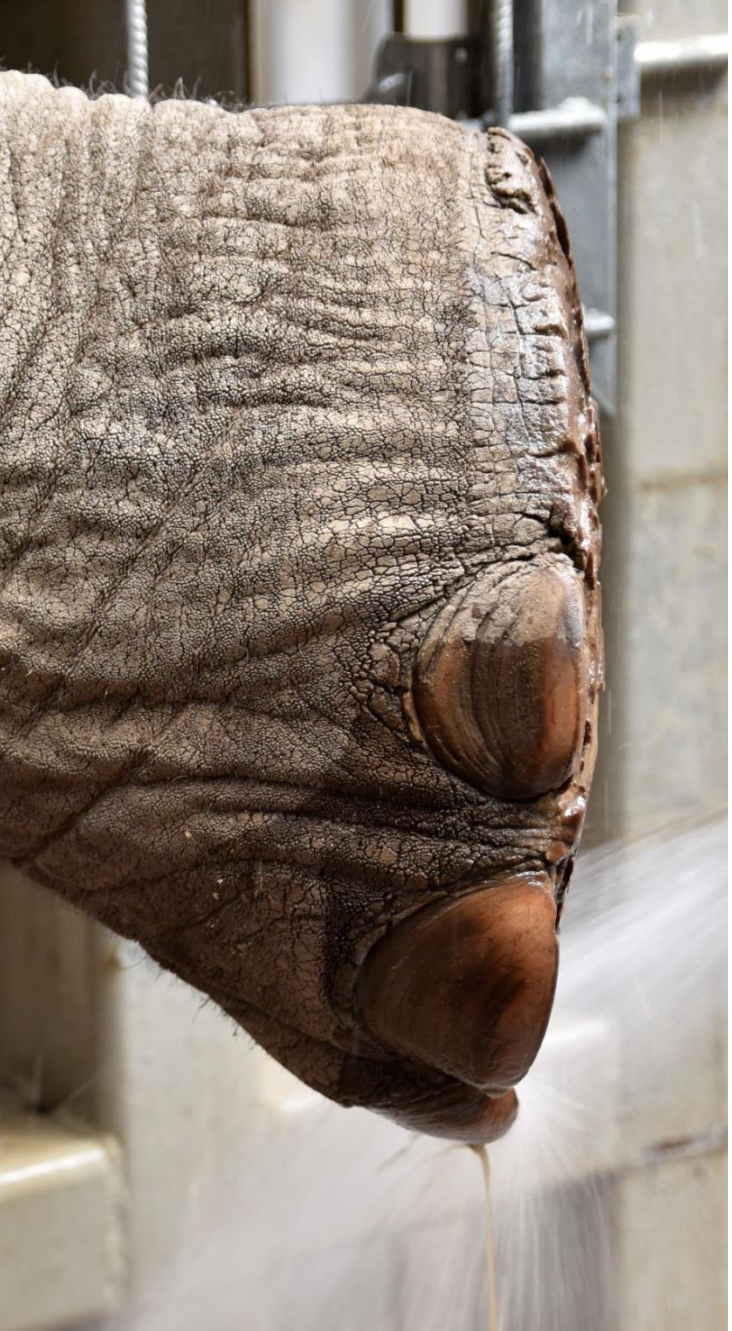
Elephant Physiology

Walsh, B. (2017). Asian elephant (*Elephas maximus*) sleep study – long-term quantitative research at Dublin Zoo. *Journal of Zoo and Aquarium Research*, *5*(2), 82–85. https://doi.org/10.19227/jzar.v5i2.174

Excerpt: Sleep is an essential aspect of Asian elephant wellbeing in zoos. Recent improvements in elephant habitats and husbandry have increased their wellbeing, but few studies have focused on night time behaviour. This study measured sleep behaviour in a group of Asian elephants in Dublin Zoo and how it related to elephant husbandry. A total of 704 nights of elephant behaviour were recorded over a 33-month period. Adults slept for an average of three hours and thirty three minutes per night, while calves slept an average of five hours and eight minutes per night. One of the three elephants who became a mother during the study slept 68.3% less in the first nine months after giving birth. Another mother slept 13% less after parturition, while a third female slept more after giving birth (up 10.3%). Reduction in sleep duration appeared to be primarily because of calf guarding behaviour, but establishing successful suckling may also be a factor. The bull showed consistent sleep duration, while sleep in the other elephants varied through pregnancy, parturition and the immediate post-partum period.

Brady, A., McMahon, B. J., & Naulty, F. (2021). Estimates of locomotion in Asian elephants *Elephas maximus* using video monitoring at Dublin Zoo, Ireland. *Journal of Zoo and Aquarium Research*, *9*(2), 124–133. https://doi.org/10.19227/jzar.v9i2.502

Excerpt: Welfare of elephants in zoos is a major concern within the public and zoo community. The aim of this study was to examine locomotory behaviour and associated habitat use in the adult members of the Dublin Zoo herd over a 2-month period using pre-recorded closed circuit television (CCTV) footage. Overall, the elephants in Dublin Zoo were found to display behaviours and travel distances comparable to those in the wild. The mean daily distance travelled (24 hours) was 9.35 km/day. Asian elephant herds in the wild travel distances of 5–10 km/day during non-extreme weather conditions. Free-ranging elephants are reported to spend 60–80% active hours feeding and up to 20 hours of their day is spent actively moving. The elephants in Dublin Zoo were found to spend 50% of their time foraging and 18% engaging in locomotion. Dublin Zoo elephants displayed locomotion and behavioural patterns more similar to the wild than to previous zoo studies.



Foot Health

Wendler, P., Ertl, N., Flügger, M., Sós, E., Schiffmann, C., Clauss, M., & Hatt, J.M. (2019). Foot health of Asian elephants (*Elephas maximus*) in European Zoos. *Journal of Zoo and Wildlife Medicine*, *50*(3), 513–527. https://doi.org/10.1638/2018-0228

Excerpt: Foot problems are a common concern in elephant husbandry. We investigated foot health of 243 Asian elephants in 69 European institutions (including Dublin Zoo). During on-site visits between August 2016 and July 2017, standardized pictures were taken of each elephant's nails and pads. The pictures were analysed with respect to pathological lesions (i.e. nail cracks, abscesses), care issues (i.e. minor abnormalities, which are easily resolvable with routine foot work), and pad structure. Of all analysed nails and pads, 35.6% revealed varying degrees of pathological lesions, with minor nail cracks and overgrown cuticles being most frequently observed. The most common issues requiring foot care were fissures in the nail sole. It may be prudent to implement husbandry protocols that could alleviate commonly observed pathological and care foot issues in captive Asian elephants. A standardized approach to evaluate elephant foot health will provide a more objective way to monitor responses to management and medical decisions and ultimately contribute to the overall wellbeing of elephants in human care.

Wendler, P., Ertl, N., Flügger, M., Sós, E., Torgerson, P., Paul Heym, P., Schiffmann, C., Clauss, M., & Hatt, J.M. (2020). Influencing factors on the foot health of captive Asian elephants (*Elephas maximus*) in European zoos. *Zoo Biology*, *39*(2), 109–120. https://doi.org/10.1002/zoo.21528

Excerpt: Pathological lesions of feet occur frequently in captive elephant populations. To improve foot health, it is important to identify risk factors associated with such pathologies. This study analyzed the relationship between 87 independent variables and the foot health score of 204 Asian elephants in European zoos using bivariate correlation, multivariable regression models, and principal component analysis. Factors representing more advanced husbandry conditions (e.g. large areas, high proportions of sand flooring) were associated with each other and with decreased foot scores, whereas indicators of more limited conditions (e.g. high proportions of hard ground, much time spent indoors) were also associated with each other, but increased the foot score. In conclusion, instead of resulting from just one or two factors, reduced foot health might be an indicator of a generally poorer husbandry system. The elephants at Dublin Zoo, and our elephant care team, participated in this study through direct observations and interviews.

Publications

A list of peer-reviewed scientific publications which the elephants at Dublin Zoo have contributed to.

Rose, J. B., Leeds, A., Yang, L. M., LeMont, R., Fayette, M. A., Proudfoot, J. S., Bowman, M. R., Woody, A., Oosterhuis, J., & Fagan, D. A. (2022). Treatment and Outcomes of Tusk Fractures in Managed African Savanna and Asian Elephants (*Loxodonta africana* and *Elephas maximus*) across Five Continents. *Animals*, *12*(9), 1125. https://doi.org/10.3390/ani12091125

Brady, A., McMahon, B. J., & Naulty, F. (2021). Estimates of locomotion in Asian elephants *Elephas maximus* using video monitoring at Dublin Zoo, Ireland. *Journal of Zoo and Aquarium Research*, *9*(2), 124–133. https://doi.org/10.19227/jzar.v9i2.502

Grenus, B. G., Latimer, E., Cullinane, A., Lyons, P., Creighton, G., & Nutter, F. B. (2020). Evaluation of the efficacy of two different sampling sites for the detection of Elephant Endotheliotropic Herpesvirus (EEHV) in three Asian elephants (*Elephas maximus*) in Ireland. *Journal of Zoo and Wildlife Medicine*, *51*(2), 303–307. https://doi.org/10.1638/2018-0193

Wendler, P., Ertl, N., Flügger, M., Sós, E., Torgerson, P., Paul Heym, P., Schiffmann, C., Clauss, M., & Hatt, J.-M. (2020). Influencing factors on the foot health of captive Asian elephants (*Elephas maximus*) in European zoos. *Zoo Biology*, *39*(2), 109–120. https://doi.org/10.1002/zoo.21528

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Williams, E., Carter, A., Hall, C., & Bremner-Harrison, S. (2019). Exploring the relationship between personality and social interactions in zoo-housed elephants: Incorporation of keeper expertise. *Applied Animal Behaviour Science*, *221*, 104876. https://doi.org/10.1016/j.applanim.2019.104876

Schiffmann, C., Clauss, M., Pastorini, J., Wendler, P., Ertl, N., Hoby, S., Hatt, J.-M., & Fernando, P. (2018). Body condition scores in European zoo elephants (*Elephas maximus* and *Loxodonta africana*) – Status quo and influencing factors. *Journal of Zoo and Aquarium Research*, *6*(3), 91–103. https://doi.org/10.19227/jzar.v6i3.355

Tighe, A., Gandola, R., Fulanda, B., Thurman, K., Overby, S., Byrne, J., & Carlsson, J. (2018). Testing PCR amplification from elephant dung using silica-dried swabs. *Pachyderm*, *59*, 56-65. https://pachydermjournal.org/index.php/pachyderm/article/view/81/42

Walsh, B. (2017). Asian elephant (*Elephas maximus*) sleep study – long-term quantitative research at Dublin Zoo. *Journal of Zoo and Aquarium Research*, *5*(2), 82–85. https://doi.org/10.19227/jzar.v5i2.174

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Dale, R. H. I. (2008). Calf Development: Most Births at Night. *Journal of the Elephant Managers Association*, *19*(1), 14–15.

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