

# The weight of getting old

## Sex-specific body mass ageing in Asian elephants

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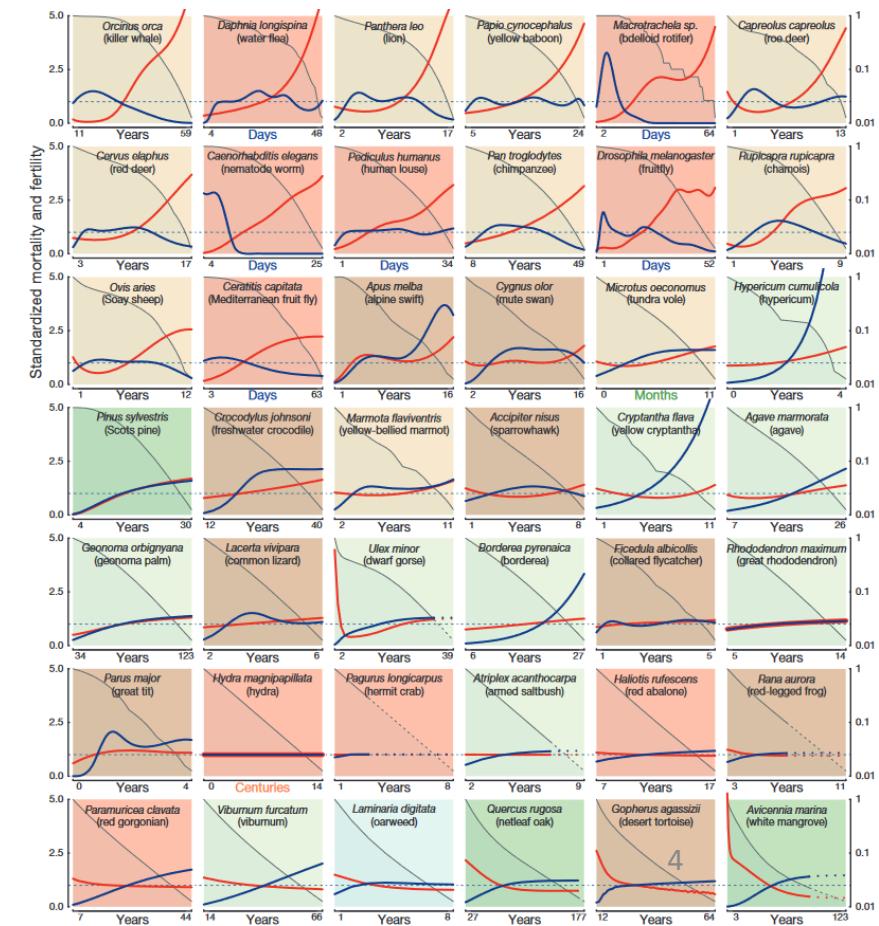
# Ageing

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- A phenomenon observed in many species



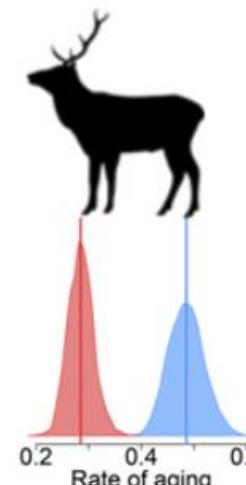
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A main challenge in ageing research is to quantify and explain such differences in the onset and rates of ageing

# Sex-specific ageing

The sex with the highest intrasexual competition = higher mortality rate  
→ shorter lifespan and an earlier onset and/or higher rate of ageing

# Sex-specific ageing

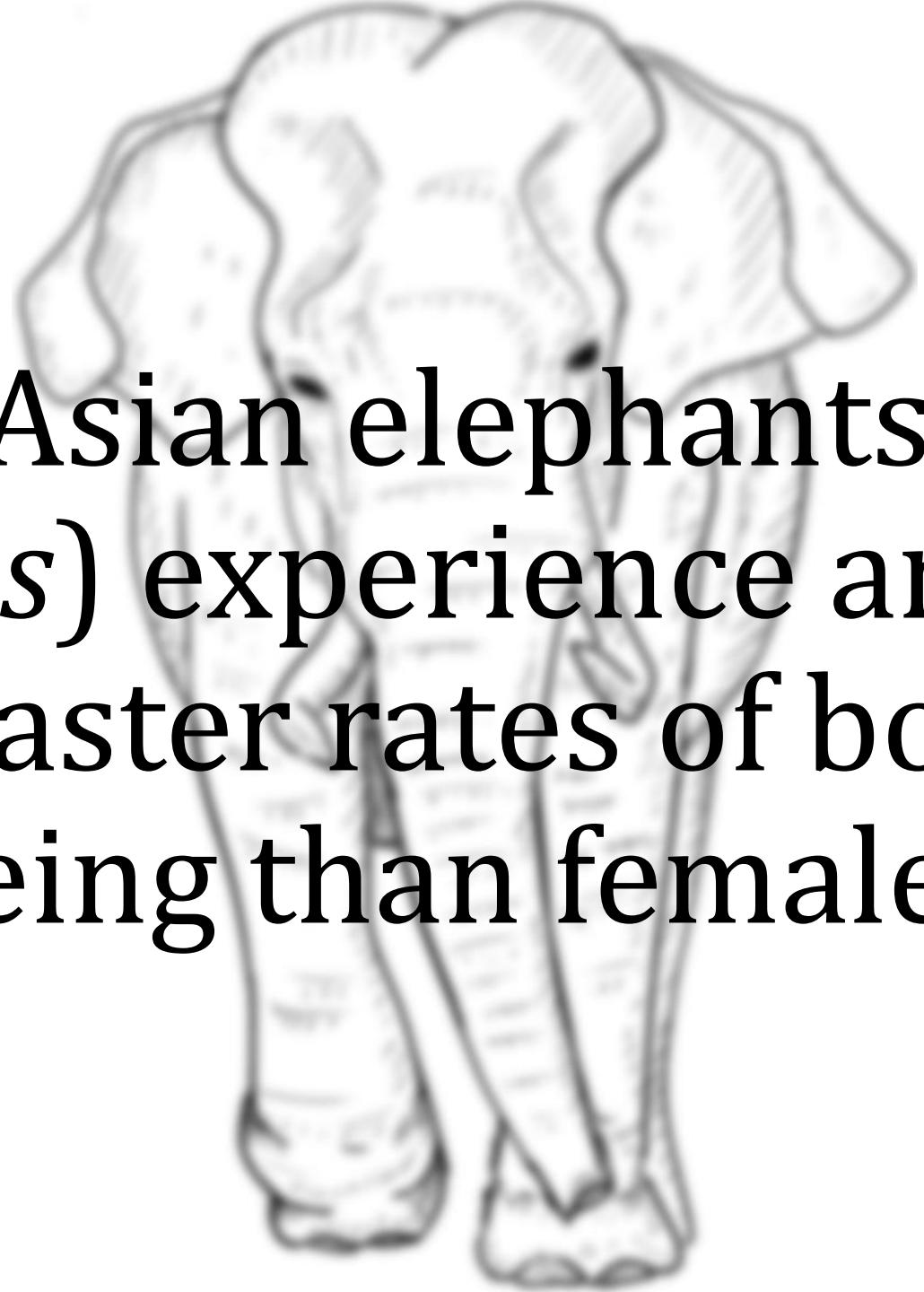
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# Sex-specific ageing

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- *Live fast, die young* pace of life: Deleterious mutations are not counter selected due to a weakened force of selection in late-life
- In polygynous species with male-biased intrasexual competition, males often die earlier and age earlier or faster than females



Do male Asian elephants (*Elephas maximus*) experience an earlier and/or faster rates of body mass ageing than females ?

# Asian elephants

- Long-lived, social and sexually dimorphic species



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- Females live in kin groups



# Asian elephants

- Long-lived, social and sexually dimorphic species
- Females live in kin groups
- Males: solitary, more intense intrasexual competition for dominance and mating → bigger, heavier, more aggressive and less sociable → higher mortality



# Body mass

- Positively associated with key life-history traits in many non-human species

# Body mass

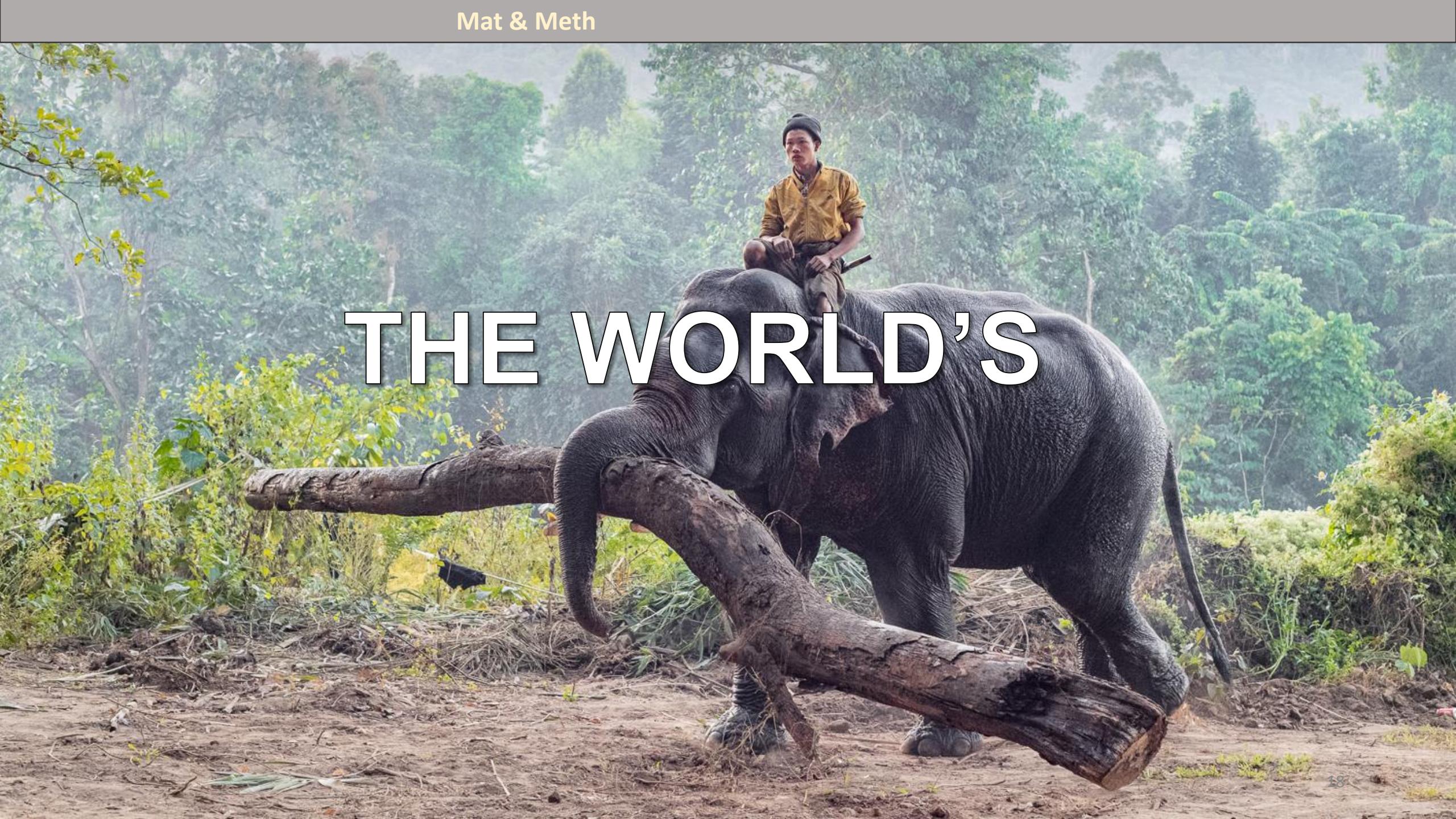
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- Non-invasive, easy to measure



# Body mass

- Positively associated with key life-history traits in many non-human species
- Non-invasive, easy to measure
- In Asian elephants
  - Seasonal variation in body mass is positively associated to survival the following month
  - Male Asian elephants benefit from being heavy during intrasexual competition for dominance and mating

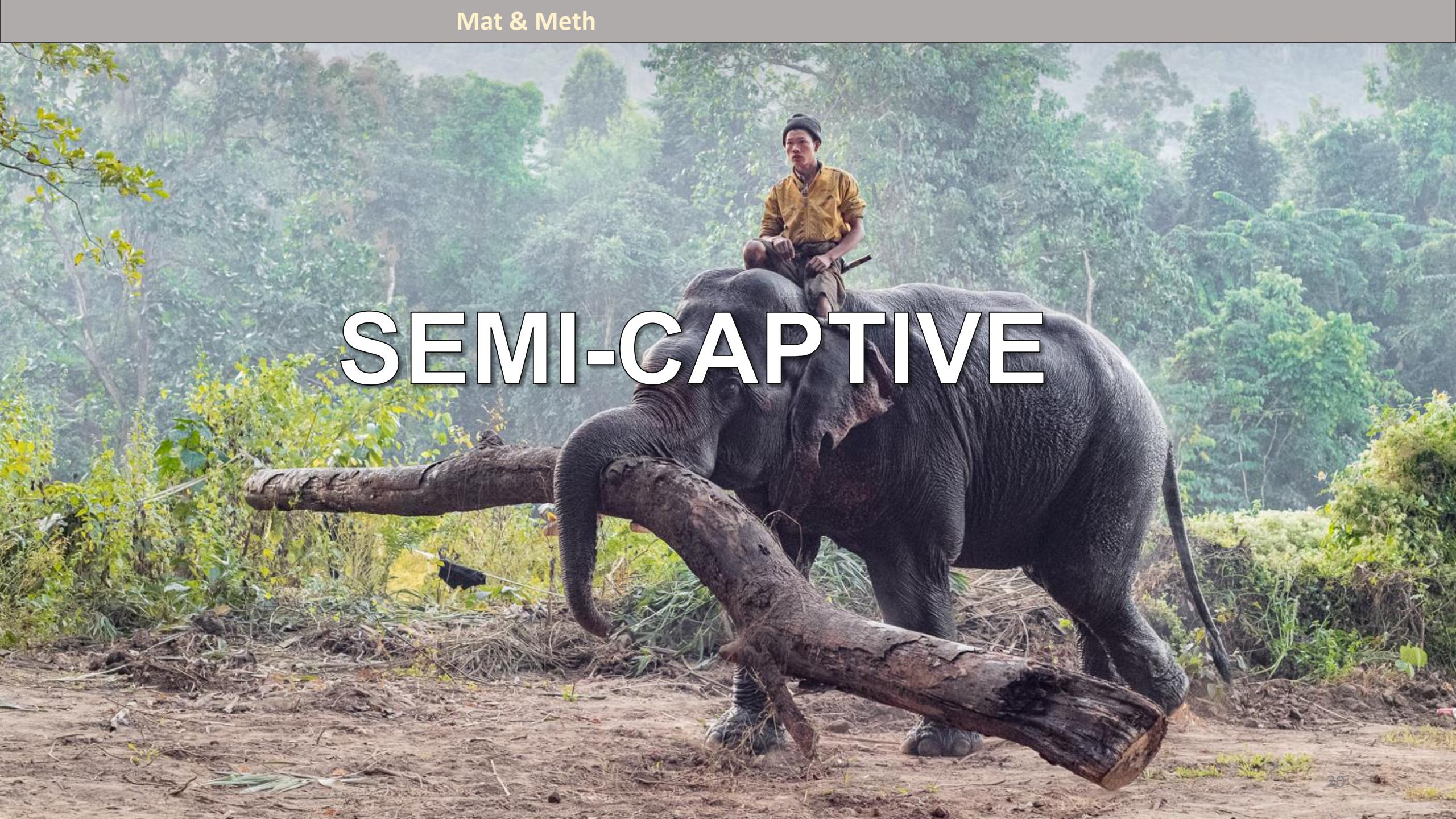


A large elephant is shown carrying a massive, long wooden log on its back. A person wearing a yellow shirt and a dark beanie is riding the elephant, holding onto a stick or tool. The elephant is walking through a lush, green forest with dense foliage and trees in the background. The scene is captured in a wide-angle shot, emphasizing the size of the elephant and the log.

THE WORLD'S

A large elephant is shown carrying a massive, long wooden log on its back. A person wearing a yellow shirt and a dark beanie is riding the elephant, holding onto its back. The elephant is walking through a lush, green forest. The word "LARGEST" is overlaid in large, white, sans-serif capital letters across the center of the image.

LARGEST

A large, dark-skinned elephant is shown from the side, walking towards the right. A person wearing a yellow shirt and brown pants is seated on its back. The elephant is carrying a long, thick log on its back. The background is a dense, green forest with misty hills in the distance.

SEMI-CAPTIVE

# POPULATION



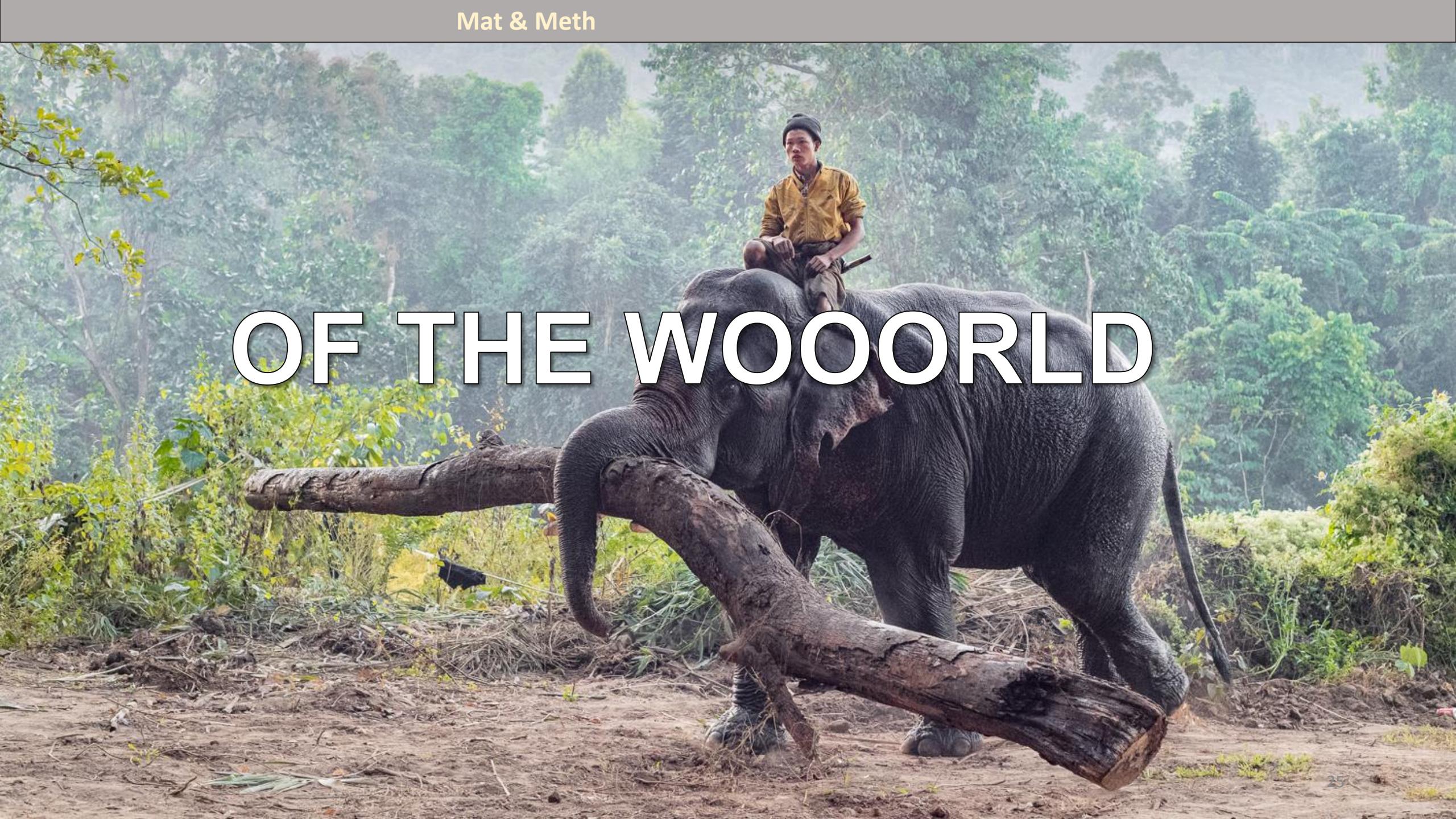
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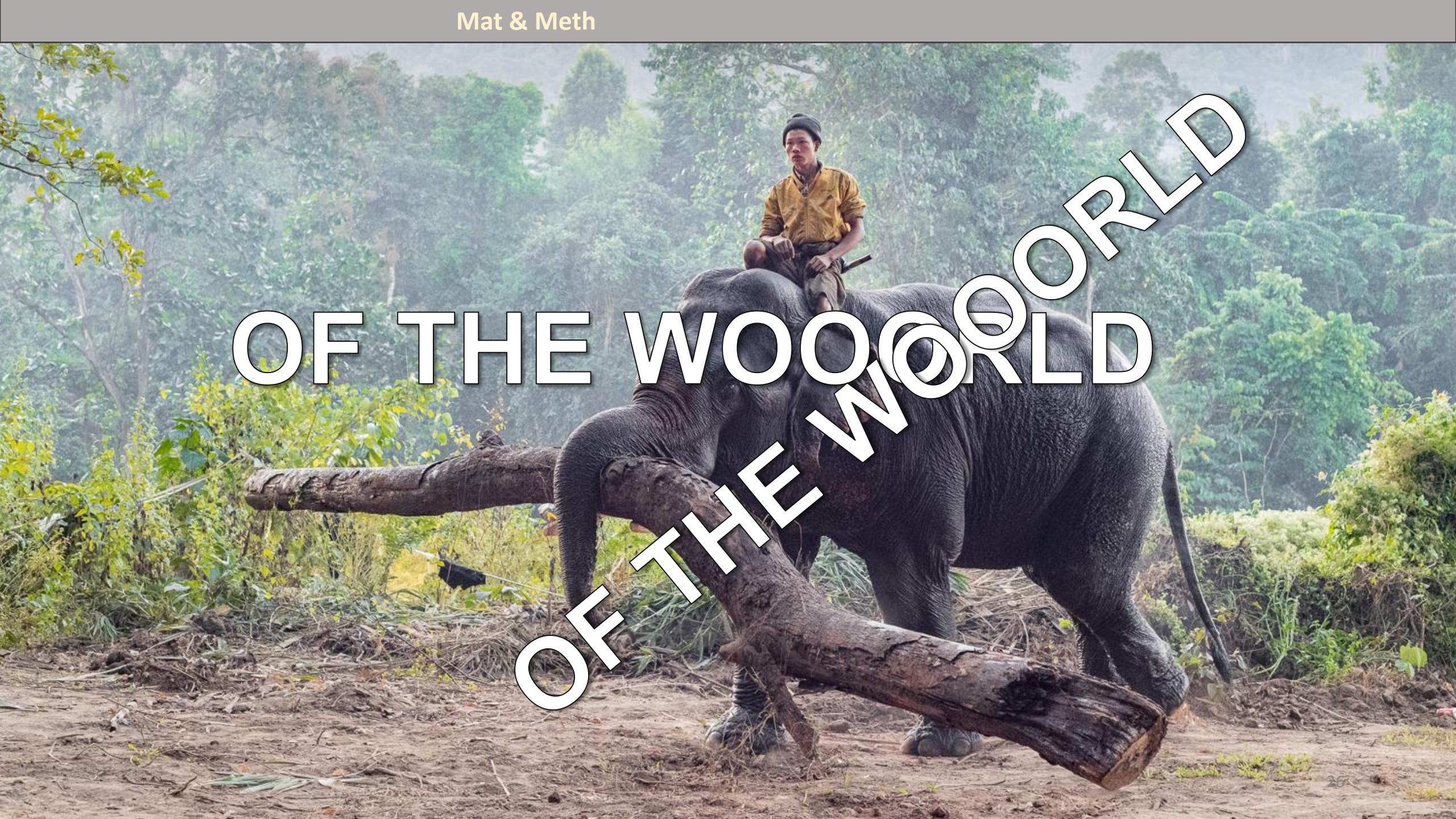
A large, dark-skinned elephant is shown in profile, facing left. It is carrying a massive, long wooden log balanced on its back. A person wearing a yellow shirt and a dark beanie is seated on the elephant's back, holding onto a stick. The setting is a lush, green forest with dense foliage and trees in the background. The ground is dirt and appears to be a clearing or path through the woods.

# ASIAN ELEPHANTS



# OF THE WOORLD

A large, dark-skinned elephant is shown carrying a massive, weathered log on its back. The elephant is walking through a dense, green forest. A person wearing a yellow shirt and a black beanie sits atop the elephant, holding a long stick or tool. The scene is set in a natural, outdoor environment with trees and foliage in the background.

A photograph of a man in traditional yellow clothing and a black turban riding an elephant through a dense green forest. The elephant is carrying a large, thick log balanced on its back. The scene is set on a dirt path with lush vegetation in the background.

# OF THE WOODWORLD

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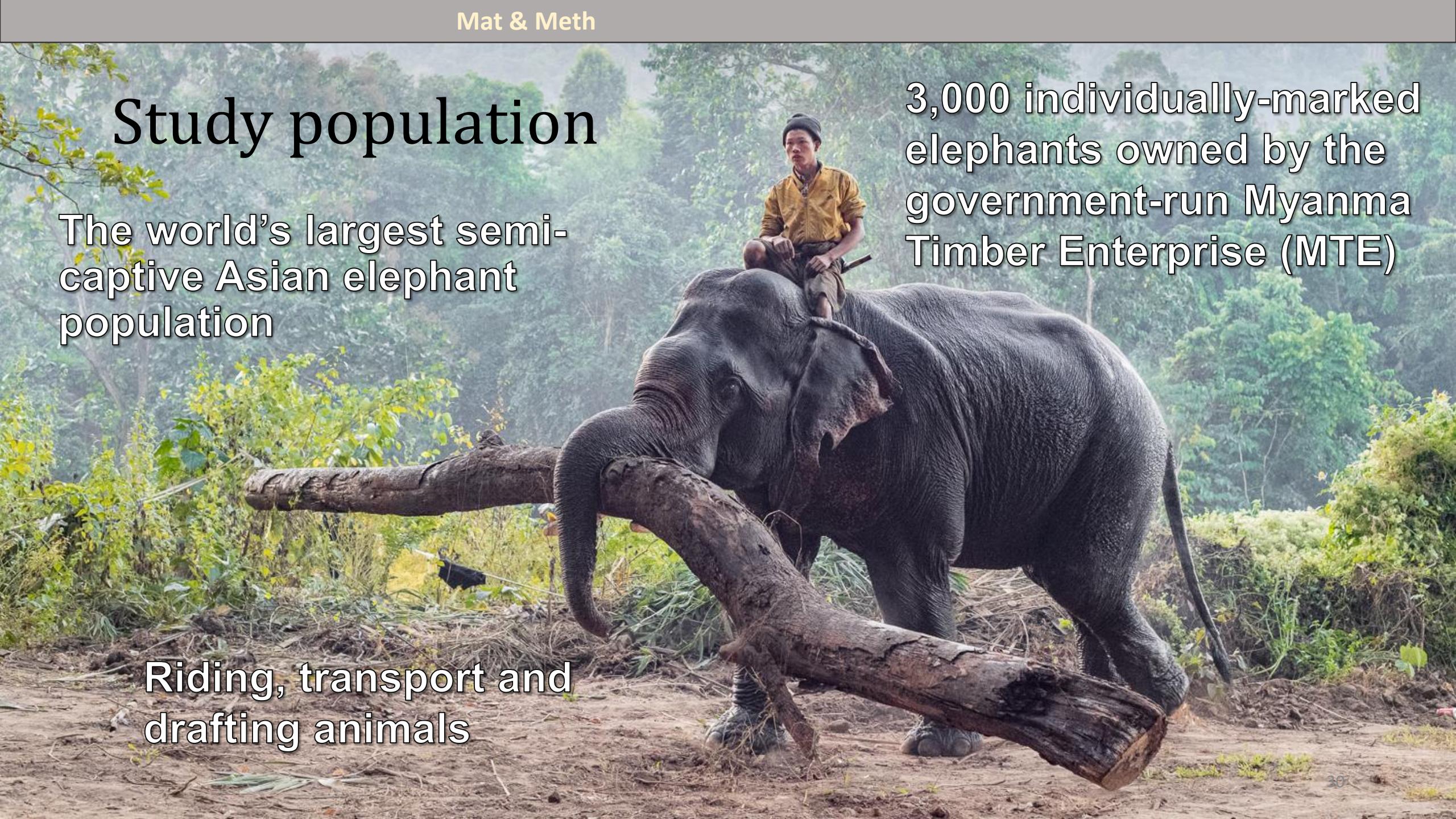


# Study population

The world's largest semi-captive Asian elephant population

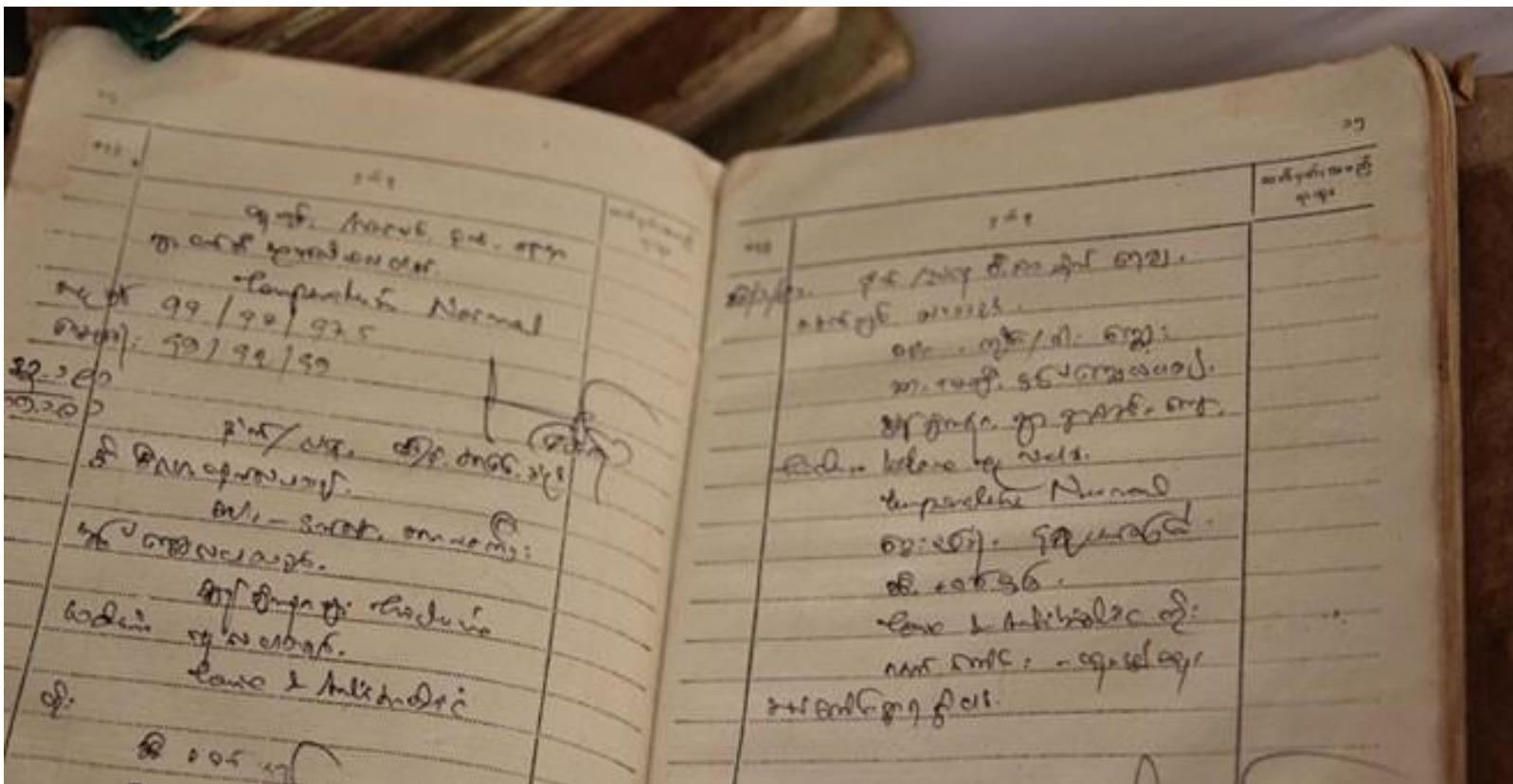
Riding, transport and drafting animals

3,000 individually-marked elephants owned by the government-run Myanma Timber Enterprise (MTE)



# Study population

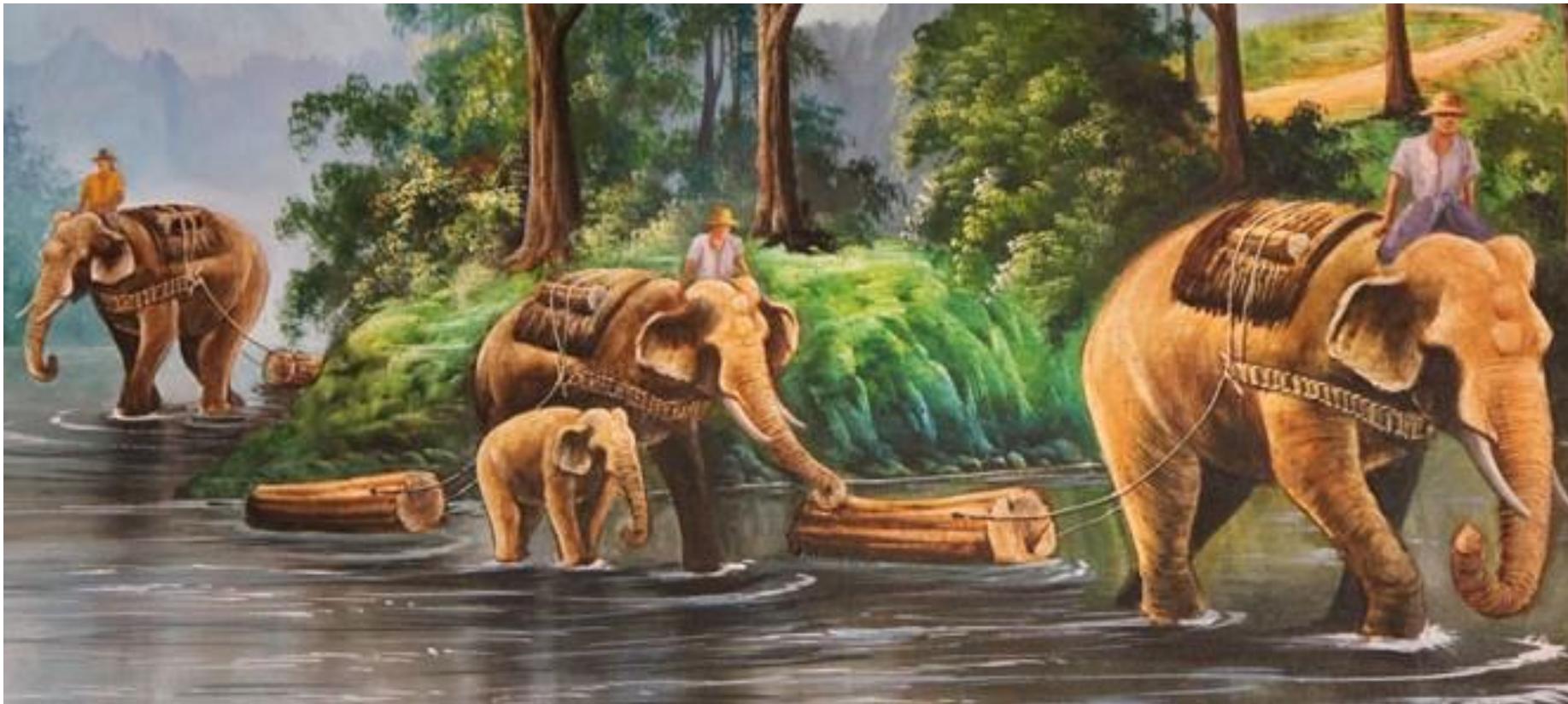
- Logbooks: birth, death, maternal-lineage pedigree, morphological measurements recorded for a century



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# Study population

- Elephants work during the day but socialise, mate and forage freely and unsupervised in forests at night



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- Government-set workload
  - Pregnant females are given pregnancy rest
  - Retirement: 50-55 years old
- Care and logbooks are maintained until death

# Data collection

Adult body mass (18 years old onwards)

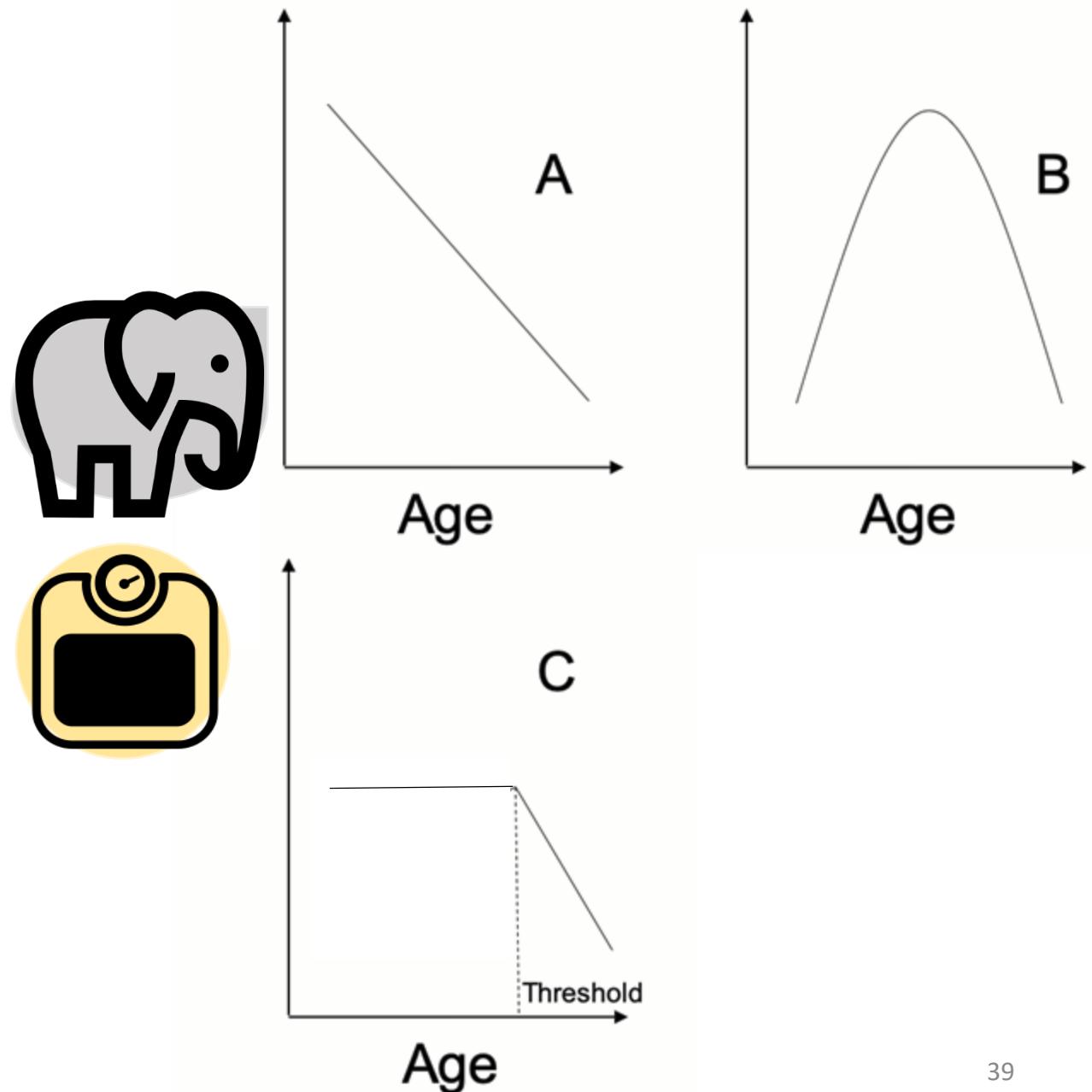
N = 3886 body masses on 493 individuals



# Ageing trajectories

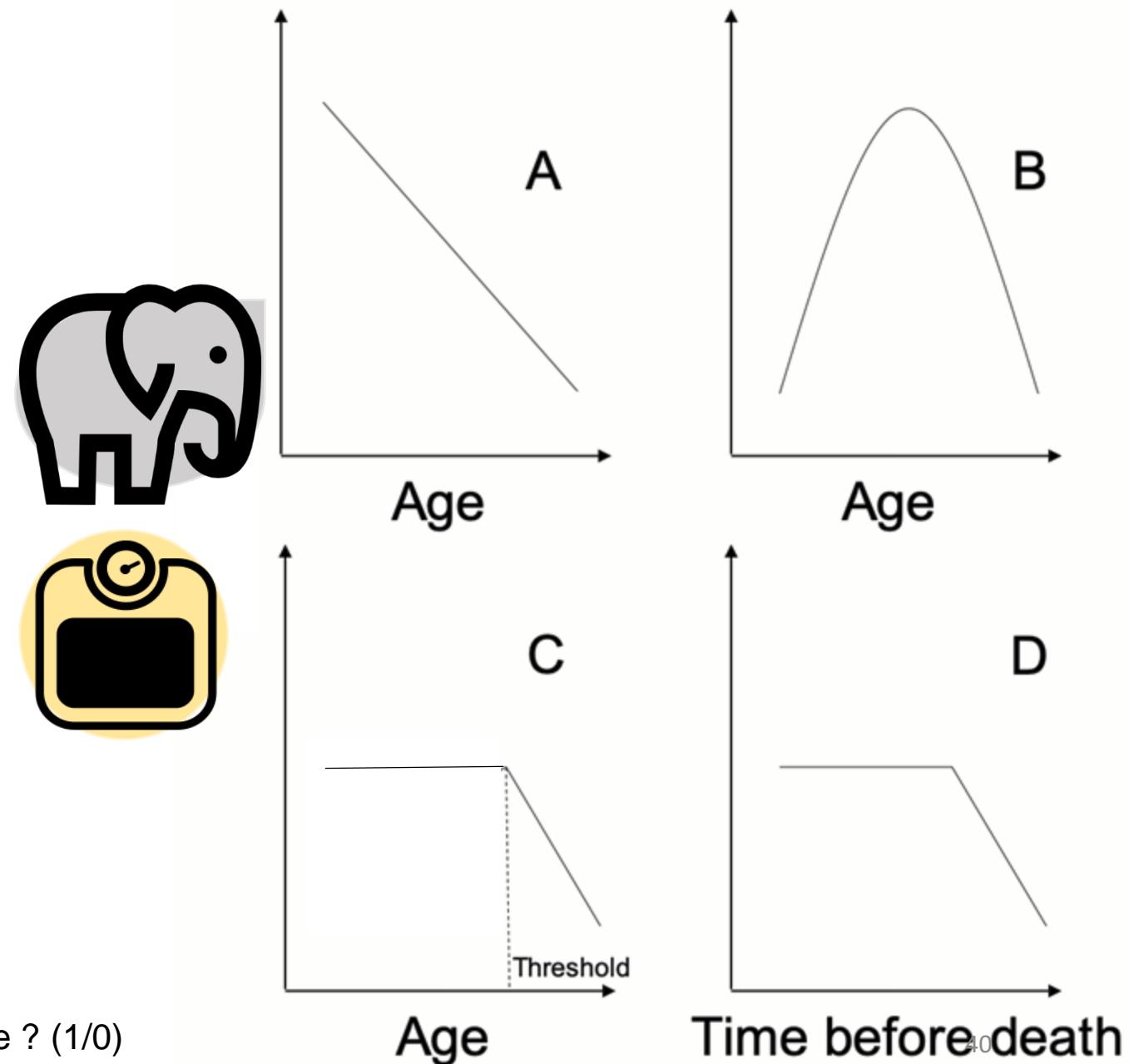
# Ageing trajectories

- Linear
- Quadratic
- Threshold

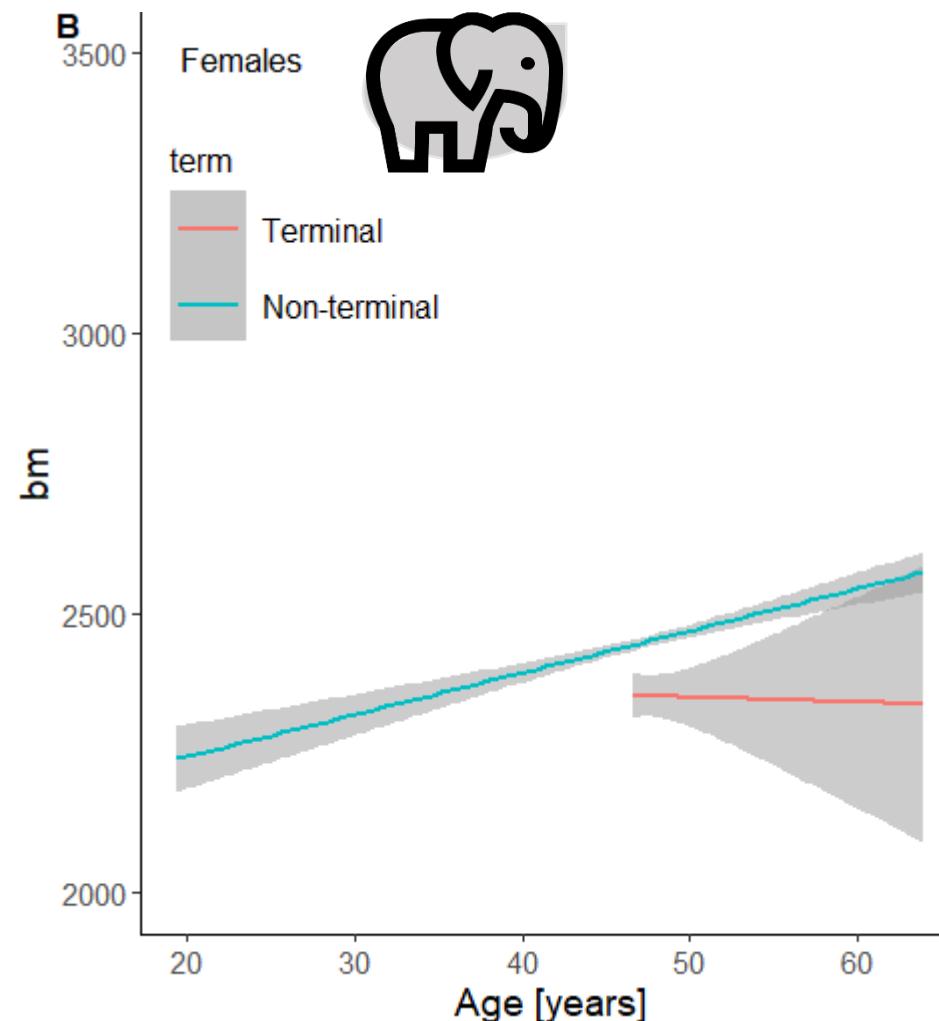
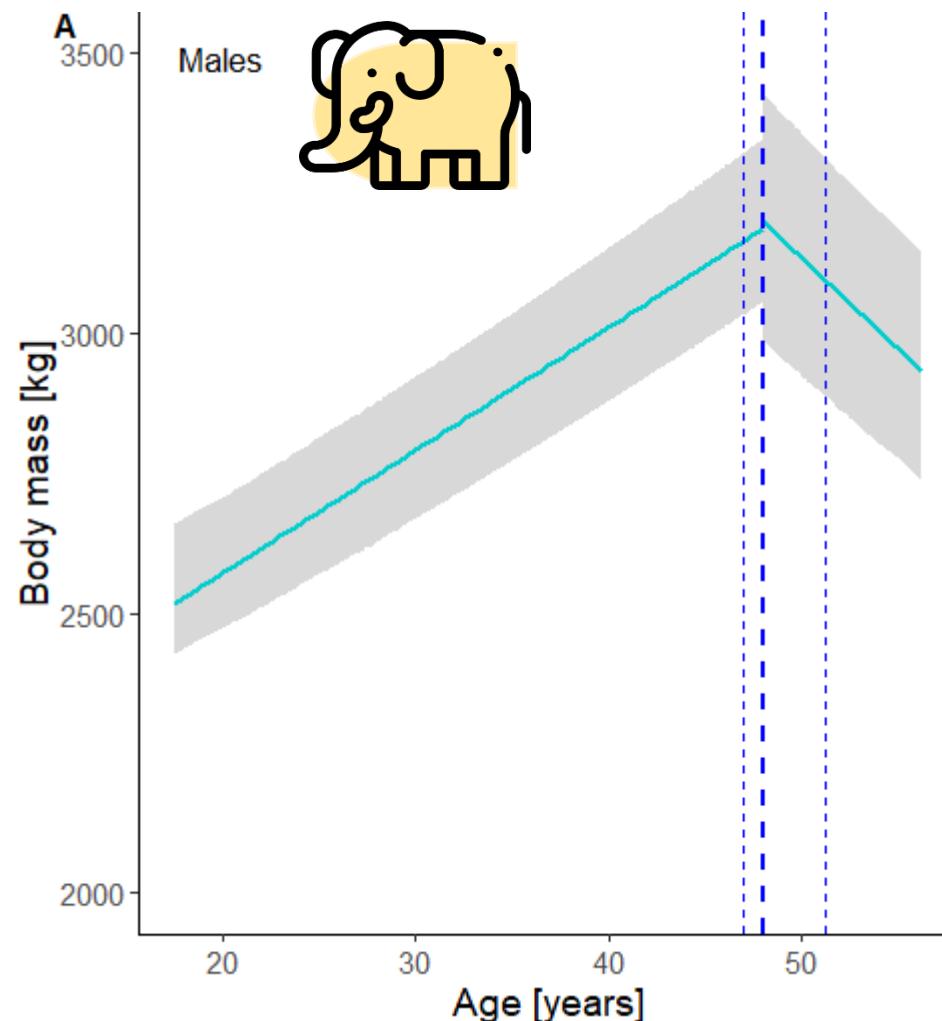


# Ageing trajectories

- Linear
- Quadratic
- Threshold
- Terminal decline
  - Age-independent
  - Fixed at 1 year prior to death
  - Factor:
    - measurement during the last year of life ? (1/0)



# Sex-specific ageing trajectories



Results are consistent with the classical theory of ageing



# Limitations ?

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1. Males might be more used for tasks requiring strength or tusks
  - Same government-set regulations on working load for both sexes, except for maternity leave
  - Parental care is concentrated on females and is not more favourable than timber working



# Limitations ?

## 2. Tooth wear

- In sexually dimorphic species of ungulates, males have smaller relative teeth size that wear down faster and deplete earlier than for females



# Limitations ?

## 3. Retirement

- ♀ Reduced intrasexual competition + diminished physical exercise = weight gain
    - fat storage declines from retirement onwards in both sexes
  - ♂ Start of body mass decline ~48 yo in males v. retirement 50-55 yo
    - Muscle function do not decline with age
- Retirement is rather a consequence than a cause



# Terminal decline

- Chronological age is rarely a perfect estimation of the biological age

# Terminal decline

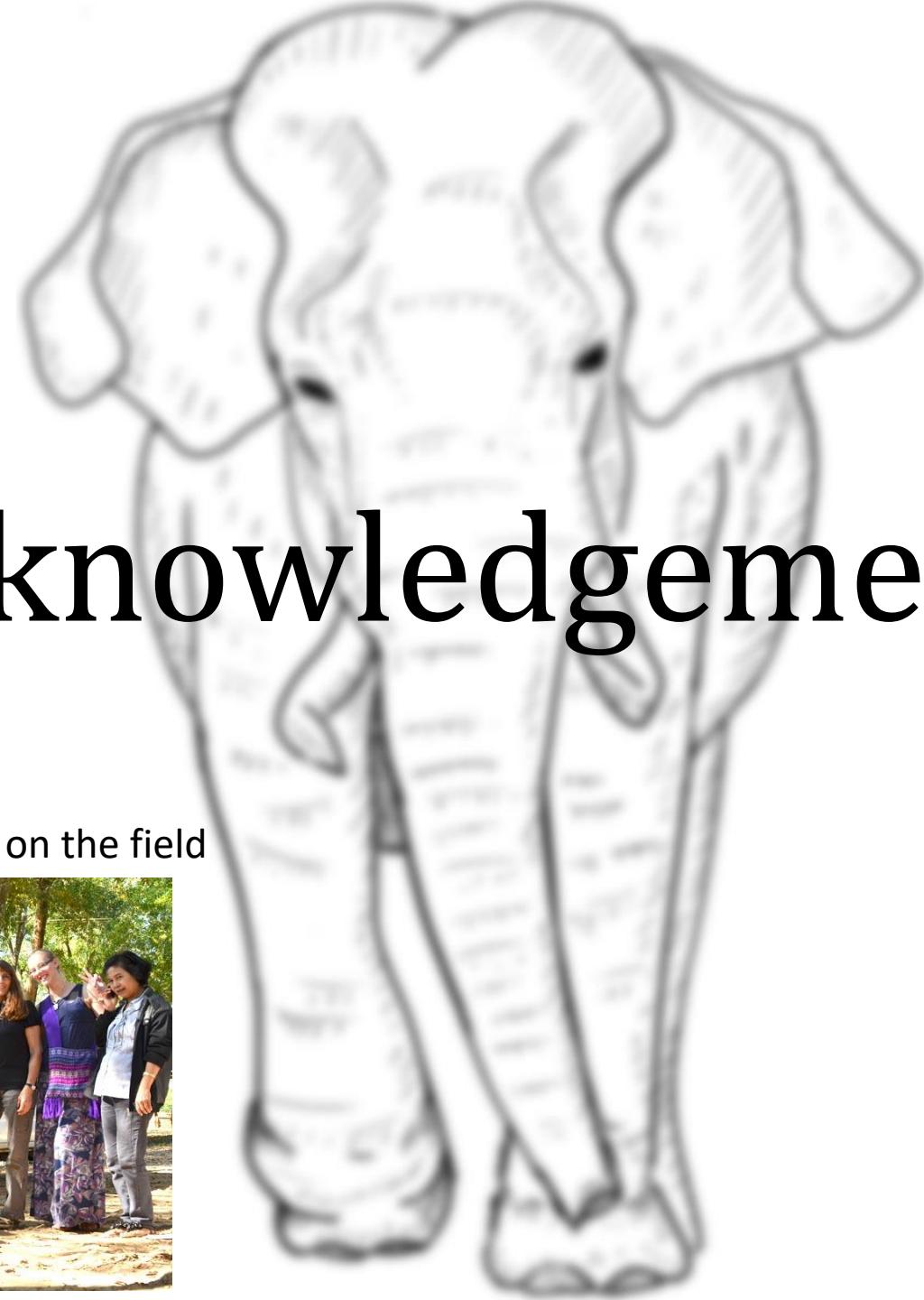
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- A terminal decline is a biomarker of health and remaining lifespan

# Terminal decline

- Chronological age is rarely a perfect estimation of the biological age
- A terminal decline is a biomarker of health and remaining lifespan
- Important managing tool in such a valuable semi-captive population of this long-lived species



Virpi Lummaa



Vérande Berger

# Acknowledgements

Michael Briga

All local veterinarians and technicians on the field

