Introduction to Biology and Conservation of

Large Vertebrates

Assoc. Prof. Dr. Bojan Lazar

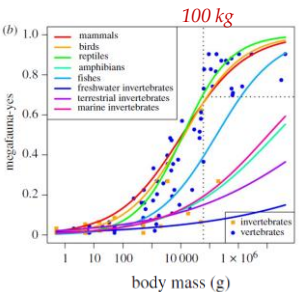
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University of Primorska



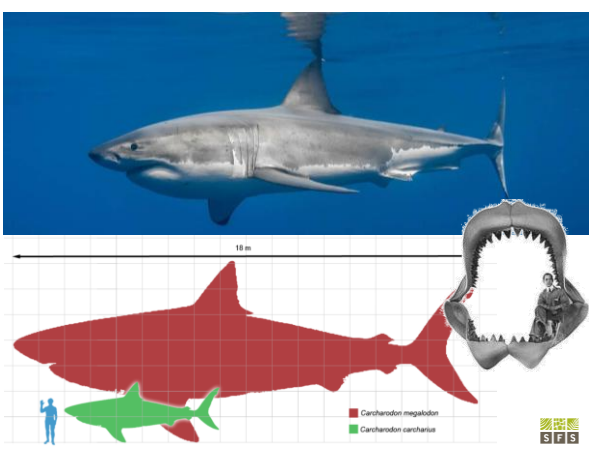
What is *Large* ?

- *Megafauna*
  - *gr.* "large, great, grand, abnormally large"
- metric system: *mega* = 10^6
  - size (length)
  - body mass (weight)

100 kg



PROCEEDINGS B
Rethinking megafauna
Moleón M. et al. 2020



Stunned Brit lads wrestle monster 51 stone bluefin tuna from water in gigantic catch

The gigantic 51-stone fish was pulled from the sea in the waters off Gibraltar by three British lads who say they couldn't even fit on their boat with the massive catch onboard





NewScientist

Human arrivals wiped out the Caribbean's giant ground sloths

EARTH 10 November 2017

By Fred Pearce





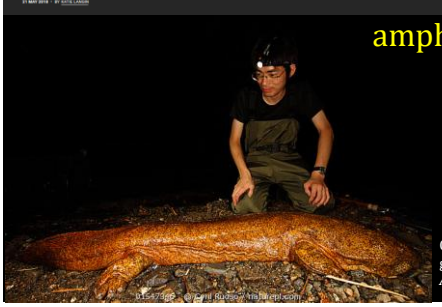
Who killed the giant ground sloth? Or the mammoth and sabre-toothed cat, come to that. Was it humans or a natural event, like the end of the last ice age? The question is endlessly debated. But the answer, at least in the Caribbean, now seems certain: it was humans.

NEWS CAREERS COMMENTARY JOURNALS COVID-19 Science

The world's largest amphibian is being bred to extinction

The Chinese giant salamander is actually five distinct species, all of which are virtually extinct in the wild

Large amphibians…



Chinese giant salamander
Andrias davidianus



Saltwater crocodile
(*Crocodylus porosus*)

Large reptiles…



Leatherback sea turtle
(*Dermochelys coriacea*)

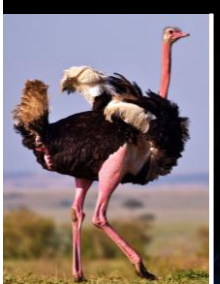


Green anaconda
Eunectes murinus

Comodo dragon
Varanus comodoensis

Galapagos tortoise
Geochelone elephantopus

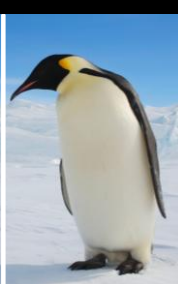
Large birds…



Common ostrich
Struthio camelus



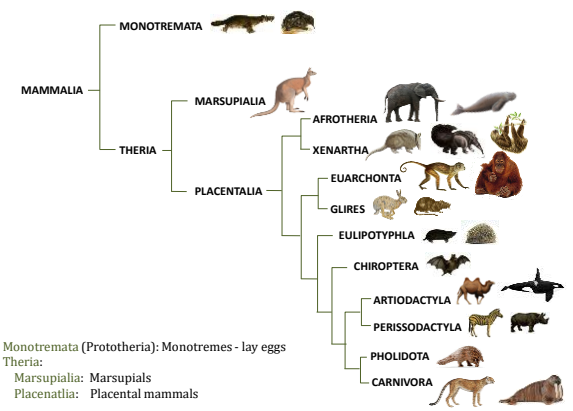
Southern cassowary
Casuarius casuarius



Emperor penguin
Aptenodytes forsteri

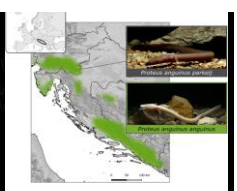
Large mammals…



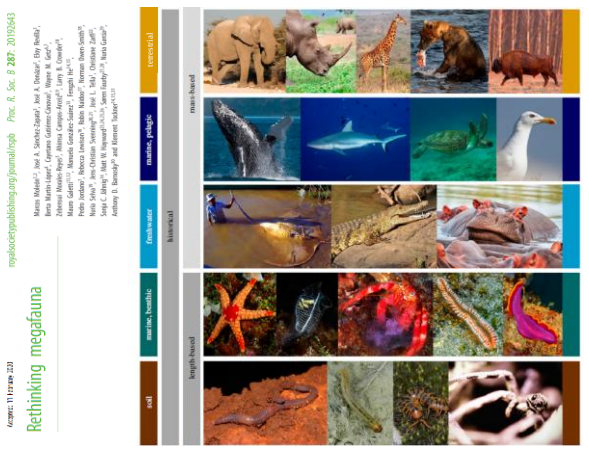


Monotremata (Prototheria): Monotremes - lay eggs
Theria:
Marsupialia: Marsupials
Placenatlia: Placental mammals

Megafauna?



Proteus anguinus (Amphibia: Urodela)
Cave salamander, Olm



Rethinking megafauna

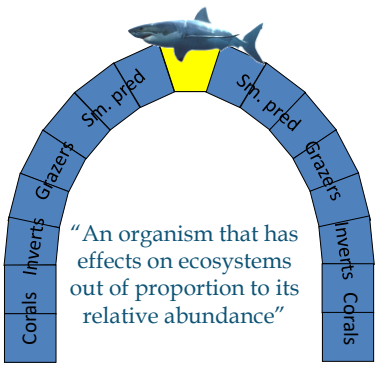
Moleón M *et al.* 2020

- Arbitrary body size related criteria (?)
  - e.g. ≥100 kg for terrestrial herbivores, ≥15 kg for carnivores
- **Functional** megafauna:
  The subset of largest species of a given clade or guild that have distinctive functional traits
  - apex megafauna
  - megaherbivores
- **Keystone** megafauna
  The subset of animals among the largest in size that have consistently strong effects on the structure or functioning of a community or an ecosystem
  - all species that have a strong influence on their ecosystems, in general, stronger than expected by their abundance or biomass

Focal Species Concept

- Concept in applied ecology and conservation that connects *single- species* and *multiple-species* approach
  - *Flagship species*
  - *Umbrella species*
  - *Indicator species*
  - *Keystone species*

The Keystone concept



Keystone Species

- Species that have a large influence on the community or ecosystem
  - *Keystone predators*
    - *Pisaster* seastar
    - Sea otter…
  - *Structural species*: species that *are* habitat
    - Trees
    - Corals
    - Kelp…
  - *Ecosystem engineers*: species that alter habitat
    - Beavers
    - Some fishes (*e.g.* groupers)
    - Estuary shrimp, worms…

Umbrella Species

- Species whose protection ensures conservation of a large number of other species that *share the same areas/habitats*
  - large animals, large *home-ranges*
- Species that require particular types of rare habitat
- Protection of (large) habitats of umbrella species simultaneously protect the habitats of other cooccurring species



Pongo pygmaeus
("forest man")

Home range:

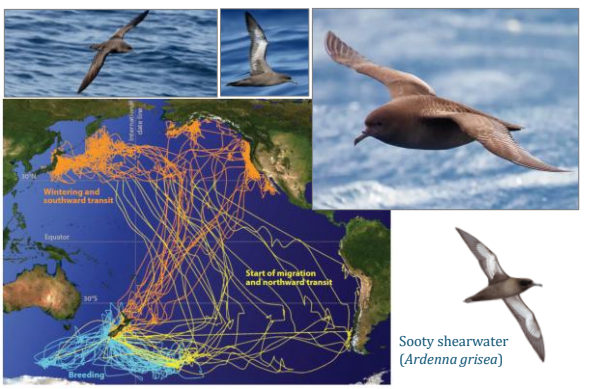
- adult female: ≈ 1.5 km²
- adult male: min. 8 km²



Panthera tigris sumatrae

Home range:

- adult female: ≈ 20 km²
- males: 60 – 100 km²



Sooty shearwater
(*Ardenna grisea*)

Interpolated geolocation tracks of 19 sooty shearwaters during breeding (light blue) and subsequent migration pathways (yellow - start of migration and northward transit; orange - wintering grounds and southward transit).

Costa et al. 2012. Ann. Rev. Ecol. Evol. Syst.

Box B1

Types of 'Focal' Species

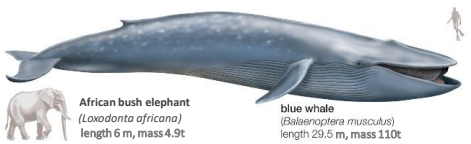
(adapted from Noss, 1990)

- Endemics – species that are only found to occur naturally in the waters near the MPA.
- Exotics – non-native species that are of concern due to their negative effects on the local ecology. For example, introduced algae that aggressively spreads and smothers native habitat.
- Flagships – charismatic species that are of social or cultural significance and are therefore used by managers as symbols of MPA efforts to encourage public interest and support.
- Indicators – species that signal how disturbances may be impacting other organisms within the community. For example, sea otters in kelp forests.
- Keystones – species upon which others in the community directly depend. For example, top fish predators that maintain a coastal food chain, or a coral reef species that provides living space (habitat) for others.
- Targets – species of interest due to their extractive or non-extractive use value. For example, shellfish commonly harvested for local diet needs, or humpback whales that bring tourists to the area. As not all target species will be priorities for management, they will therefore not all be focal species.
- Vulnerables – species that are known to be less resilient to environmental change than others in the community and/or require careful management to sustain. For example, slow-growing organisms or those with few offspring, or threatened, endangered or rare species (such as those on IUCN's Red List of Threatened Species).



Charismatic Megafauna

Large vertebrates

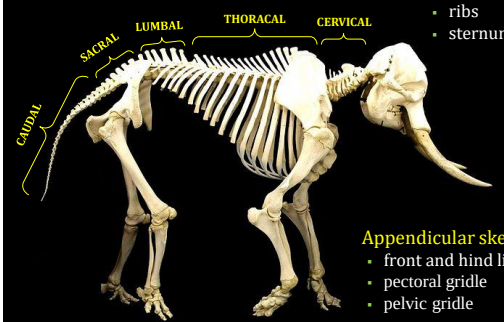






Skeleton

Axial skeleton
- skull (cranium)
- vertebrae
- ribs
- sternum

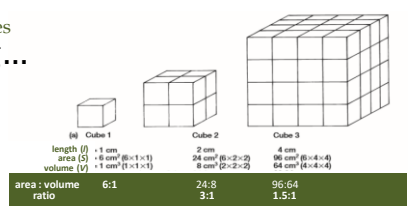


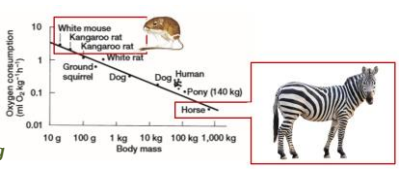
Appendicular skeleton
- front and hind limbs
- pectoral gridle
- pelvic gridle

Large Vertebrates

Going big…

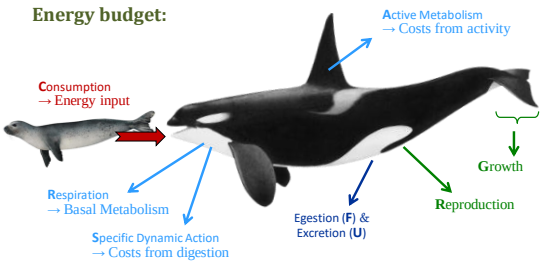
Benefits
- Outgrowing predators (→ increased survival)
- Higher energetic efficiency





Down sides of being big?

Bioenergetics & energy allocation



$$C = (R + A + S) + (F + U) + (G + R)$$

Life history theory

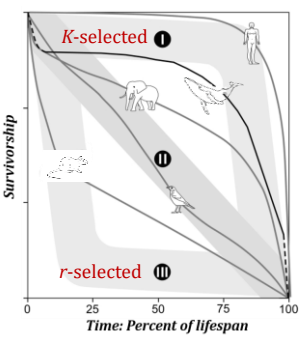
- Explains how natural selection and other evolutionary forces shape organisms to optimize their *survival* and *reproduction* through the course of ontogeny
  - defines life cycles of organisms
- Analyzes evolution of fitness components - ***life history traits***:
  - size at birth
  - somatic growth pattern
  - age and size at maturity
  - reproductive traits: number, size, and sex of offspring
  - age-, stage- or size-specific reproductive effort
  - age-, stage- or size-specific rates of survival
  - lifespan

evolutionary trade-off

- evolutionary optimization of fitness: *allocation of resources/energy*

Life history strategies

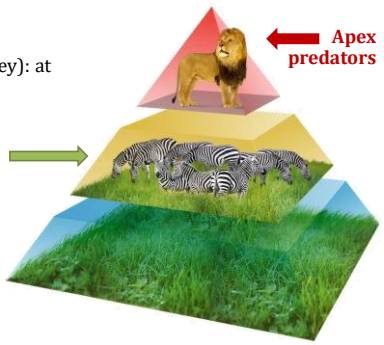
- Larger animals tend to have longer lifespans
- Requires high survival of large-size individuals
  - large juveniles/subadults
  - adults



Large Vertebrates

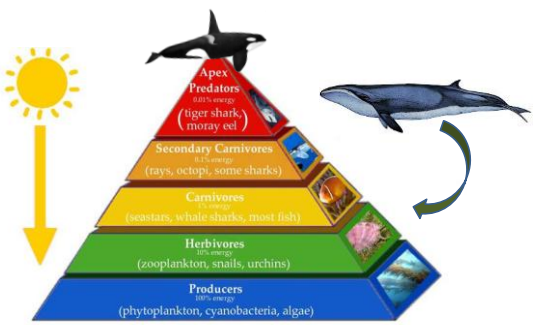
Trophic ecology

- *eating big* (big prey): at top trophic level
- *eating a lot*: (abundant food): grazing



Large Marine Vertebrates

Trophic ecology



Growing big – moving big…

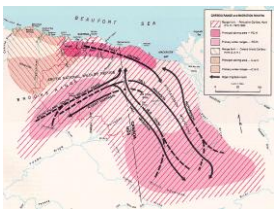
Terrestrial migrations

- 1.3 million wildebeest
  - plus antelopes and zebras
- ≈ 3.000 km each year as they follow rain around the Serengeti





Growing big – moving big…



Terrestrial migrations

- Caribou, N America: 4,800 km/yr
- record for terrestrial migration



biology letters
Marine biology
Biol. Lett. (2007) **3**, 302–305
doi:10.1098/rsbl.2007.0067
Published online 3 April 2007

Southern Hemisphere humpback whales wintering off Central America: insights from water temperature into the longest mammalian migration

Kristin Rasmussen[1,2,*], Daniel M. Palacios[3,4], John Calambokidis[5], Marco T. Saborío[1], Luciano Dalla Rosa[6,7], Eduardo R. Secchi[7], Gretchen H. Steiger[3], Judith M. Allen[8] and Gregory S. Stone[9]

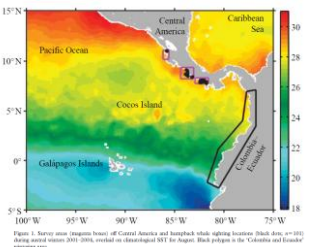


Figure 1. Survey areas (magenta boxes) off Central America and humpback whale sighting locations (black dots; *n* = 101) during austral winters 2001–2006, overlaid on climatological SST for August. Black polygon is the 'Colombia and Ecuador' wintering area.

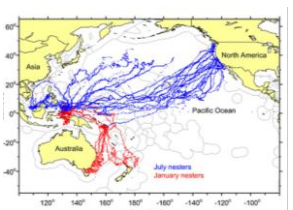
Marine migrations

Humpback whales:

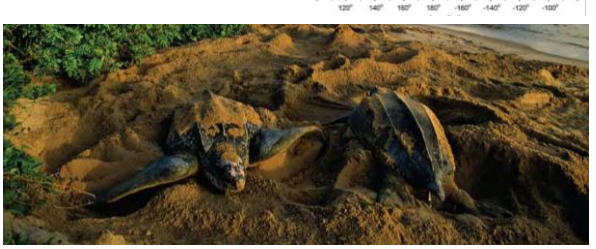
- 8.300 km btw. feeding areas off Antartica and wintering areas off Pacific Central America



Leatherback turtle



- 20.500 km from Indonesian breeding ground to feeding grounds off the Pacific coast



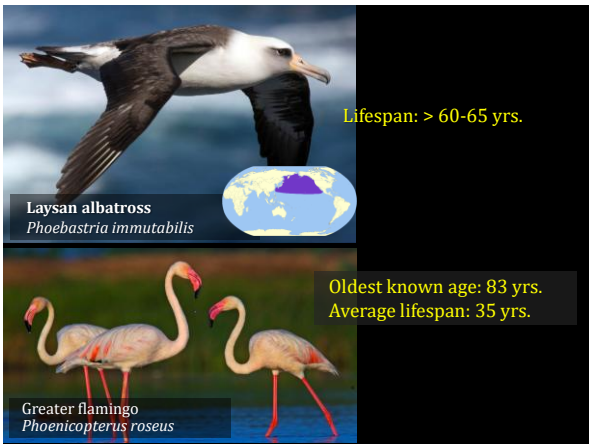
…long time to grow big…

- Larger animals tend to have longer lifespans











Large Vertebrates

Life history traits

Large body size:

- Long life span
- High survival of large-size individuals
  - large juveniles/subadults, adults
- Low reproduction
- High energy demands
  - Grazers
  - Top predators
- Large home-ranges
  - migrations…

K-selected life history

DIRECT & INDIRECT TAKE

Highly sensitive to changes in survival

HABITAT DESTUCTION, DEGRADATION and FRAGMENTATION