How zoos contribute to fundamental biological knowledge
the example of reproductive seasonality

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University of Zurich[UZH]

Clinic of Zoo Animals, Exotic Pets and Wildlife

Structure

1. Incentives for zoo research
2. Zoos are a control group
3. Zoos collect enormous amounts of data
4. Reproductive seasonality – examples what on can do with the data
5. Final thoughts on research communication

Research obligation

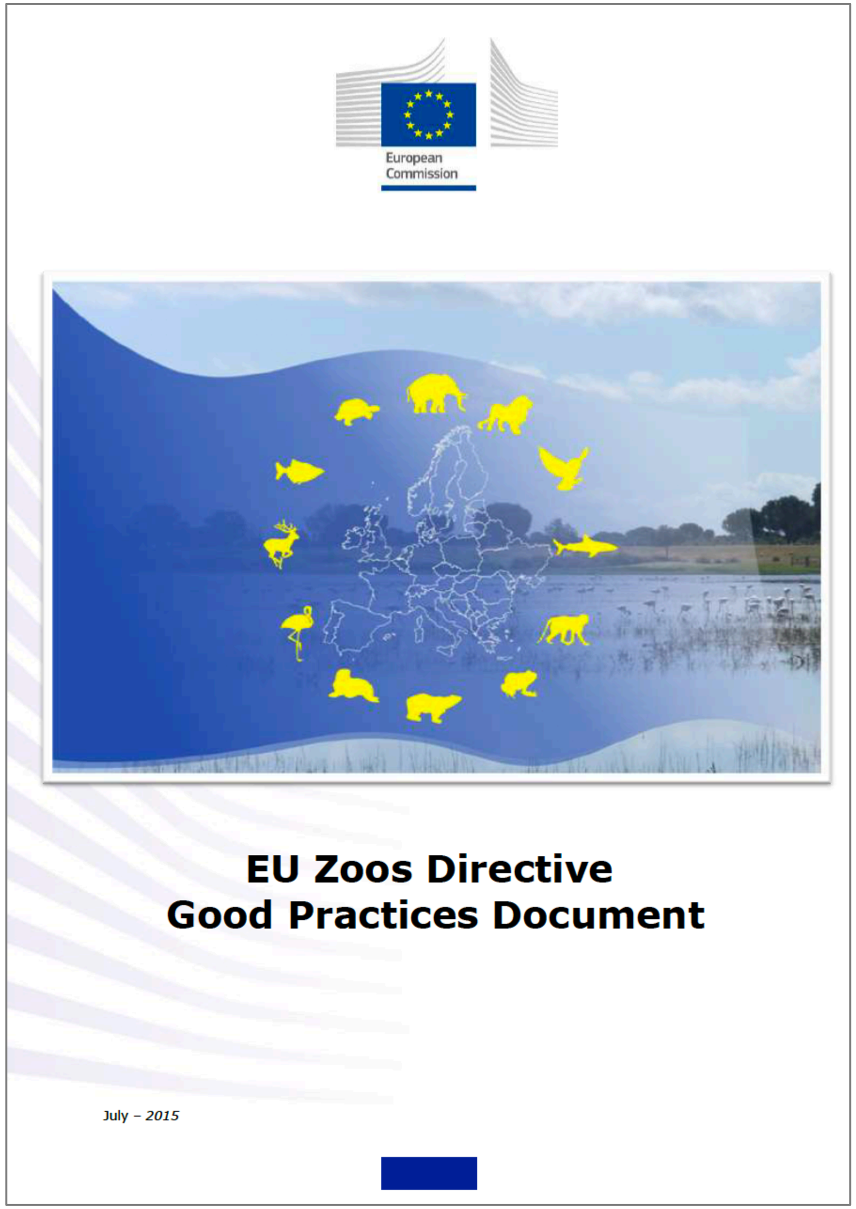
The European Council Directive 1999/22/EC relating to the keeping of wild animals in zoos (the EU Zoos Directive)

The Member States guarantee that all zoos will implement the following conservation measures:

> participating in research from which conservation benefits accrue to the species, and/or training in relevant conservation skills, and/or the exchange of information relating to species conservation and/or, where appropriate, captive breeding, repopulation or reintroduction of species into the wild;

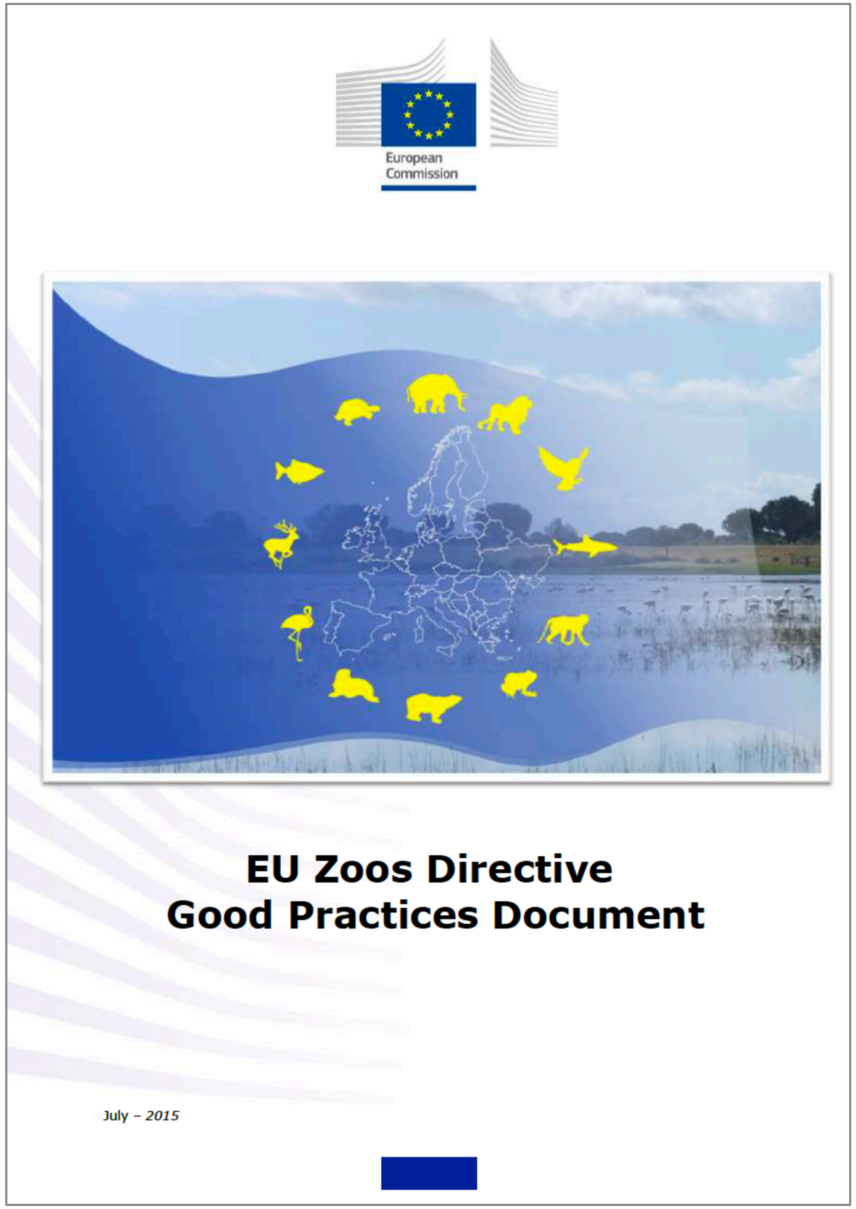
The EAZA Research Strategy

Research obligation



What does count as ‘conservation benefit’ ?

Research obligation



Examples

Research *"from which conservation benefits accrue to the species"* will often encompass an applied component and may be undertaken as part of *ex situ* conservation or *in situ* projects. It may include a wide variety of topics, such as:

- Use of zoo data to create demographic projections, advance metapopulation management possibilities and study the viability of captive populations.
- Further knowledge on research methodologies and technology to apply in the field (e.g. camera trapping, non- invasive hormone and genetic make-up determination, telemetry systems). E.g. Budapest Zoo "tested" some intracoelomic radiotelemetry devices in zoo vipers before using them in the reintroduced Hungarian meadow vipers as part of its collaboration with a LIFE+ project.
- Research pertaining to the health of wild animals which may directly contribute to that of their wild counterparts.
- Research to determine basic physiological parameters that can be used (or need to be calculated) to make proper interpretation of field data and to be used in mathematical models (e.g., isotopic fractionation indexes, metabolic rates, basal metabolism, etc.).
- Research on genetic and behavioural adaptations to captivity and how to overcome them (e.g. stimulating species typical behaviours, advancing soft release and pre-release techniques)
- Reproductive technologies (assisted reproduction and contraception). This and other types of delicate research may sometimes be undertaken using "surrogate species", i.e. taxonomically similar non-endangered species, instead of the often few individuals available from endangered species.
- Conservation medicine research (e.g. epidemiology, parasitology of wild vs. captive populations).
- Invasive Alien Species (IAS) research. Case Study: Combating the threat of IAS at Latgales Zoo (Latvia).
- Experimental wildlife conflict mitigation and management techniques, e.g. research on carnivore deterrent systems (as long as it does not cause an excessive disturbance to the individual animals), or attraction systems for census or monitoring purposes.
- Research on solving sustainability issues. For example, biomimicry research uses biological systems knowledge to solve (often ecological) problems, and the controlled conditions of zoos might be ideal sources of information for this type of research (e.g. Biomimicry Europa, Biomimicry 3.8 Institute, Zurich Zoo and San Diego Zoo participate in biomimicry research).
- Research on the two relatively new fields or integrated concepts of "conservation psychology" (which explores connections between the study of human behaviour and the achievement of conservation goals, (e.g. Conservation psychology and zoos, Litchfield & Foster, 2009) and "conservation welfare", which calls for a better integration of these disciplines, both in *ex situ* and *in situ* situations (e.g. Conservation welfare, Walker, 2012; Animal welfare and conservation: Working towards a common goal, WILDCRU, 2010)

‘Research’ is an obligation zoos have to ‘tick off’ for political reasons.

JZAR www.jzar.org JOURNAL OF ZOO AND AQUARIUM RESEARCH

EAZA

Research article

The contributions of EAZA zoos and aquaria to peer-reviewed scientific research

Helene Lina Åhman Welden[1], Mikkel Stelvig[1], Cecilia Kimmie Nielsen[1], Ciara Purcell[2,3], Lindsay Eckley[2], Mads F. Bertelsen[1], Christina Hvilsom[1*]

Research necessity

Value in zoo management As emphasised in *Building a Future for Wildlife* (WAZA, 2005): 'Research is a tool to assist in doing any activity better'.

The EAZA Research Strategy

Research necessity

EUROPEAN ASSOCIATION OF ZOOS AND AQUARIA

EAZA

Developing the research potential of zoos and aquaria

The EAZA Research Strategy

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ZOOBIOLOGY WILEY

Check for updates

RESEARCH ARTICLE

Influencing factors on the foot health of captive Asian elephants (*Elephas maximus*) in European zoos

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Abstract

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. Several previous studies have analyzed potentially influencing factors but were limited, for example, by small sample sizes. This study analyzed the relationship between 87 independent variables and the foot health score of 204 Asian elephants (*Elephas maximus*) in European zoos using bivariate correlation, multivariable regression models, and principal component analysis (PCA). Correlation and regression tests revealed significant results for 30 different variables, mainly with small effect sizes. Only three variables were significant in more than one test: sex, time spent indoors, and time spent on hard ground, with lower scores (i.e. less or less severe pathological lesions) in females, and when less time is spent indoors or on hard ground. Due to small effect sizes and differing results of the statistical tests, it is difficult to determine which risk factors are most important. Instead, a holistic consideration appears more appropriate. A biplot of the PCA shows that 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.

KEYWORDS
elephant, flooring, health, husbandry, management

1 | INTRODUCTION

As the largest terrestrial mammal with sophisticated cognitive abilities and a complex social structure, elephants are a very popular species kept in many of the larger zoos worldwide. By holding elephants in captivity, we take responsibility for their welfare and for providing conditions that prevent suffering due to health issues and pain. There is intensive research on infectious diseases and the investigation of reproductive aspects has already yielded major successes, for example in the establishment of artificial insemination techniques (Hildebrandt et al., 2006; Long, Latimer, & Hayward, 2016; Thongtip et al., 2009). Another very important topic of elephant medicine is foot health, as foot problems have a high incidence in different captive populations (80.4% in the UK, Harris, Sherwin, & Harris, 2008; 98.5% in Europe, Wendler et al., 2019;

*Paulin Wendler and Nicolas Ertl should be considered as joint first authors.

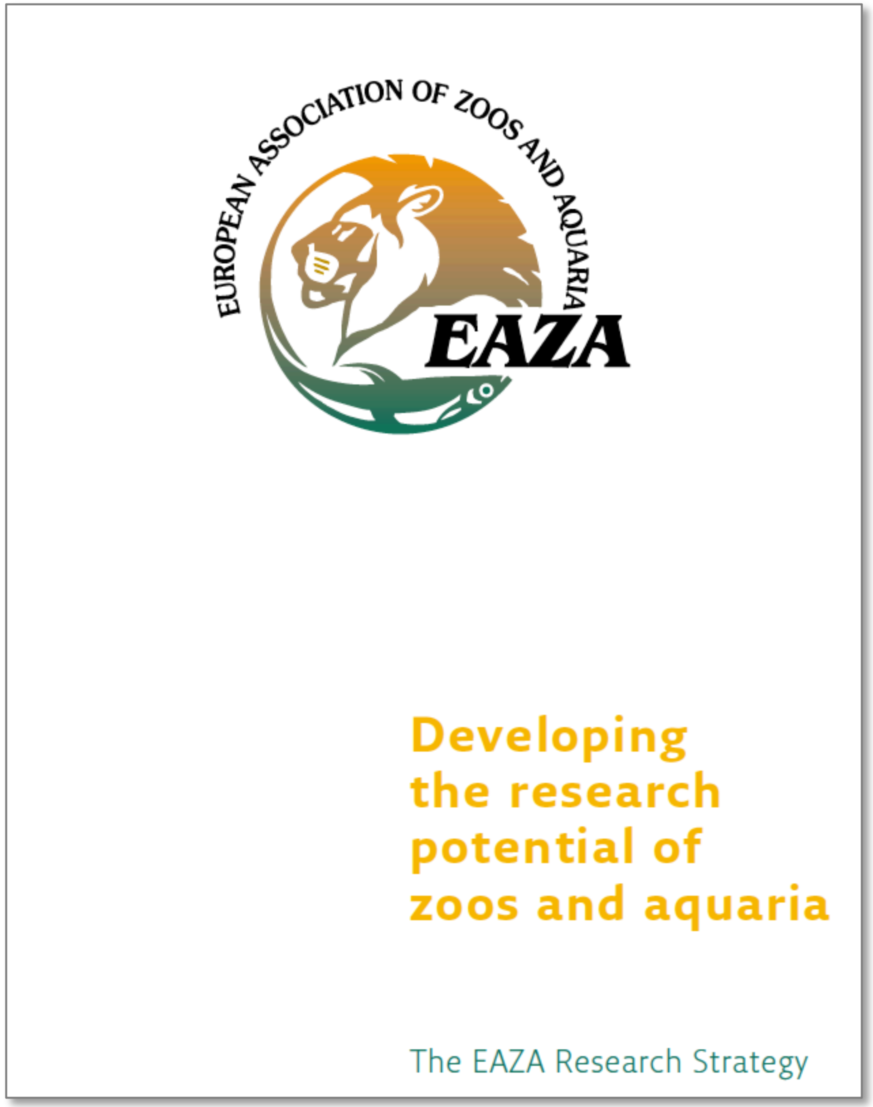
‘Research’ is our means to improve whatever it is we are doing.

… if you want to do something (complicated) right, you need to practice research to find out whether you are doing it right, and how you could improve.

Do you want to do it right ?

Let's do it right !

Research necessity



PeTA **ANIMALS ARE NOT OURS** to experiment on, eat, wear, use for entertainment, or abuse in any other way.

The purpose of most zoos' research is to find ways to breed and maintain more animals in captivity. If zoos ceased to exist, so would the "need" for most of their research.

Research privilege

Curiosity

Research privilege

EUROPEAN ASSOCIATION OF ZOOS AND AQUARIA

EAZA

Wider needs and benefits As well as underpinning practical or applied science, zoo research can make a general, perhaps major contribution to fundamental or theoretical knowledge.

The EAZA Research Strategy


SERENISSIMI REGIS


G-STAR RAW

‘Research’ is our means to express and satisfy our curiosity.

Accumulating knowledge, and passing it on to others, is a primary human characteristic.

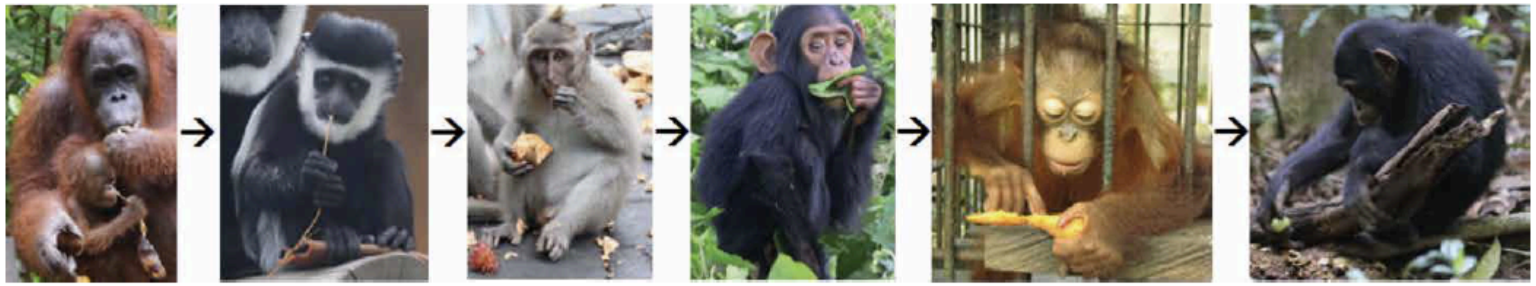
Knowledge fosters fascination.
Knowledge is generated by research.

Research privilege

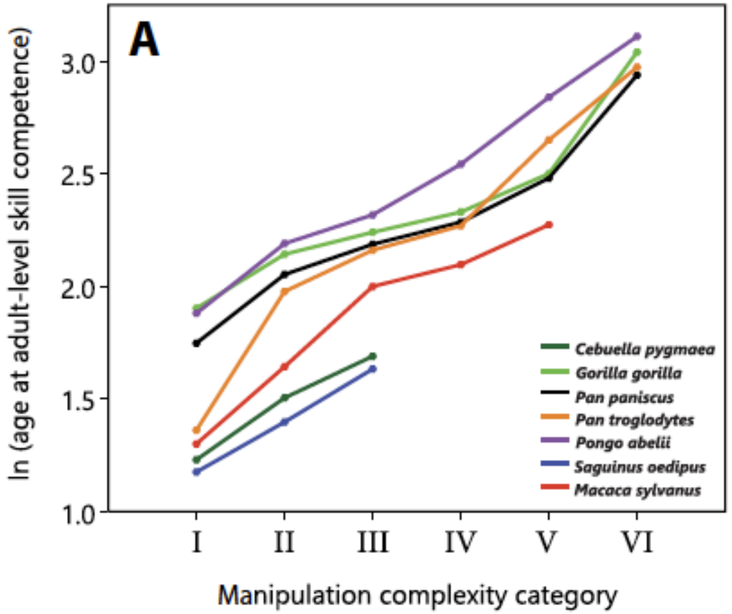
When ontogeny recapitulates phylogeny: Fixed neurodevelopmental sequence of manipulative skills among primates

Sandra A. Heldstab*, Karin Isler, Caroline Schuppli†, Carel P. van Schaik

Sci. Adv. 2020; **6** : eabb4685



Unimanual grasping	Bimanual synchronous hands	Bimanual asynchronous hands	Unimanual independent fingers	Bimanual independent fingers	Multiple objects
I	II	III	IV	V	VI

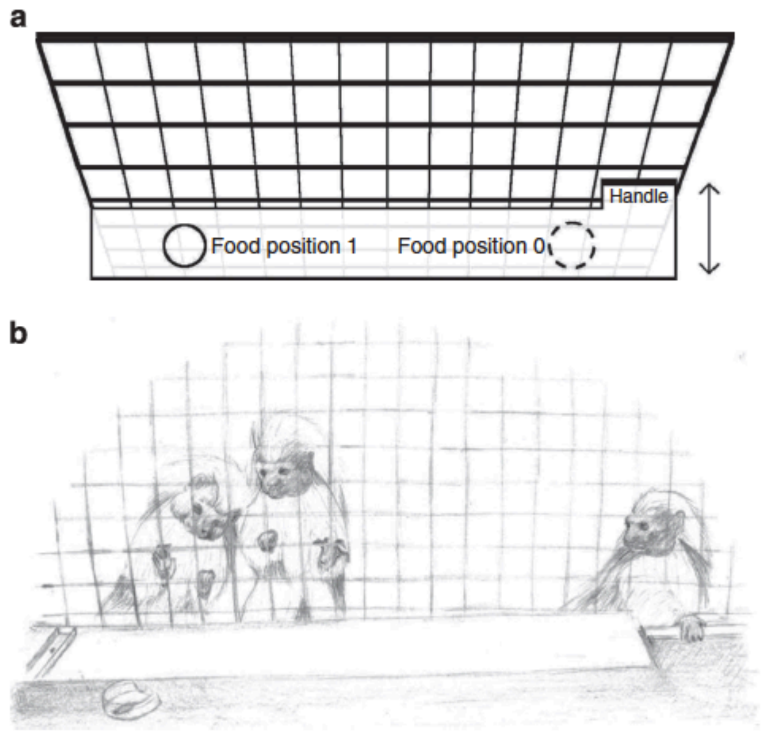


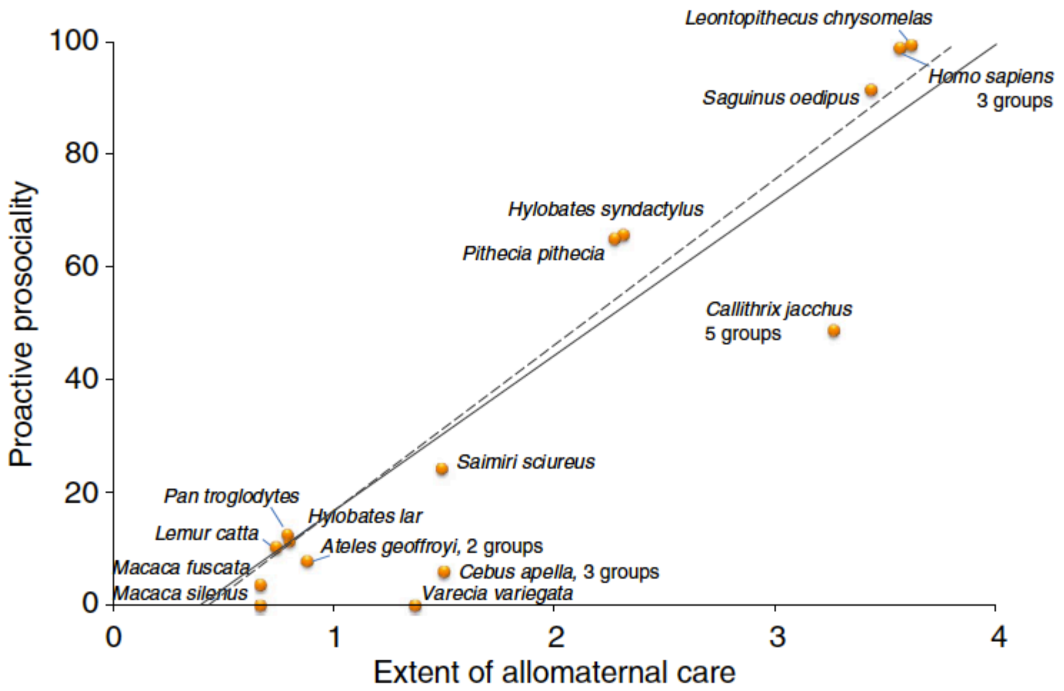
Research privilege

The evolutionary origin of human hyper-cooperation

NATURE COMMUNICATIONS | 5:4747

J.M. Burkart[1], O. Allon[2], F. Amici[3], C. Fichtel[4], C. Finkenwirth[1], A. Heschl[5], J. Huber[6], K. Isler[1], Z.K. Kosonen[1], E. Martins[1], E.J. Meulman[1], R. Richiger[1], K. Rueth[1], B. Spillmann[1], S. Wiesendanger[1] & C.P. van Schaik[1]





The fascination of comparisons

Comparisons

A typical source of human fascination:

comparisons

Comparisons

A typical source of human fascination:

comparisons

Comparisons

A typical source of human fascination:

comparisons

Comparisons

A typical source of human fascination:

comparisons – comparative research

When ontogeny recapitulates phylogeny: Fixed neurodevelopmental sequence of manipulative skills among primates

Sandra A. Heldstab*, Karin Isler, Caroline Schuppli†, Carel P. van Schaik

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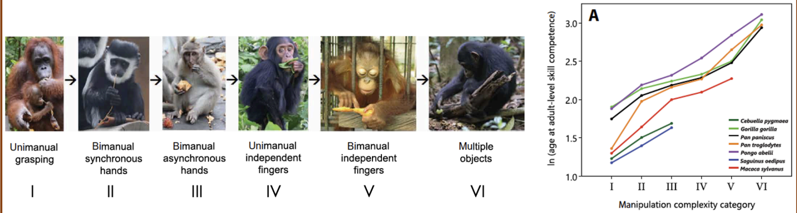

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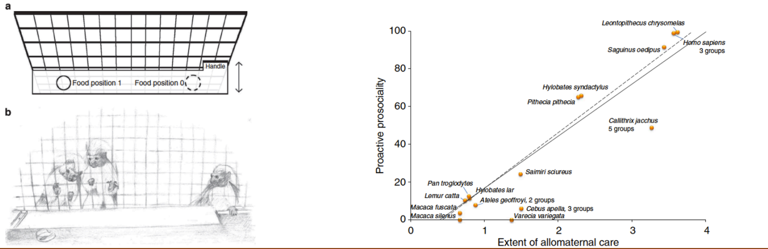
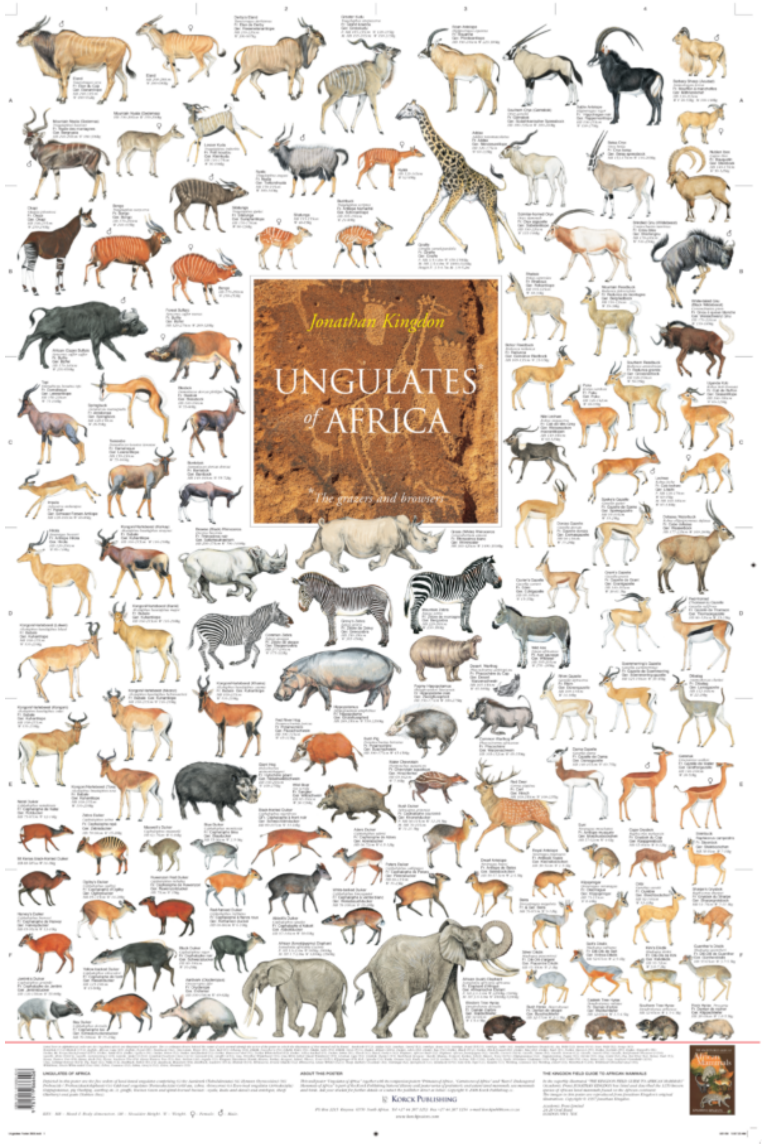
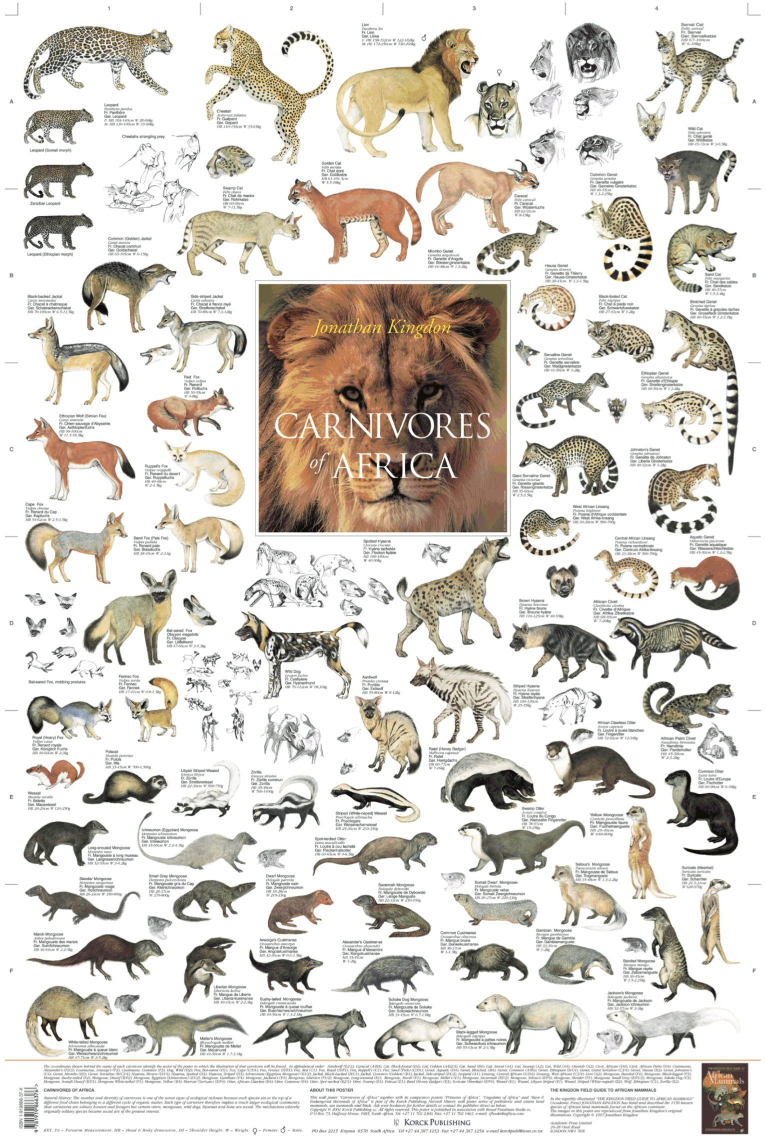
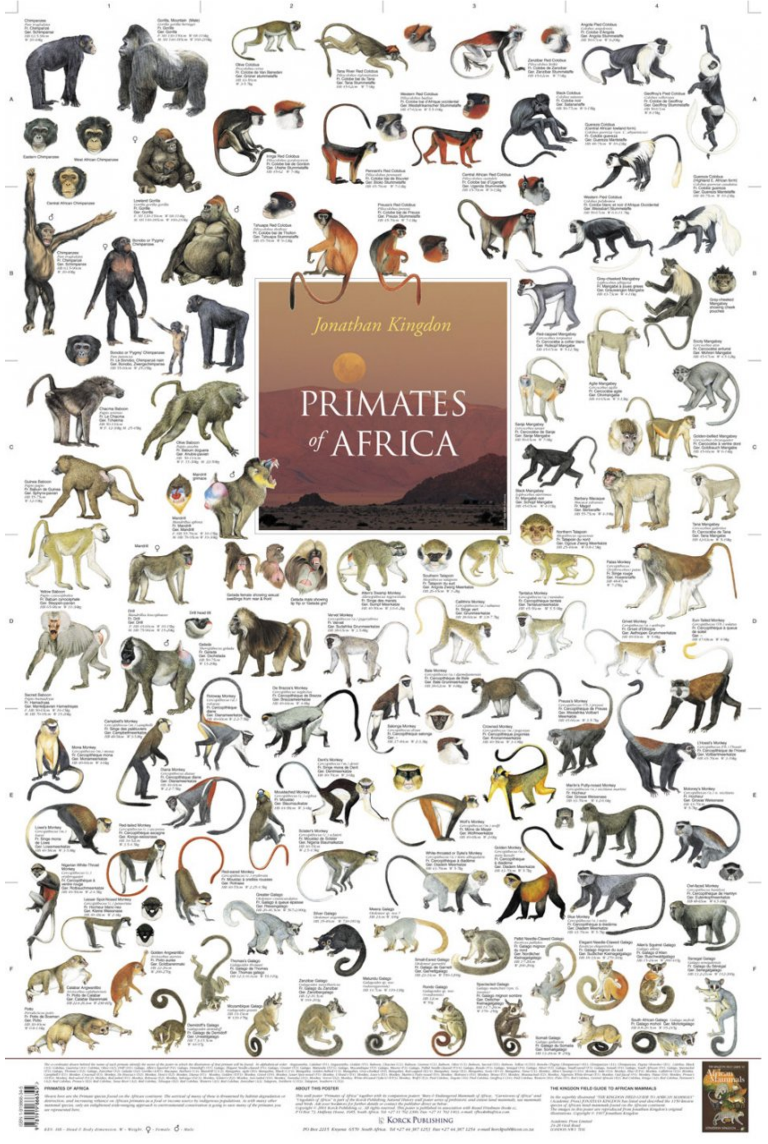


Fascination for variety







Fascination for variety



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Reproductive seasonality in captive wild ruminants: implications for biogeographical adaptation, photoperiodic control, and life history

Philipp Zerbe[1,2], Marcus Clauss[1,*], Daryl Codron[1,3,4,5], Laurie Bingaman Lackey[6], Eberhard Rensch[1], Jürgen W. Streich[7], Jean-Michel Hatt[1] and Dennis W. H. Müller[1,8]

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ABSTRACT

Many ruminant species show seasonal patterns of reproduction. Causes for this are widely debated, and include adaptations to seasonal availability of resources (with cues either from body condition in more tropical, or from photoperiodism in higher latitude habitats) and/or defence strategies against predators. Conclusions so far are limited to datasets with less than 30 species. Here, we use a dataset on 110 wild ruminant species kept in captivity in temperate-zone zoos to describe their reproductive patterns quantitatively [determining the birth peak breadth (BPB) as the number of days in which 80% of all births occur]; then we link this pattern to various biological characteristics [latitude of origin, mother-young-relationship (hider/follower), proportion of grass in the natural diet (grazer/browser), sexual size dimorphism/mating system], and compare it with reports for free-ranging animals. When comparing taxonomic subgroups, variance in BPB is highly correlated to the minimum, but not the maximum BPB, suggesting that a high BPB (i.e. an aseasonal reproductive pattern) is the plesiomorphic character in ruminants. Globally, latitude of natural origin is highly correlated to the BPB observed in captivity, supporting an overruling impact of photoperiodism on ruminant reproduction. Feeding type has no additional influence; the hider/follower dichotomy, associated with the anti-predator strategy of 'swamping', has additional influence in the subset of African species only. Sexual size dimorphism and mating system are marginally associated with the BPB, potentially indicating a facilitation of polygamy under seasonal conditions. The difference in the calculated Julian date of conception between captive populations and that reported for free-ranging ones corresponds to the one expected if absolute day length was the main trigger in highly seasonal species: calculated day length at the time of conception between free-ranging and captive populations followed a $y = x$ relationship. Only 11 species (all originating from lower latitudes) were considered to change their reproductive pattern distinctively between the wild and captivity, with 10 becoming less seasonal (but not aseasonal) in human care, indicating that seasonality observed in the wild was partly resource-associated. Only one species (*Antidorcas marsupialis*) became more seasonal in captivity, presumably because resource availability in the wild overrules the innate photoperiodic response. Reproductive seasonality explains additional variance in the body mass–gestation period relationship, with more seasonal species having shorter gestation periods for their body size. We conclude that photoperiodism, and in particular absolute day length, are genetically fixed triggers for reproduction that may be malleable to some extent by

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Geographical Origin, Delayed Implantation, and Induced Ovulation Explain Reproductive Seasonality in the Carnivora

Sandra A. Heldstab,[*,†,1] Dennis W. H. Müller,[‡] Sereina M. Graber,[*] Laurie Bingaman Lackey,[§] Eberhard Rensch,[†] Jean-Michel Hatt,[†] Philipp Zerbe,[†] and Marcus Clauss[†,2]

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Abstract Patterns of reproductive seasonality in the Carnivora are difficult to study comparatively, due to limited numbers of species for which information is available. Long-term databases of captive populations could overcome this difficulty. We apply a categorical description and a quantitative high-resolution measure (birth peak breadth, the number of days in which 80% of all births occur) based on daily observations in captivity to characterize the degree of reproductive seasonality in the Carnivora for 114 species with on average 1357 births per species. We find that the majority of species retained the birth seasonality displayed in the wild. Latitude of natural origin, delayed implantation, and induced ovulation were the main factors influencing reproductive seasonality. Most species were short-day breeders, but there was no evidence of an absolute photoperiodic signal for the timing of mating or conception. The length of the gestation period (corrected for body mass) generally decreased with birth seasonality but increased in species with delayed implantation. Birth seasons become shorter with increasing latitude of geographical origin, likely because the length of the favorable season declines with increasing latitude, exerting a strong selective pressure on fitting both the reproductive cycle and the interval offspring needs for growth following the termination of parental care into the short time window of optimal environmental conditions. Species with induced ovulation exhibit a less seasonal reproductive pattern, potentially because mates do not have to meet during a short time window of a fixed ovulation. Seasonal species of Carnivora shorten their gestation period so reproduction can occur during the short time window of optimal environmental conditions. Alternatively, other Carnivora species lengthen their gestation periods in order to bridge long winters. Interestingly, this occurs not by decelerating intrauterine growth but by delaying implantation.

Keywords Carnivora, seasonality, reproduction, gestation, photoperiodism, delayed implantation, induced ovulation, latitude

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Reproductive seasonality in primates: patterns, concepts and unsolved questions

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ABSTRACT

Primates, like other mammals, exhibit an annual reproductive pattern that ranges from strictly seasonal breeding to giving birth in all months of the year, but factors mediating this variation are not fully understood. We applied both a categorical description and quantitative measures of the birth peak breadth based on daily observations in zoos to characterise reproductive seasonality in 141 primate species with an average of 941 birth events per species. Absolute day length at the beginning of the mating season in seasonally reproducing species was not correlated between populations from natural habitats and zoos. The mid-point of latitudinal range was a major factor associated with reproductive seasonality, indicating a correlation with photoperiod. Gestation length, annual mean temperature, natural diet and Malagasy origin were other important factors associated with reproductive seasonality. Birth seasons were shorter with increasing latitude of geographical origin, corresponding to the decreasing length of the favourable season. Species with longer gestation periods were less seasonal than species with shorter ones, possibly because shorter gestation periods more easily facilitate the synchronisation of reproductive activity with annual cycles. Habitat conditions with higher mean annual temperature were also linked to less-seasonal reproduction, independently of the latitude effect. Species with a high percentage of leaves in their natural diet were generally non-seasonal, potentially because the availability of mature leaves is comparatively independent of seasons. Malagasy primates were more seasonal in their births than species from other regions. This might be due to the low resting metabolism of Malagasy primates, the comparatively high degree of temporal predictability of Malagasy ecosystems, or historical constraints peculiar to Malagasy primates. Latitudinal range showed a weaker but also significant association with reproductive seasonality. Amongst species with seasonal reproduction in their natural habitats, smaller primate species were more likely than larger species to shift to non-seasonal breeding in captivity. The percentage of species that changed their breeding pattern in zoos was higher in primates (30%) than in previous studies on Carnivora and Ruminantia (13 and 10%, respectively), reflecting a higher concentration of primate species in the tropics. When comparing only species that showed seasonal reproduction in natural habitats at absolute latitudes ≤11.75°, primates did not differ significantly from these two other taxa in the proportion of species that changed to a less-seasonal pattern in zoos. However, in this latitude range, natural populations of primates and Carnivora had a significantly higher proportion of seasonally reproducing species than Ruminantia, suggesting that in spite of their generally more flexible diets, both primates and Carnivora are more exposed to resource fluctuation than ruminants.

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Zoos are a control (or treatment) group

Zoos are the control group for 'the wild'

natural ⟷ human-controlled

"what the species adapted to" | *"what we expose it to"*

FATTY-ACID RATIOS IN FREE-LIVING AND DOMESTIC ANIMALS

Possible Implications for Atheroma

THE LANCET M. A. CRAWFORD 1968

TABLE III—PROPORTIONS (*molecular equivalents*) OF POLYUNSATURATED FATTY ACIDS TO THE SATURATED AND MONOUNSATURATED FROM VARIOUS SOURCES

Source	Proportion	Source	Proportion
Wild African woodland/bushland:		*Captive and domestic:*	
Eland	35/65	Giraffe (mean of 2)	4/96
Hartebeest (1)	32/68	Somali fat-tailed sheep	4/96
Hartebeest (2)	29/71	Domestic pork	8/92
Topi	23/76	Man (Western)	4/96
Warthog	27/63	Beef	2/98
Giraffe	39/61		

Zoos are the control group for 'the wild'

natural ⟷ human-controlled

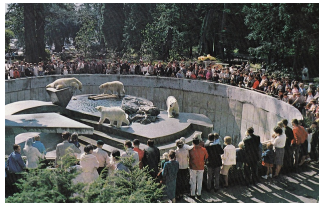
"what the species adapted to"

"what we expose it to"

"civilisation diseases", problems due to captivity, husbandry, nutrition, social systems …





Zoos are the control group for ‘the wild’

natural ⟷ human-controlled

“what the species adapted to”

“what we expose it to”

“civilisation diseases”, problems due to captivity, husbandry, nutrition, social systems …

attempt to make human-controlled environment similar to the natural conditions

Zoos are the control group for ‘the wild’

natural ⟷ human-controlled

“what the species adapted to”

“what the species is exposed to”

“what we expose it to”

“what we protect it from”

predation, intra-specific aggression, diseases, food and water scarcity, fear, suffering





Zoos are the control group for 'the wild'

natural ⟷ human-controlled

"what the species adapted to" — *"what we expose it to"*

"what the species is exposed to" — *"what we protect it from"*

Comparative analyses of longevity and senescence reveal variable survival benefits of living in zoos across mammals

Morgane Tidière[1], Jean-Michel Gaillard[1], Vérane Berger[1], Dennis W. H. Müller[2], Laurie Bingaman Lackey[3], Olivier Gimenez[4], Marcus Clauss[5] & Jean-François Lemaître[1]

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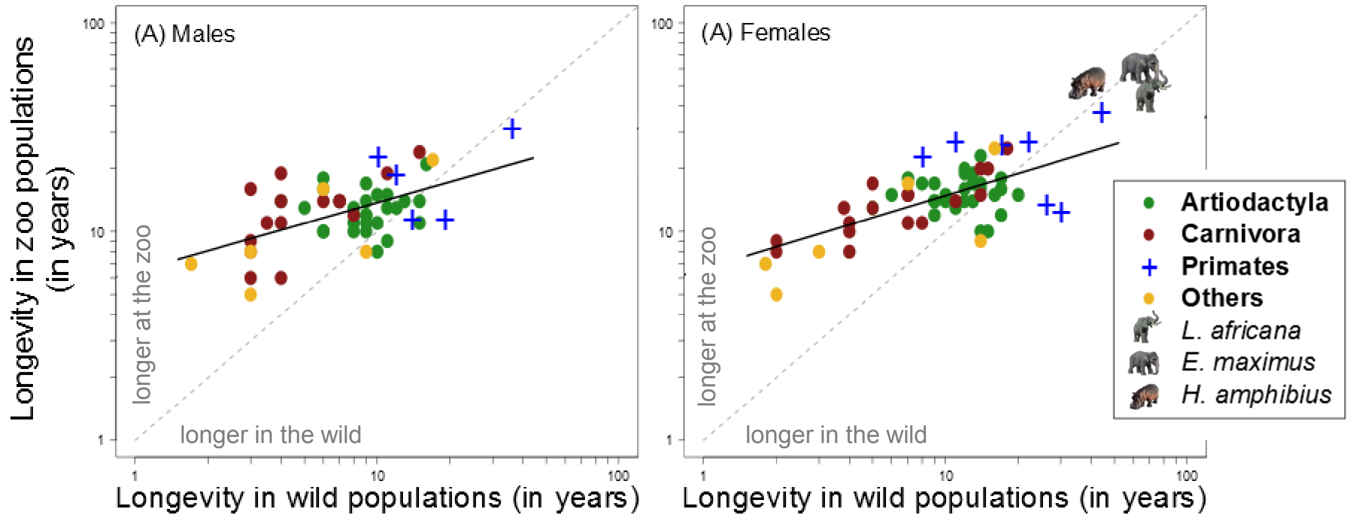


Zoos are the control group for ‘the wild’

natural ⟷ human-controlled

“what the species adapted to”

“what the species is exposed to”

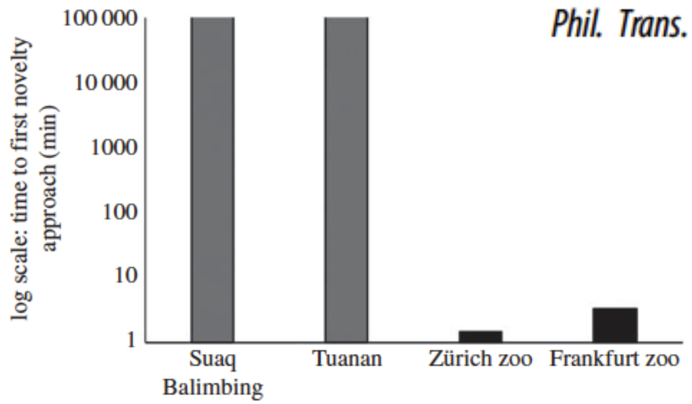
“what we expose it to”

“what we protect it from”

The reluctant innovator: orangutans and the phylogeny of creativity

C. P. van Schaik, J. Burkart, L. Damerius, S. I. F. Forss, K. Koops, M. A. van Noordwijk and C. Schuppli

Phil. Trans. R. Soc. B **371**: 20150183.



Wild orangutans are therefore not innovative. In striking contrast, zoo-living orangutans actively seek novelty and are highly exploratory and innovative, probably because of positive reinforcement, active encouragement by human role models, increased sociality and an expectation of safety.

Zoos collect immense amounts of data

Research opportunity

Basic and advanced biological data on up to two million individual animals and 10,000 taxa have already been gathered and recorded in scientifically sound ways in zoos and aquaria and entered into ISIS-ZIMS – the revolutionary new computerised global Zoo Information Management System – and this process must now be greatly expanded.

The EAZA Research Strategy

Zoo records

ISIS
International Species Information System

→

SPECIES 360
Global information serving conservation.

Zoo records

Species360
Conservation Science Alliance
SHARING DATA
Transforming
45 years of data
to save species
www.species360.org

Zoo records

Research Request Process

Husbandry Data

In collaboration with the Interdisciplinary Center on Population Dynamics (CPop) at the University of Southern Denmark, we are developing tools to extract and curate data in ZIMS for Husbandry. This allows us to provide data in an accessible format while maintaining the anonymity of our members.

To obtain data access

Complete a Research Request through this link. Any email communications should be directed to support@species360.org.

The review process is outlined in detail in the following pages.

ZIMS FOR HUSBANDRY

Our members record husbandry data for 21,000 species, with more than 10 million records available for historical and live individuals.

Includes data on births and deaths (including dates), paternity, maternity, litter/clutch size, and weight.

Review Process

Initial Review

Your Research Request will first be reviewed by our Product Development and Science Departments to estimate the effort required to extract the data. Following this first review, your Research Request will be sent to the Species360 Research Committee for evaluation or returned to you for revision or clarification, if needed.

In the review process, we evaluate:

- The data requested are hosted in ZIMS.
- The data can be queried and formatted by our Product Development and Science Departments. This will also determine required funding and timeframes to deliver the data.
- The data requested are directly related to answering the specific research question(s) stated in your proposal.
- The scope is limited and clear (i.e., requests for all species of birds, mammals, or all species in ZIMS will not be approved).
- The data can be supplied while ensuring the anonymity of our members.
- The proposal demonstrates scientific merit and is feasible.
- The research can be of value to our members (note, this is not a compulsory requirement).

Final Evaluation by Our Board of Trustees

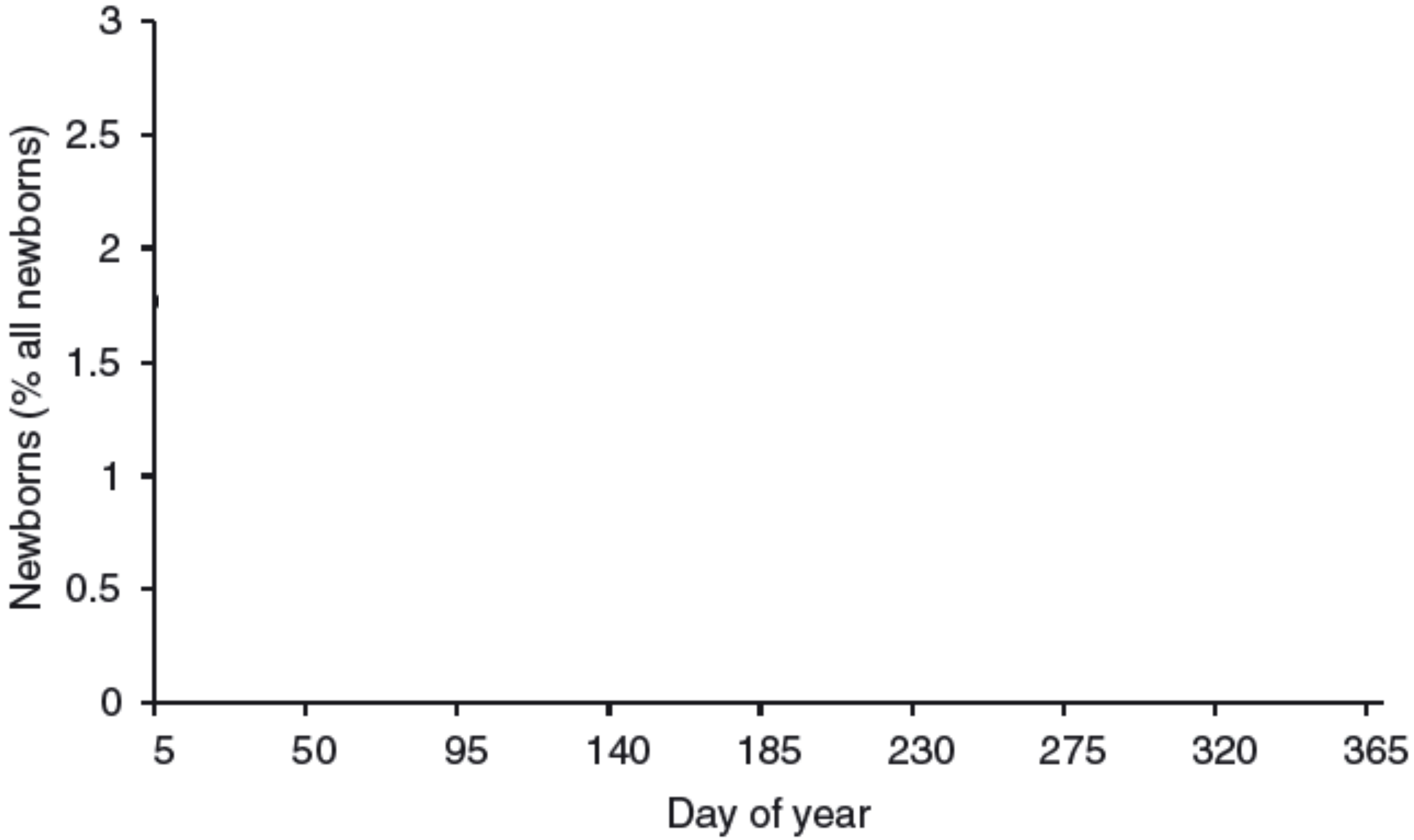
The Research Committee will provide a recommendation to our Board of Trustees, who make the final decision on the use of the data on behalf of our members. Once the Request is approved, you will receive a Data Use Agreement and a Data Accession Number.

The example of fundamental research on reproductive seasonality

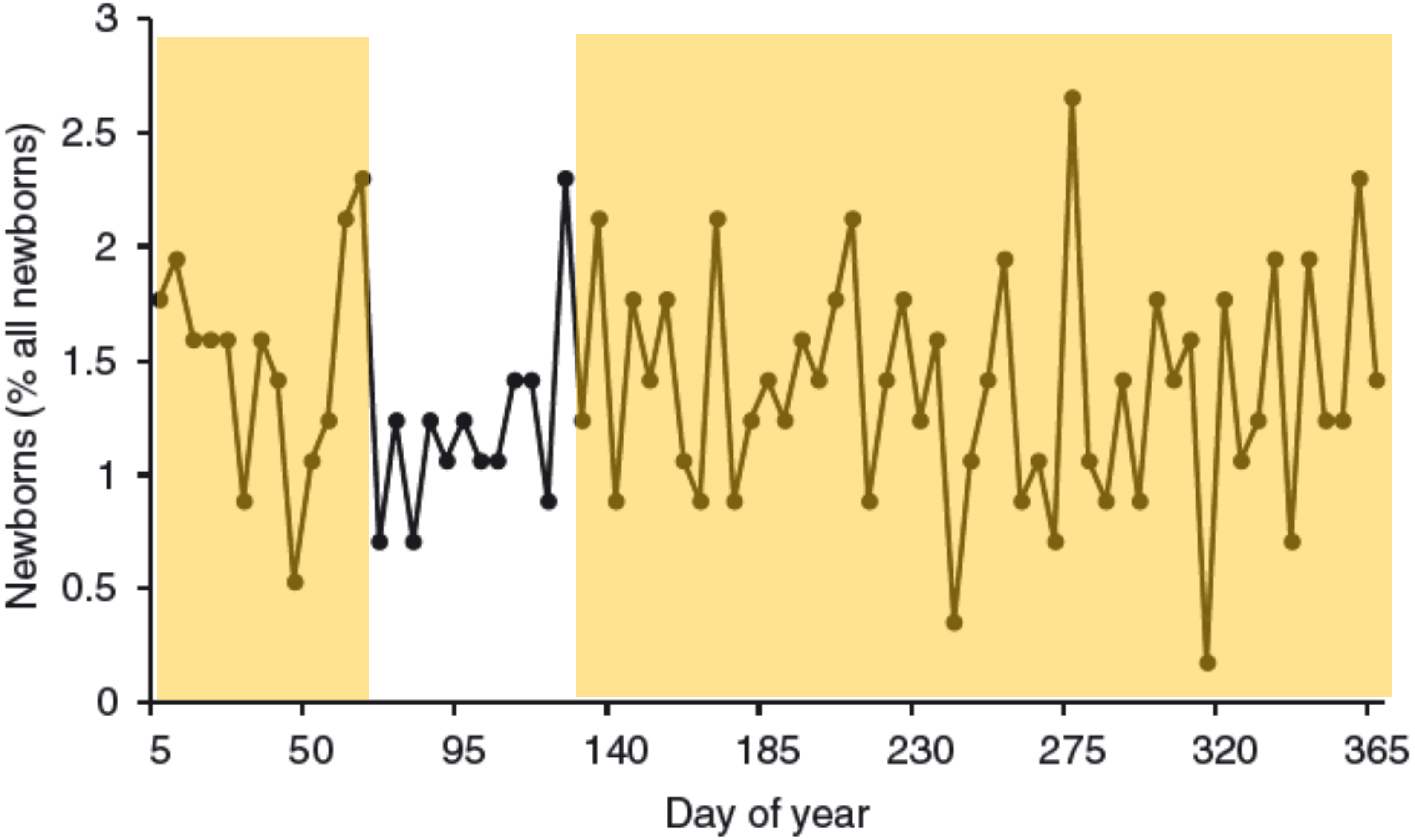
Data on birth dates

natural	human-controlled
difficult to observe in many species	*easy to observe*
knowledge based on small sample sizes	*huge collections*
	(app. 480’000 individuals, 365 species, average 1’199 births per species, minimum 50, maximum 14’000)
resolution in the literature often only to the month	*resolution on a day basis*
‘categories’	*‘categories’ but also continuous measure*

Birth data from zoos



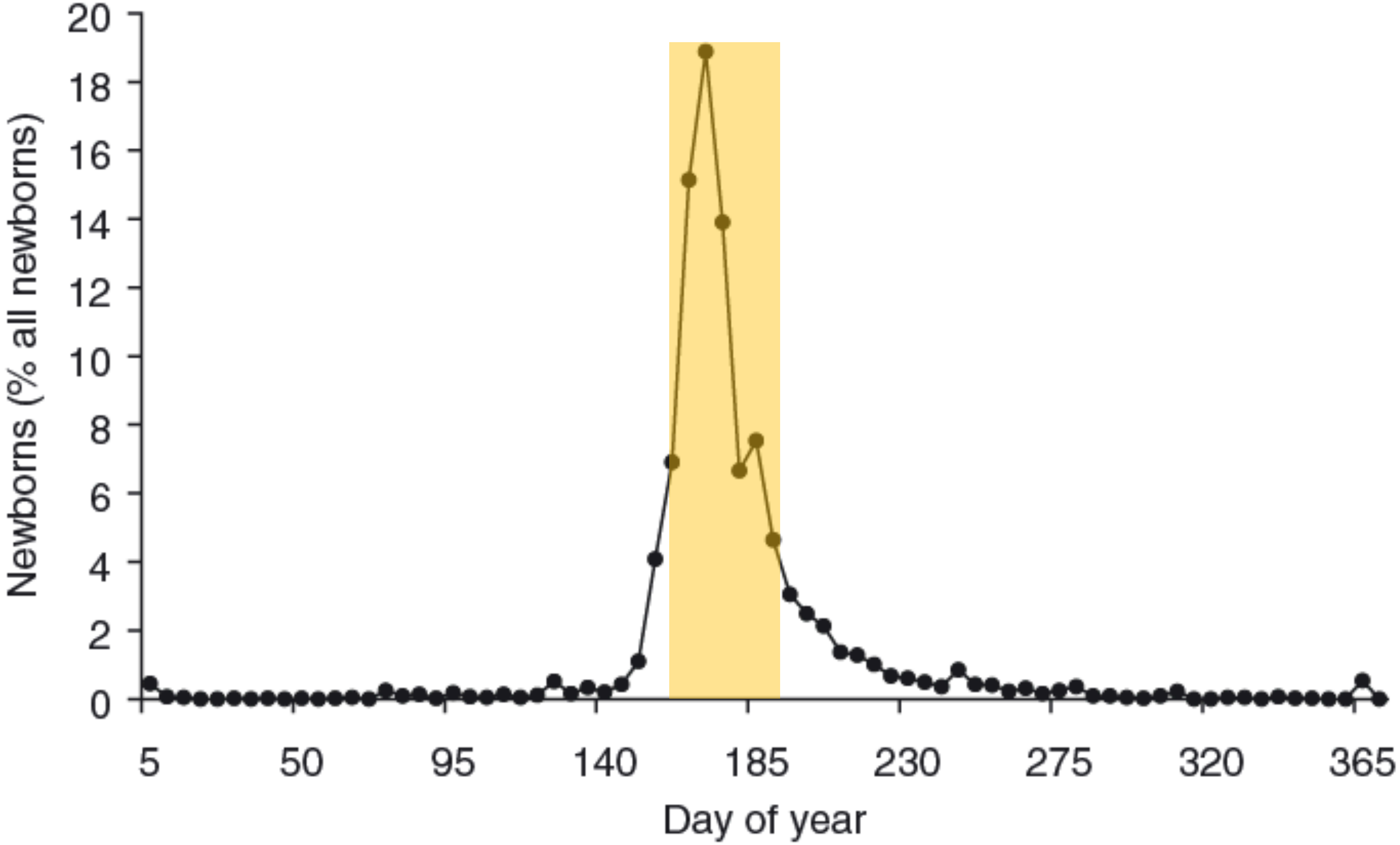
Birth data from zoos



80% of all births

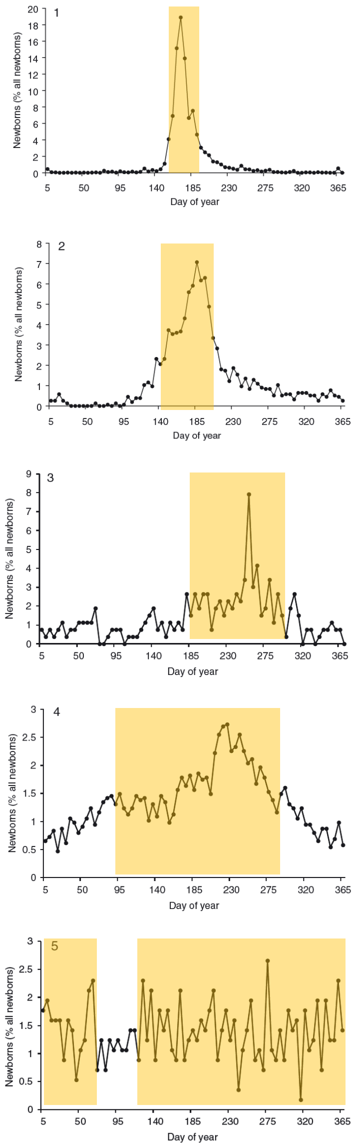
'birth peak breadth'

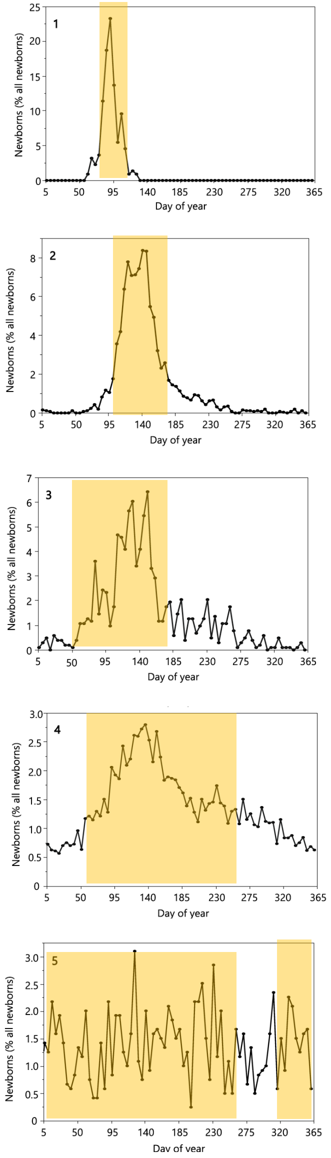
Birth data from zoos



80% of all births

'birth peak breadth'


1
2
3
4
5
Newborns (% all newborns)
Day of year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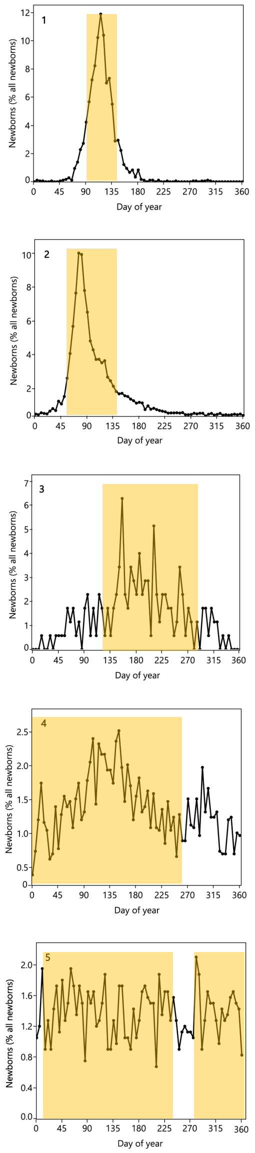
Newborns (% all newborns)
Day of year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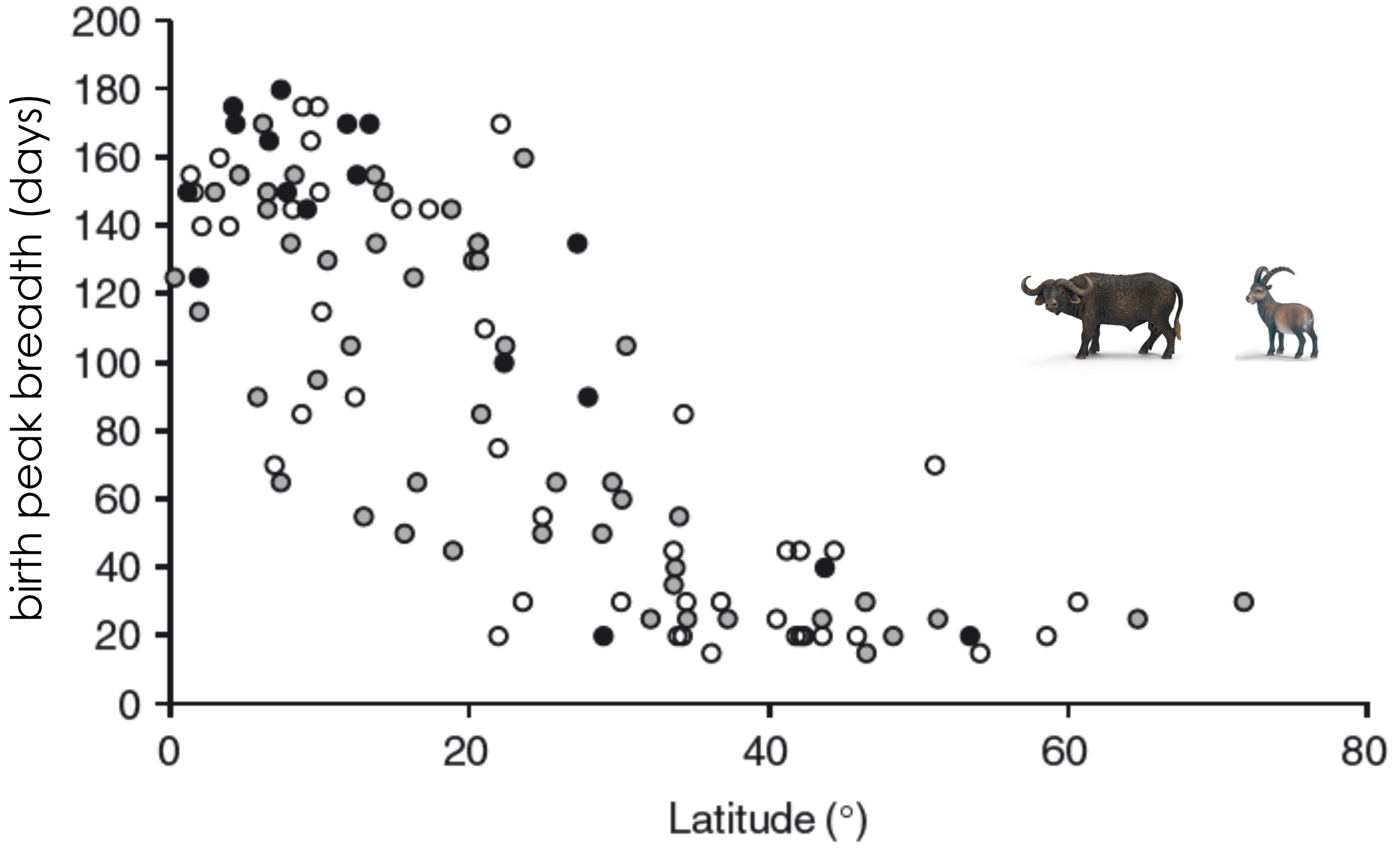
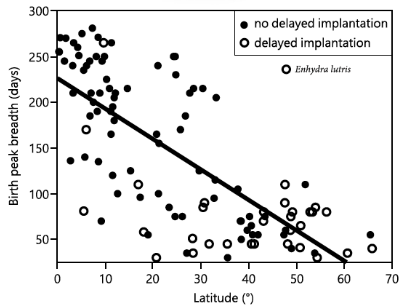
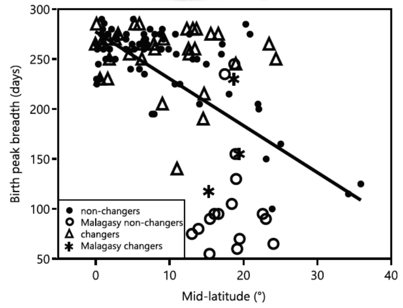
Newborns (% all newborns)
Day of year

Continuous data for correlations

the further the natural habitat is from the equator, the more seasonal the species





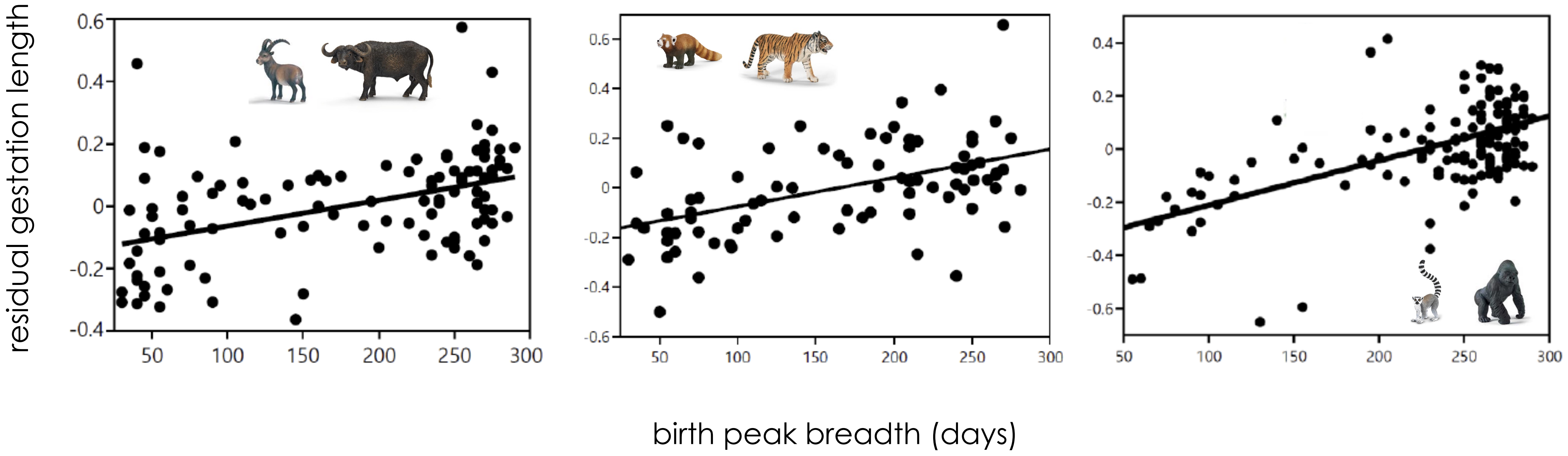


Continuous data for correlations

the further the natural habitat is from the equator, the more seasonal the species

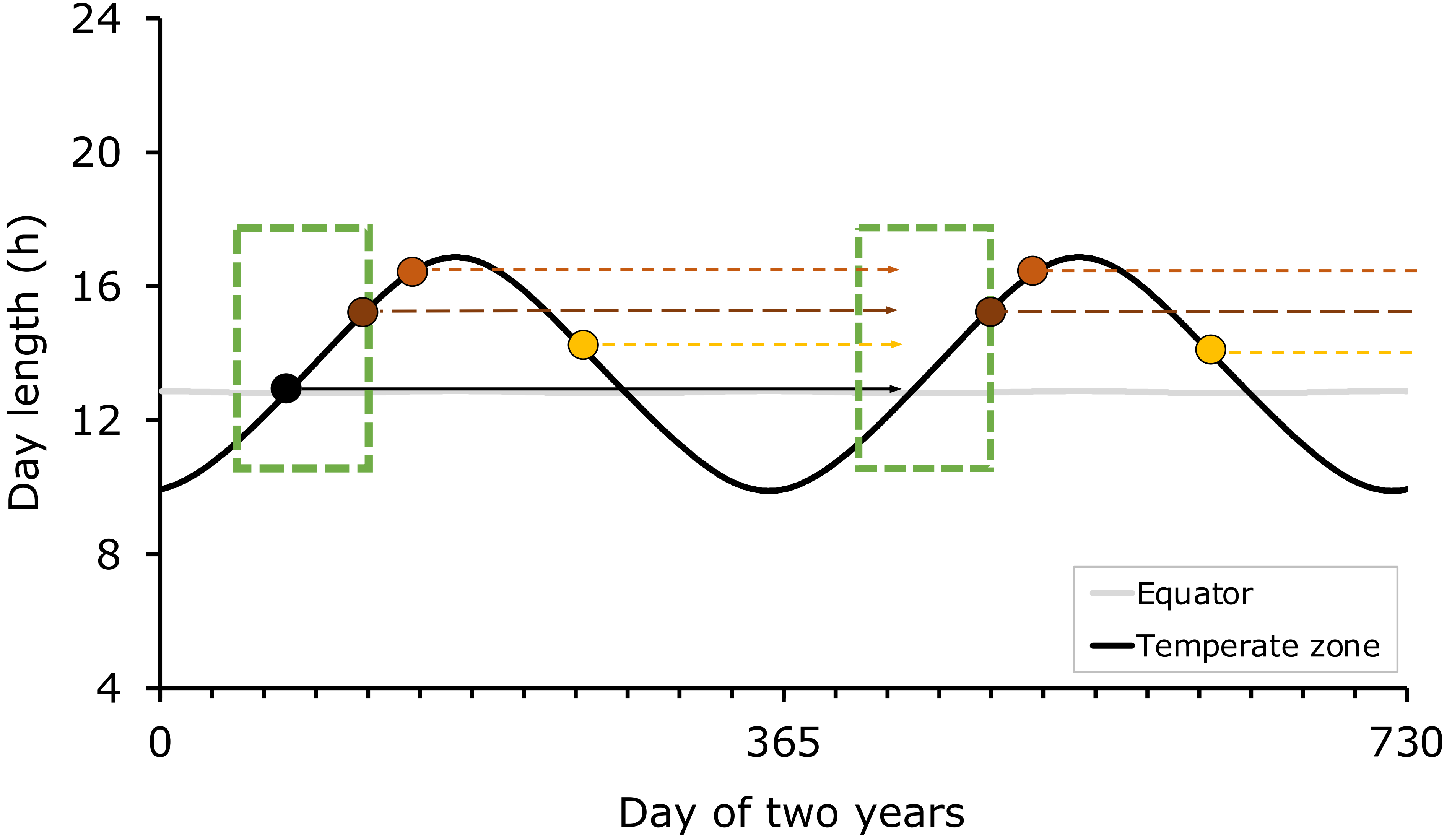
Continuous data for correlations

more seasonal species have shorter gestation periods



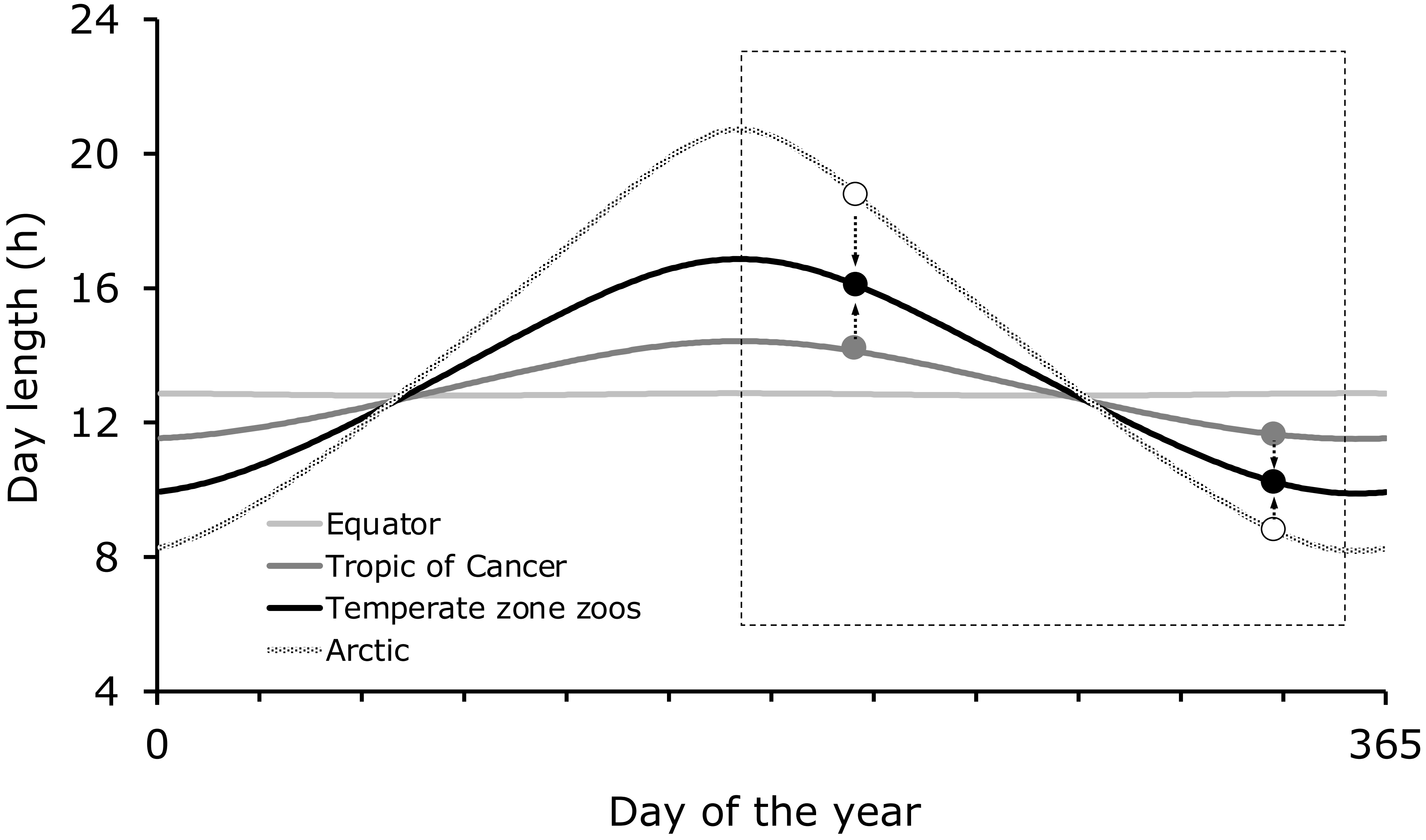
← more seasonal ----- less seasonal →

Gestation length is crucial for seasonality

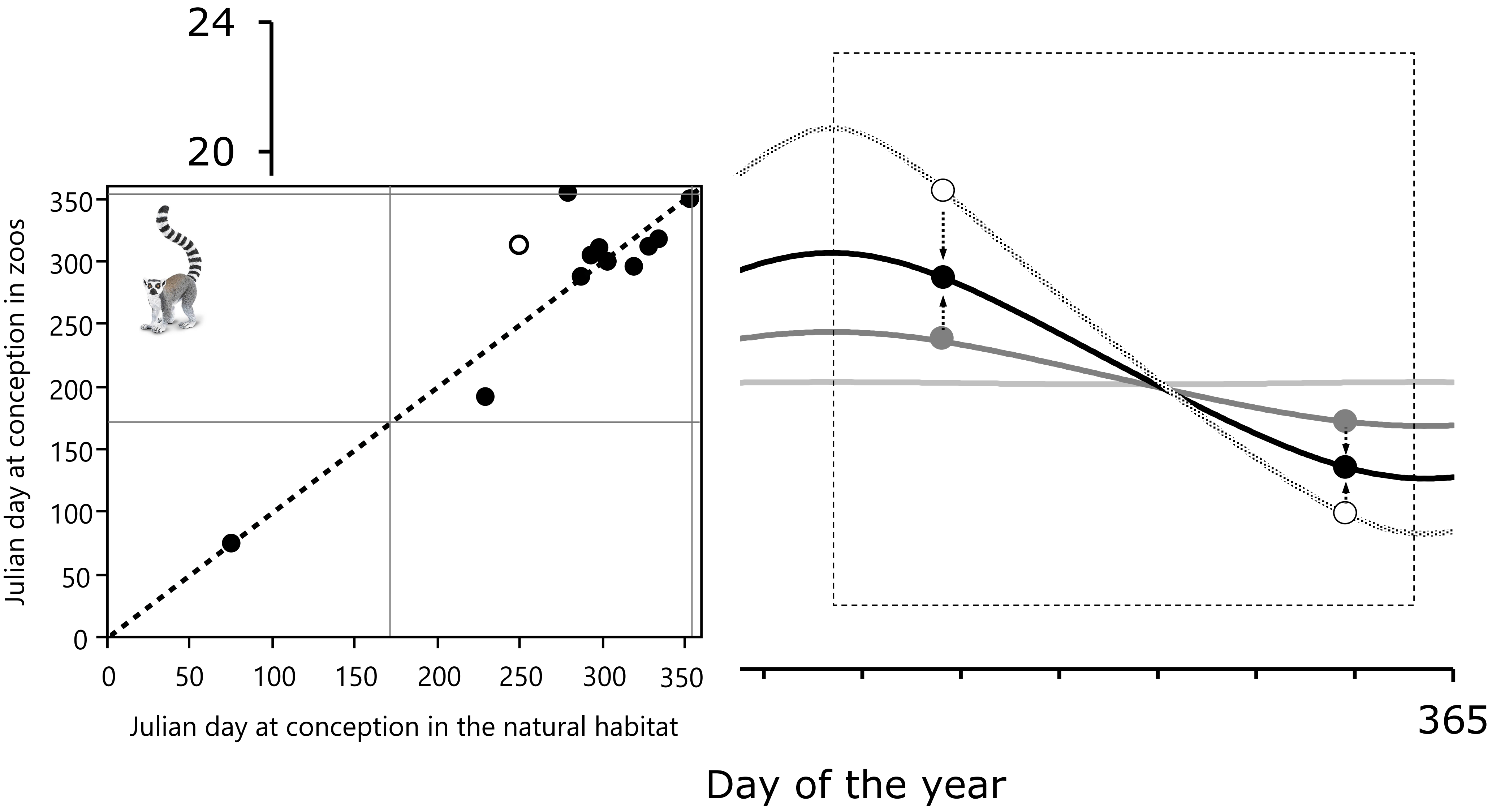


What is the trigger for seasonality?

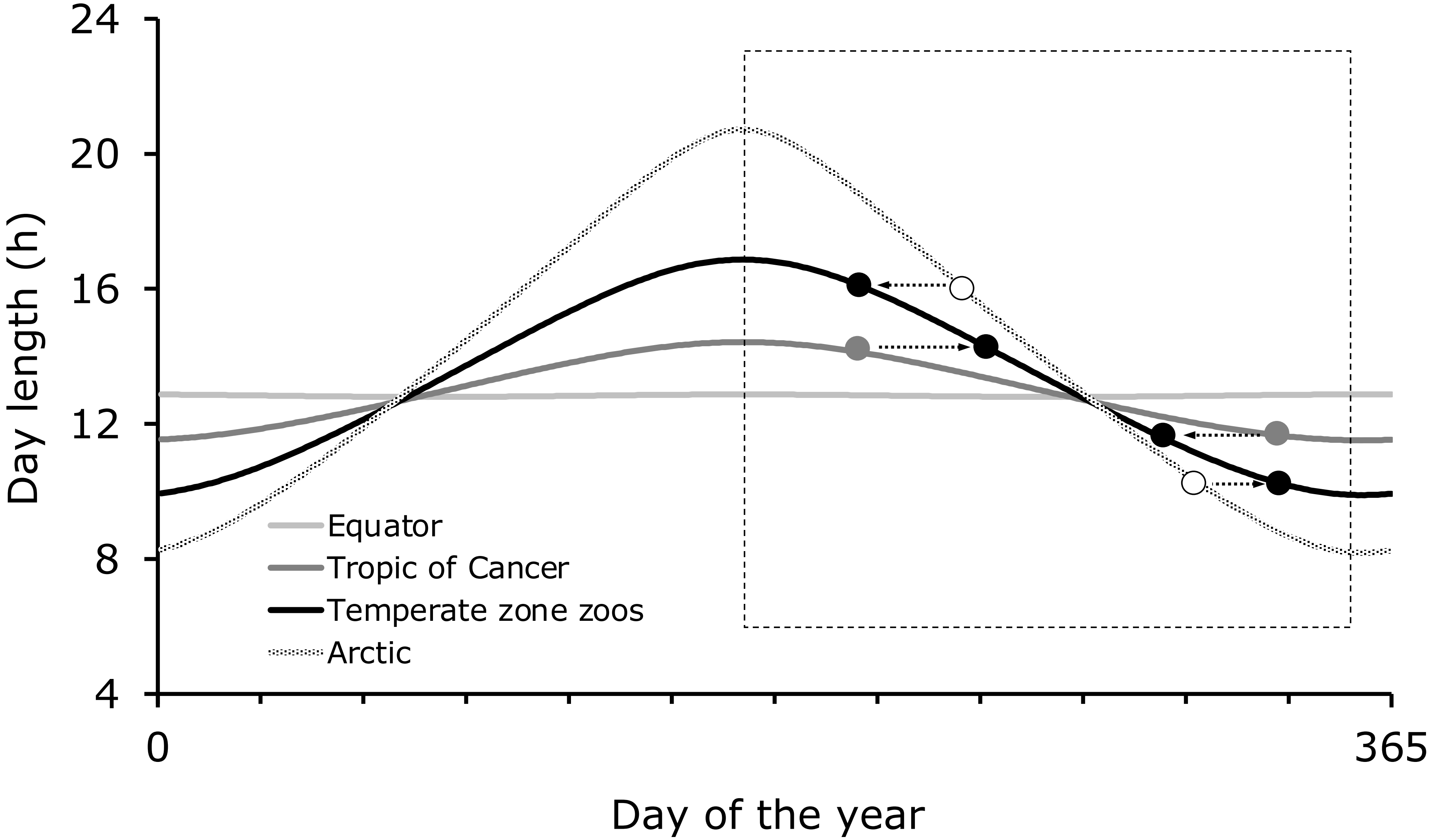
Trigger: number of days after a marker



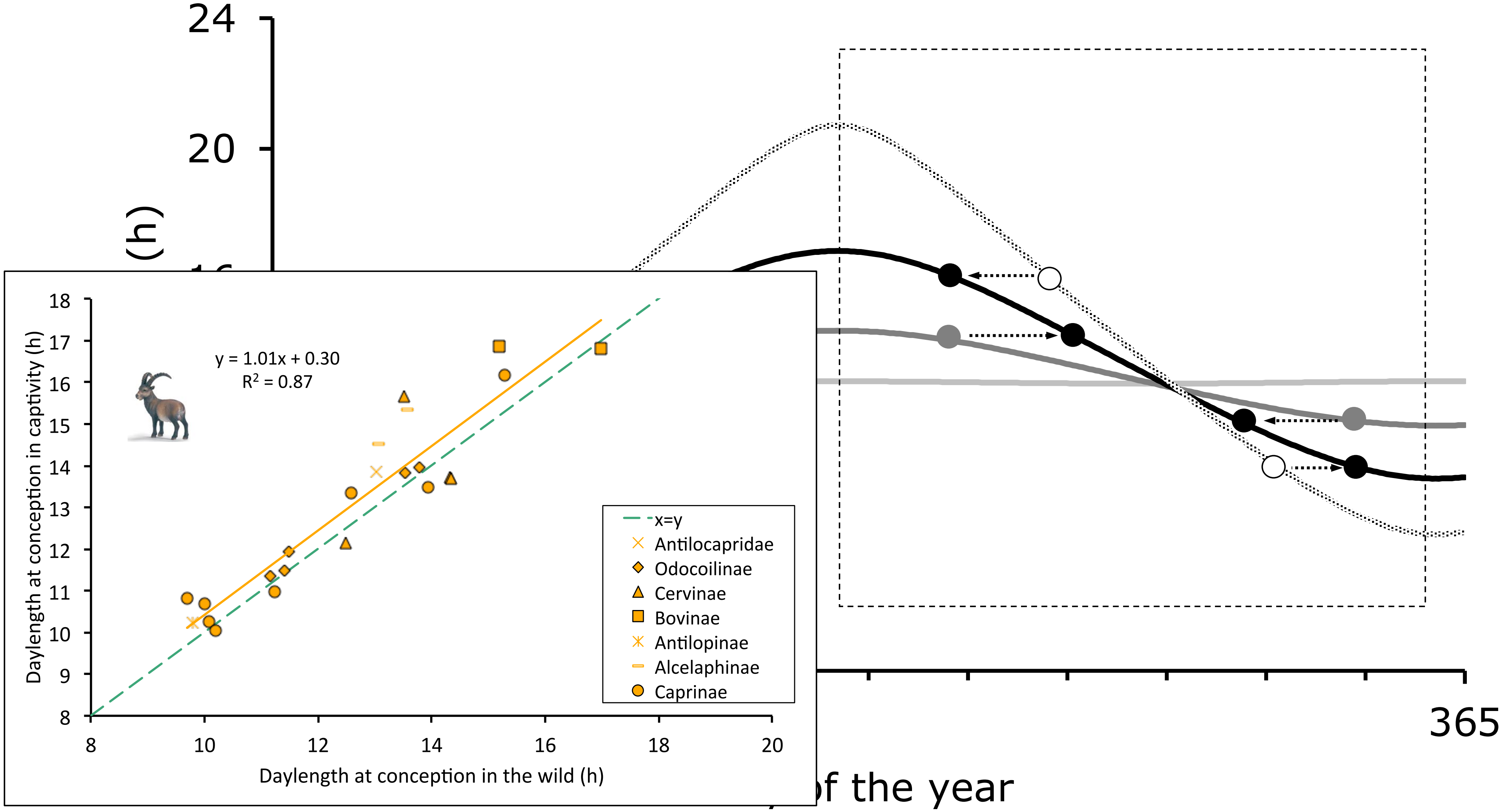
Trigger: number of days after a marker



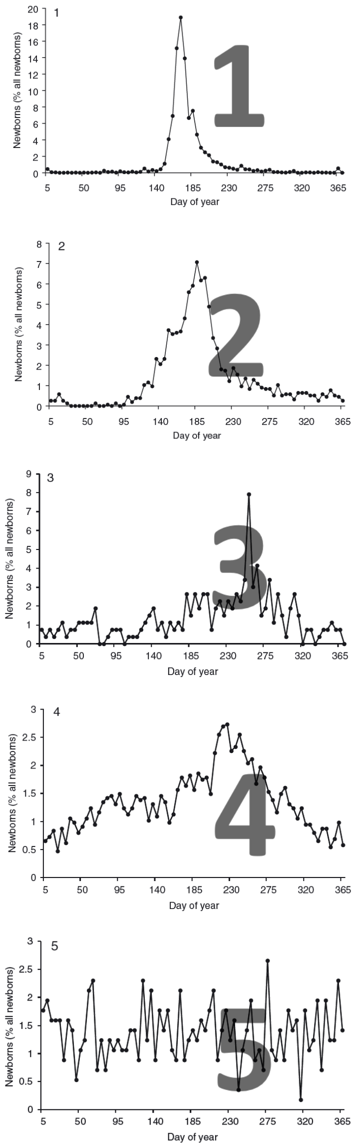
Seasonal changes in daylight hours



Seasonal changes in daylight hours



Comparisons with the natural habitat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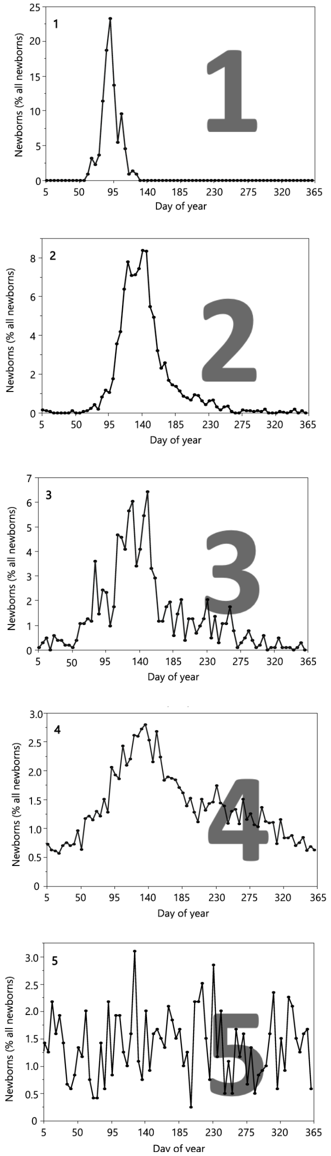
Newborns (% all newborns)
Day of year


1
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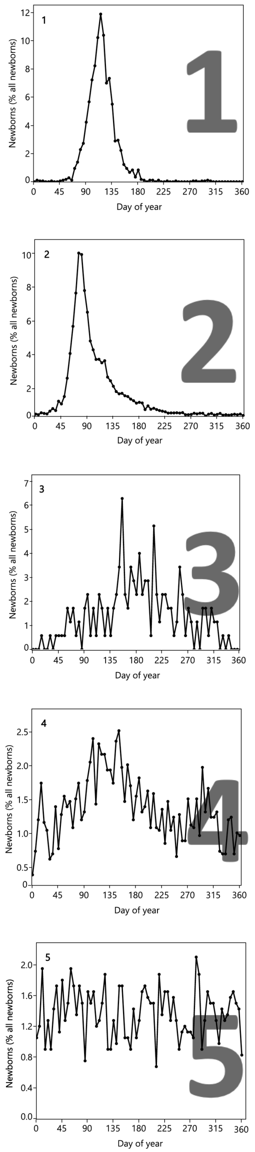
Newborns (% all newborns)
Day of year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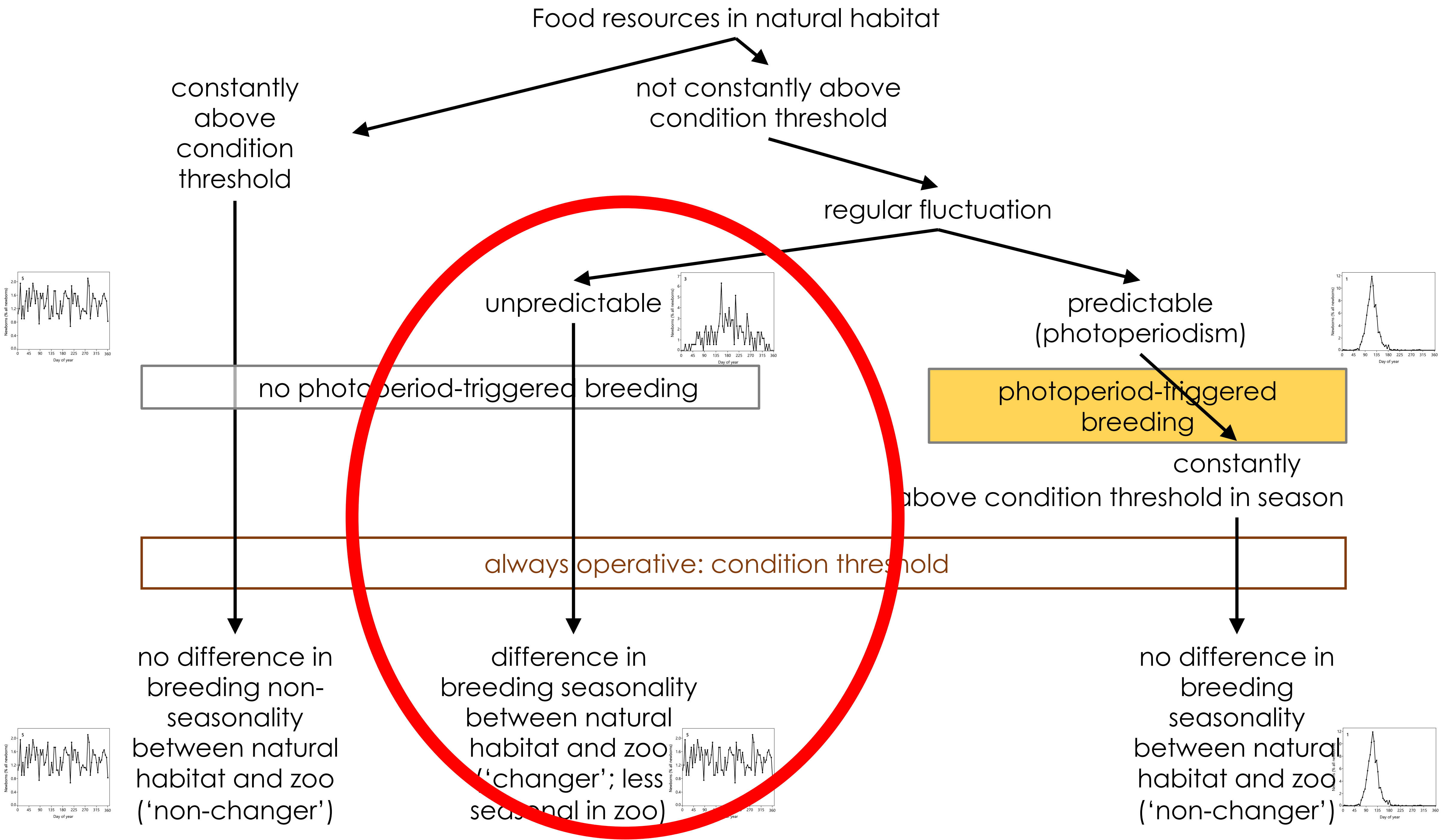
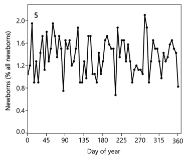
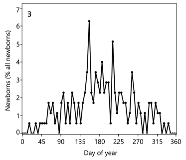
Newborns (% all newborns)
Day of year

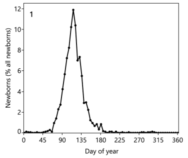

Food resources in natural habitat
constantly above condition threshold
not constantly above condition threshold
regular fluctuation
unpredictable
predictable (photoperiodism)
no photoperiod-triggered breeding
photoperiod-triggered breeding
constantly above condition threshold in season
always operative: condition threshold
no difference in breeding non-seasonality between natural habitat and zoo ('non-changer')
difference in breeding seasonality between natural habitat and zoo ('changer'; less seasonal in zoo)
no difference in breeding seasonality between natural habitat and zoo ('non-changer')

Relaxing constraints in zoos

How many species change their reproductive pattern ?







41 %

10 %

49 %

20 %

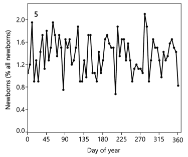
15 %

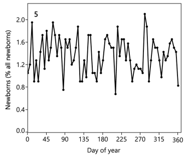
66 %

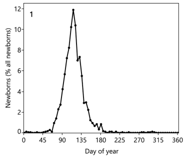
37 %

31 %

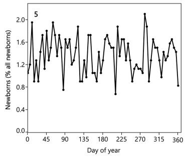
33 %

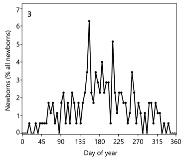


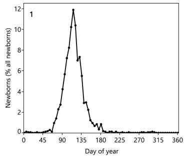




Relaxing constraints in zoos

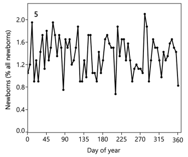


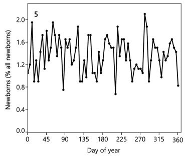


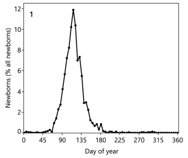


because primates have a higher proportion of species originating from the tropics

31 %

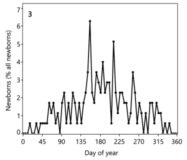






Relaxing constraints in zoos

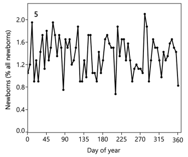
How many species originating from the tropics are have a seasonal reproduction in their natural habitat ?



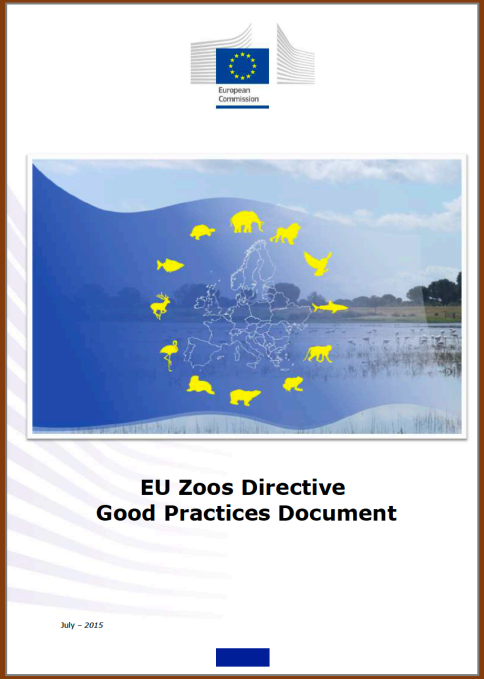
in spite of presumably 'more flexible diets', carnivores and primate species are more subjected to resource limitations than ruminants in natural habitats

47 %

52 %



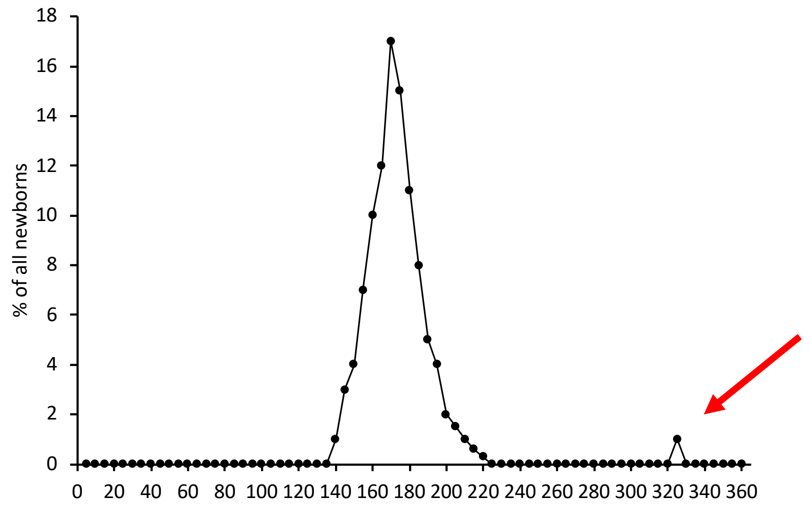
Any relevance for conservation ?



Relevance for conservation

When thinking about reintroductions:

- Species do not lose a photoperiodic trigger in captivity if they have one.
- Be particularly pregnancy-sensitive when transporting between hemispheres.



Relevance for conservation

When thinking about reintroductions:

- Species do not lose a photoperiodic trigger in captivity if they have one.
- Be particularly pregnancy-sensitive when transporting between hemispheres.

- Species whose natural habitat subjects them to seasonal reproduction by resource scarcity without phototrigger should be ‘synchronized’ before release.

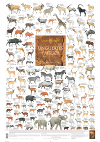
Summary

Research summary

A. Research in zoos is

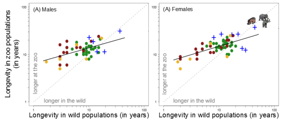
- a political obligation
- a logic necessity
- a fascinating opportunity

B. Zoo research has the fascination opportunity of comparative knowledge.



C. Zoos are a control group to the natural habitat

- with respect to ‘factors not provided’
- with respect to ‘factors protected from’



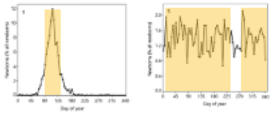
D. Zoos collect immense amounts of data.

SPECIES 360

Global information serving conservation.

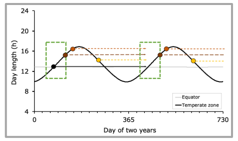
Seasonality summary

1. Zoo data allows the categorisation but also quantification of seasonality.

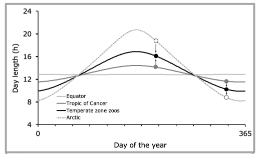


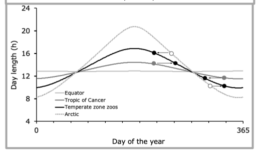
2. Seasonality mainly depends on the latitude of origin of a species.

3. More seasonal species have relatively shorter gestation periods.

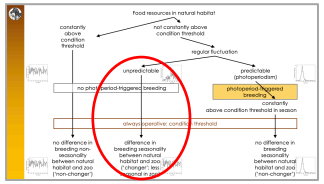


4. Whereas primates generally seem to have a clock that counts from a photo marker till breeding, ruminants seem to be triggered by absolute daylength.





5. The majority of species has the same reproductive seasonality in zoos as in their natural habitats.



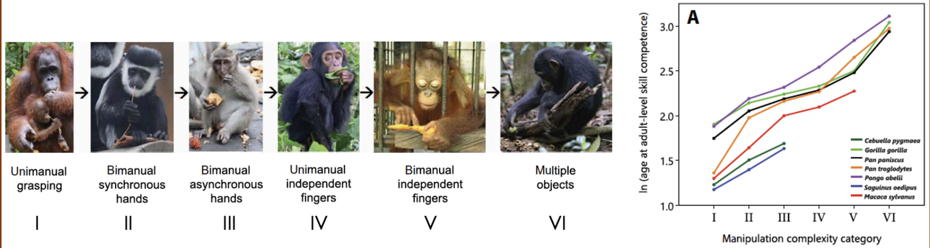
6. For a certain proportion of species, zoos relax resource constraints in their natural habitat, allowing them to breed non-seasonally (particularly primates).

How do we communicate about research ?

When ontogeny recapitulates phylogeny: Fixed neurodevelopmental sequence of manipulative skills among primates

Sandra A. Heldstab*, Karin Isler, Caroline Schuppli†, Carel P. van Schaik

Sci. Adv. 2020; **6** : eabb4685



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Pediatrics

Big brains and dexterous hands

by Newsemia · July 27, 2020 · 0 · 6

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Primates with large brains can master more complex hand movements than those with smaller brains. However, fine motor skills such as using tools can take time to learn, and humans take the longest of all. Large-brained species such as humans and great apes do not actually learn more slowly than other primates but instead start later, researchers have shown.

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Published on: 24 July 2020
Last updated on: 26 July 2020

193

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News release, 24 July 2020

Big Brains and Dexterous Hands

Primates with large brains can master more complex hand movements than those with smaller brains. However, fine motor skills such as using tools can take time to learn, and humans take the longest of all. Large-brained species such as humans and great apes do not actually learn more slowly than other primates but instead start later, researchers at the University of Zurich have shown.

Parents have to invest a lot of time and energy until their offspring are independent - like this Hanuman langur mother with her offspring. (Image: Karin Isler, ZOOM Erlebniswelt, Gelsenkirchen)

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Big brains and dexterous hands

Date: July 24, 2020

Source: University of Zurich

Summary: Primates with large brains can master more complex hand movements than those with smaller brains. However, fine motor skills such as using tools can take time to learn, and humans take the longest of all. Large-brained species such as humans and great apes do not actually learn more slowly than other primates but instead start later, re-searchers have shown.

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Humans develop fine motor skills later than other primates because we have bigger brains that take longer to develop dexterous abilities

- Swiss researchers observed 36 different primate species over about seven years
- Great apes have the bigger brains and so take longer to reach their full potential
- Despite this biologists found that different primates learn skills in the same order

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Cambridge Philosophical Society

Biol. Rev. (2020), pp. 000–000.
doi: 10.1111/brv.12646

Reproductive seasonality in primates: patterns, concepts and unsolved questions

Sandra A. Heldstab[1,2*], Carel P. van Schaik[2], Dennis W. H. Müller[3], Eberhard Rensch[1], Laurie Bingaman Lackey[4], Philipp Zerbe[1], Jean-Michel Hatt[1], Marcus Clauss[1*] and Ikki Matsuda[5,6,7,8]

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[3]*Zoological Garden Halle (Saale), Fasanenstrasse 5a, 06114, Halle (Saale), Germany*
[4]*World Association of Zoos and Aquariums (WAZA), Carrer de Roger de Llúria, 2, 2-2, Barcelona, Spain*
[5]*Chubu University Academy of Emerging Sciences, 1200, Matsumoto-cho, Kasugai-shi, Aichi, 487-8501, Japan*
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[7]*Japan Monkey Centre, Inuyama, Aichi, 484-0081, Japan*
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ABSTRACT

Primates, like other mammals, exhibit an annual reproductive pattern that ranges from strictly seasonal breeding to giving birth in all months of the year, but factors mediating this variation are not fully understood. We applied both a categorical description and quantitative measures of the birth peak breadth based on daily observations in zoos to characterise reproductive seasonality in 141 primate species with an average of 941 birth events per species. Absolute day length at the beginning of the mating season in seasonally reproducing species was not correlated between populations from natural habitats and zoos. The mid-point of latitudinal range was a major factor associated with reproductive seasonality, indicating a correlation with photoperiod. Gestation length, annual mean temperature, natural diet and Malagasy origin were other important factors associated with reproductive seasonality. Birth seasons were shorter with increasing latitude of geographical origin, corresponding to the decreasing length of the favourable season. Species with longer gestation periods were less seasonal than species with shorter ones, possibly because shorter gestation periods more easily facilitate the synchronisation of reproductive activity with annual cycles. Habitat conditions with higher mean annual temperature were also linked to less-seasonal reproduction, independently of the latitude effect. Species with a high percentage of leaves in their natural diet were generally non-seasonal, potentially because the availability of mature leaves is comparatively independent of seasons. Malagasy primates were more seasonal in their births than species from other regions. This might be due to the low resting metabolism of Malagasy primates, the comparatively high degree of temporal predictability of Malagasy ecosystems, or historical constraints peculiar to Malagasy primates. Latitudinal range showed a weaker but also significant association with reproductive seasonality. Amongst species with seasonal reproduction in their natural habitats, smaller primate species were more likely than larger species to shift to non-seasonal breeding in captivity. The percentage of species that changed their breeding pattern in zoos was higher in primates (30%) than in previous studies on Carnivora and Ruminantia (13 and 10%, respectively), reflecting a higher concentration of primate species in the tropics. When comparing only species that showed seasonal reproduction in natural habitats at absolute latitudes ≤11.75°, primates did not differ significantly from these two other taxa in the proportion of species that changed to a less-seasonal pattern in zoos. However, in this latitude range, natural populations of primates and Carnivora had a significantly higher proportion of seasonally reproducing species than Ruminantia, suggesting that in spite of their generally more flexible diets, both primates and Carnivora are more exposed to resource fluctuation than ruminants.

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September 16, 2020 Mary Ellen Amodeo 0 Comments

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A study published today in ***Biological Reviews***, and using Species360 data, provides new insight to reproduction in primates living in in situ versus ex situ environments.

Thanks to the researchers at Clinic for Zoo Animals at the University of Zurich, for the discoveries involving data curated by the Species360 member community using ZIMS (Zoological Information Management System). Among the researchers, **Marcus Clauss**, Clinic for Zoo Animals at the University of Zurich, is also a member of the Species360 Conservation Science Alliance Research Committee.

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