Towards a transdisciplinary framework to analyze birth and death patterns. Discussion.

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Why do we age

- From "why do we age?" to "Why do we age differently from other species?"
- Distinction of shape and pace of aging
- Starting point, Lotka–Euler equation where the implicit growth rate r is the measure of "fitness"
- Pace of aging measured via life expectancy at birth (e_0) and shape via lifespan disparity ($e^\dagger$)
- Final (new starting) point: "Born once, die once". Replicate pace and shape measures for reproduction

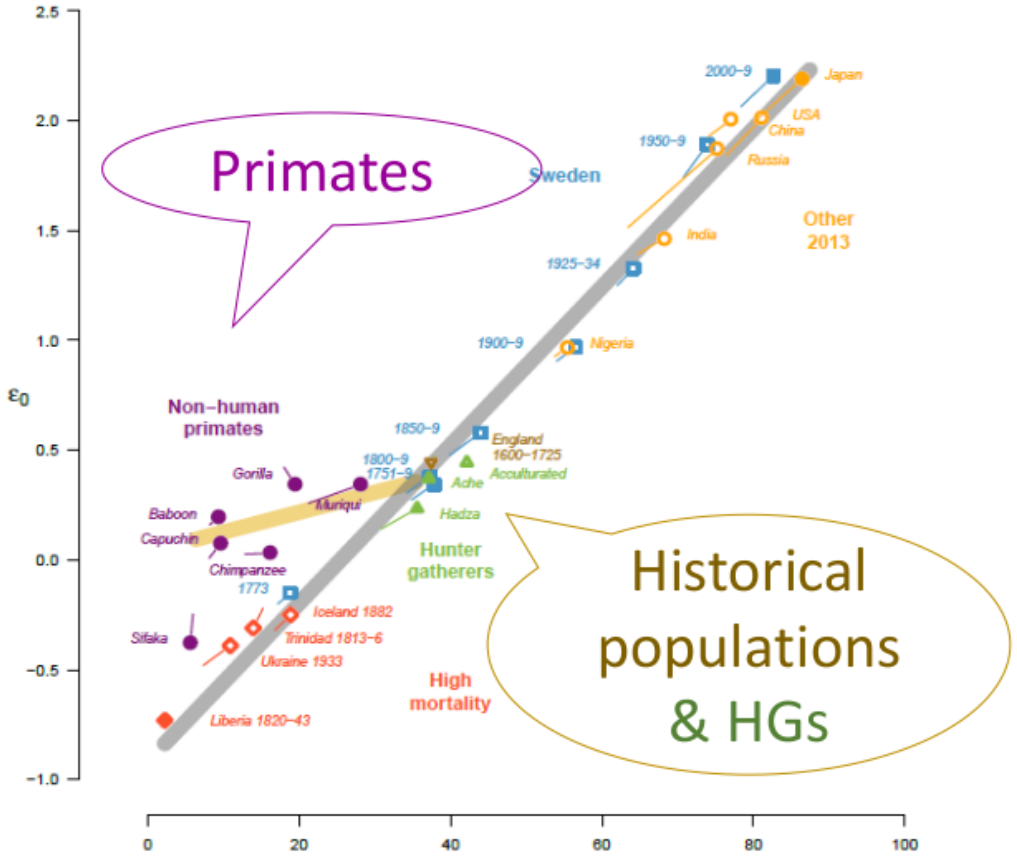
Lotka-Euler

$$\int_{\alpha}^{\omega} e^{-rx} l(x) f(x) dx = 1 \tag{1}$$

BUT it assumes

- Infinite resources (see Cinzia's discussion)
- Closed populations

Lotka-Euler


Primates
Historical populations & HGs
Sweden
Other 2013
Non-human primates
Hunter gatherers
High mortality
2000–9
Japan
USA
China
Russia
1950–9
India
1925–34
1900–9
Nigeria
1850–9
England 1600–1725
Acculturated
1800–9
1751–9
Ache
Hadza
Muriqui
Gorilla
Baboon
Capuchin
Chimpanzee
1773
Iceland 1882
Trinidad 1813–6
Ukraine 1933
Sifaka
Liberia 1820–43
ε_0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
0
20
40
60
80
100

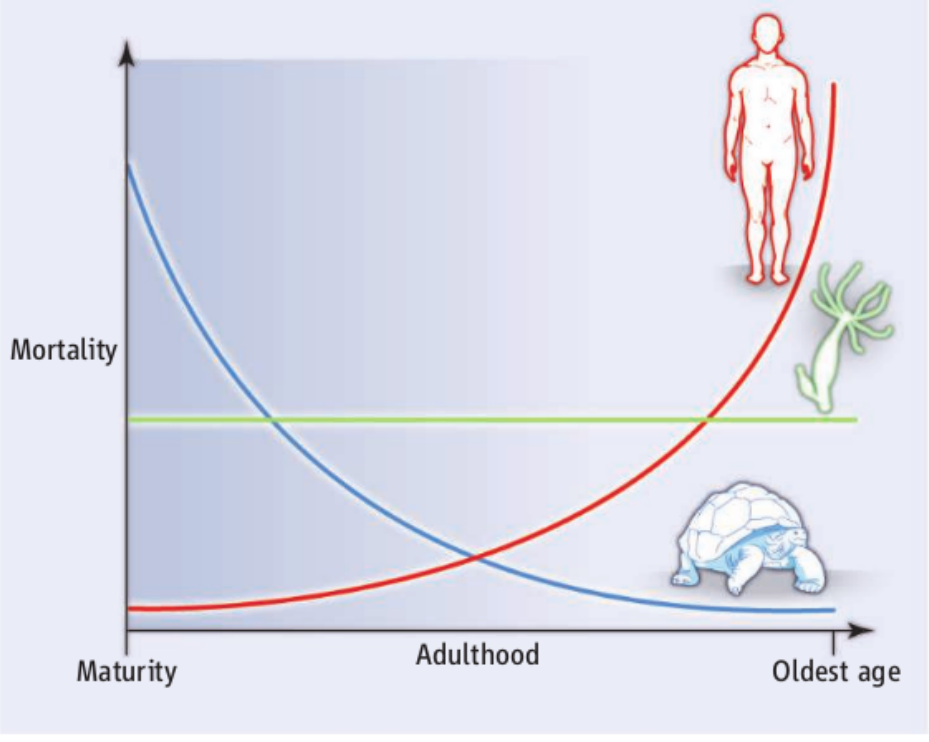
The role of migration

- Migration usually compensates for low or high values of r
- This means that migration rates depends on fertility and mortality rates

$$\frac{\partial P(t)}{\partial t} = P(t) \cdot r + f(r) \cdot P(t)$$

- How does "fitness" change if we take migration into account?

The role of ~~migration~~ interaction



Does tortoises' shape of aging depend on interaction with predators?

The role of ~~migration~~ interaction

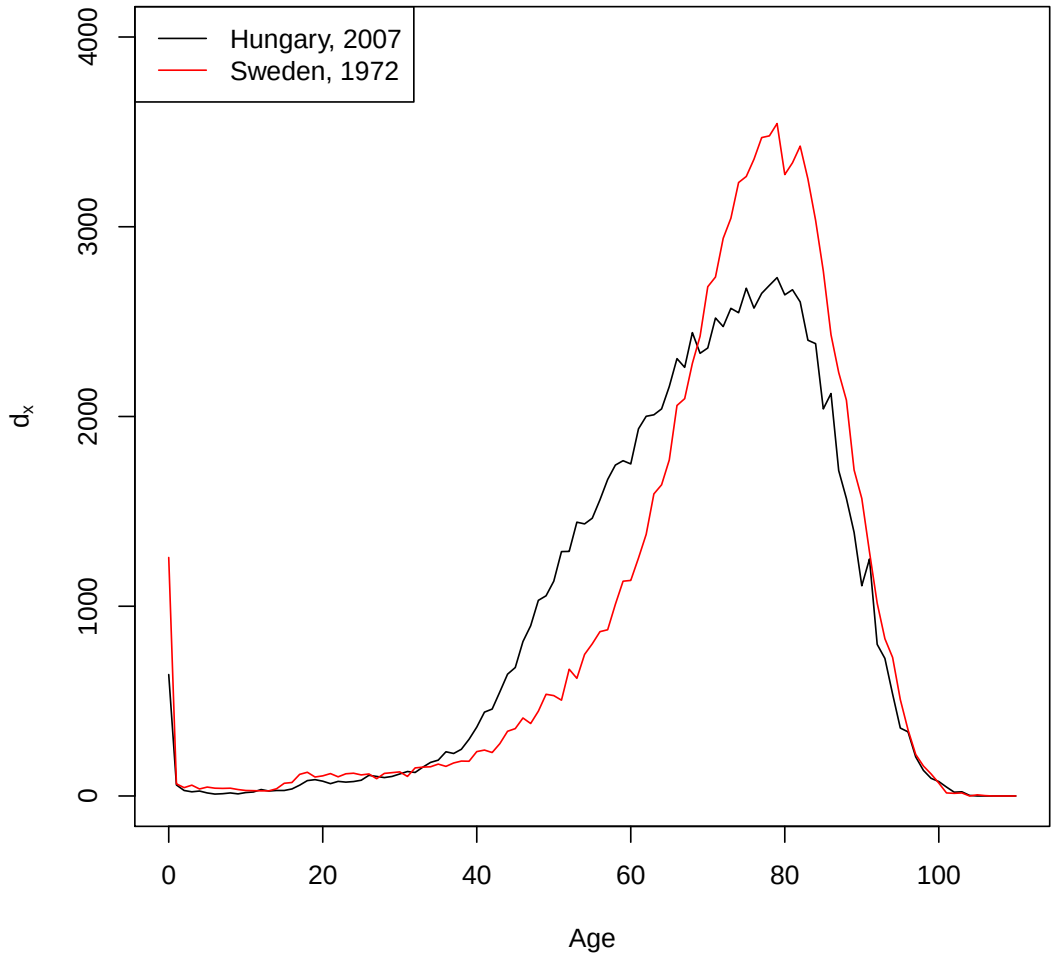
- Humans don't have predators but different human populations interact in many ways among them
-

$$\frac{\partial P(t)}{\partial t} = P(t) \cdot r + \sum_{k=1}^{K} \alpha_k \cdot P_k(t)$$

Life expectancy

- Life expectancy used as measure of length of life (pace)
- Desirable properties of e_0 but very sensitive to infant mortality
- Most of data used comes from populations with high infant mortality
- Is infant mortality related to aging? Or is it a nuisance factor?

Life expectancy



Possible alternatives

- Modal age at death (but how does it relate with $e^{\dagger}$?)
- e_5 or $e_5 + 5$ (associated with $e_5^{\dagger}$?)
- e_0 estimated through Gompertz model (estimate based on ages $30 - \omega$)

To conclude

- What is aging? Mortality rates by age shape and pace might be affected by endogenous factors and exogenous ones
- Do they equally contribute to aging?
- And how infant mortality should be accounted for in defining aging?
- Curious to see what will be the relation between pace and shape in reproduction
- This has been already somehow explored in the field of mortality (association between compression and longevity extension) but no so much in fertility