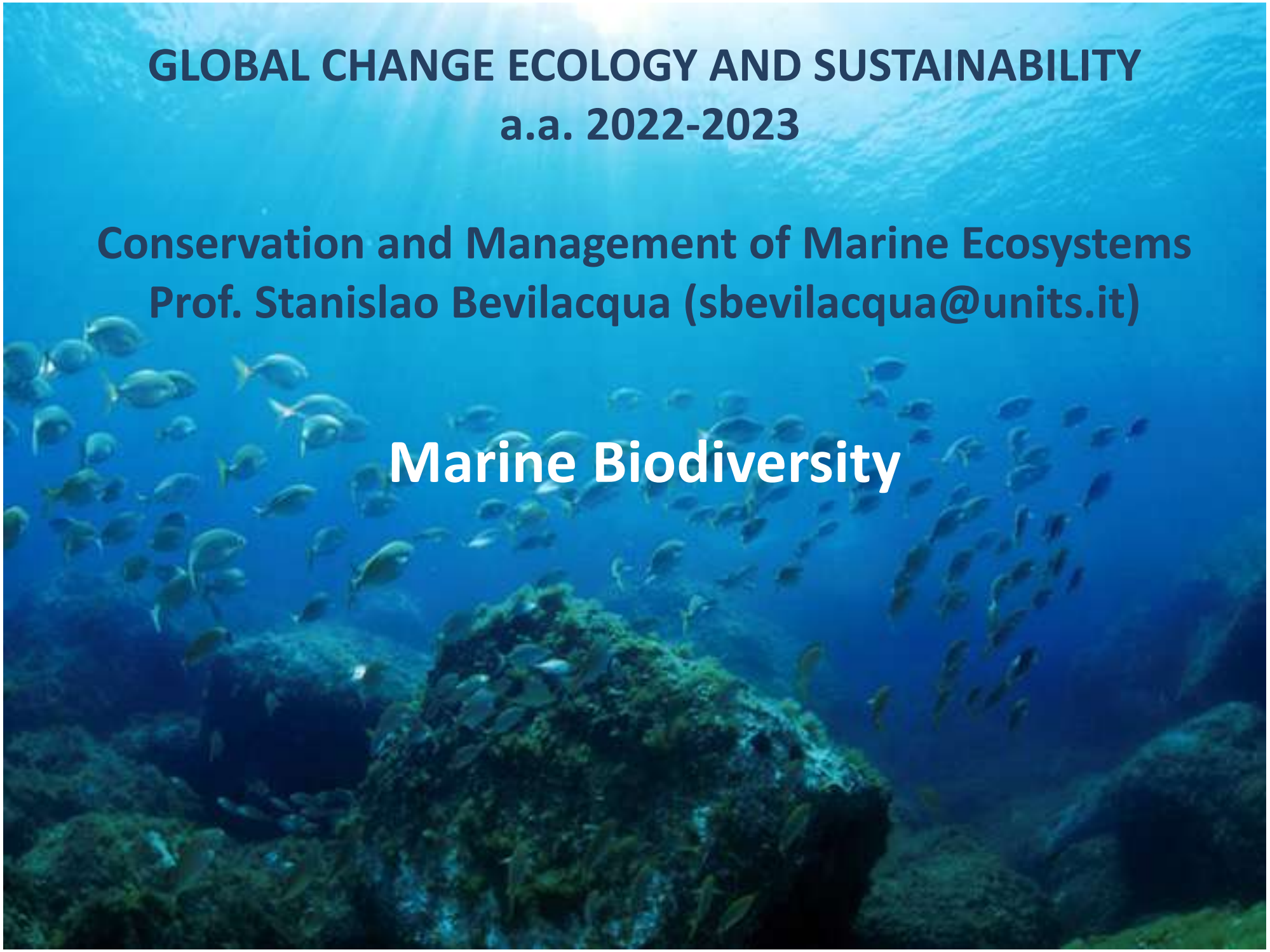
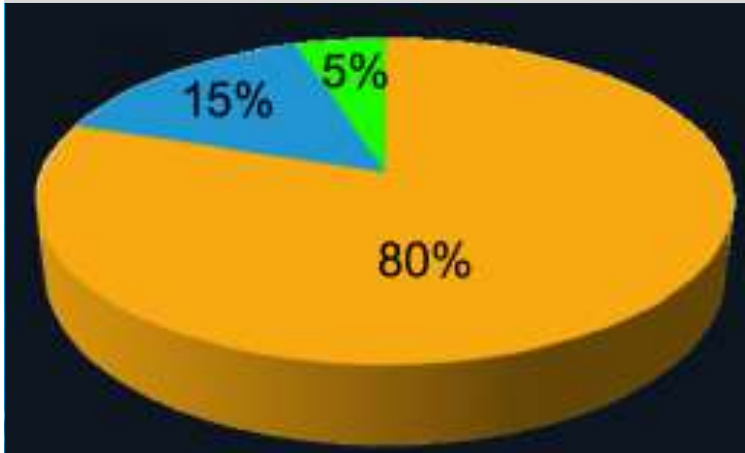


GLOBAL CHANGE ECOLOGY AND SUSTAINABILITY
a.a. 2022-2023

Conservation and Management of Marine Ecosystems
Prof. Stanislao Bevilacqua (sbevilacqua@units.it)

Marine Biodiversity

Marine biodiversity



~34 animal phyla, 80% is marine or mostly marine

~almost all of them are benthic or have benthic taxa

(…and don't forget most of algae)

~1,500,000 known species on Earth

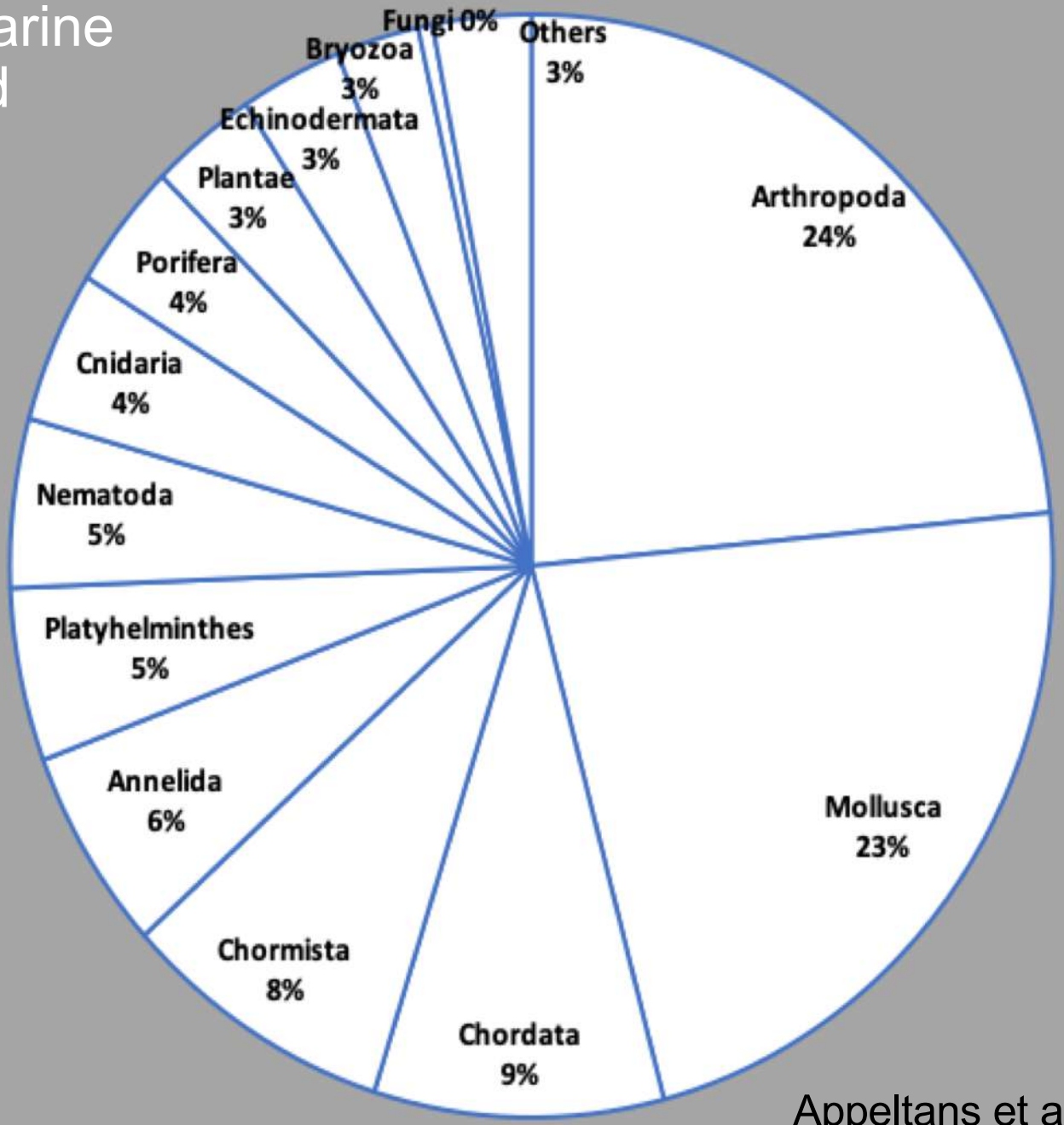
~300,000 are marine, ~85% of them are benthic

How many species

About 240,000 marine species described

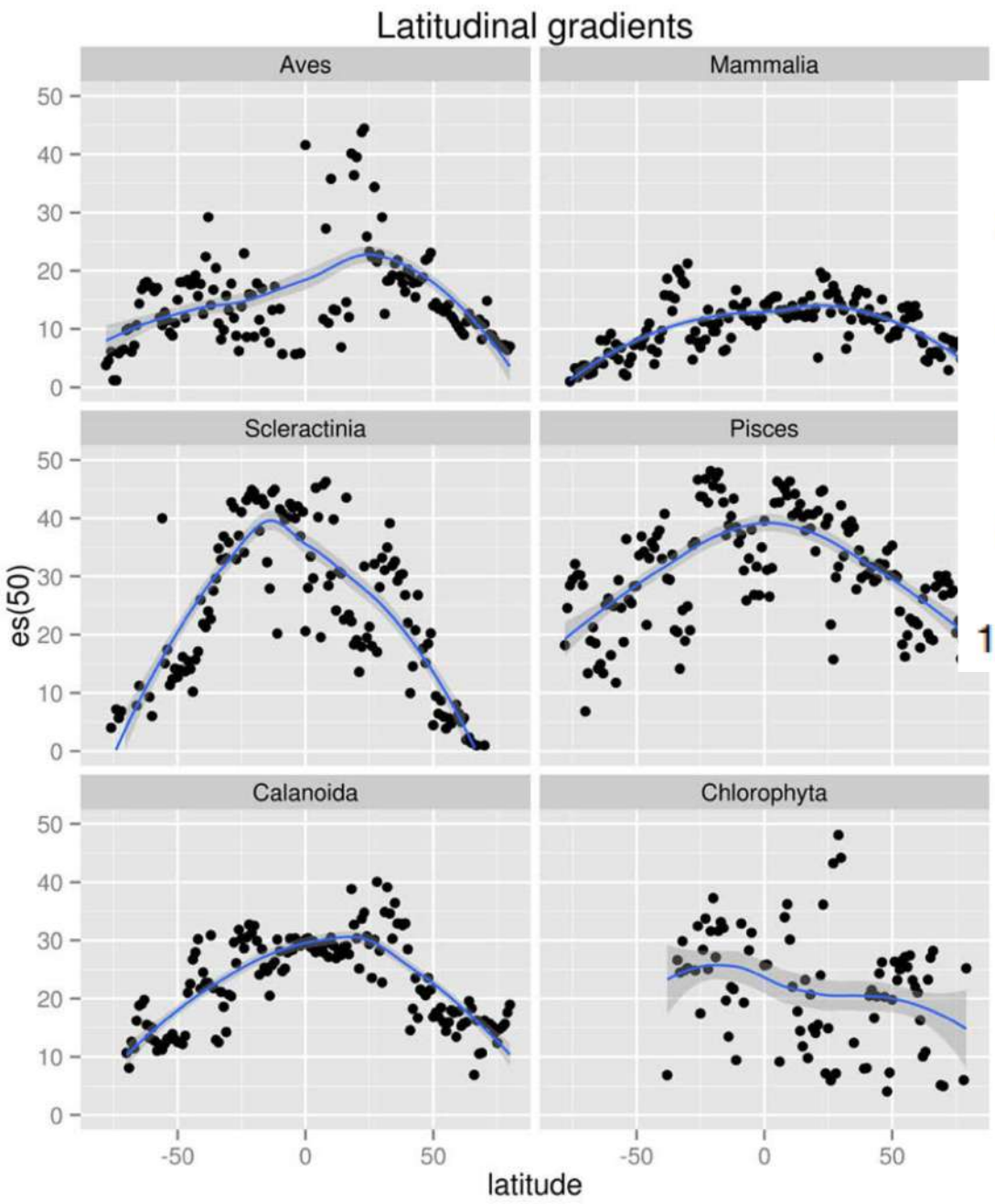
58,000-72,000 marine species sampled but still not described

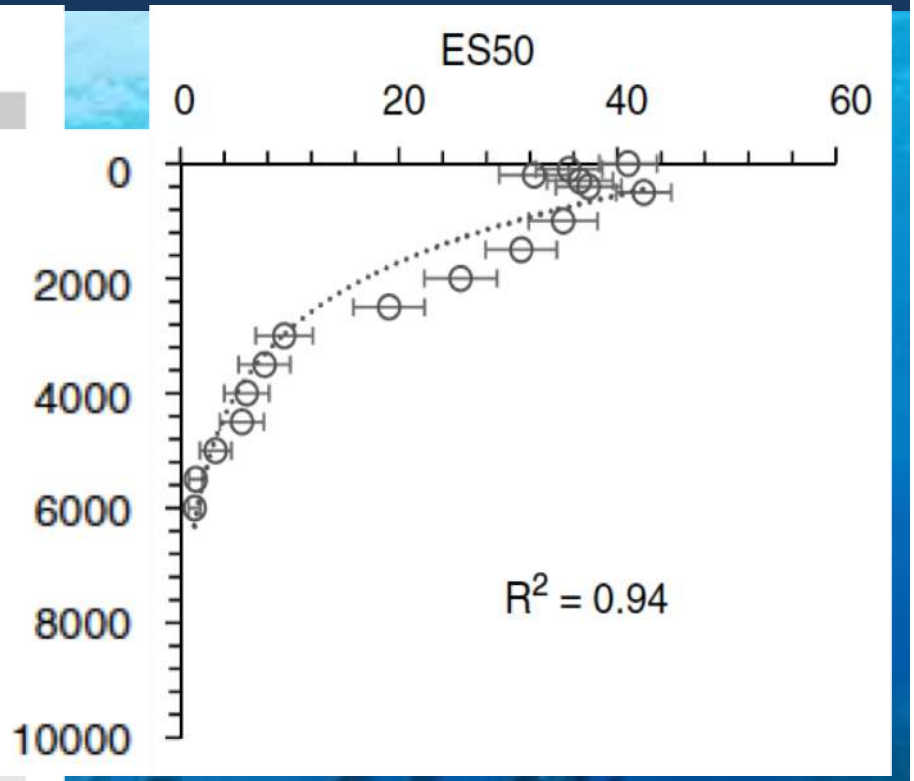
There could be 0.7-1.0 million marine species



Appeltans et al. 2012

Patterns





Marine biodiversity peaks at tropical latitude (Snelgrove et al. 2016) and at shallower depths (Costello & Chaudhary 2017)

Factors affecting biodiversity

- Geographic factors (latitude, depth)
- Productivity, climatic factors, history
- Predation, competition
- Disturbance, isolation, heterogeneity

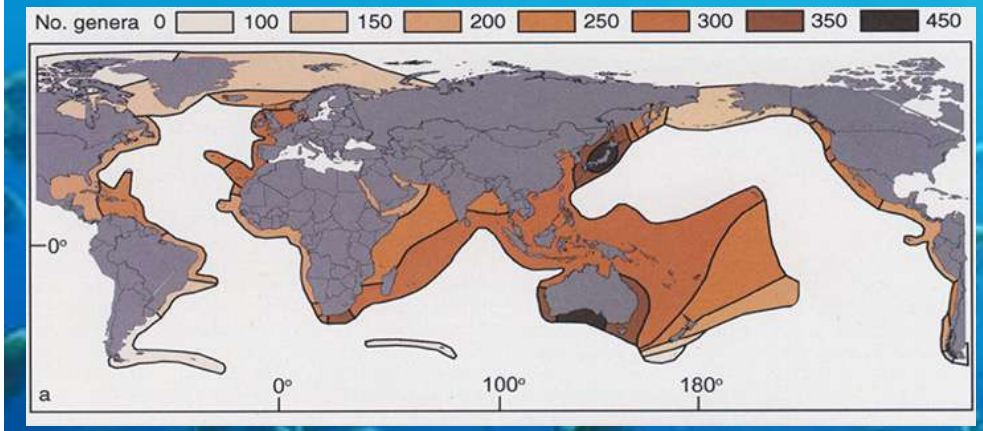
The intermediate disturbance hypothesis (Connell 1978). Small-infrequent or large-frequent disturbance could reduce diversity, which is maximum at intermedite levels of disturbance

Stability-Time Hypothesis (Sanders 1968). This model says that physical instability in an environment prevents the establishment of diverse communities. However, if physically stable conditions persist for a long period of time, speciation and immigration will cause species diversity to increase gradually.

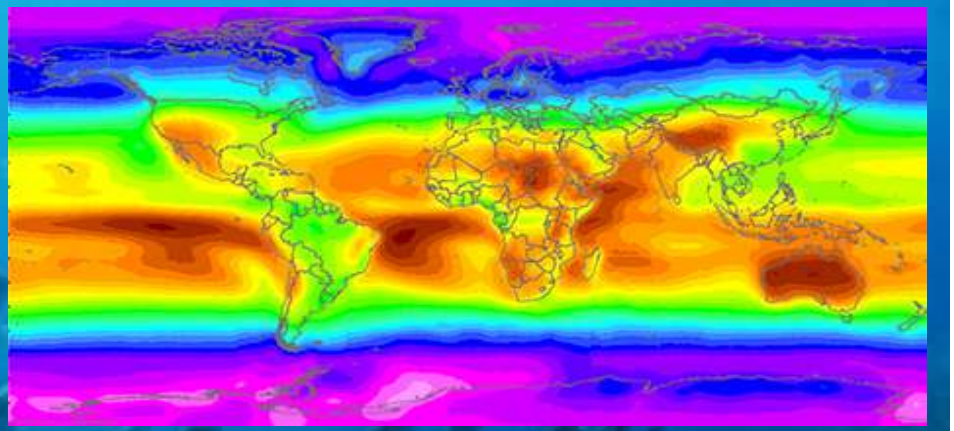
Distribution, factors and processes

Sea temperature and solar radiation influence the distribution of benthic organisms, especially algae and corals and the associated fauna. Shifts in distribution (climate change), mass mortalities, bleaching

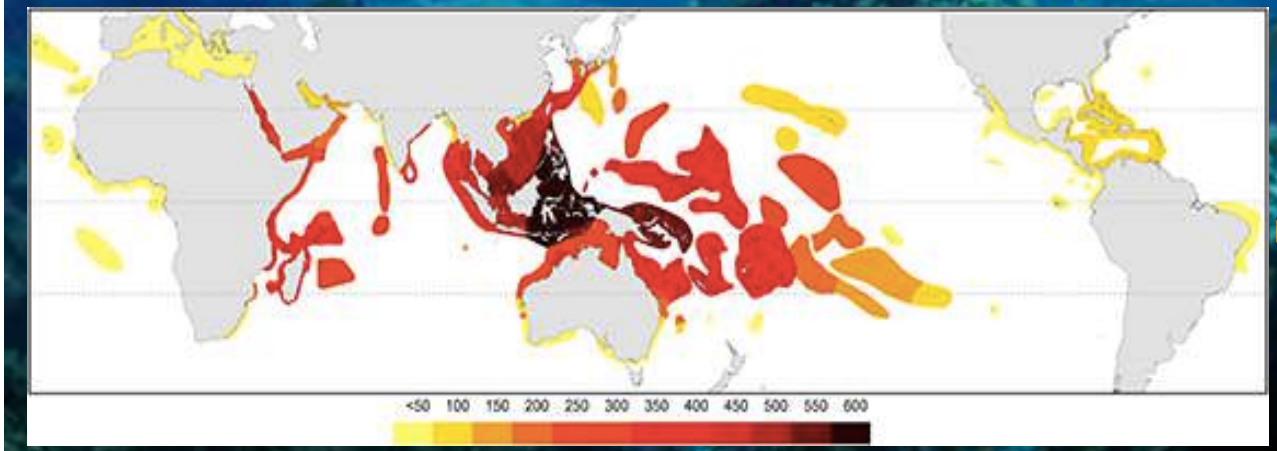
Global distribution of macroalgal genera



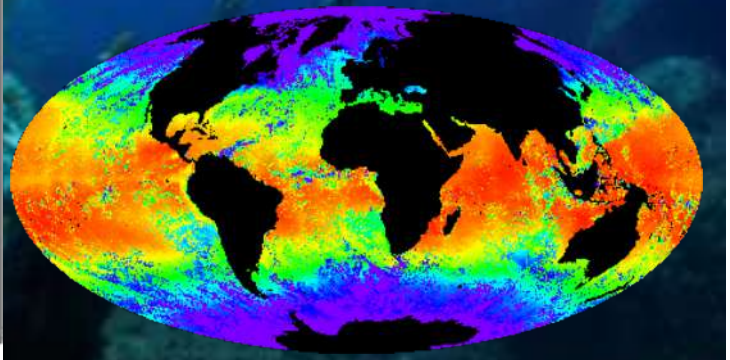
Solar radiation



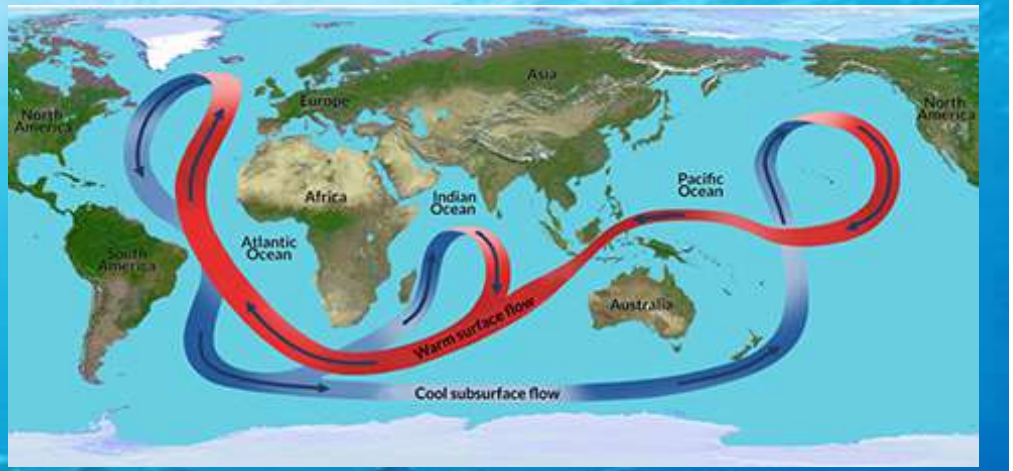
Global distribution of coral species



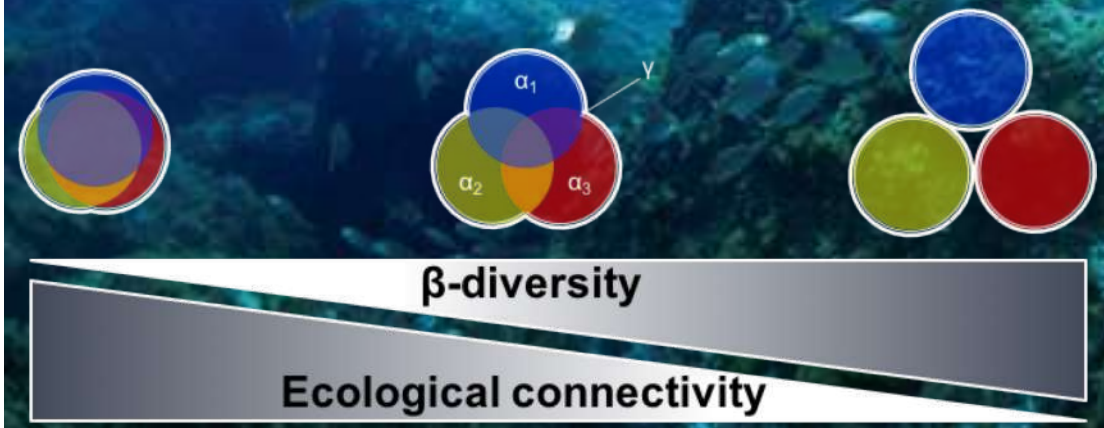
Surface temperature



Distribution, factors and processes

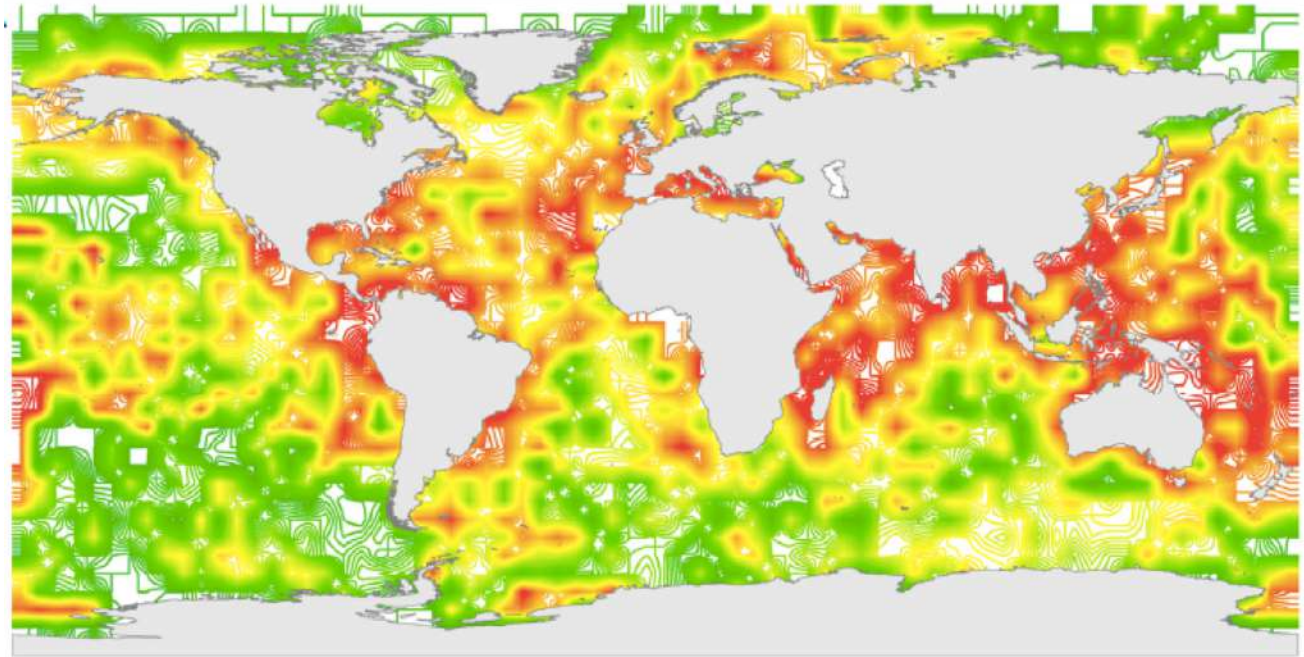


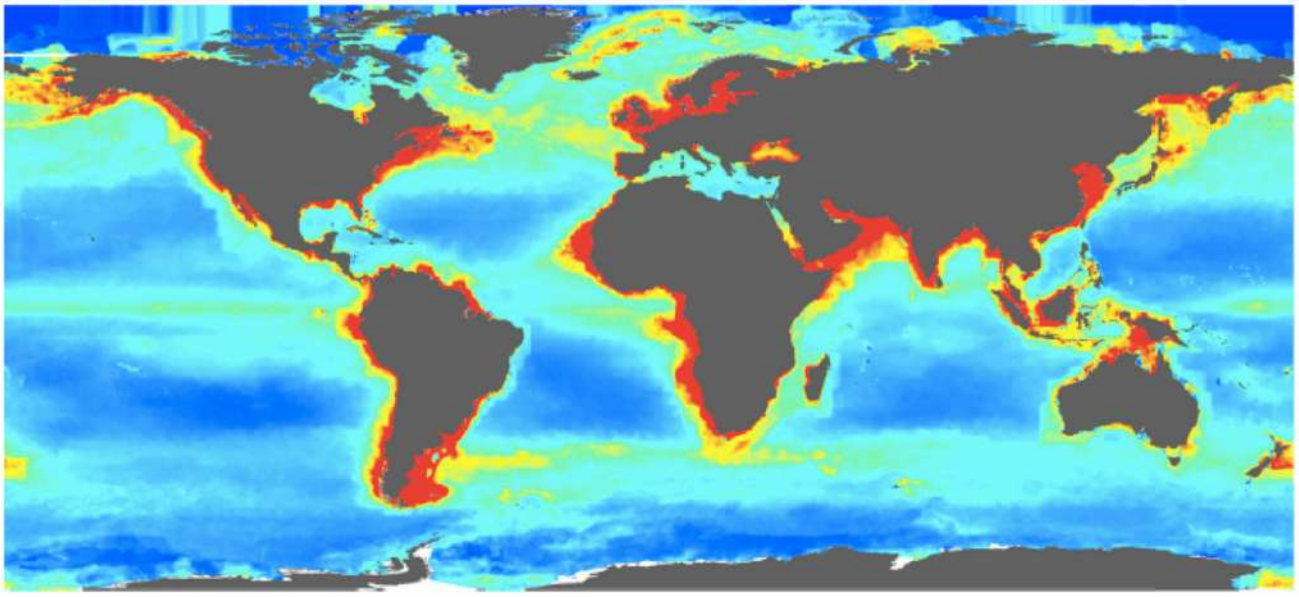
Currents play a crucial role in shaping the distribution of benthic species, which in most cases are sessile or sedentary and rely on water movements for their dispersal. Climatic factors, substrate availability, geographic barriers, pre- and post-settlements events drive community assembly generating differences in species distribution and community composition (beta-diversity).



Patterns of variation in β-diversity provide information on the structure (nodes and pathways) of units of ecological connectivity, and for conservation and resilience of marine ecosystems

Productivity

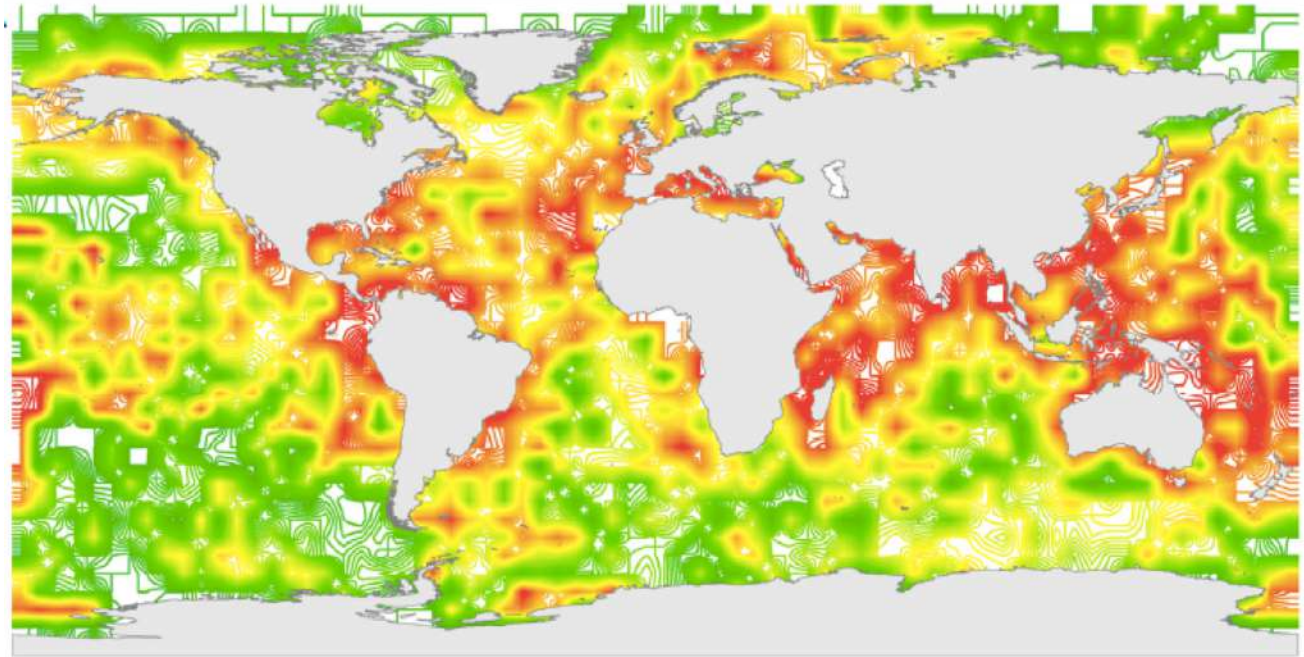


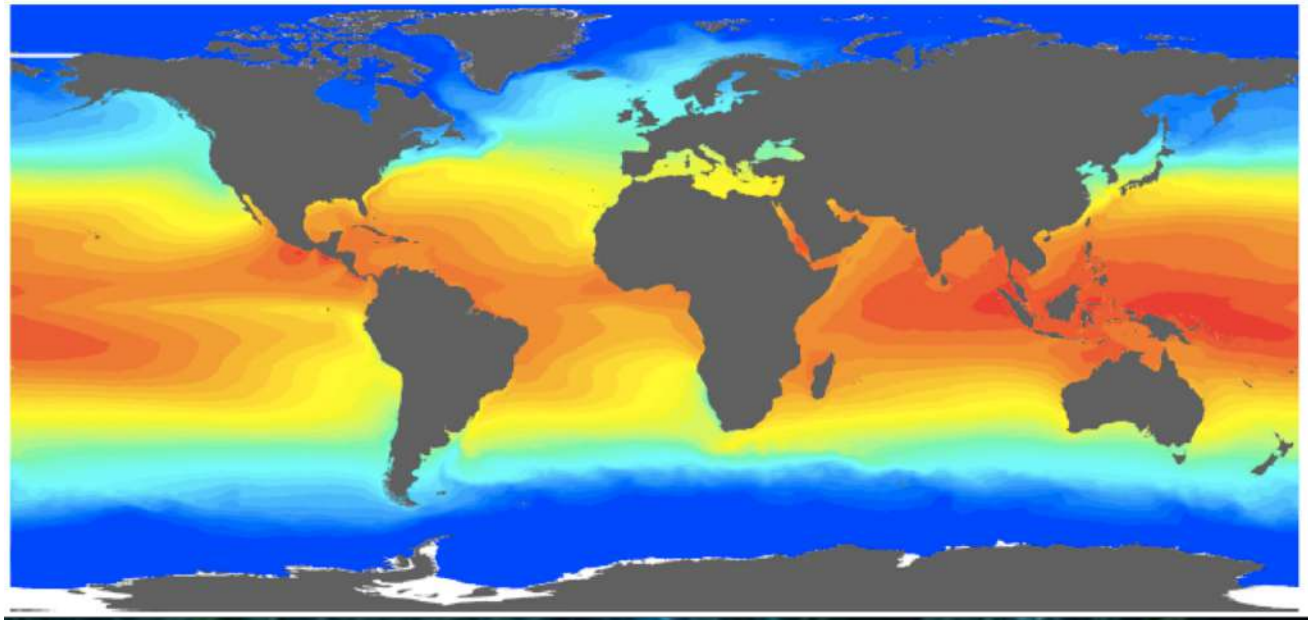


Productivity and high energy flow could sustain higher number of species with respect to less productive areas

(maps from Costello & Chaudhary 2017)

Temperature



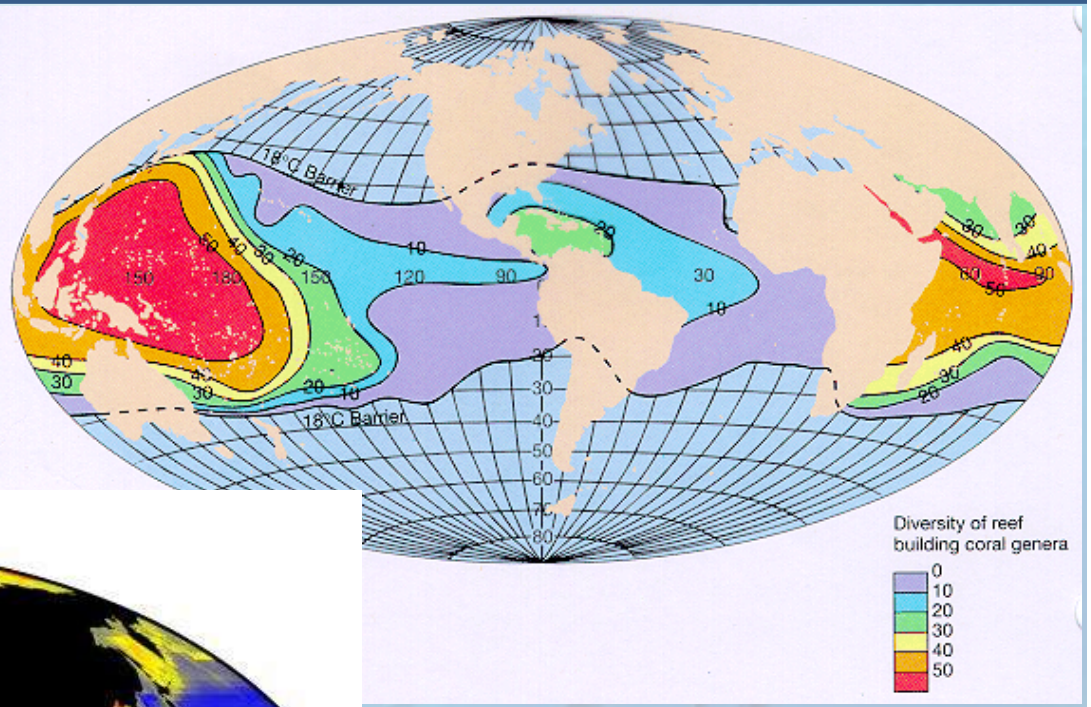


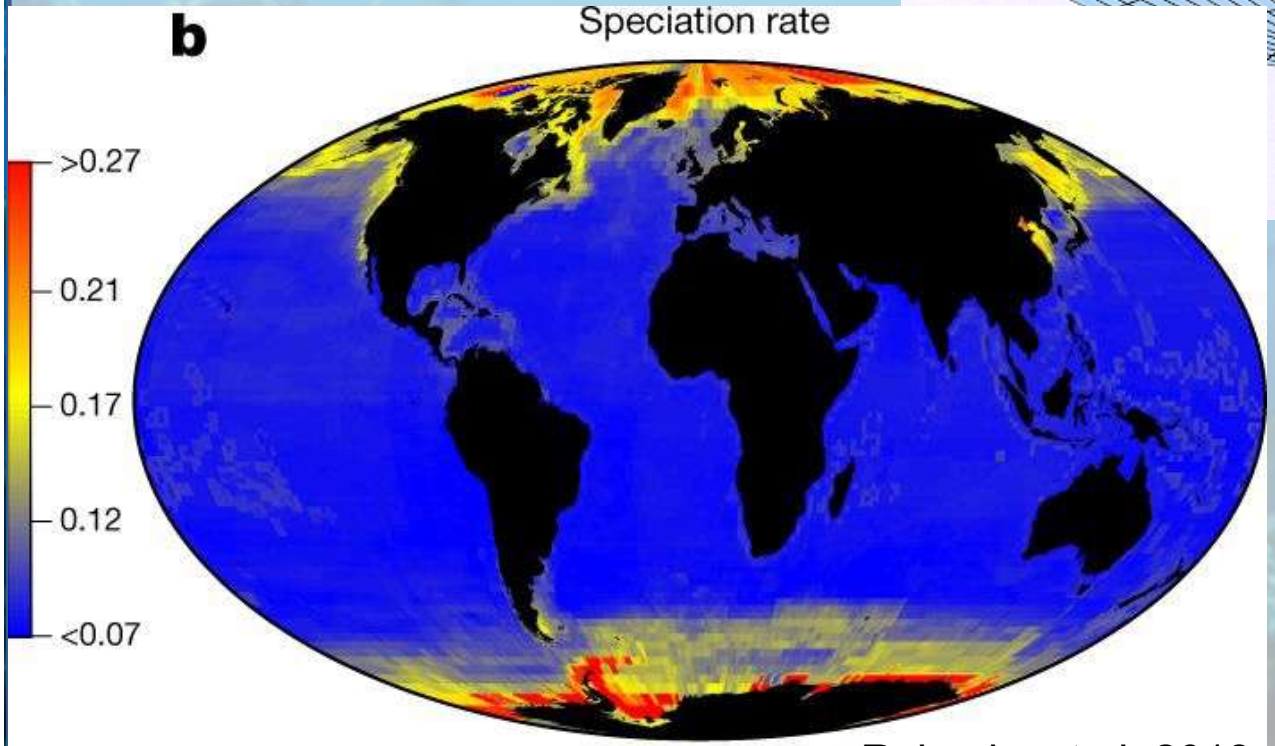
(maps from Costello & Chaudhary 2017)

Rates of genetic divergence and speciation are both governed by metabolic rate and therefore show the same exponential temperature dependence. So, higher temperature increases speciation rates (Allen et al. 2006)

Stability

A interoceanic gradient exists in benthic fauna: the Pacific Ocean (older) has much more species than the Atlantic Ocean.

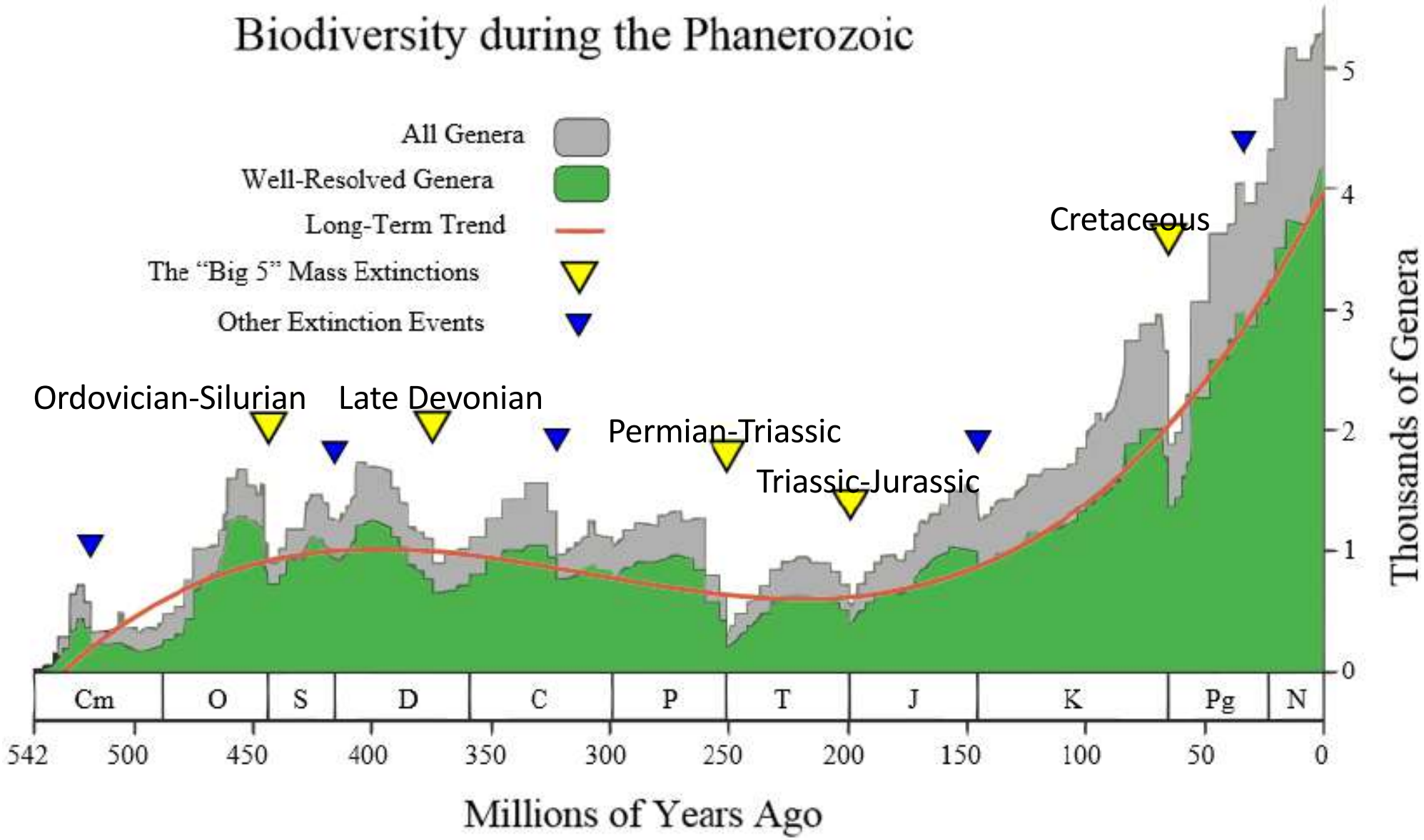




Rabosky et al. 2018

However, recent studies highlithed that speciation rates can be higher at higher latitudes

Biodiversity in the last eon



5 big mass extinctions. Biodiversity is increasing