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# Fossil record biases

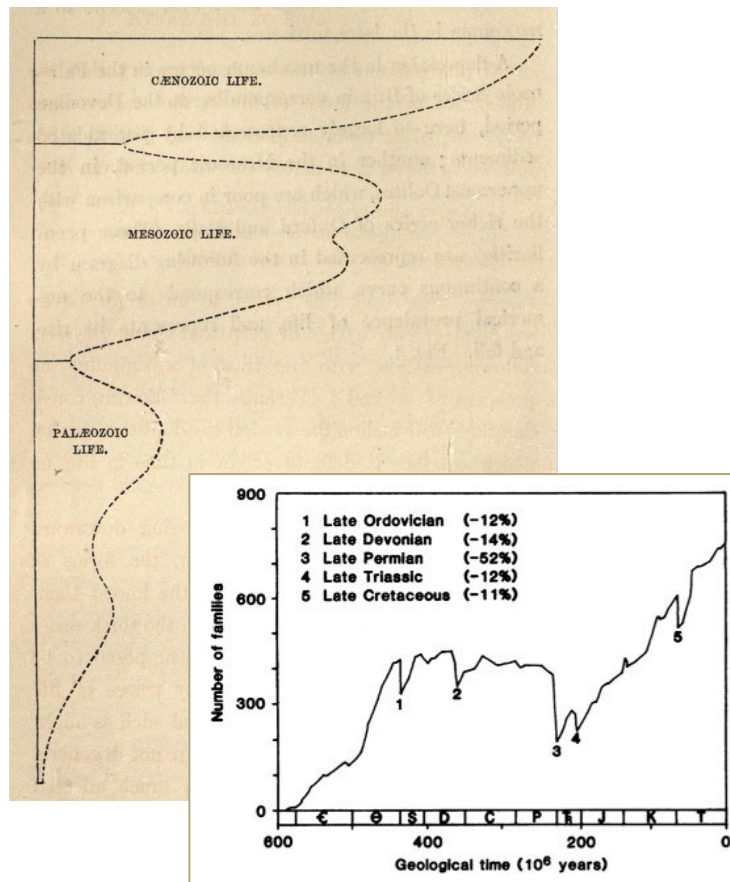
— Emma Dunne | APW 2023 | Thurs. Aug. 24th —

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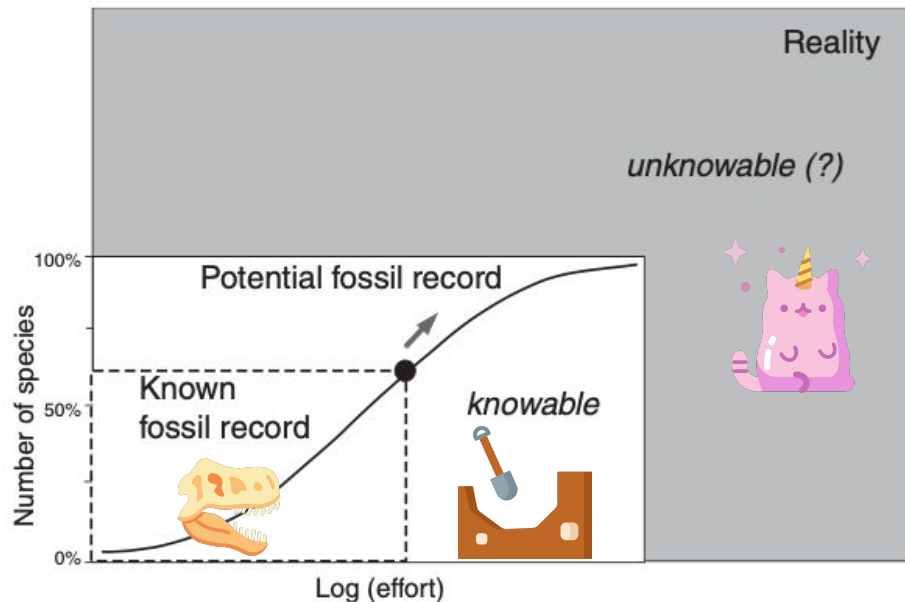
# Early paleodiversity studies

- Early palaeodiversity studies took the fossil record at **face-value**
  - Counts of taxa in bins
- But sampling of the fossil record is **uneven and incomplete**
  - Even Darwin noted this
- It wasn't until the last half century that we started to appreciate the impacts of fossil record biases...



# How much of the fossil record do we even know?

- The known fossil record is barely a **fraction** of what actually exists
- Even the potential fossil record contains only a tiny fraction of life that has ever lived!



# Fossil record biases

Habitat & mode of life



Depositional environment



Geological activity



Geographical location



Interest & resources

Occurrence data

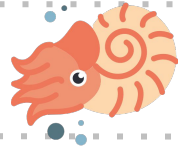
Various processes act to **remove** information from the fossil record, which creates **biases** and skews our understanding of past biodiversity



Estimates of deep-time biodiversity

# Fossil record biases

Habitat & mode of life



Depositional environment



Geological activity

Geographical location



Interest & resources

Occurrence data



PROCESSES

CATEGORY

Death & burial

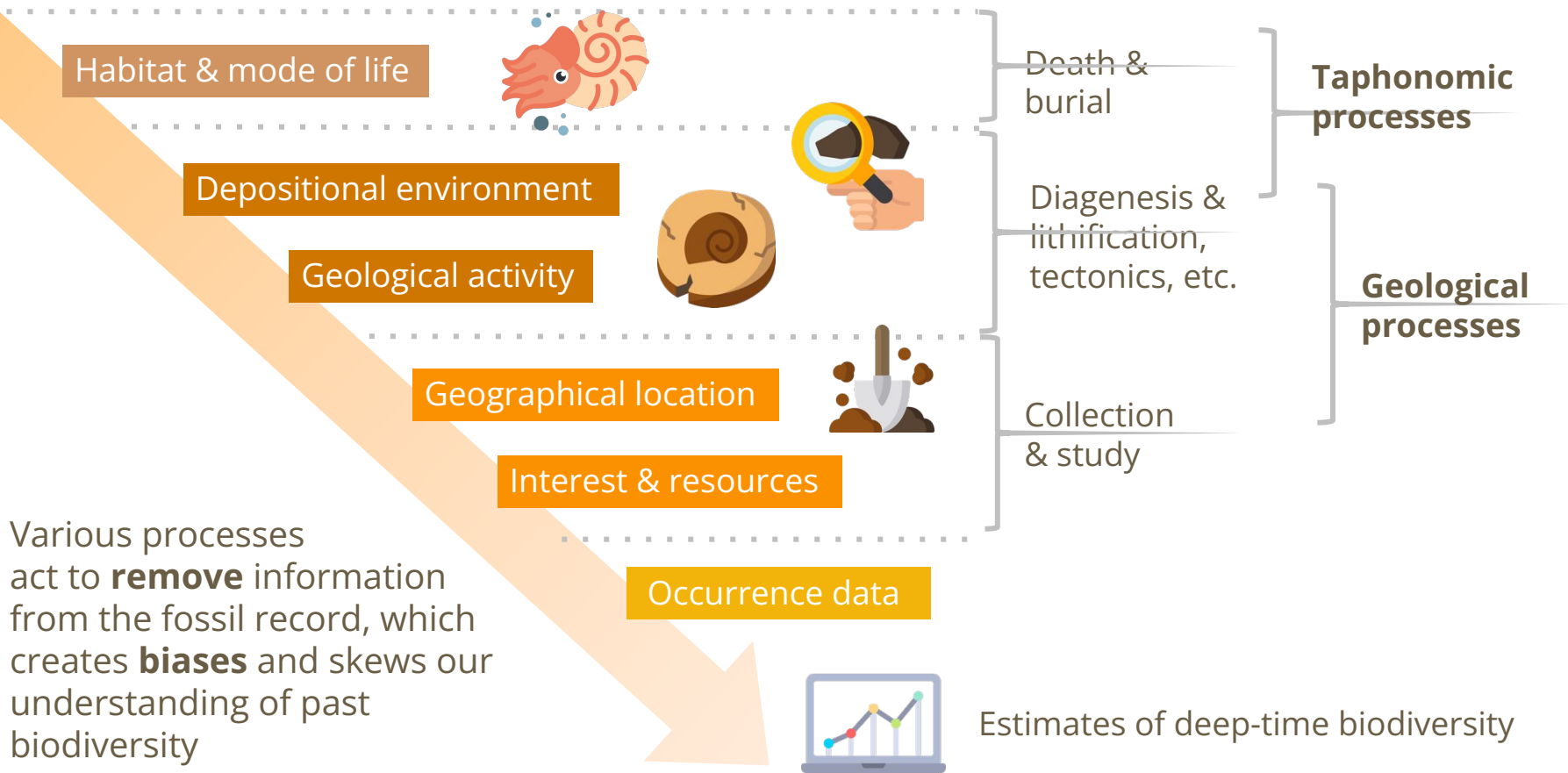
Diagenesis & lithification, tectonics, etc.

Taphonomic processes

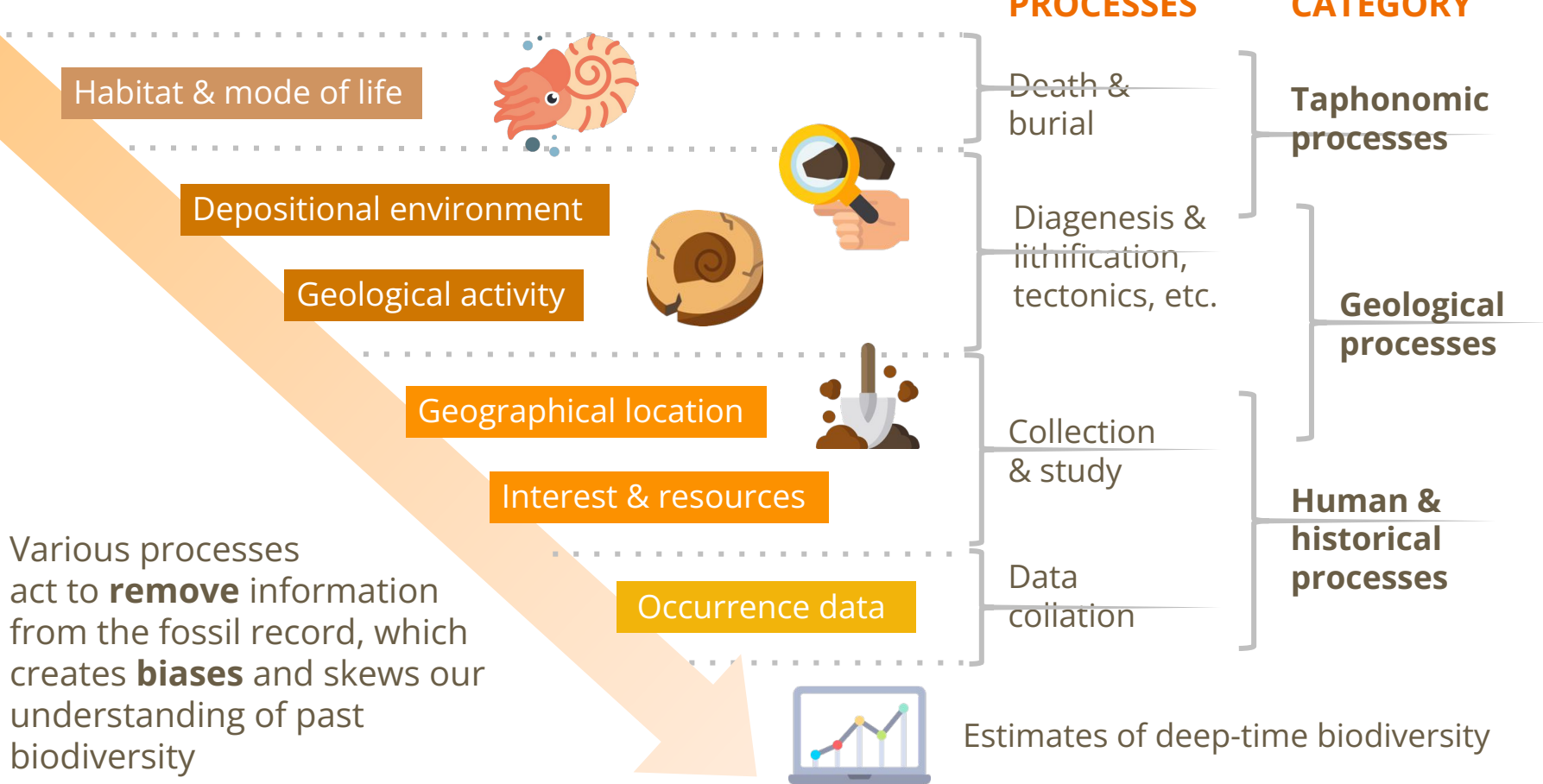
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Estimates of deep-time biodiversity

# Fossil record biases

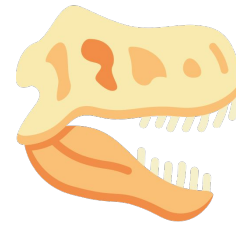


# Fossil record biases



# Raup's "7 Sources of Error"

1. Range charts
2. The 'Pull of the Recent'
3. Durations of geological units
4. Monographic effects
5. Lagerstätten
6. Area-diversity relationships
7. Sediment volume



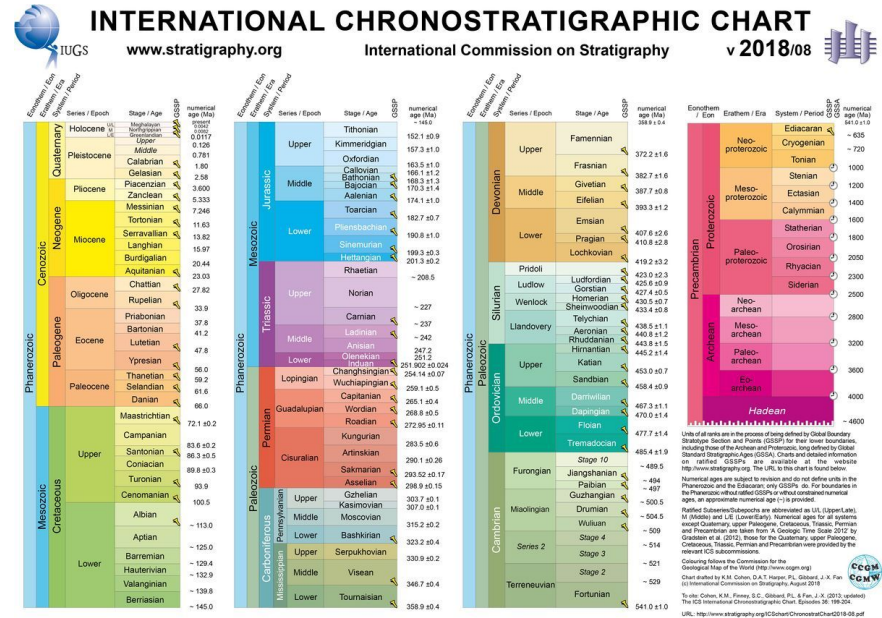
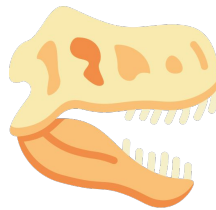


# Temporal resolution in the fossil record

Geological time intervals are not equal in length

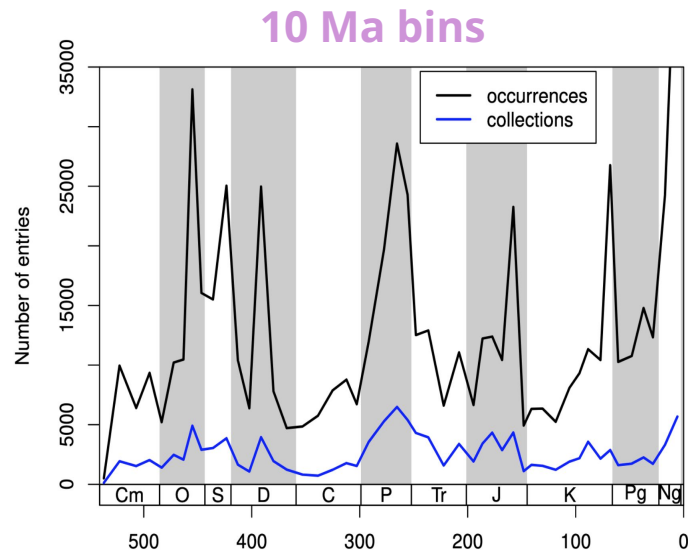
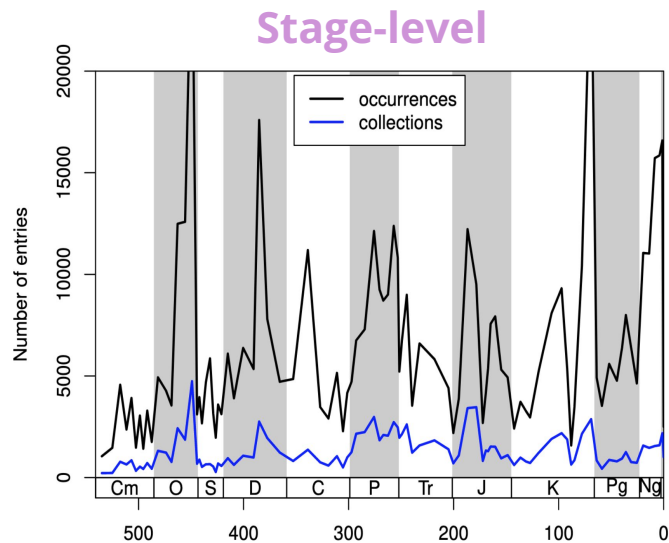
**Example:** Late Triassic epochs:

- Rhaetian ~8 Ma
- Norian ~20 Ma
- Carnian ~10 Ma



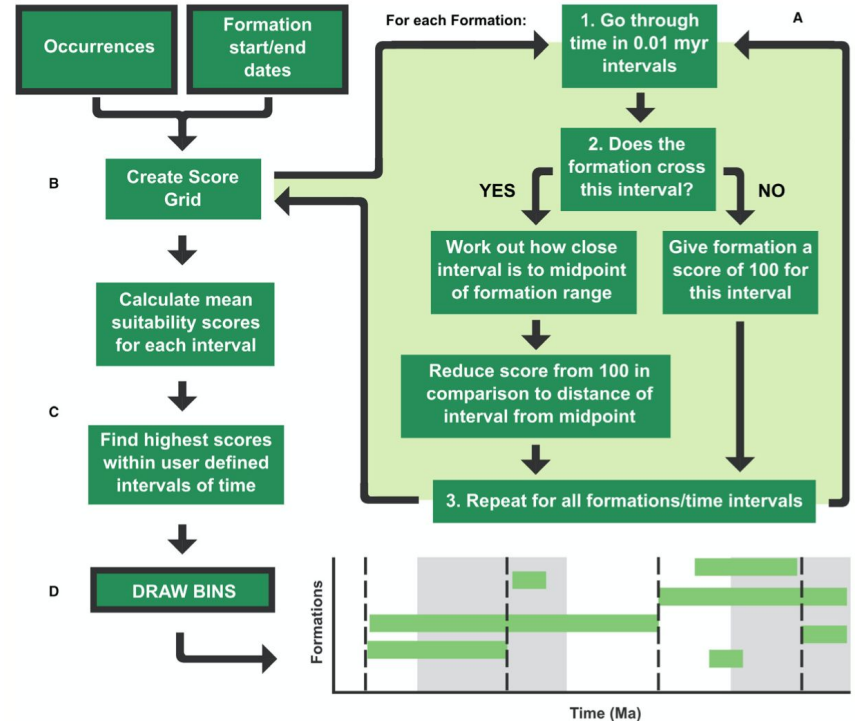
# Temporal resolution in the fossil record

Many studies focus on **stage-level** or **equal-interval** bins

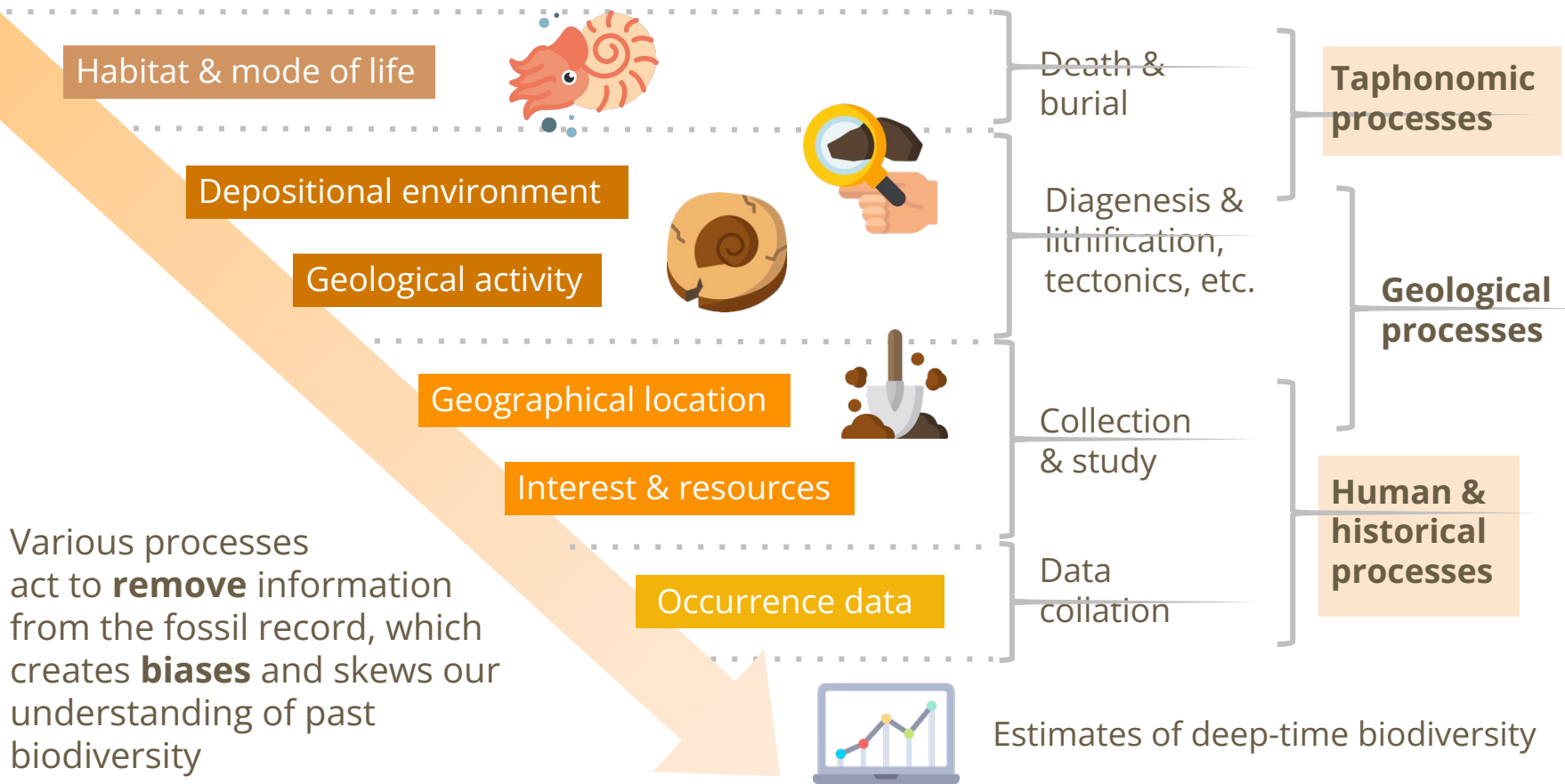


# Temporal resolution in the fossil record

- Focusing on stage-level or equal-interval bins isn't very suitable for regional studies
- Different statistical methods have been developed to bin data based on regional stratigraphy e.g. **forming-binning** ([Dean et al. 2020](#))

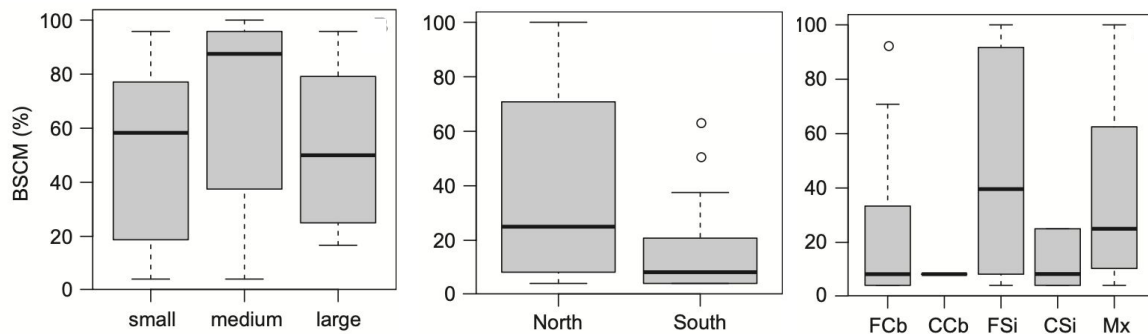
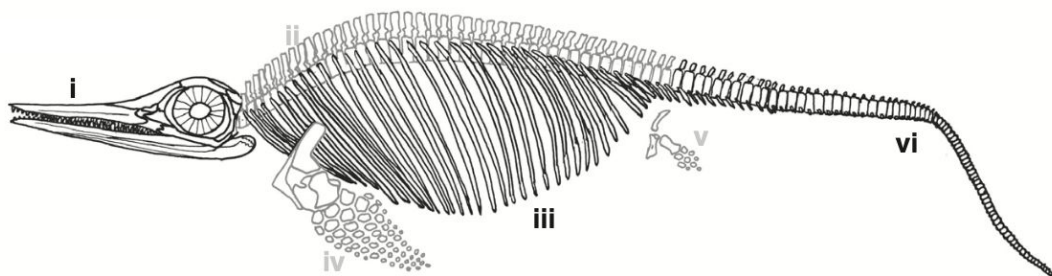


# Fossil record biases



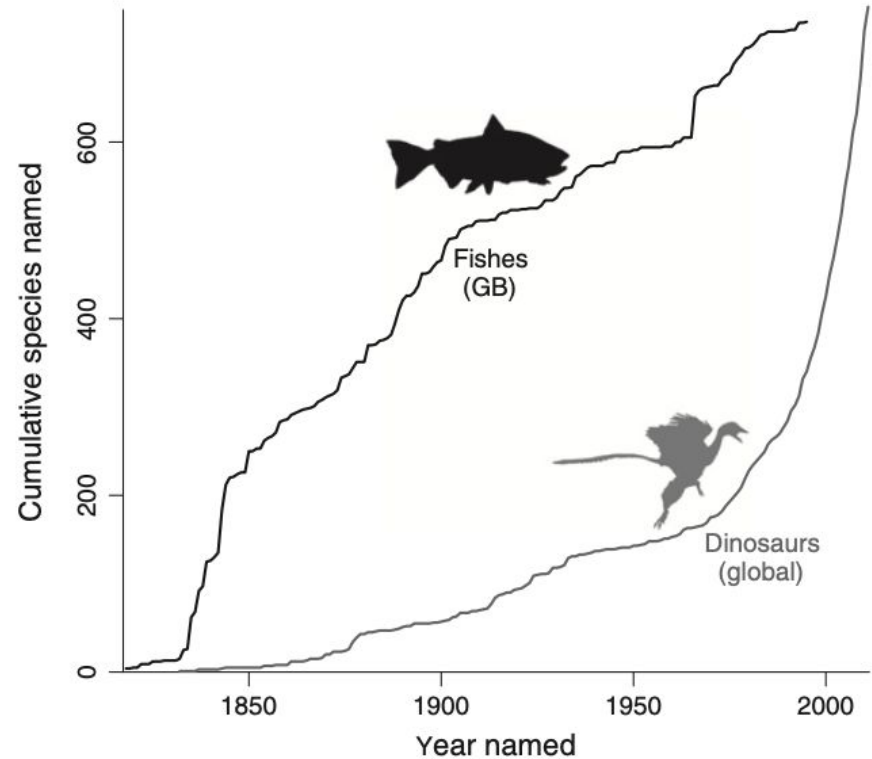
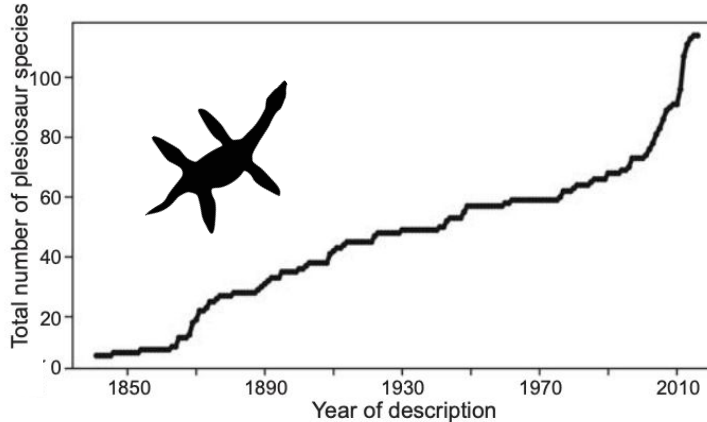
# Taphonomy & completeness

- Incomplete or damaged specimens are hard to identify
- Diversity can be **underestimated**
- Completeness varies by size, region, and lithology



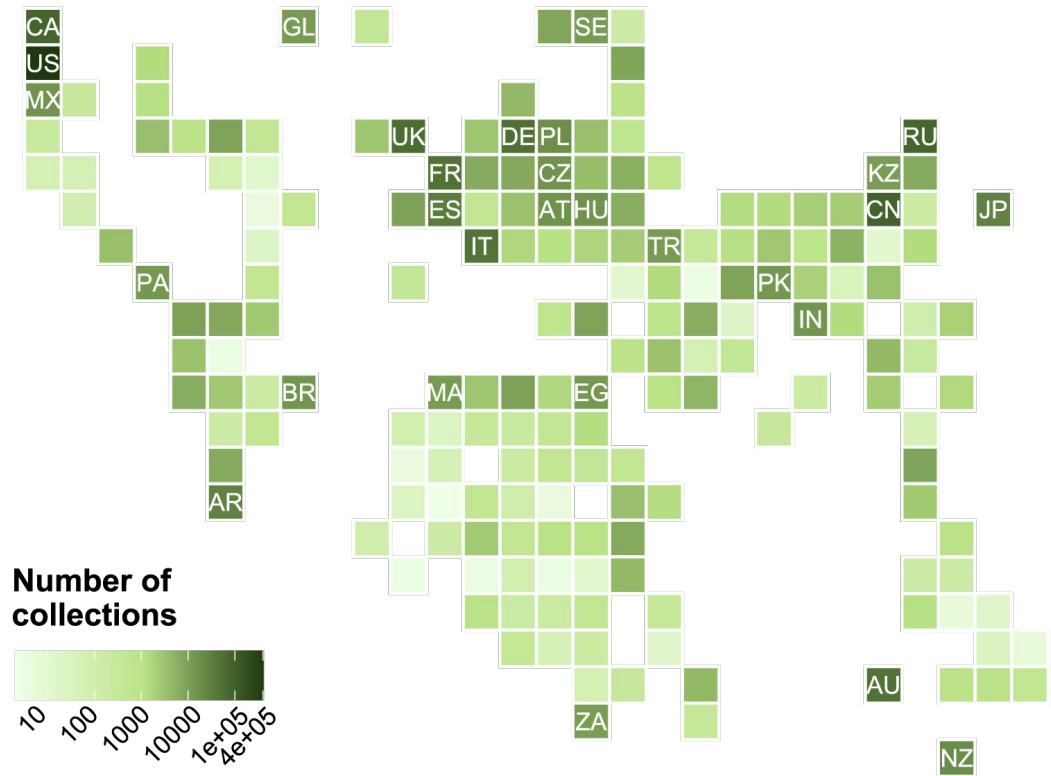
# Research interest

- More research activity (over long periods of time) contributes to better sampling



# Socio-economics

- 97% of fossil occurrence data in the PBDB were generated by researchers in North America and western Europe
- Countries with a history of colonialism have a greater paleo research output
- Sampling is biased by where the resources are



# Socio-economics

- English is the dominant language in palaeodiversity studies
- Knowledge in other languages is overlooked – this has been shown to bias outcomes of meta- analyses ([Konno et al. 2020](#))
- Impedes the accessibility and communication of science
  - e.g. Literature for fossil occurrences

