A biodiversidade no tempo profundo

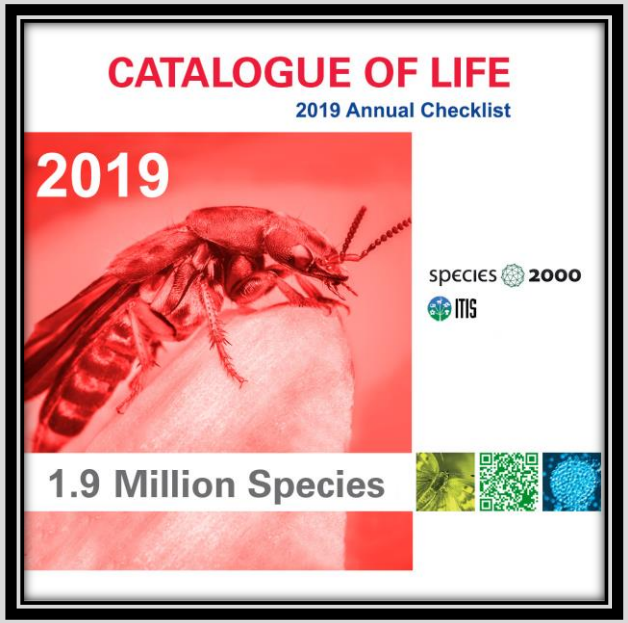
(ou como a Paleontologia nos ajuda a entender o mundo que nos cerca)

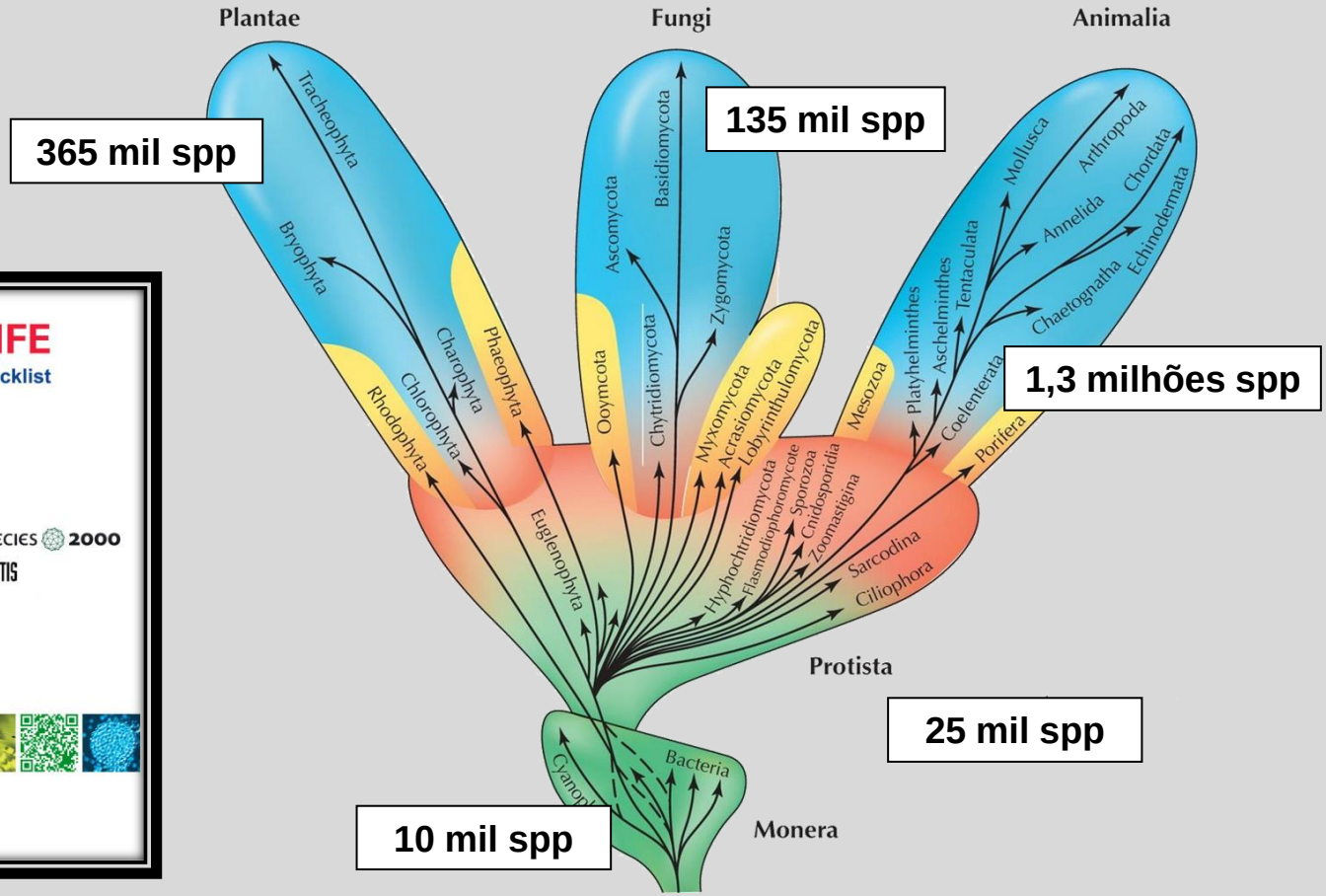
Laboratório de Paleontologia
FFCLRP-USP

Max C. Langer

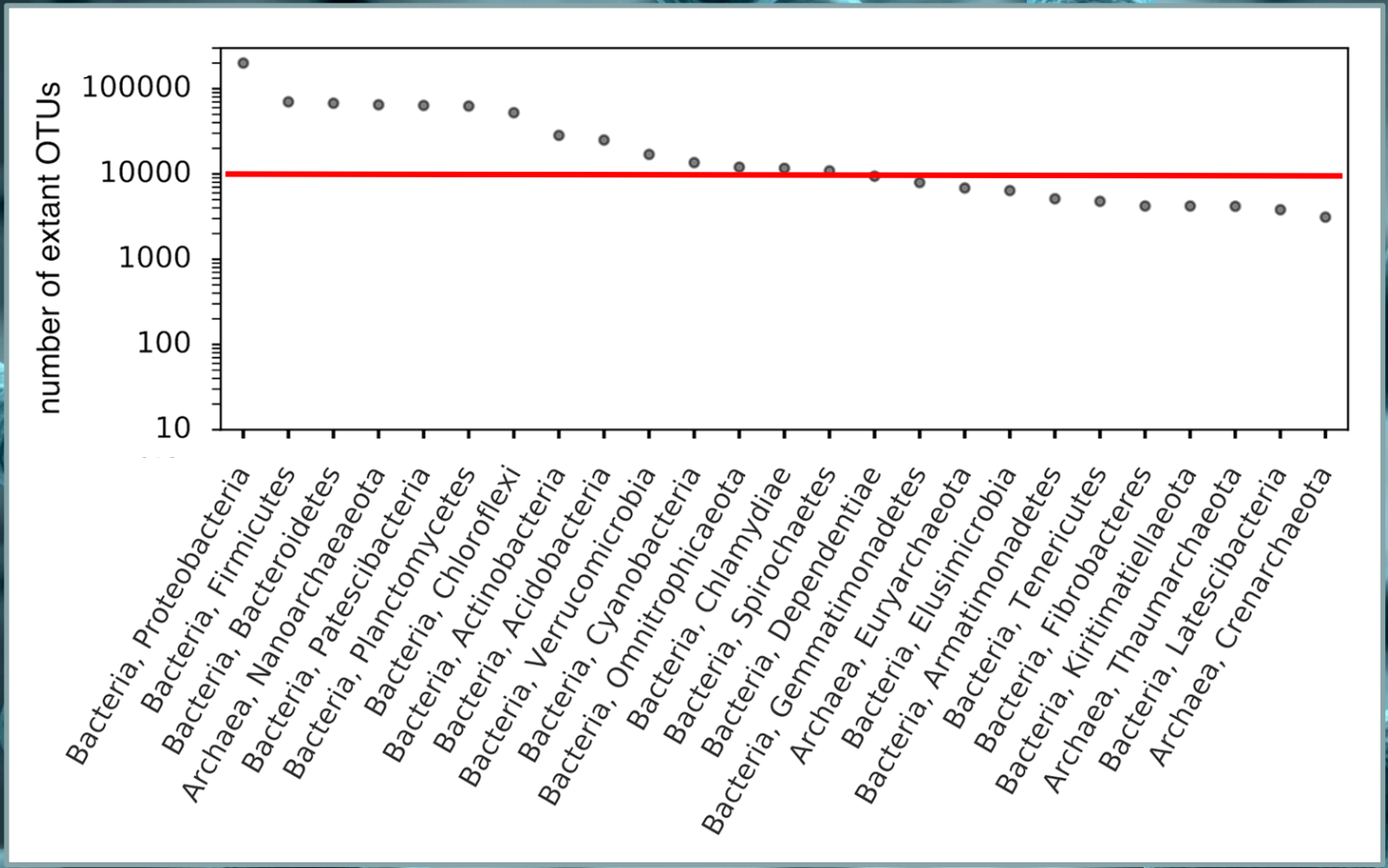
Catalogue of Life

Checklist 2021 > 2 milhões spp





Preâmbulo



"we estimate that there exist globally about 0.8–1.6 million prokaryotic OTUs"

Louca et al. 2019

Diversidade atual (2 Ma) *vs* pretérita (500 Ma)

250 x 2 milhões = 500 milhões

469 mil

c. 500 mil / 250 = 2.000 spp

Preâmbulo

Hexapoda:

900 mil *vs* 7 mil

Brachiopoda:

300 *vs* 12 mil

Por que o eixo temporal é importante no estudo da biodiversidade?

1 – Entender que a **discrepância** atual não é limite morfológico absoluto

2 – Comparar a diversidade biológica atual com aquela de épocas passadas (e estas entre si), ajudando a entender aspectos do processo **evolutivo**

3 – Investigar os eventos de **extinção** como parâmetros para estudos das relações da biota com o meio físico

4 – Desmistificar conceitos fixistas que permeiam o discurso **ambientalista**

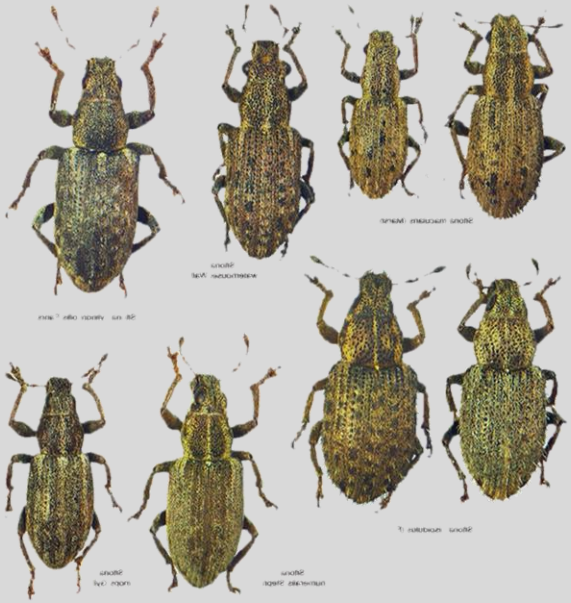
↘ ↘ ↘

entender o mundo que nos cerca

Discrepância pretérita

1 – Entender que a **discrepância** atual não é limite morfológico absoluto

Membracidae

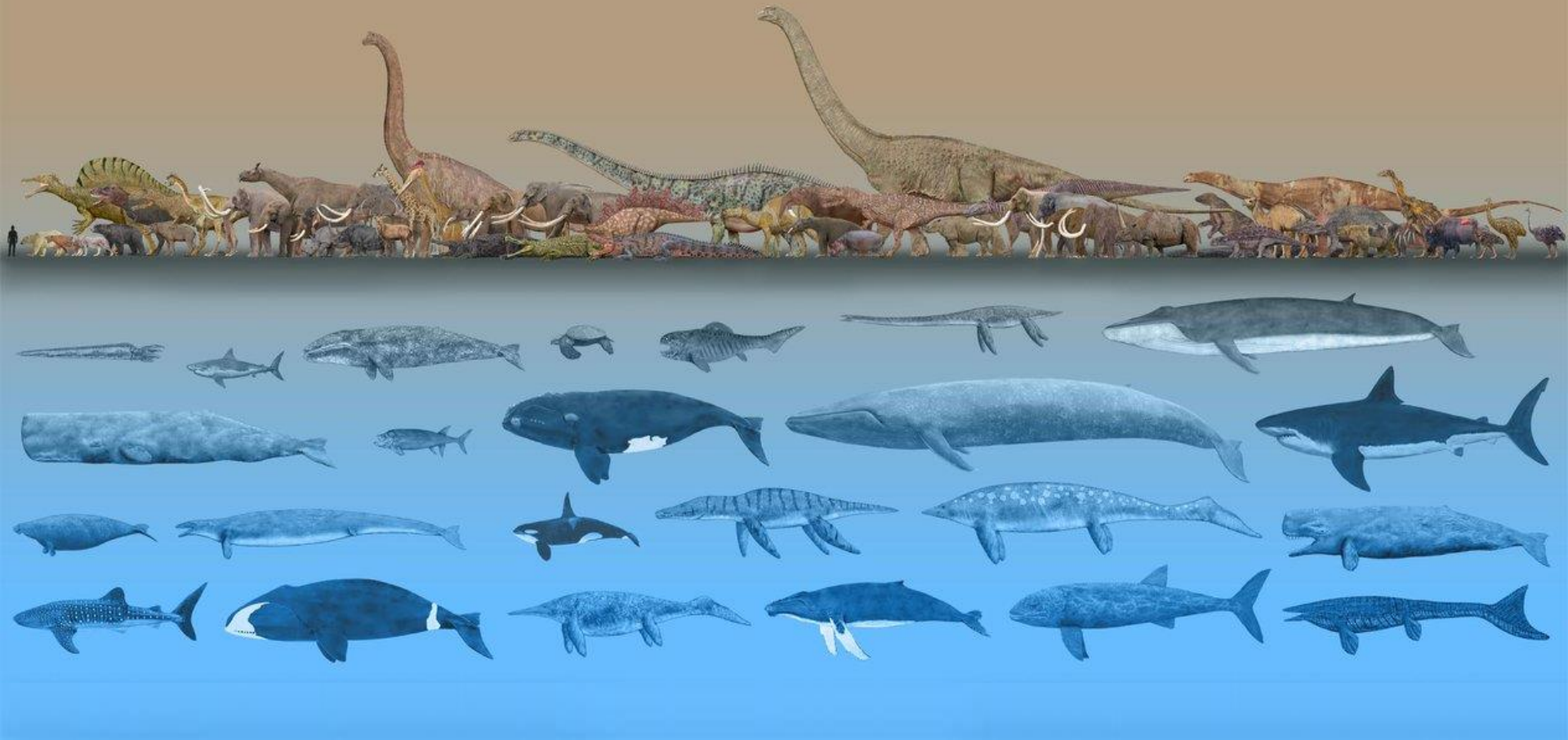


Curculionidae

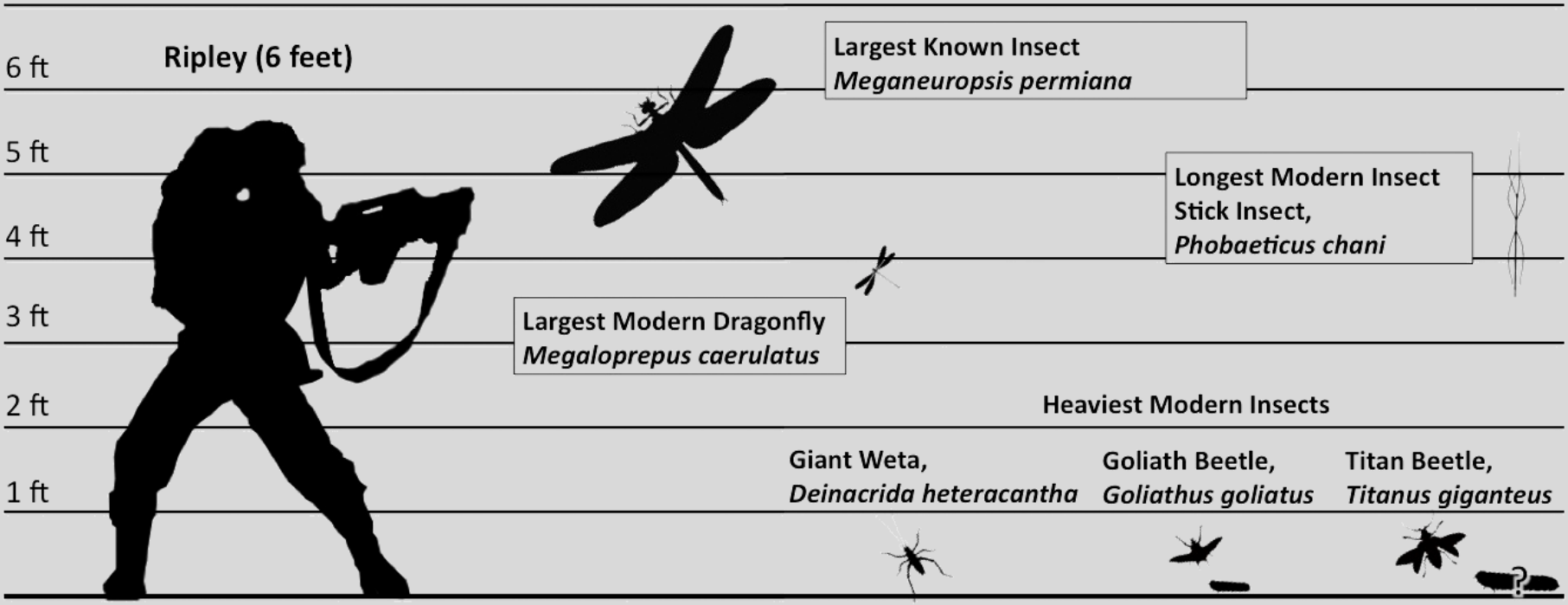
Paleontologia:
“morfo-espécies”

Discrepância pretérita

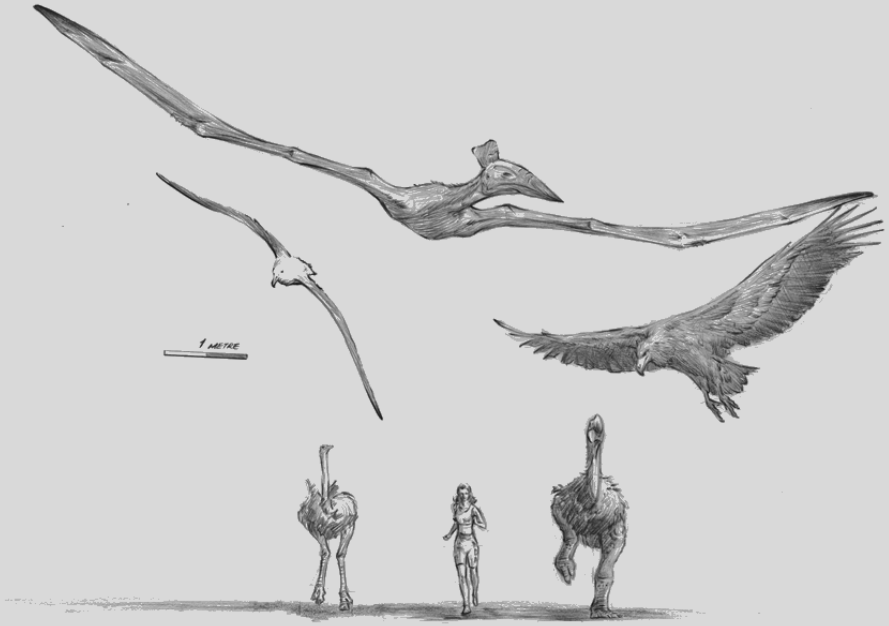
Tamanho como parâmetro para diversidade

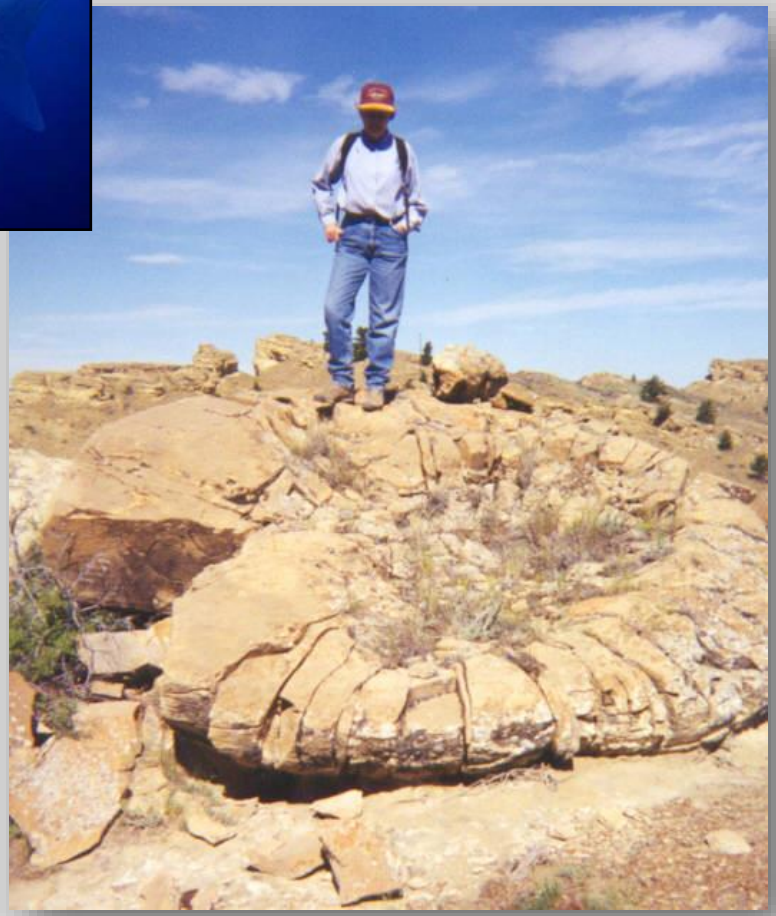


Discrepância pretérita



Discrepância pretérita





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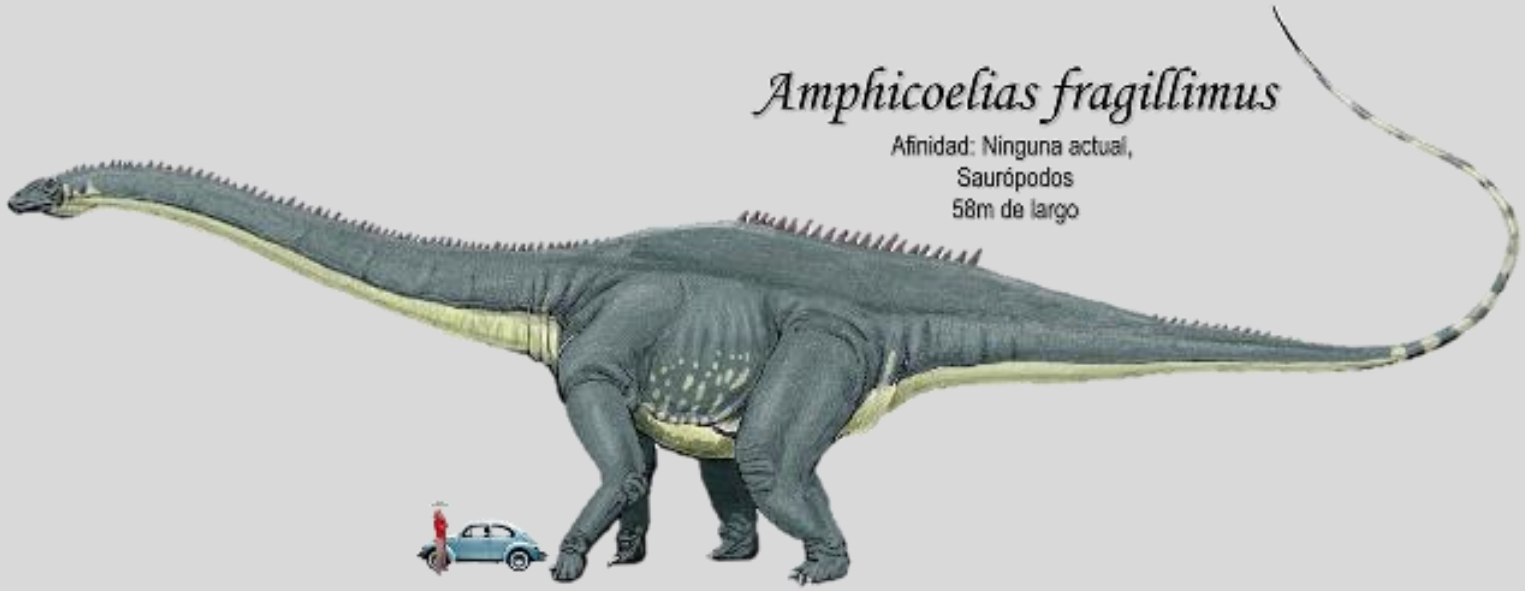

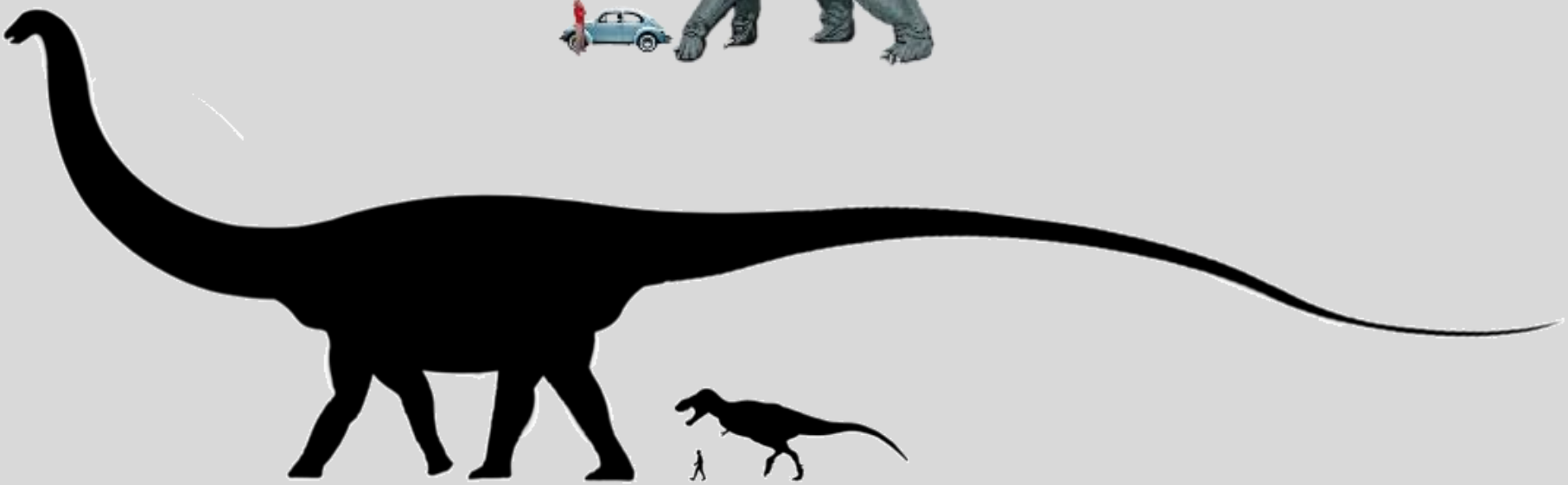

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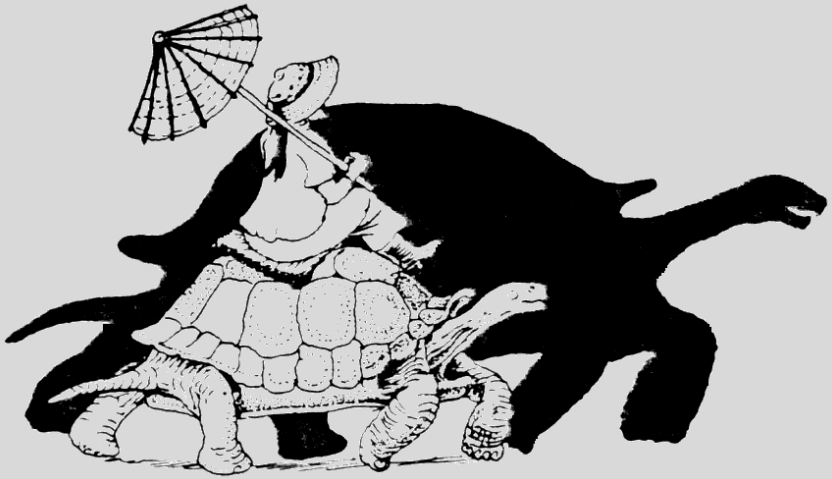

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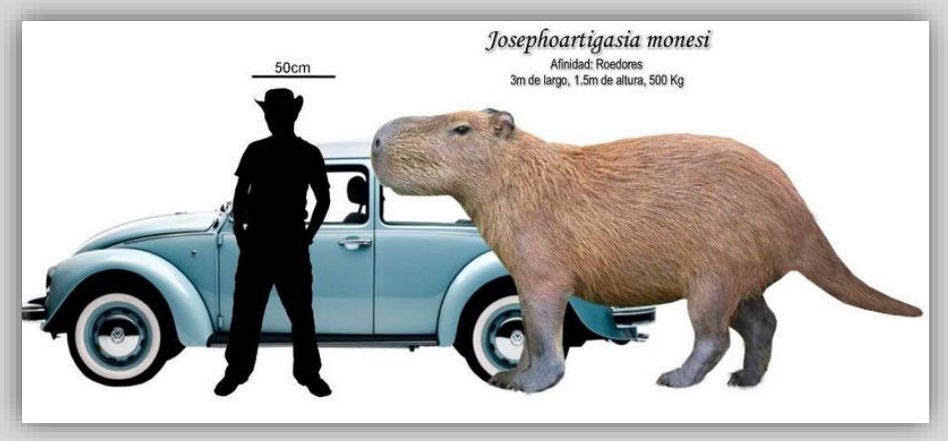

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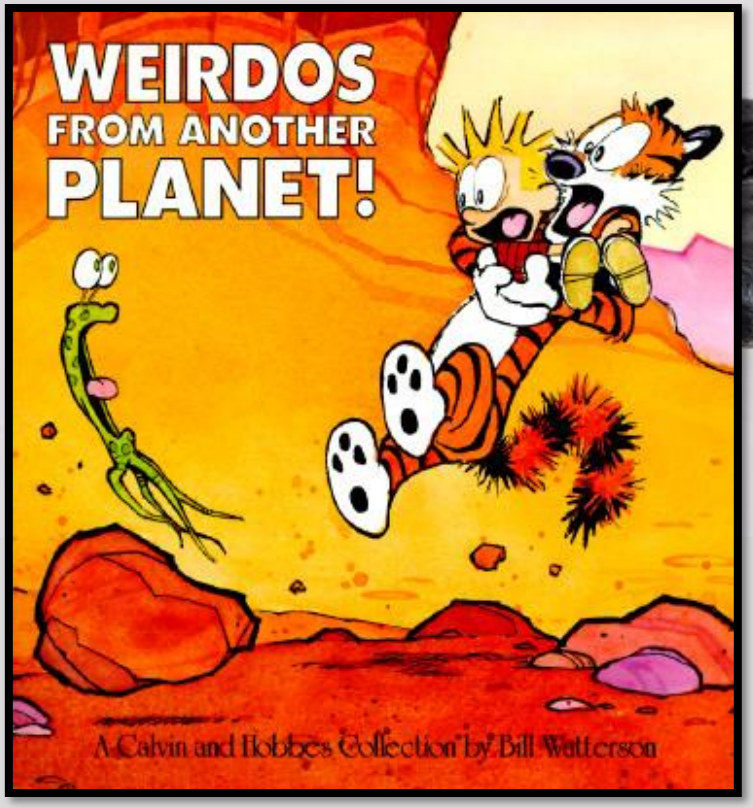


Discrepância pretérita

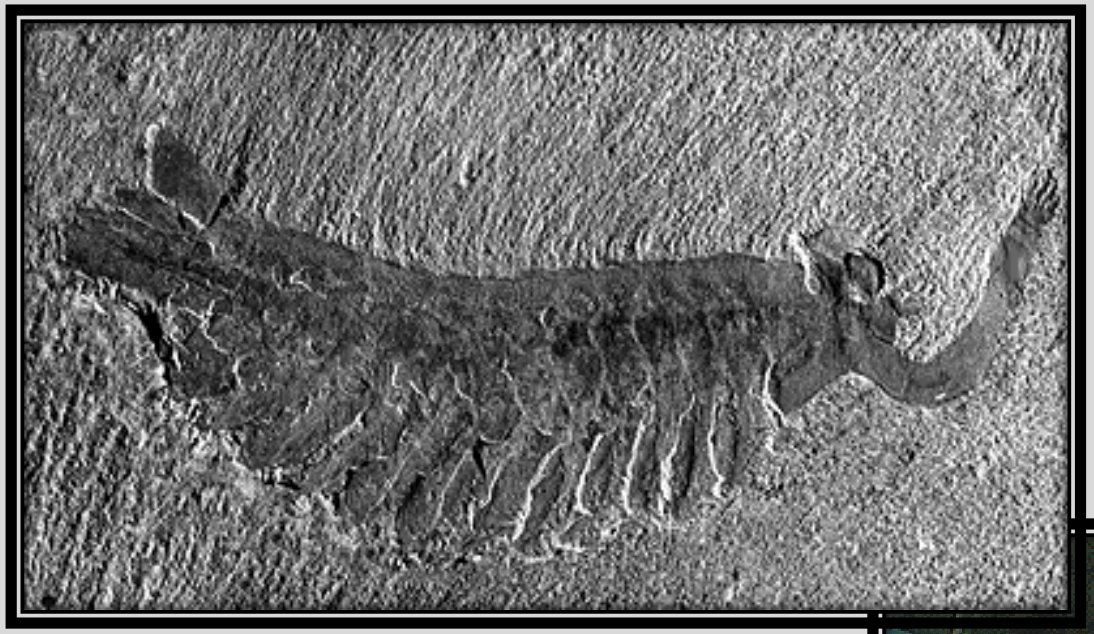
Discrepância pretérita

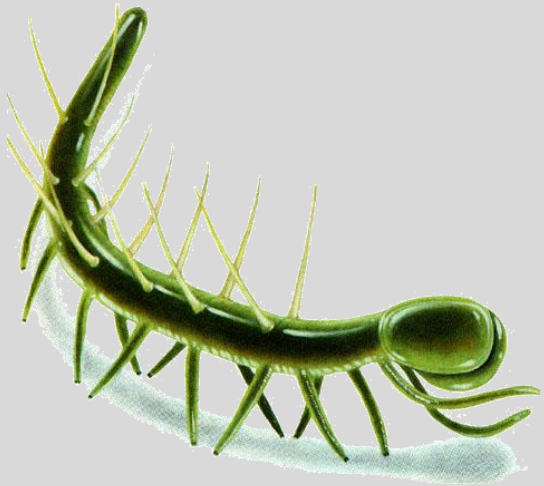
1 – Entender que a **discrepância** atual não é limite morfológico absoluto

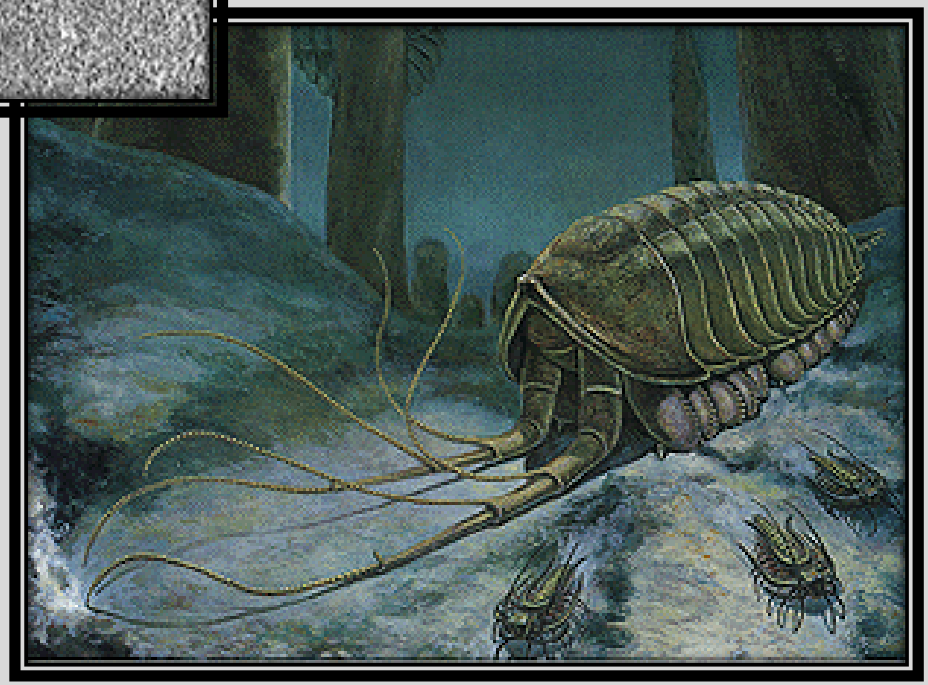
2 – Comparar a diversidade biológica atual com aquela de épocas passadas (e estas entre si), ajudando a entender aspectos do processo **evolutivo**

“Explosão” do Cambriano

Discrepância pretérita







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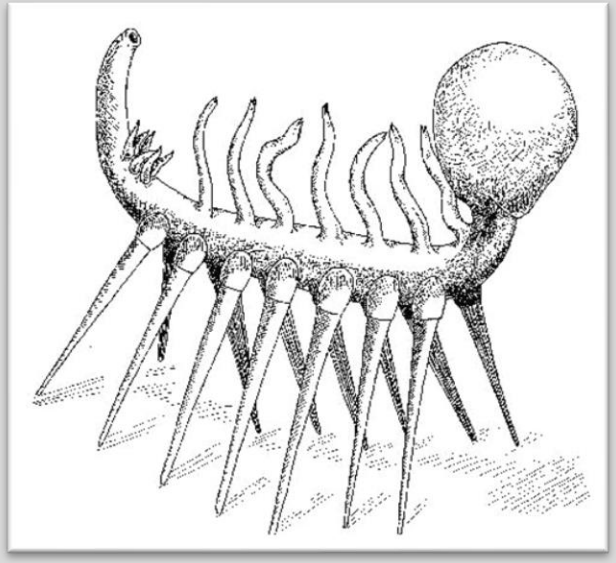
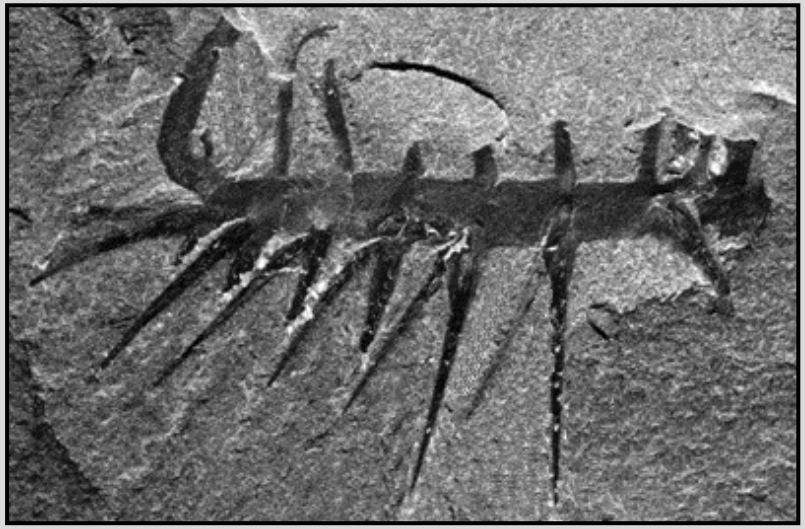
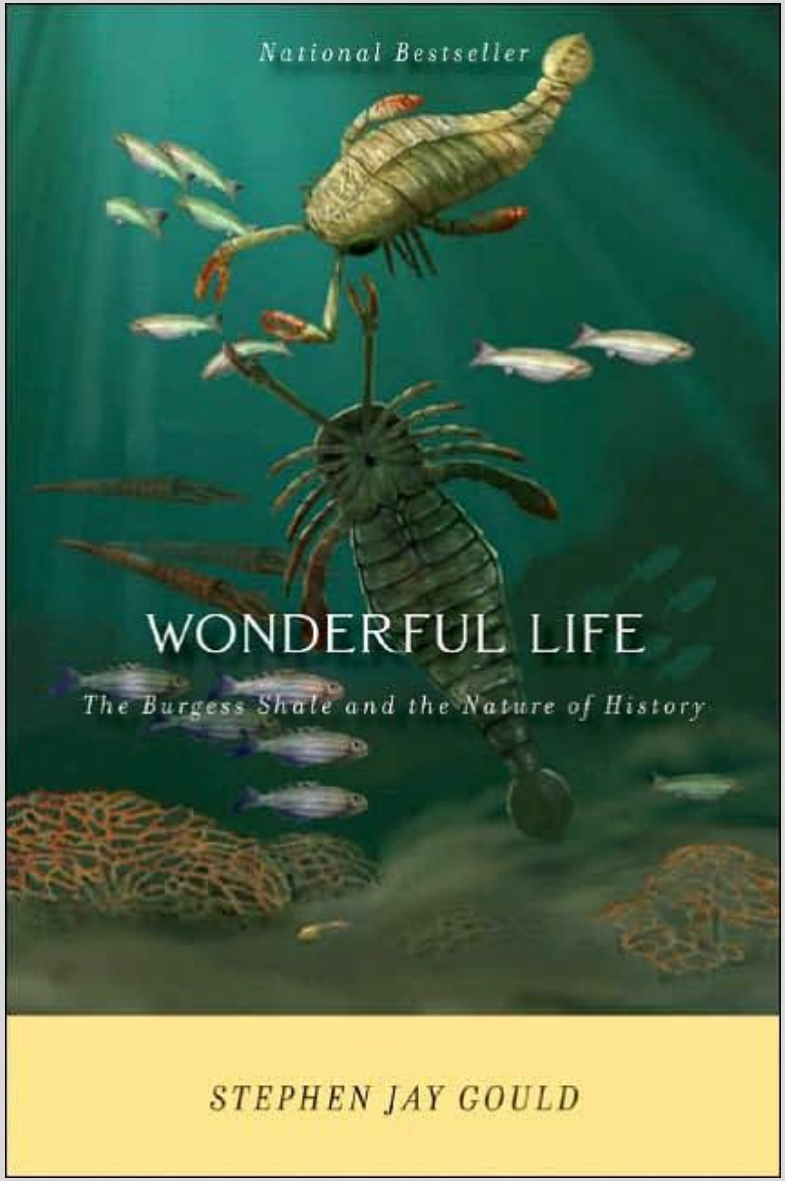
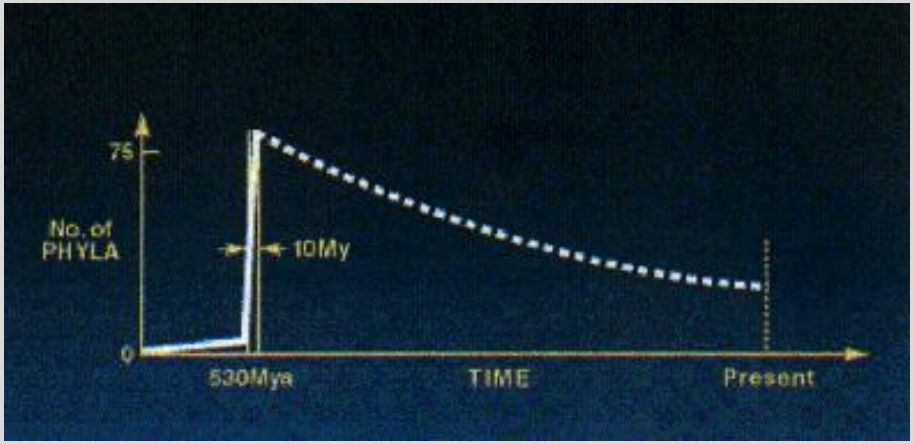




Irradiação adaptativa





Irradiação adaptativa

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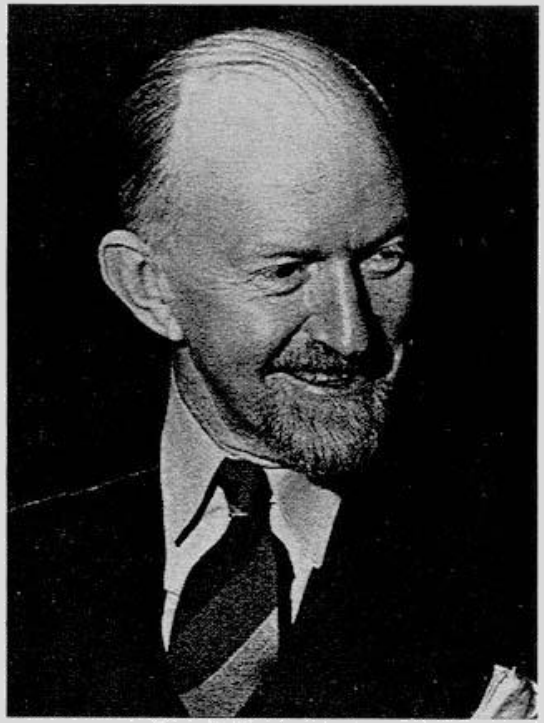
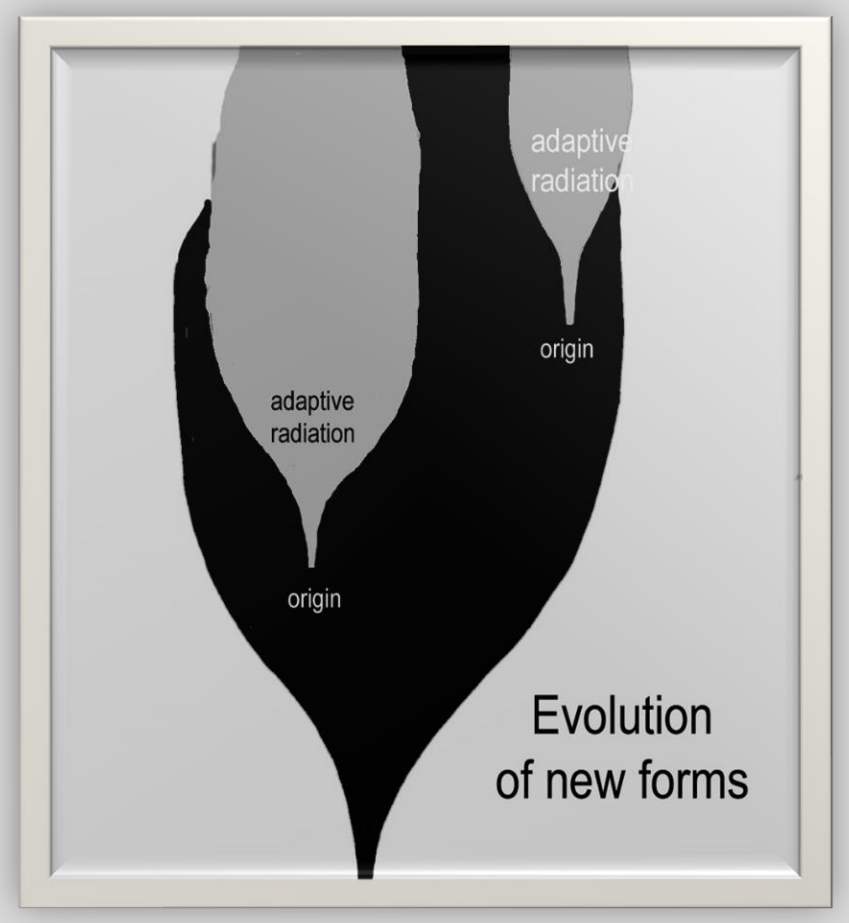
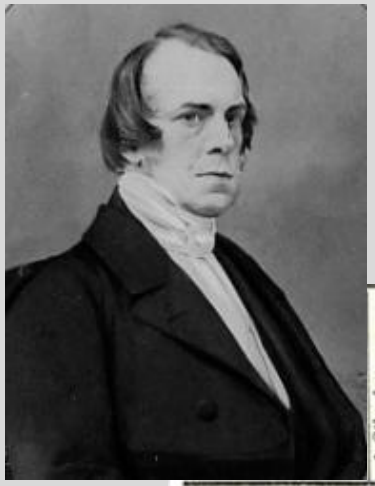
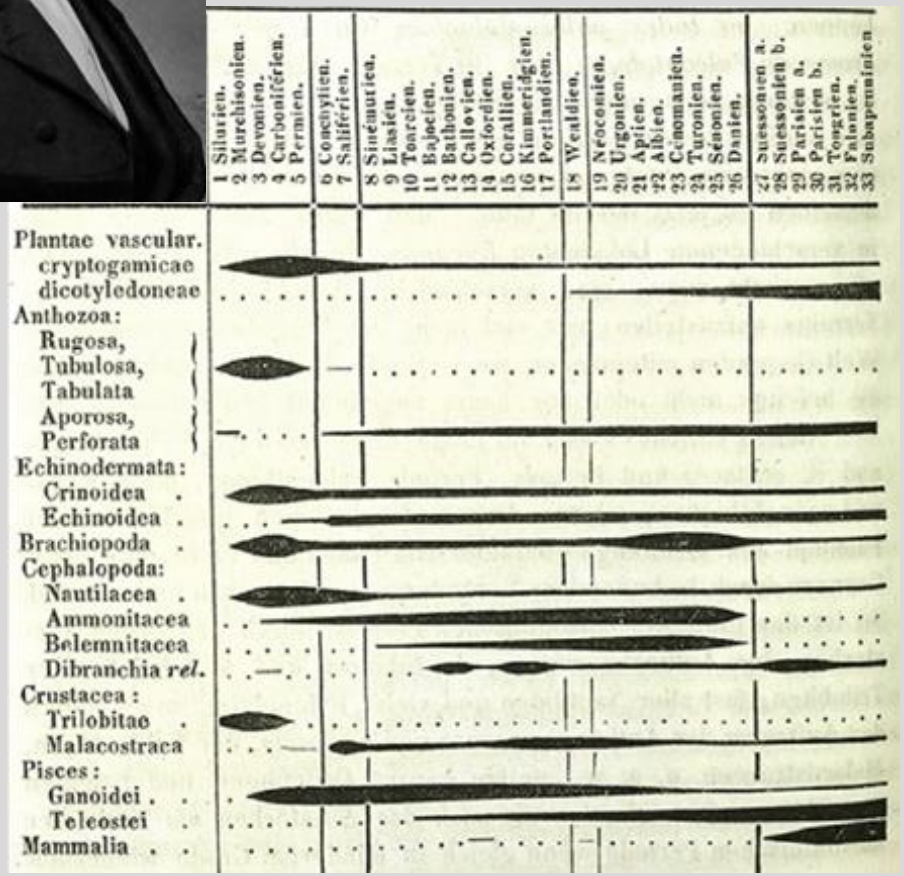




Irradiação adaptativa

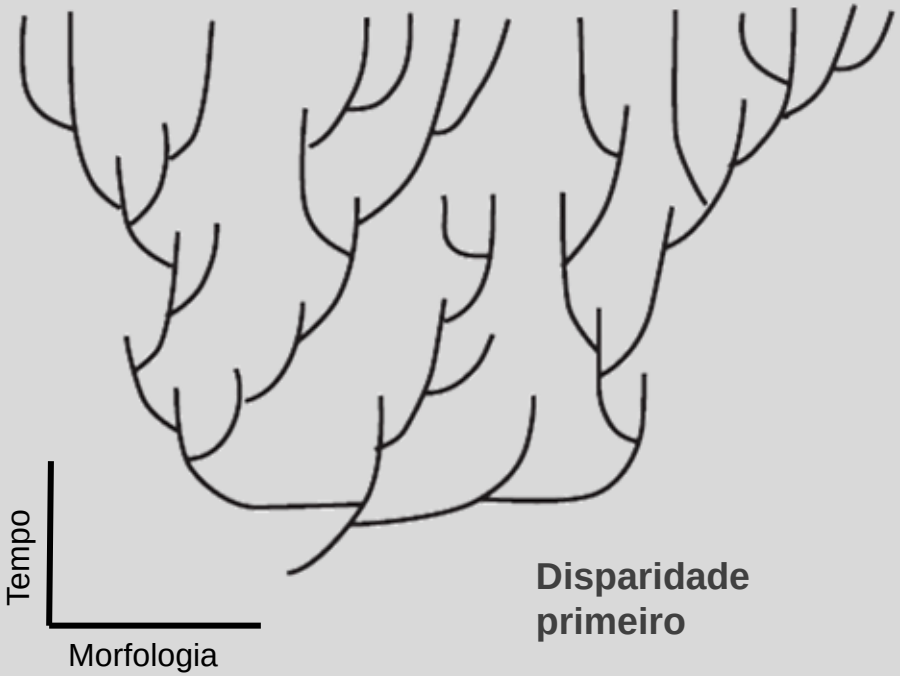


Heinrich Bronn (1800-1862): diagramas de fuso (spindle)

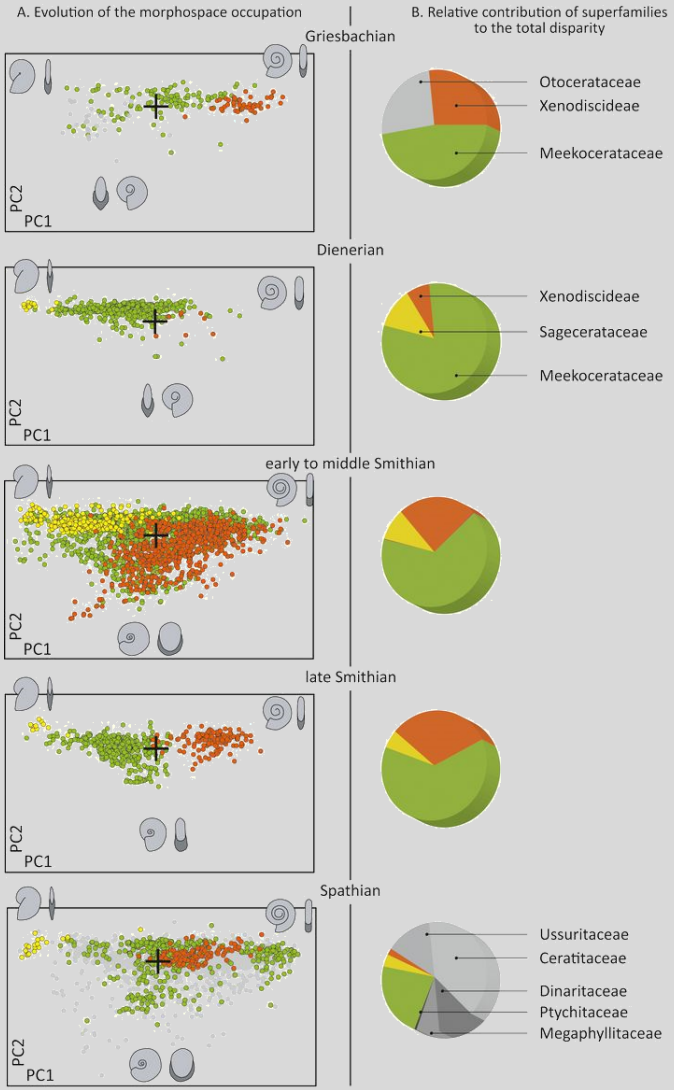


Irradiação adaptativa

“Early burst”

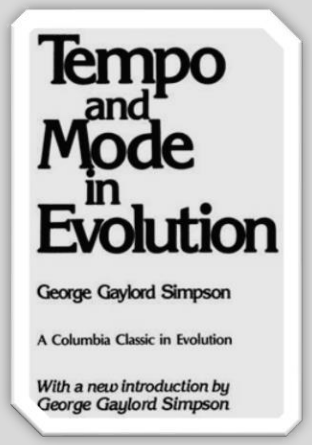


Disparidade primeiro



Erwin (2007); Broose et al. (2013)

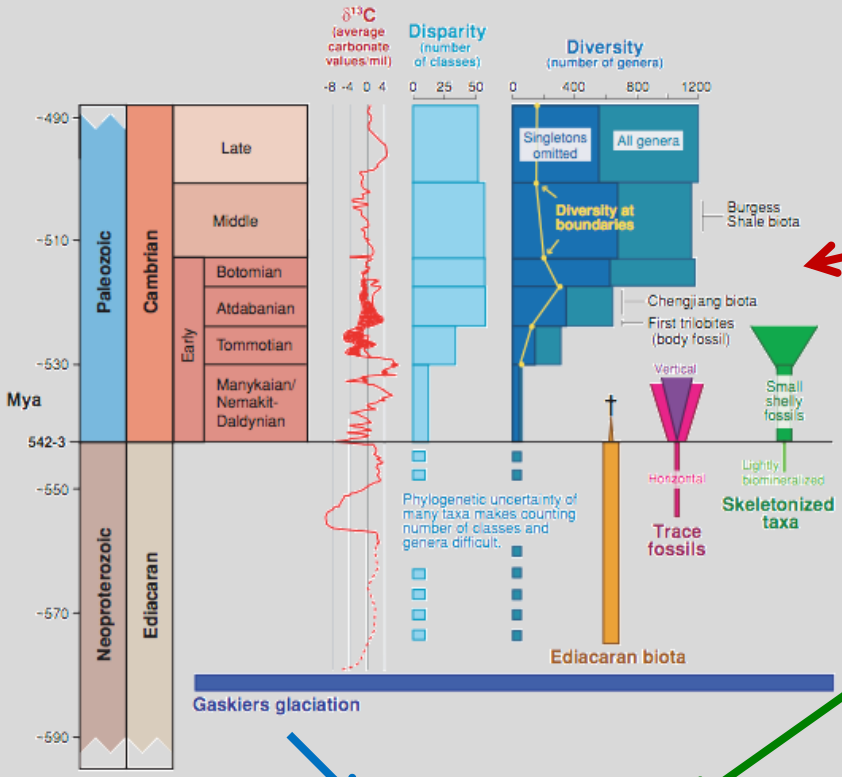
Irradiação adaptativa

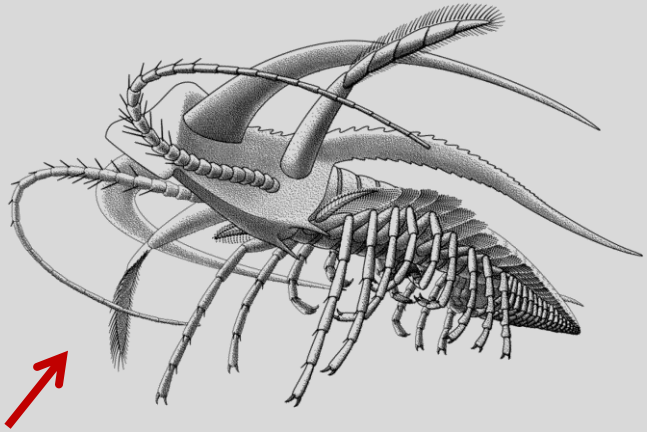


Irradiação Adaptativa

1 – Novas estruturas
2 – Mudança ambiental
3 – Extinções

Irradiação adaptativa





1 – Novas estruturas
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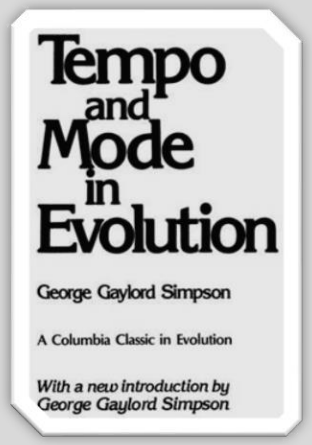

Irradiação Adaptativa

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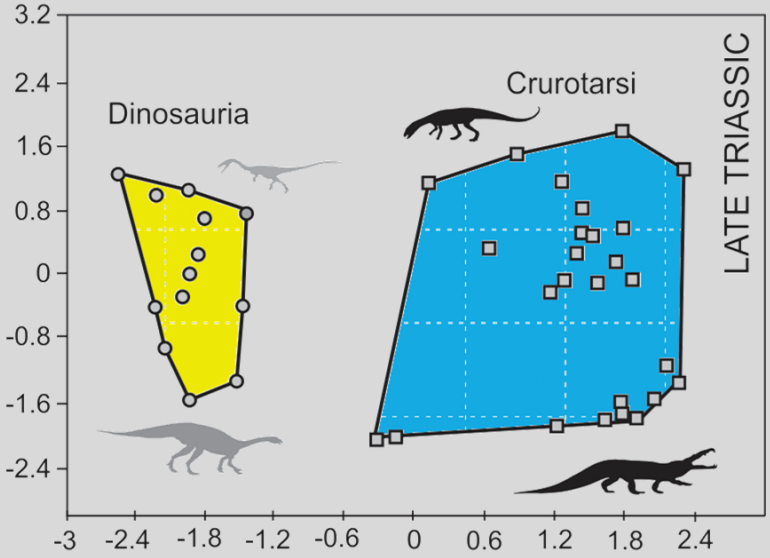
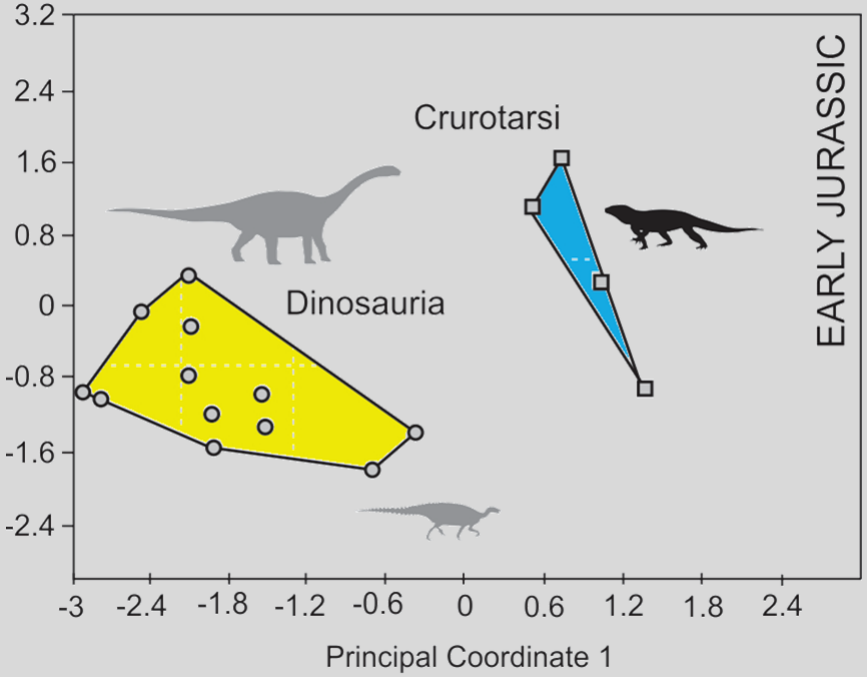
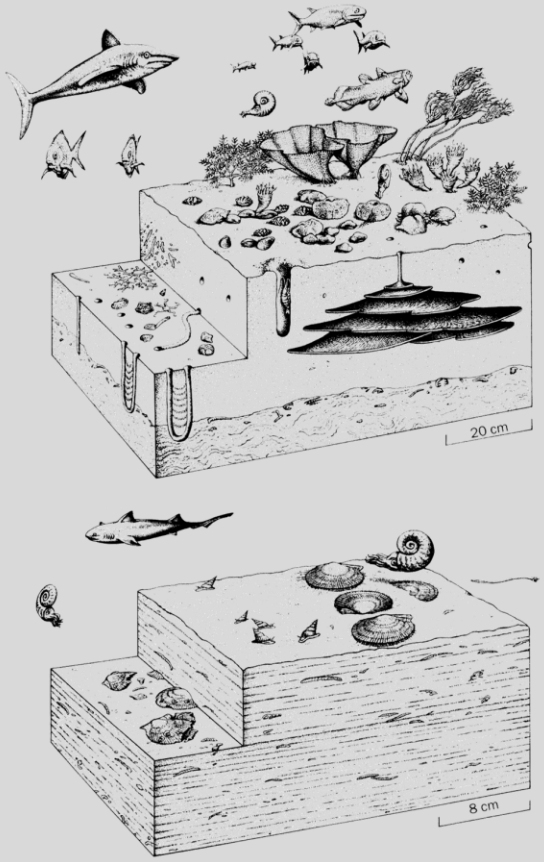




Brusatte et al. (2011)

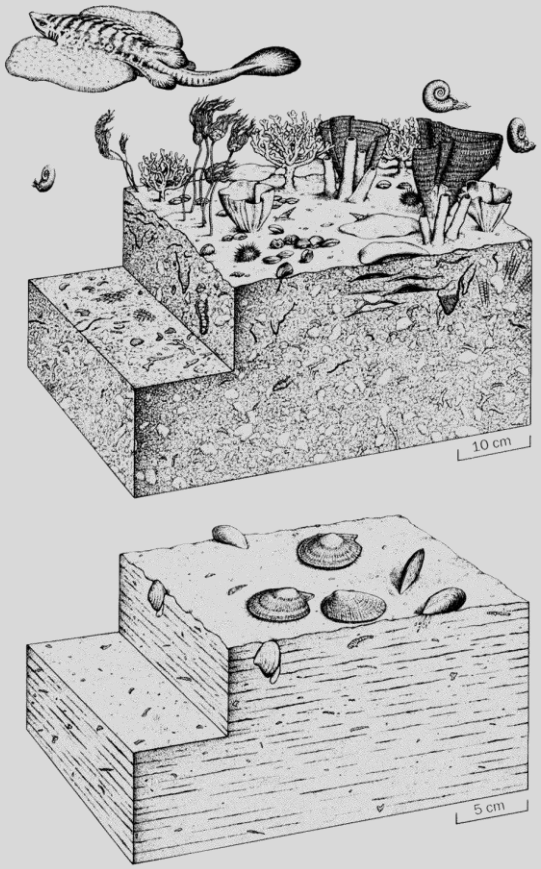
Teria a biodiversidade variado no passado?



Groenlândia

Permiano sup.

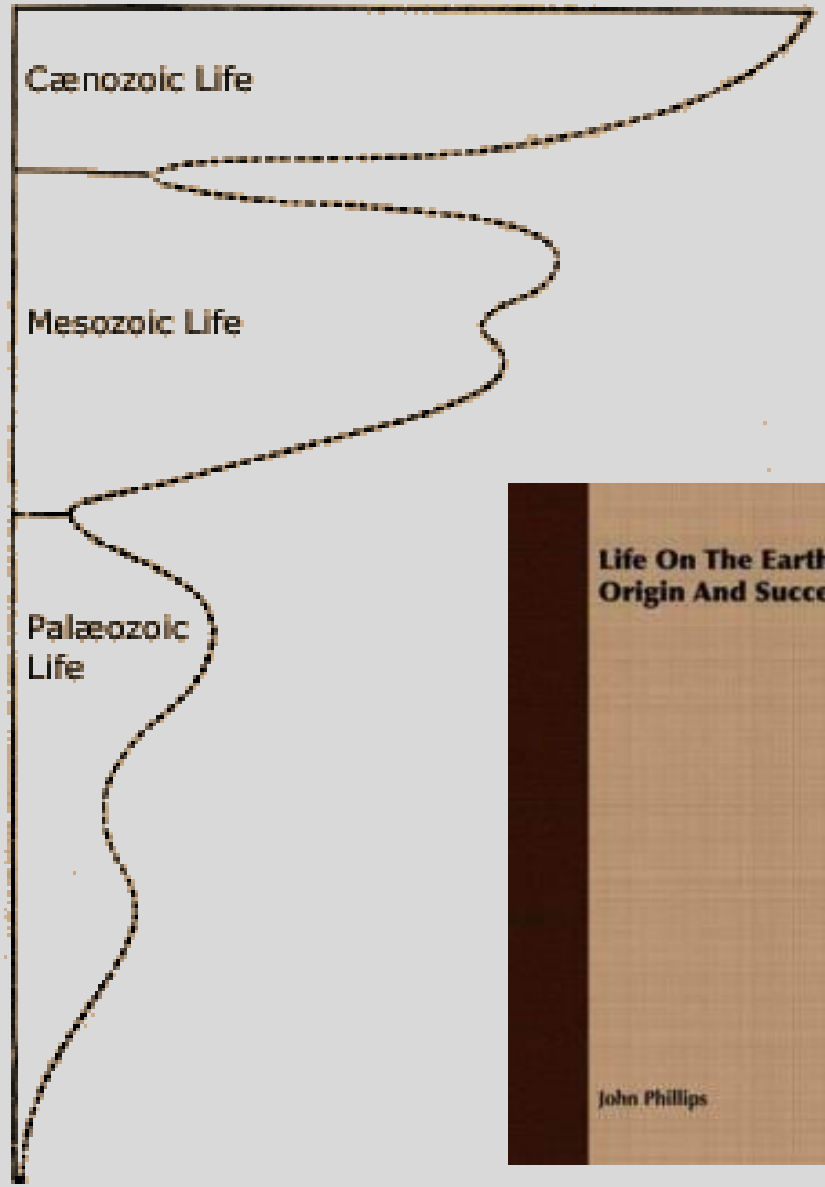
Triássico inf.

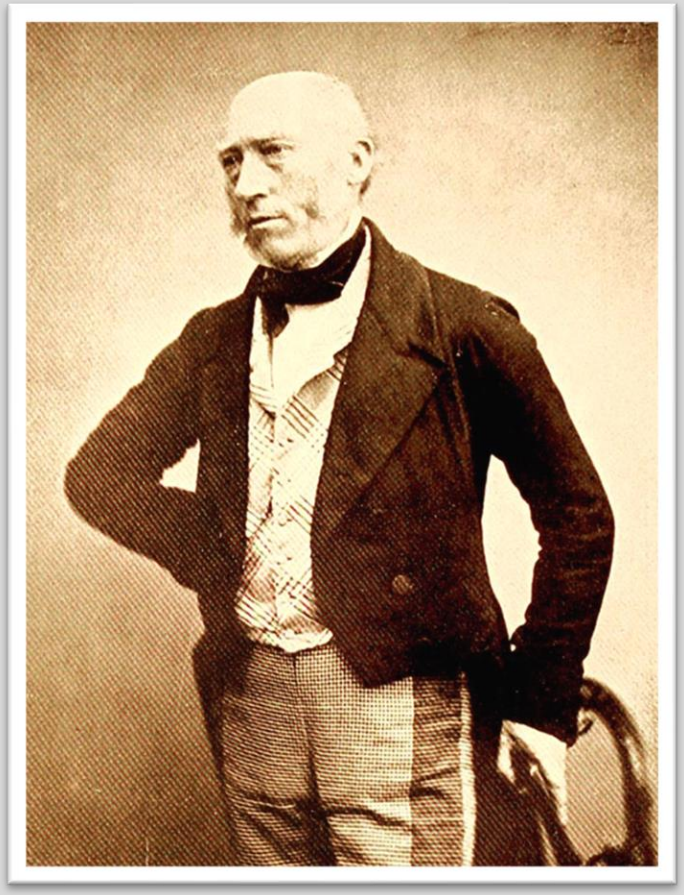


China

Padrões de biodiversidade

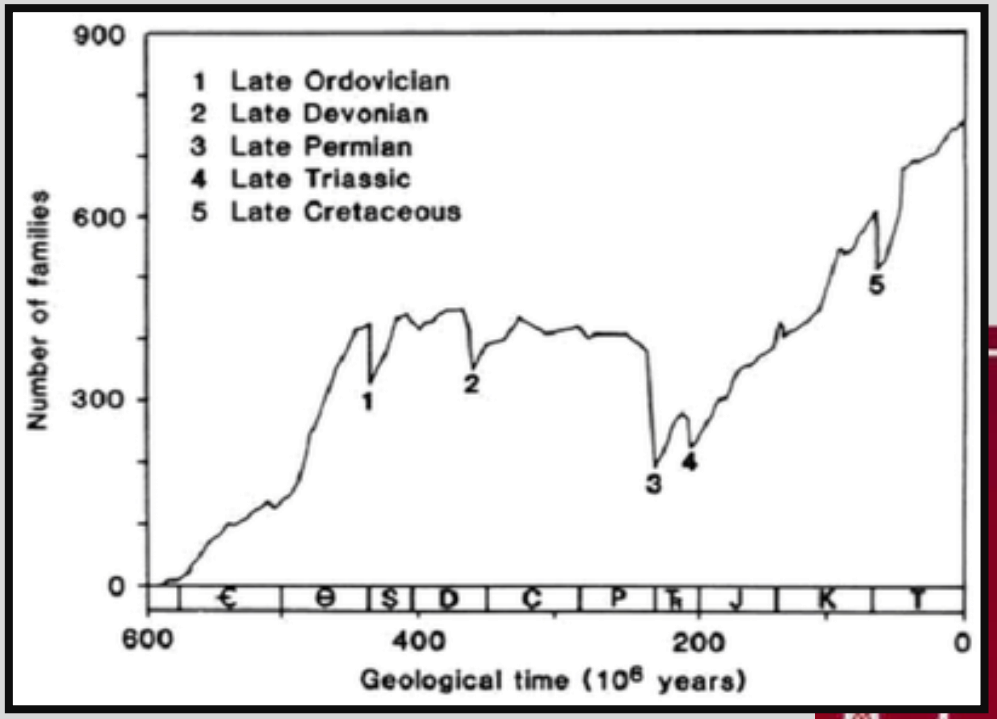
Padrões de biodiversidade



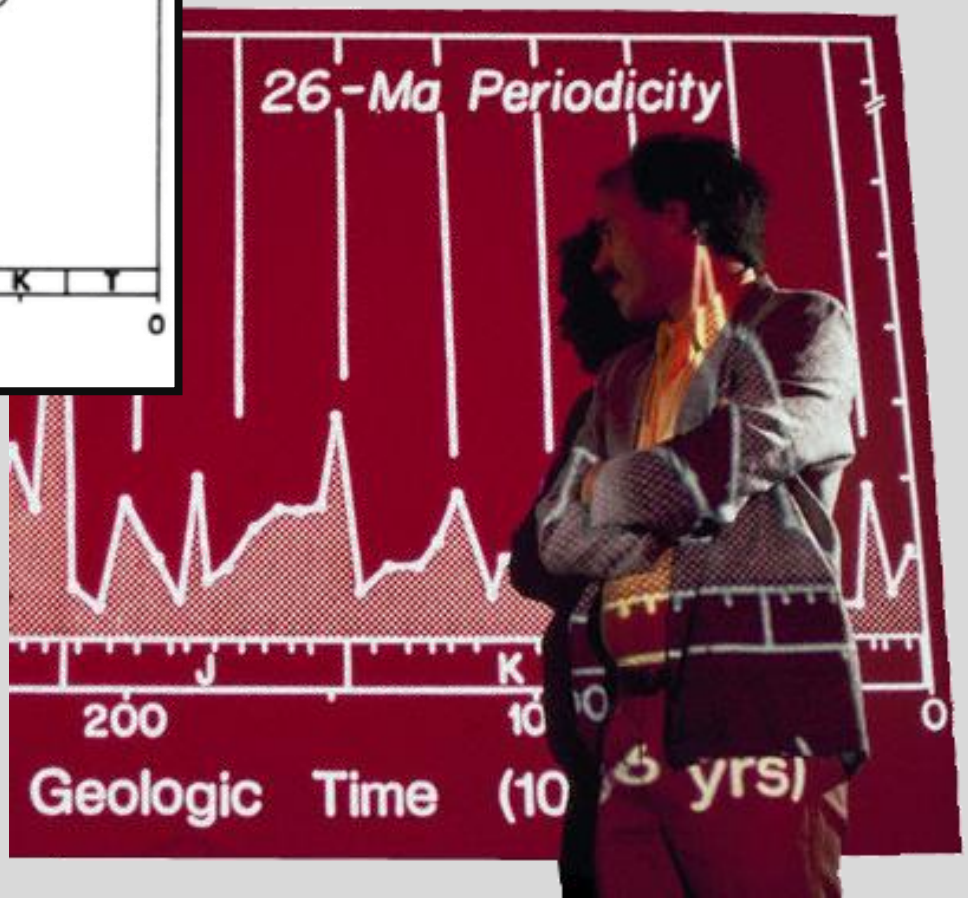


1860: registro fóssil da Ilhas Britânicas com correção para maior amostragem do Paleozóico

Padrões de biodiversidade

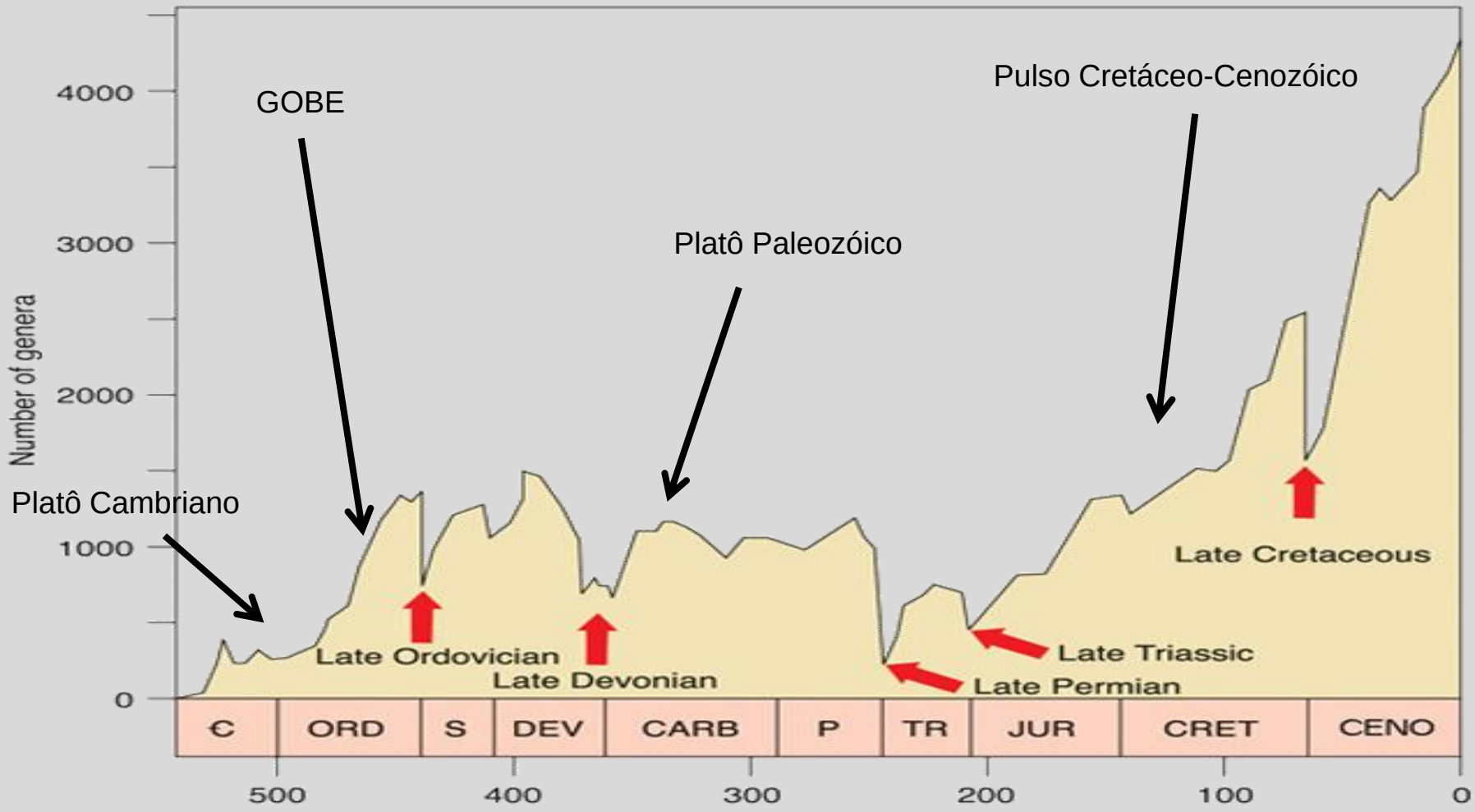


Evolução da fauna marinha fanerozóica

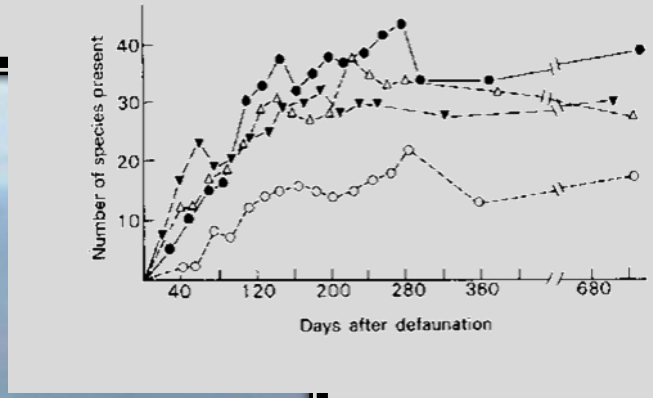


John Sepkoski

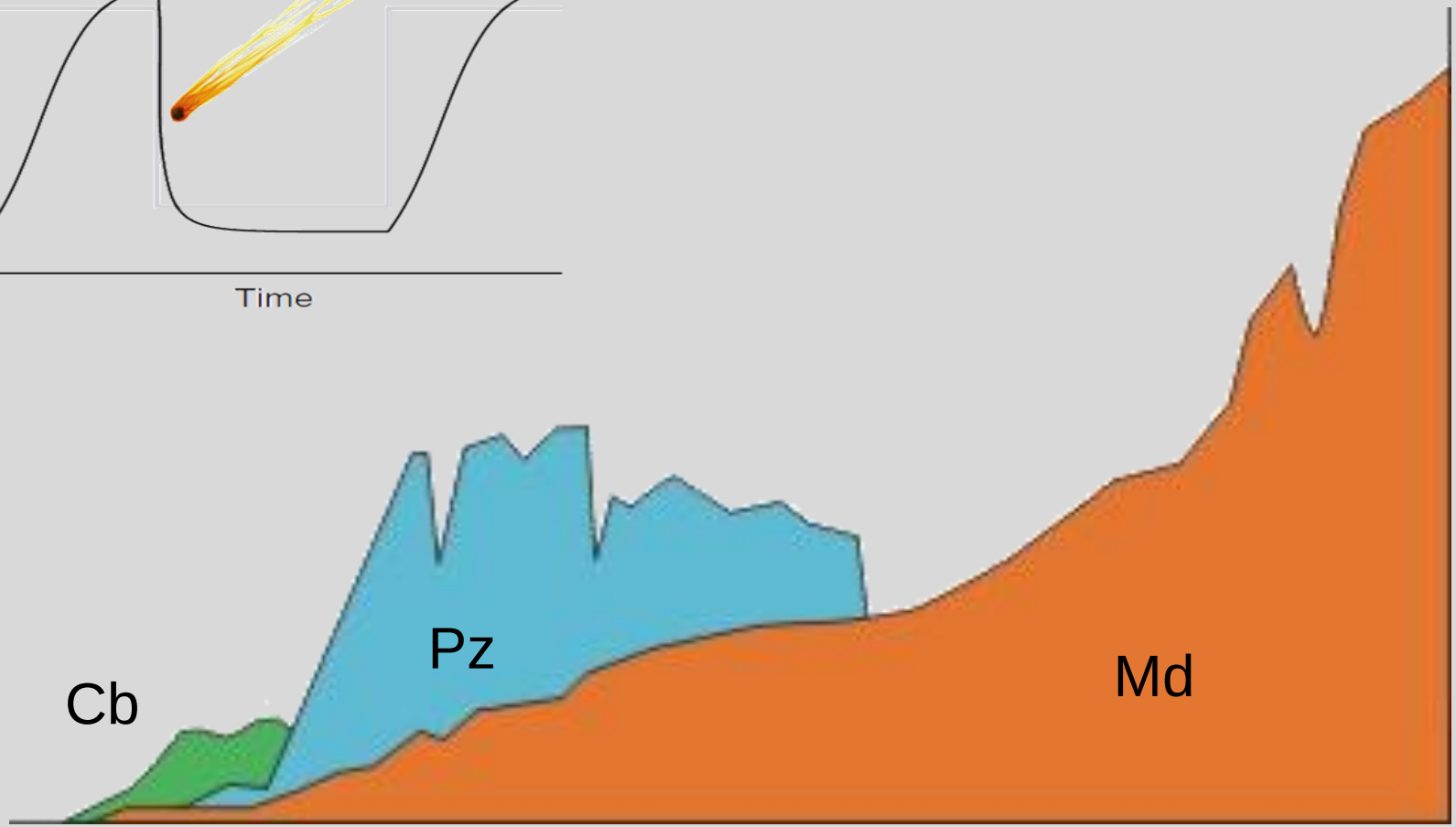
Evolução da fauna marinha fanerozóica



Evolução da fauna marinha fanerozóica

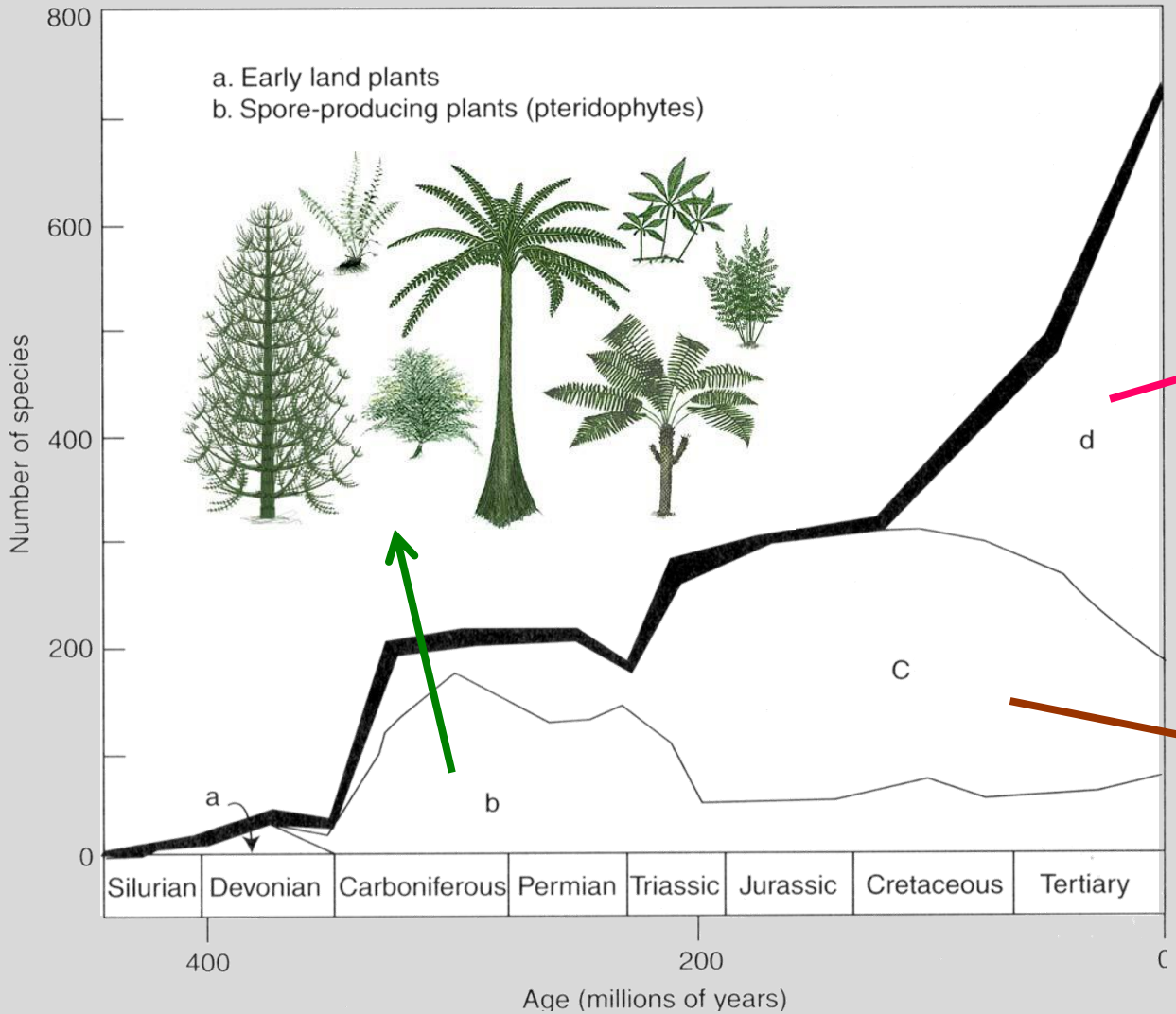


Evolução da fauna marinha fanerozóica



Padrões de biodiversidade

Enquanto isso nos continentes ...



Padrões de biodiversidade

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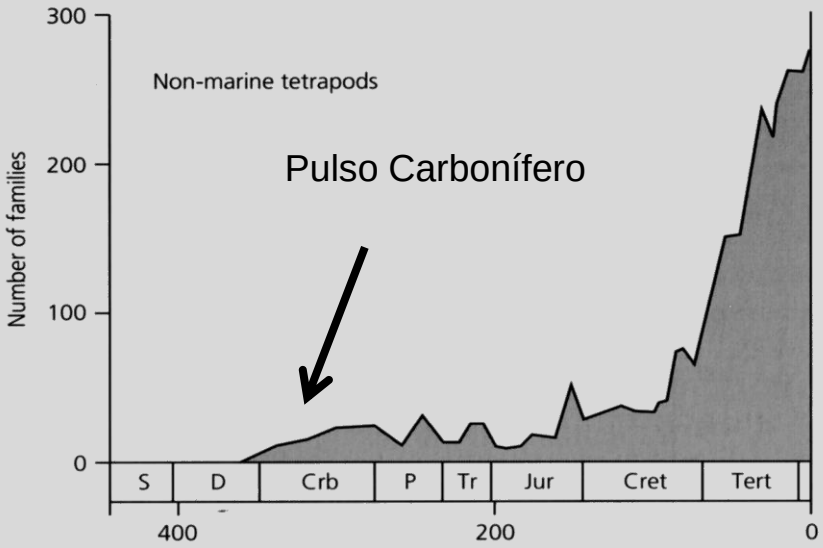
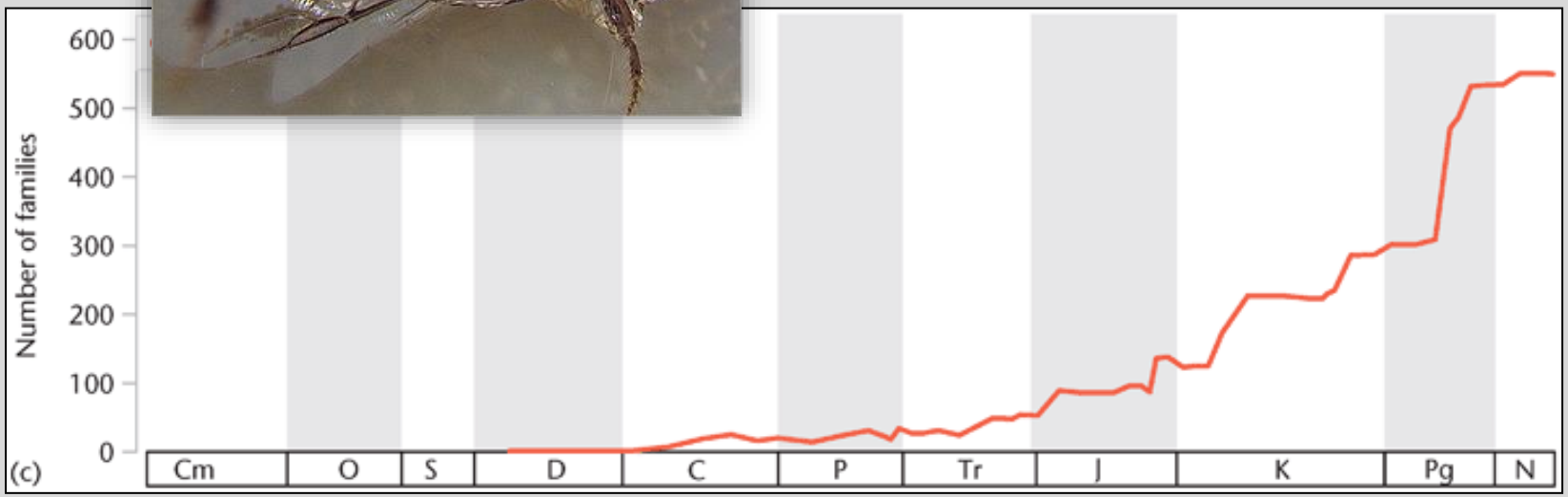
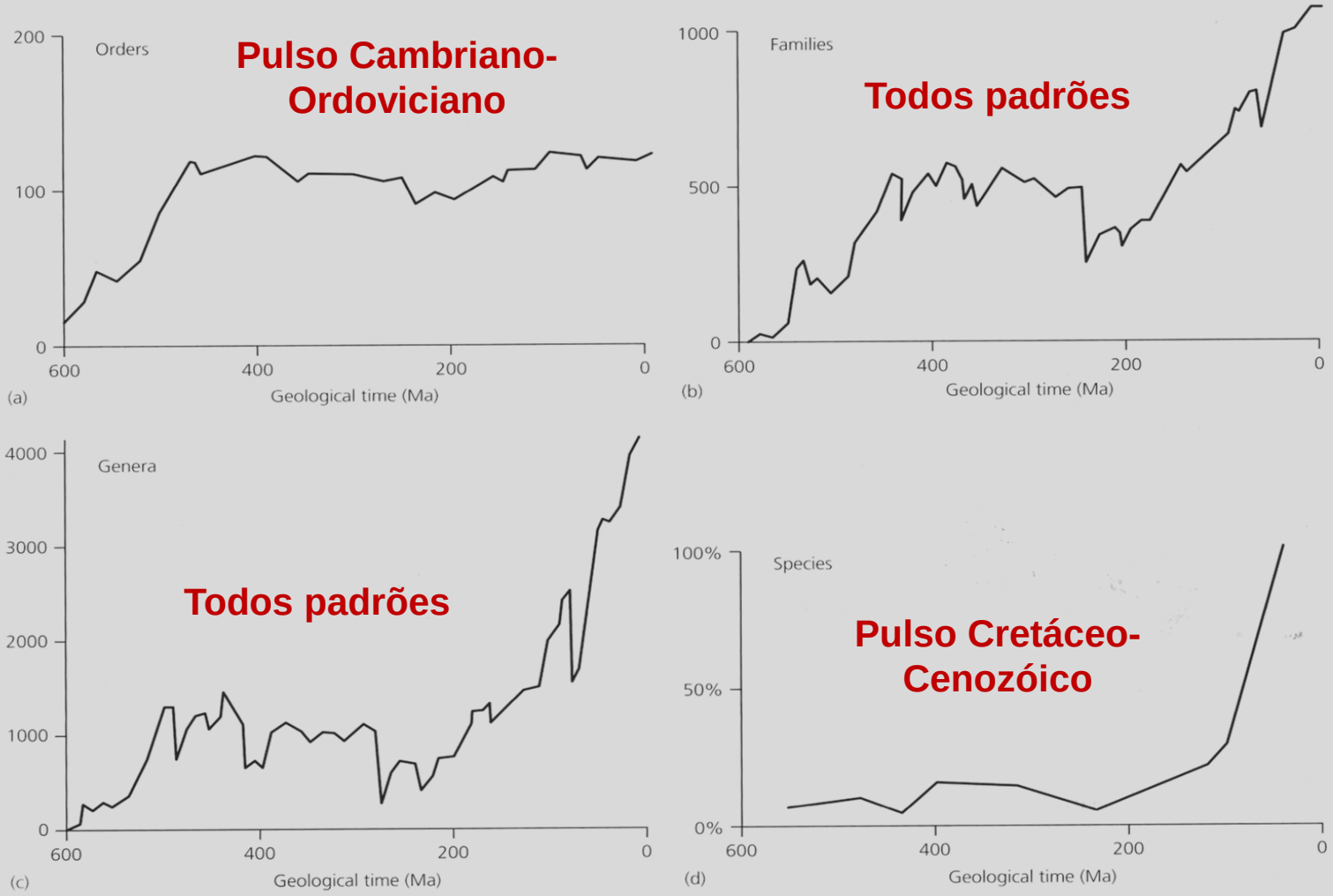




Benton (1993)

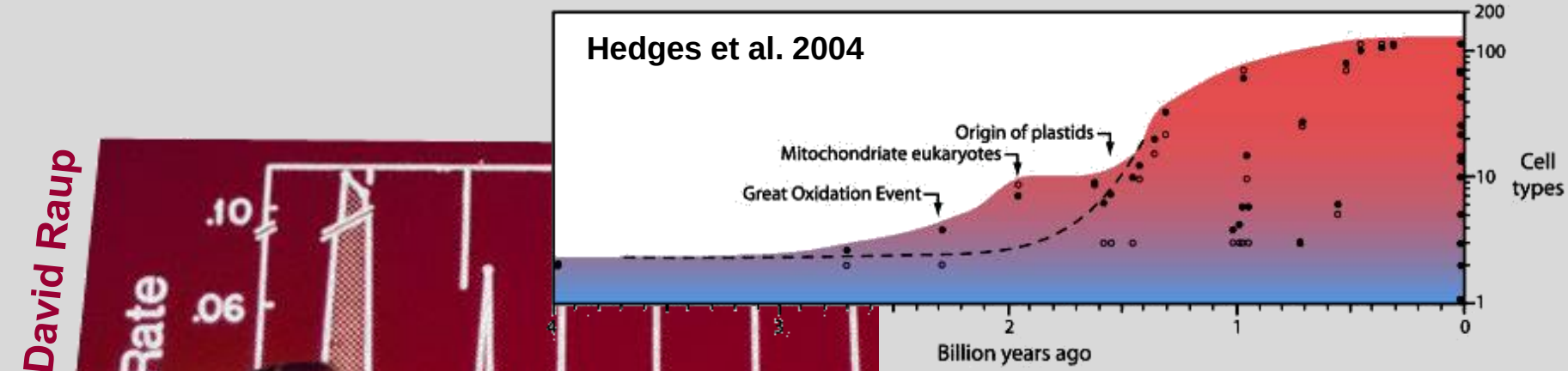
Padrões de biodiversidade

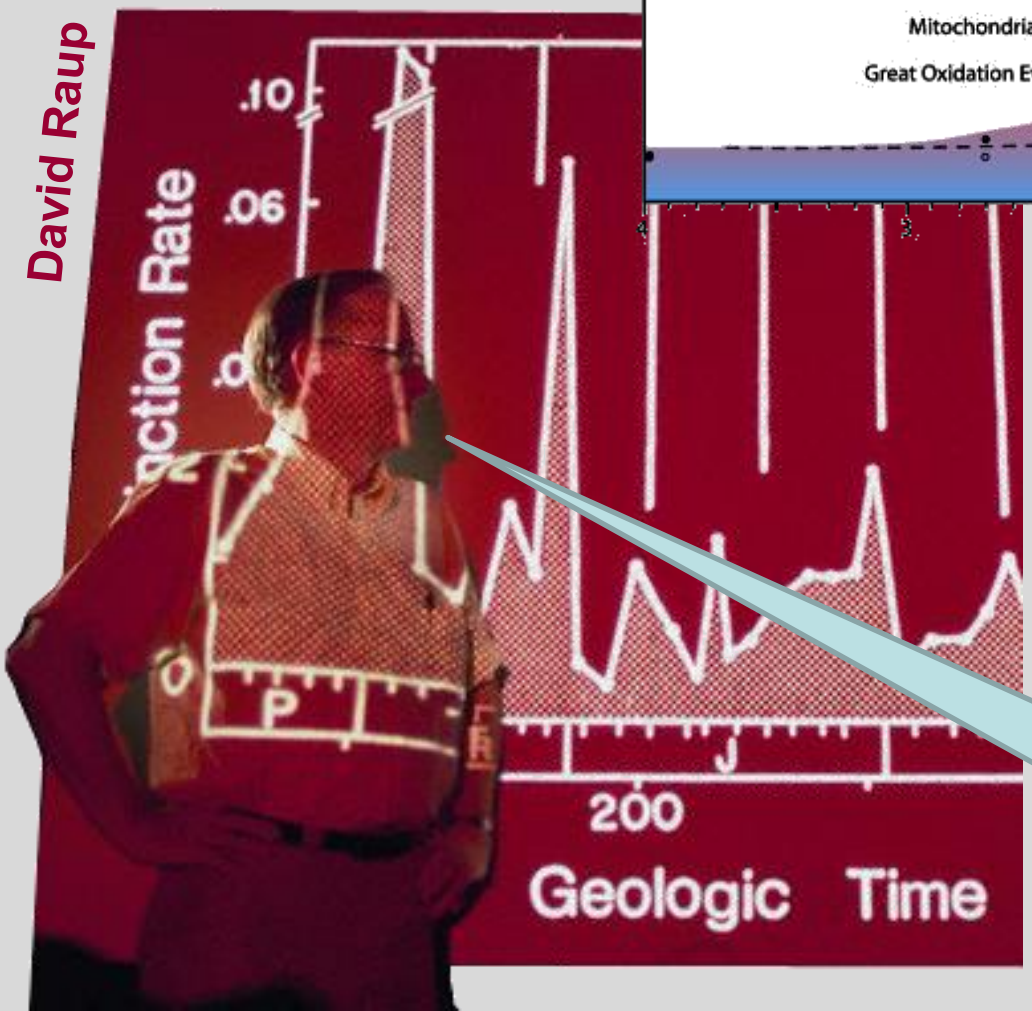
Curvas de diversidade por categorias taxonômicas



Benton (1993)

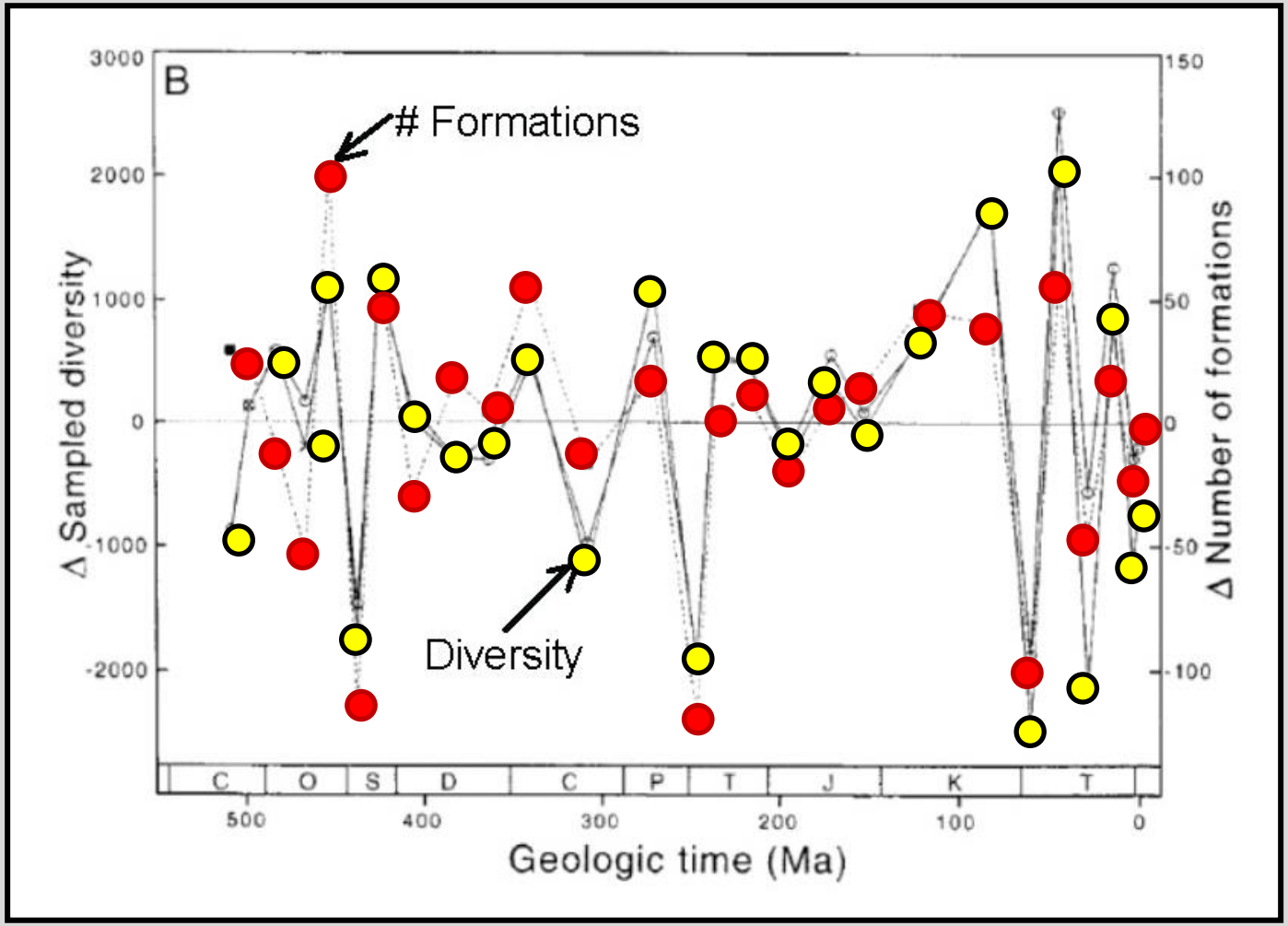
Padrões de biodiversidade





Diversidade biológica pode ter se mantido praticamente estável desde meados do Paleozóico

O problema da amostragem



Mais rochas

=

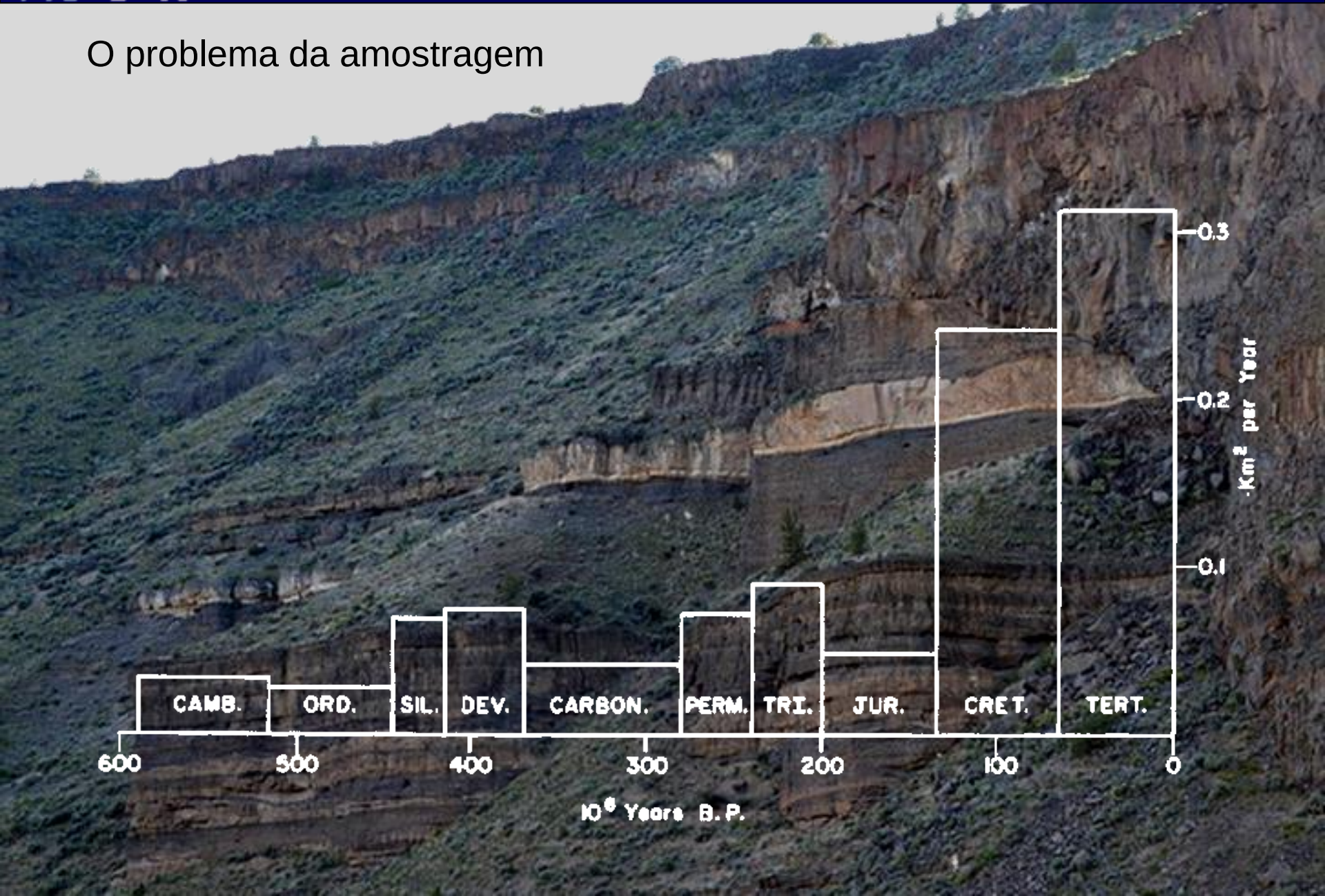
Mais fósseis

=

Mais táxons

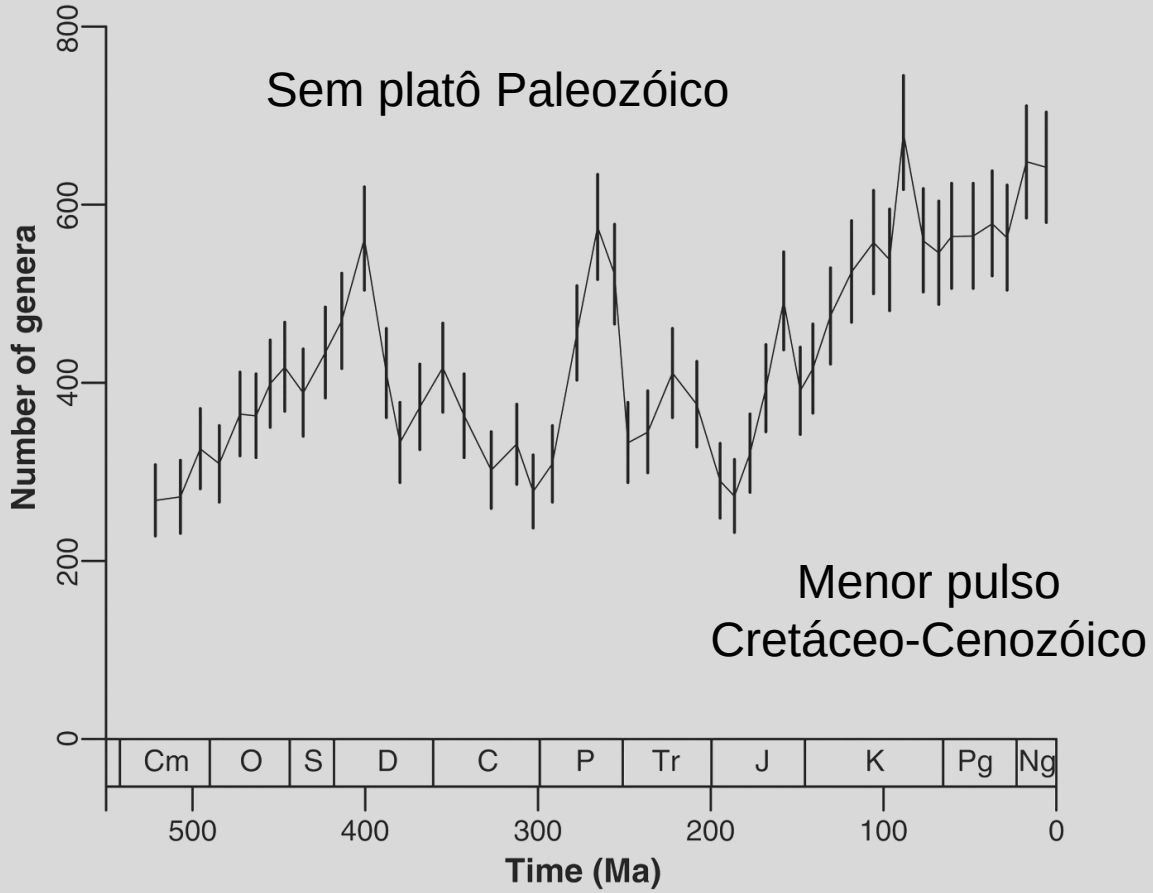
Padrões de biodiversidade

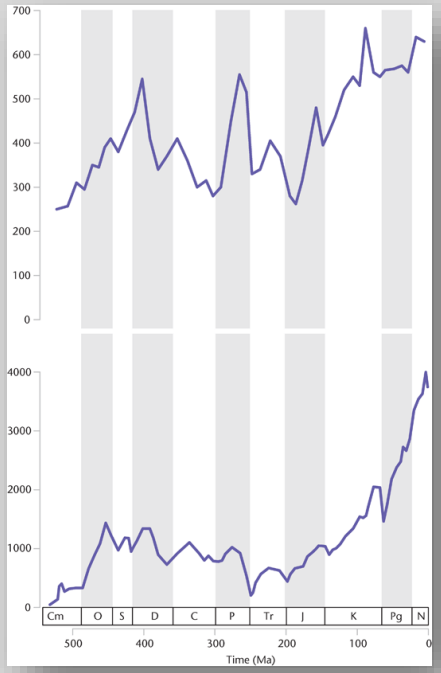
O problema da amostragem



Padrões de biodiversidade

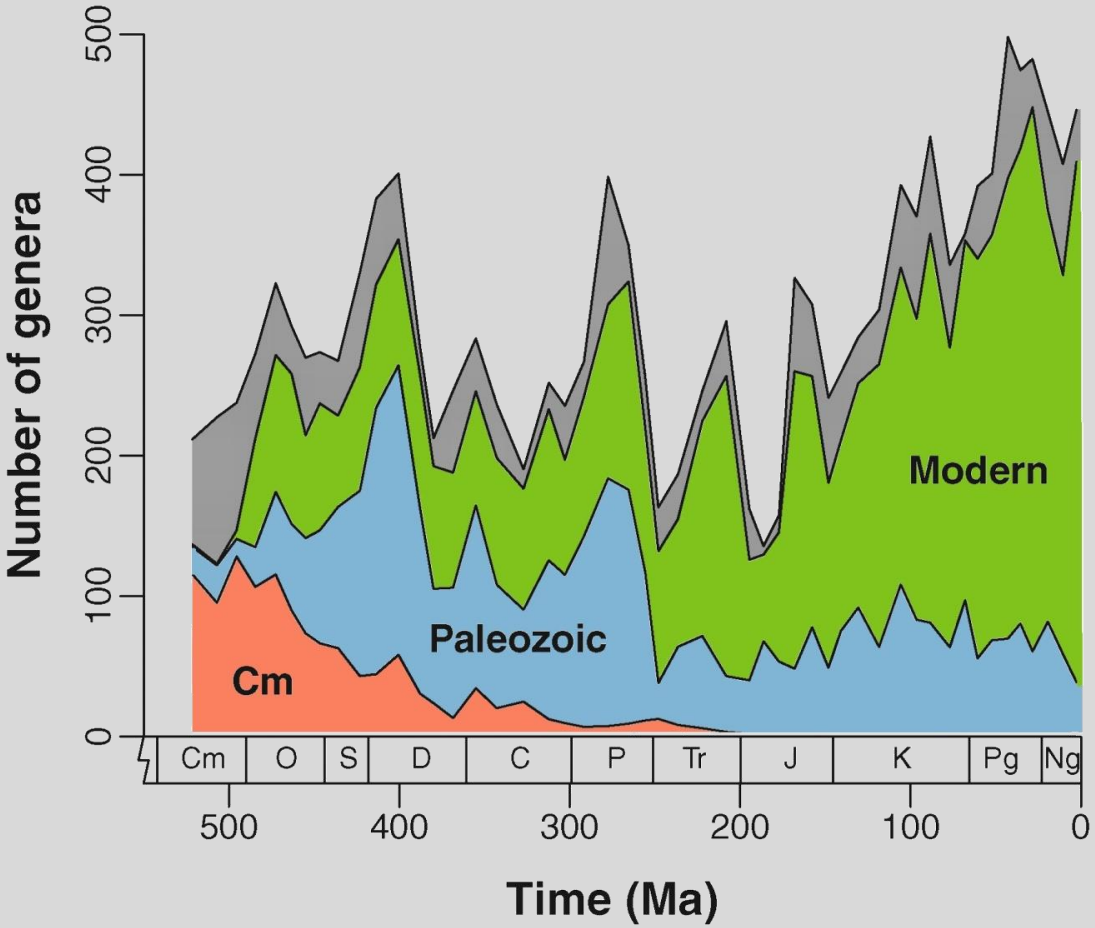
John Alroy: correção para viés de amostragem



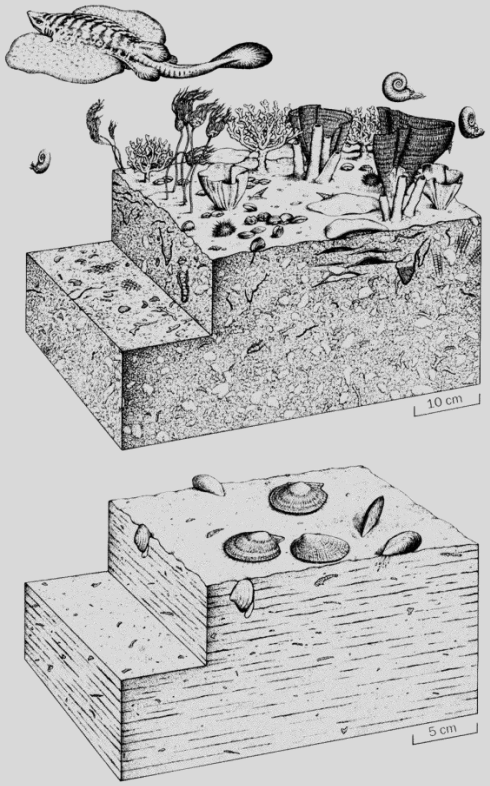


Padrões de biodiversidade

Extrapolação de padrões locais

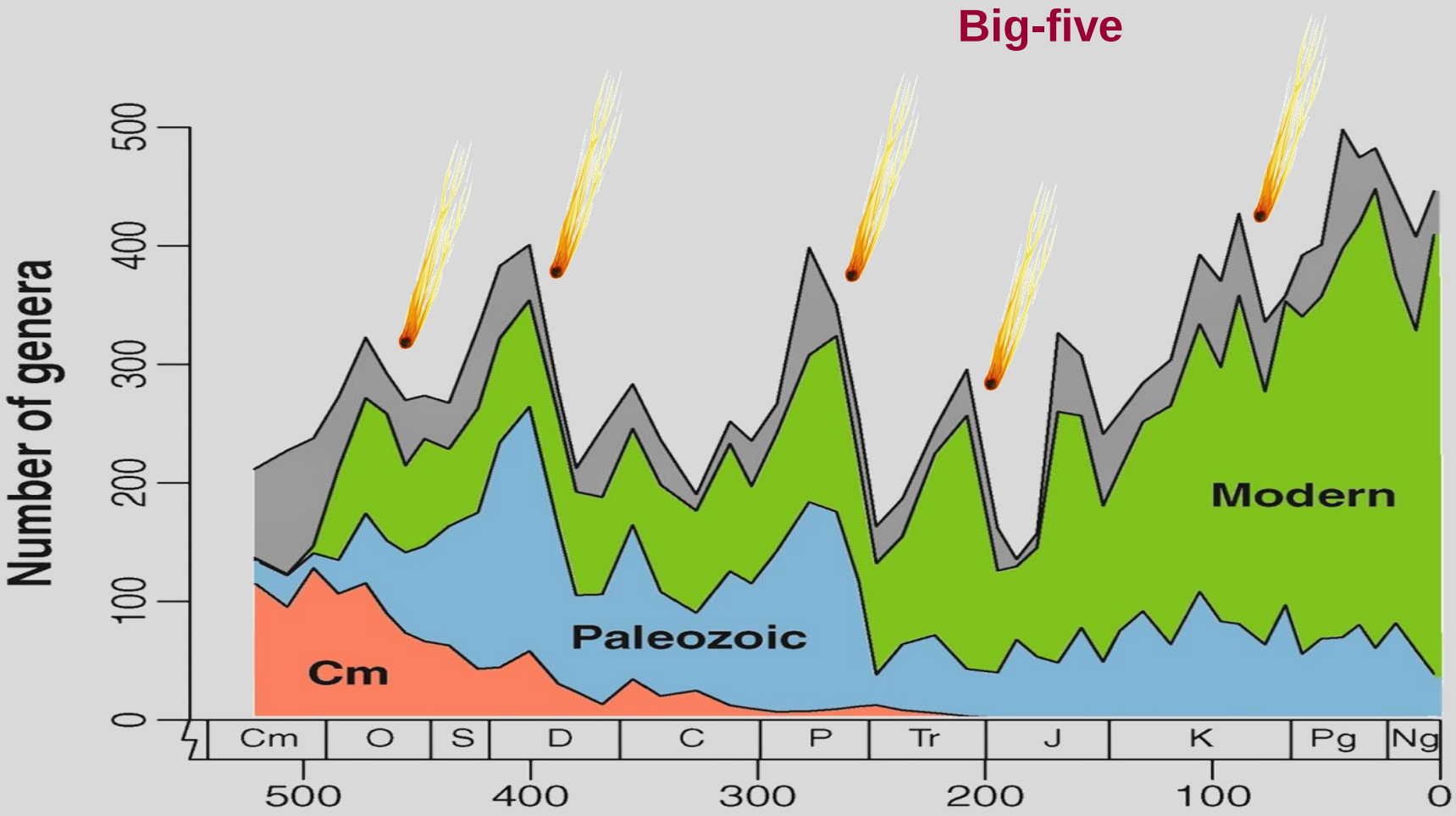


Diversidade total é fator de presença de mais rochas
Mas unidades mais novas não tem maior diversidade



Alroy (2010)

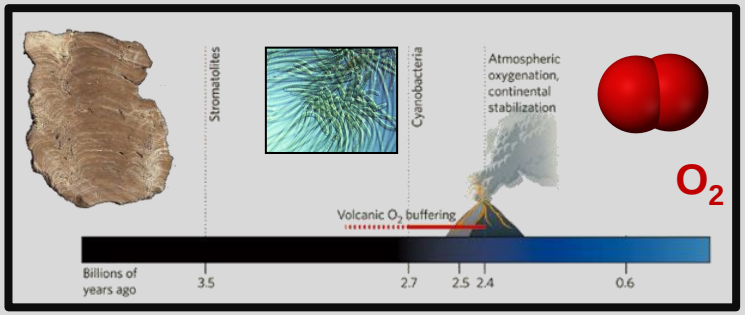
3 – Investigar os eventos de **extinção** como parâmetros para estudos das relações da biota com o meio físico



Extinções (estudos de caso)

“Positivos”

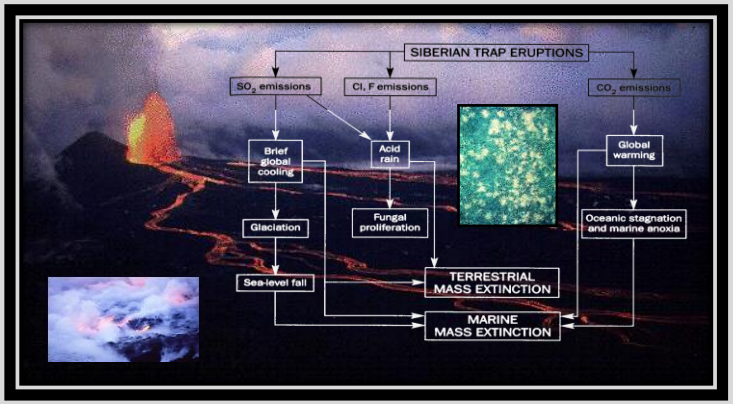
2 bilhões de anos



360 milhões de anos

“Negativos”

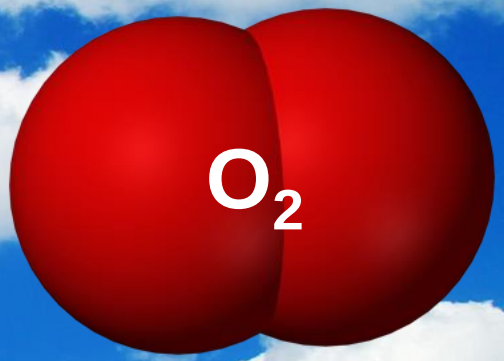
240 milhões de anos

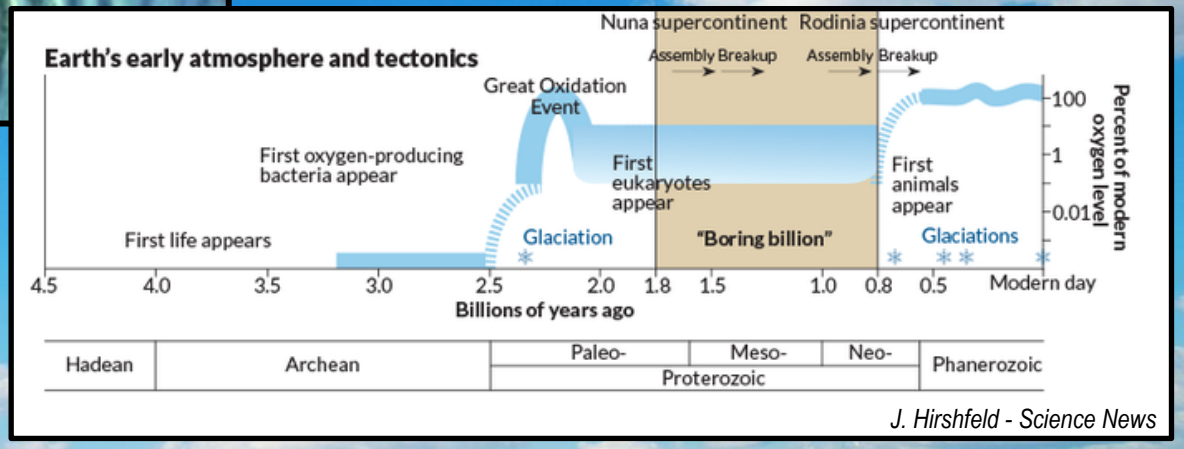


65 milhões de anos

Extinções

Extinções

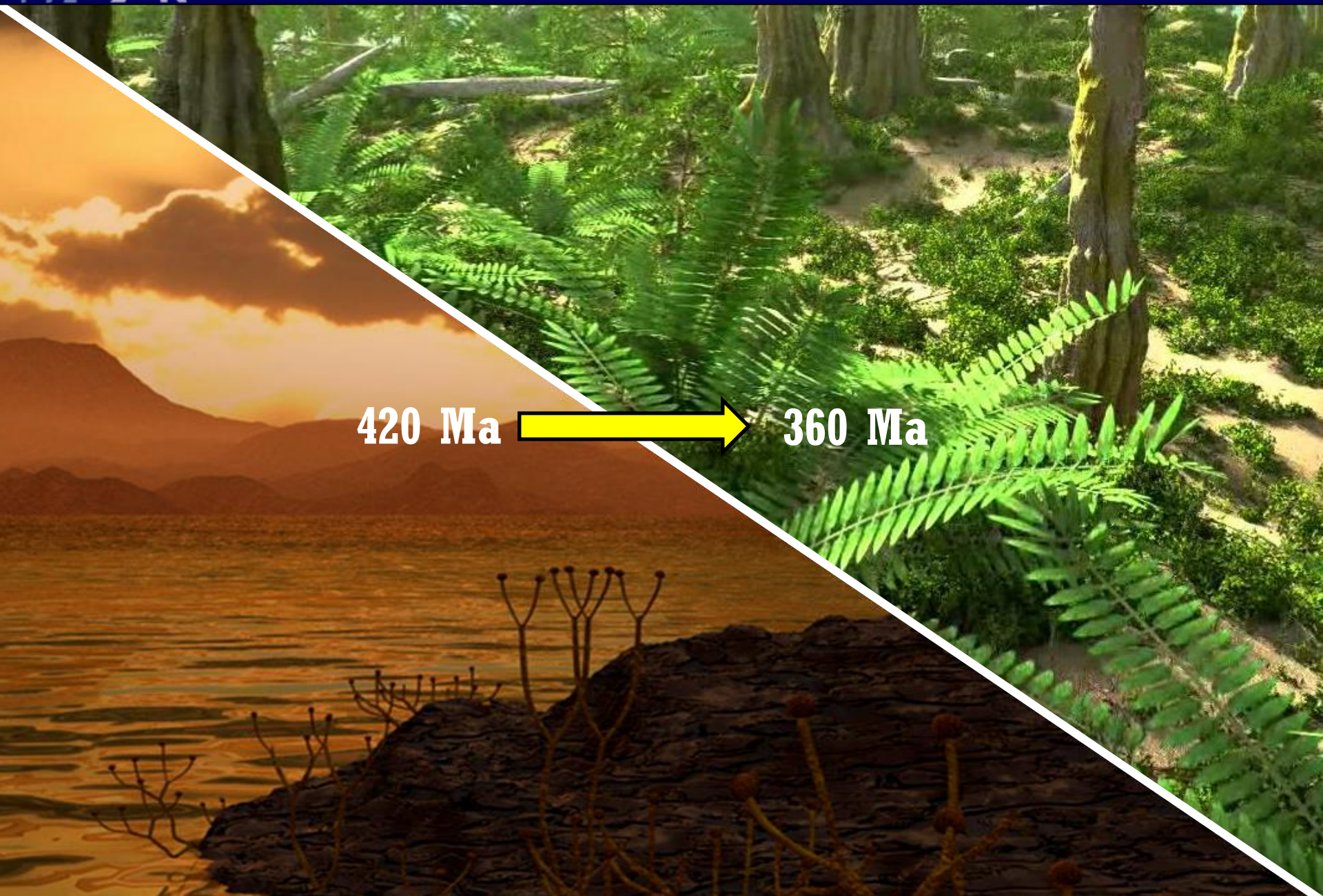




J. Hirshfeld - Science News

Extinções

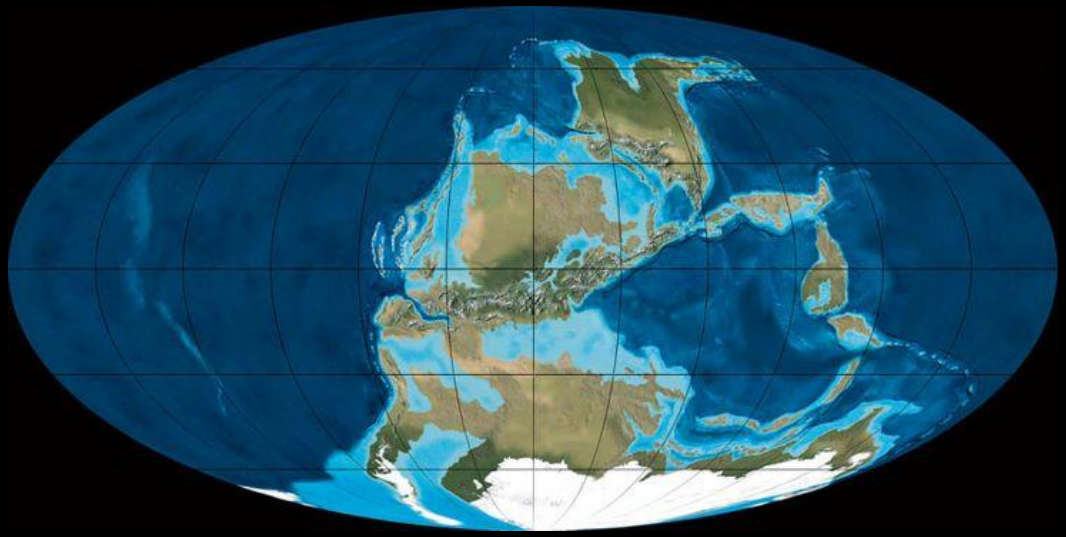
Extinções



Extinções


CO_2
CO_2
CO_2
CO_2
CO_2
Sequestro de carbono
Carbon Sequestration


R.I.P.
Devonian



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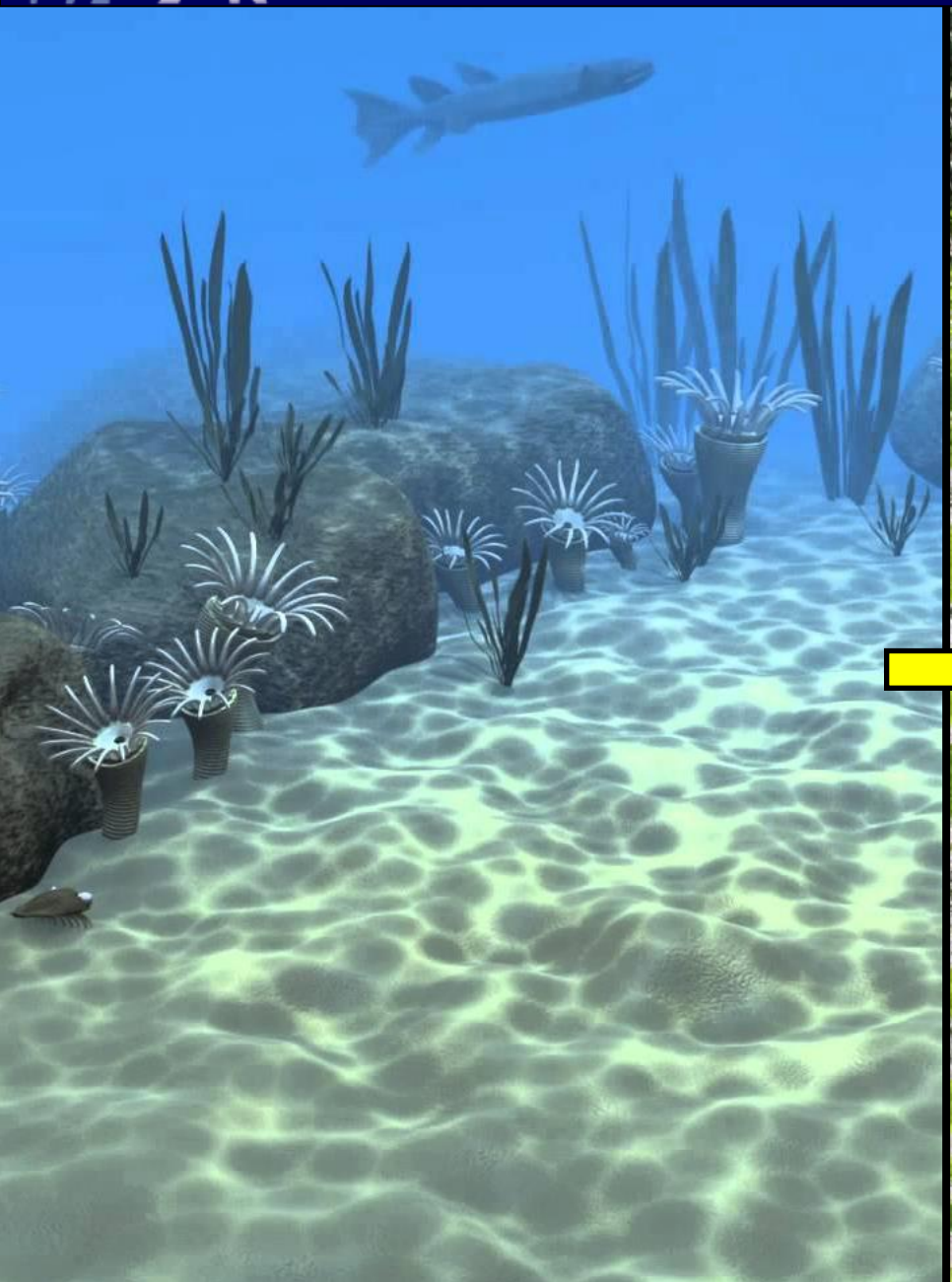

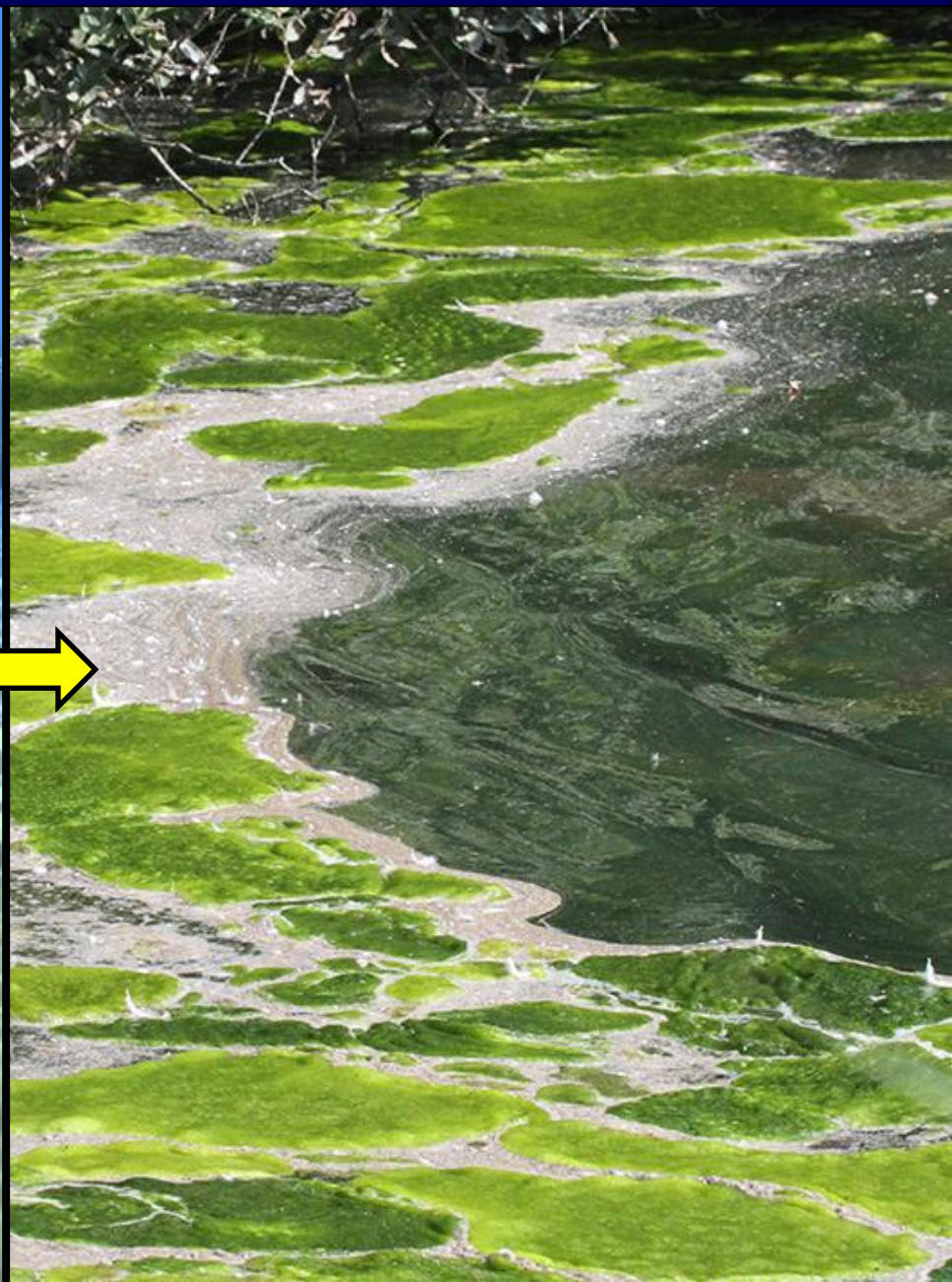

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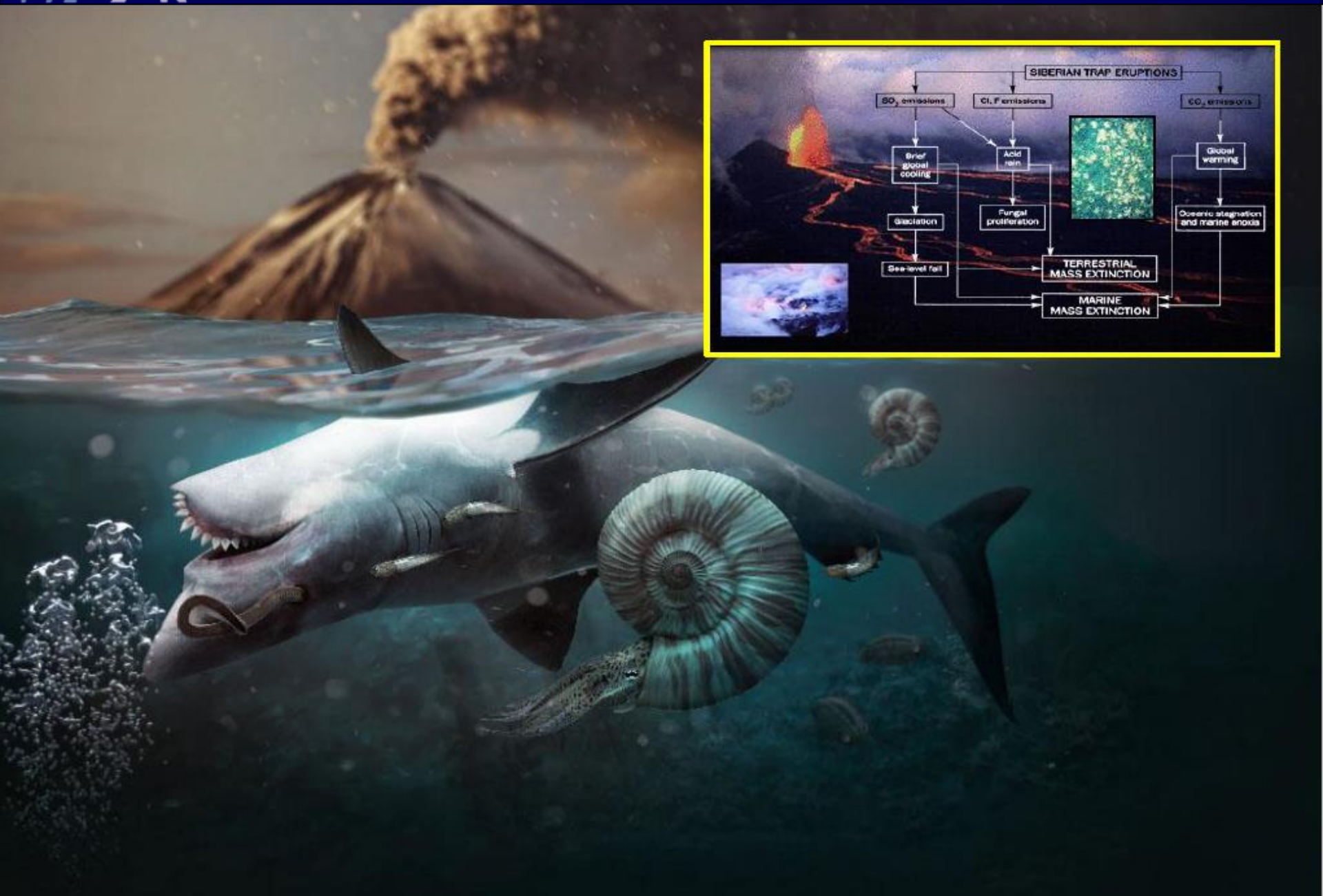
SIBERIAN TRAP ERUPTIONS
Cl, F emissions
Brief global cooling
Acid rain
Global warming
Glaciation
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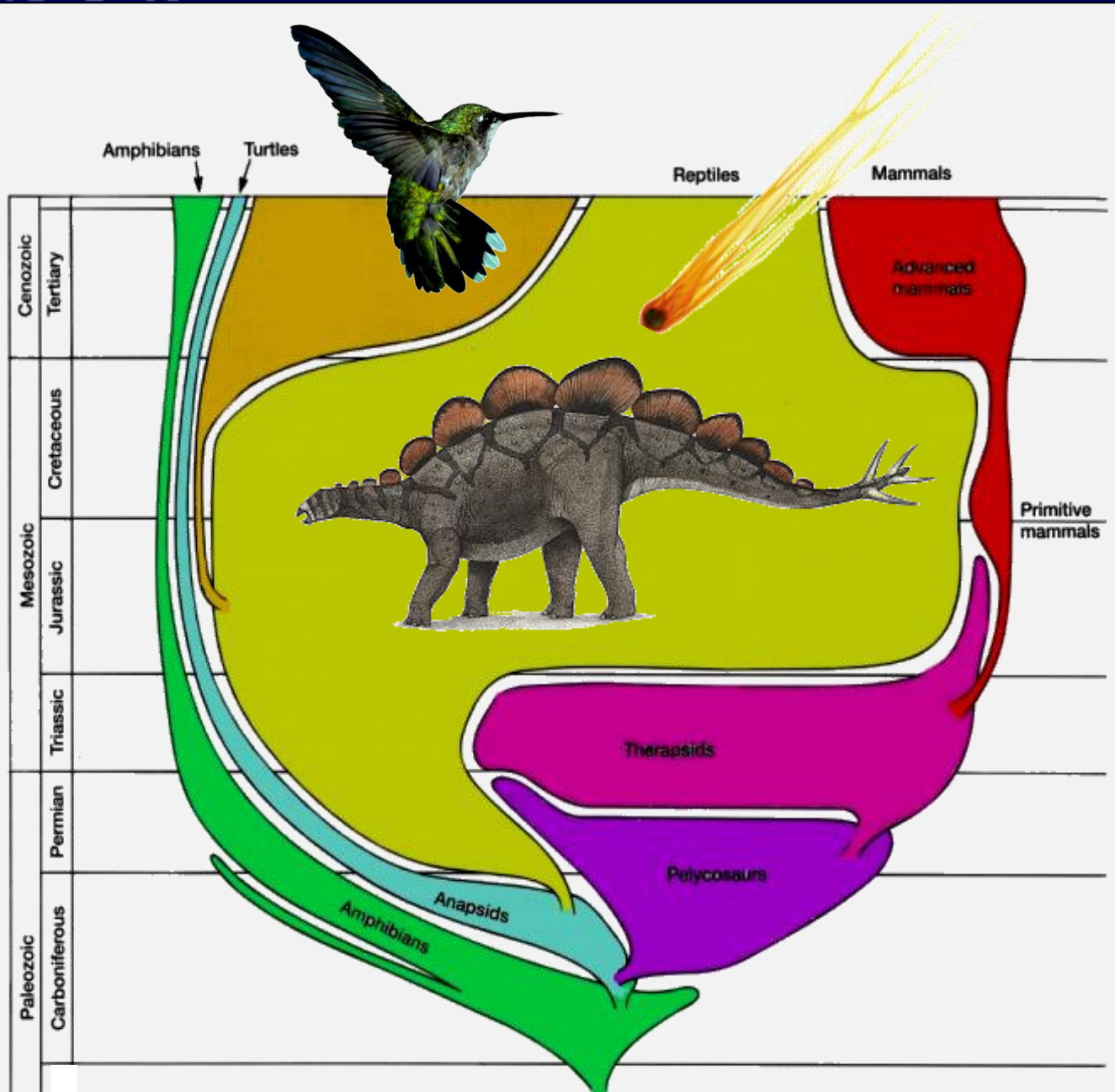
Oceanic stagnation and marine anoxia
Sea-level fall
TERRESTRIAL MASS EXTINCTION
MARINE MASS EXTINCTION

Extinções

Extinções


Amphibians
Turtles
Reptiles
Mammals
Cenozoic
Tertiary
Mesozoic
Cretaceous
Jurassic
Triassic
Paleozoic
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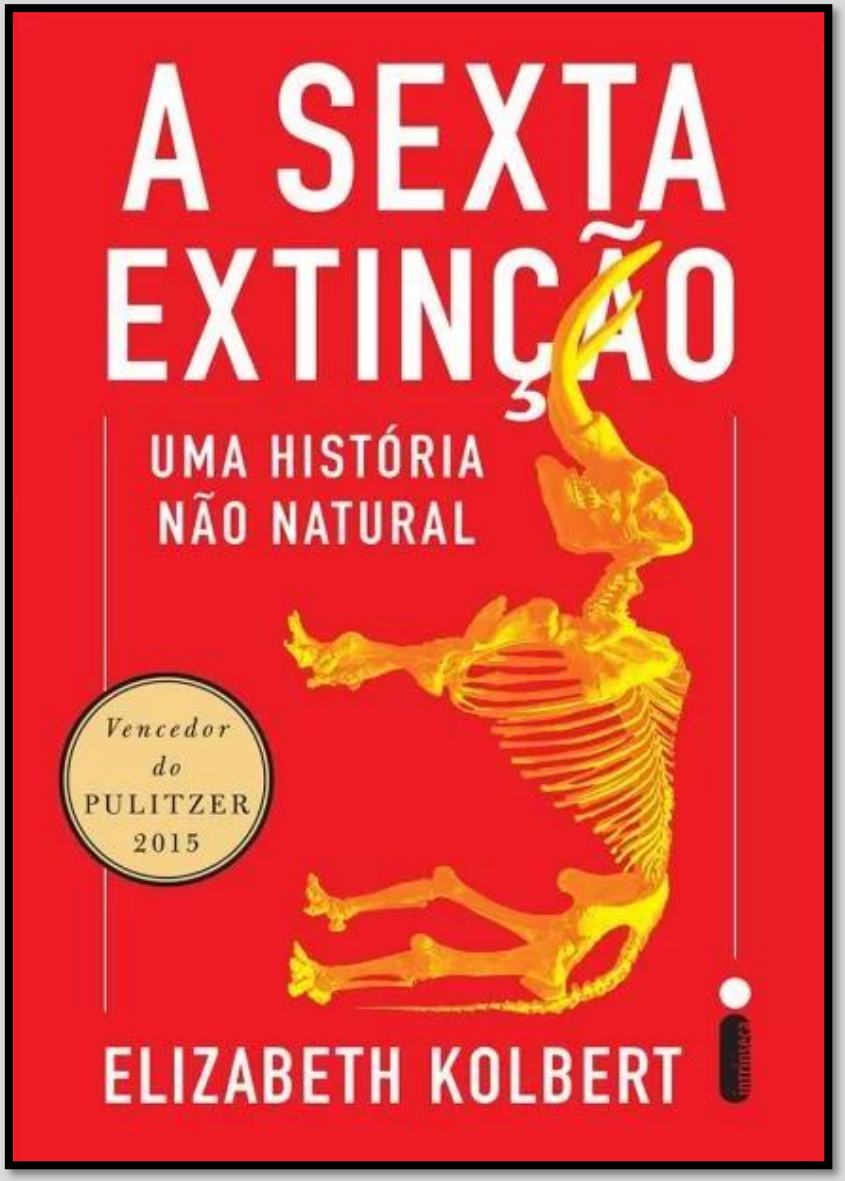
Advanced mammals
Primitive mammals
Therapsids
Pelycosaurs
Anapsids
Amphibians

Extinções

Extinções



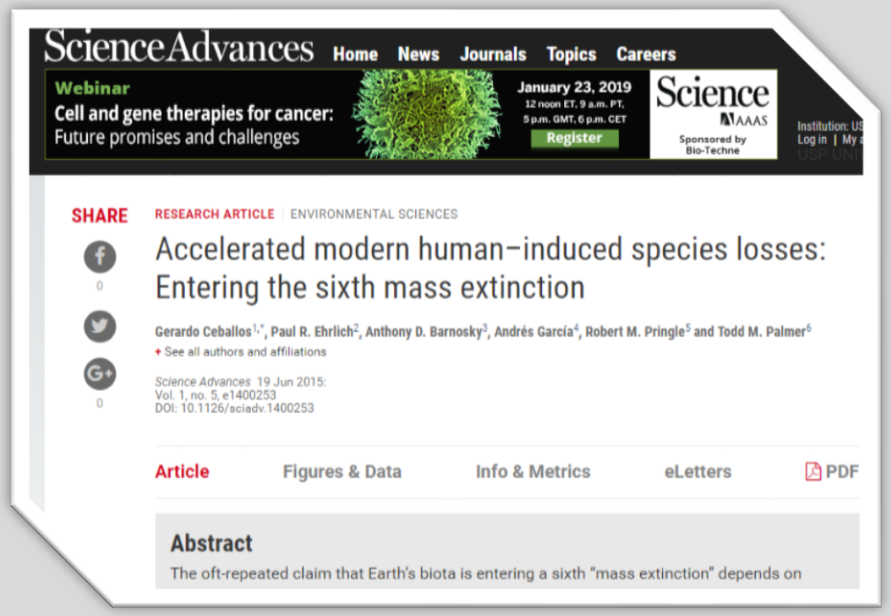
REVIEW

doi:10.1038/nature09678

Has the Earth's sixth mass extinction already arrived?

Anthony D. Barnosky[1,2,3], Nicholas Matzke[1], Susumu Tomiya[1,2,3], Guinevere O. U. Wogan[1,3], Brian Swartz[1,2], Tiago B. Quental[1,2]†, Charles Marshall[1,2], Jenny L. McGuire[1,2,3]†, Emily L. Lindsey[1,2], Kaitlin C. Maguire[1,2], Ben Mersey[1,4] & Elizabeth A. Ferrer[1,2]

Palaeontologists characterize mass extinctions as times when the Earth loses more than three-quarters of its species in a geologically short interval, as has happened only five times in the past 540 million years or so. Biologists now suggest that a sixth mass extinction may be under way, given the known species losses over the past few centuries and millennia. Here we review how differences between fossil and modern data and the addition of recently available palaeontological information influence our understanding of the current extinction crisis. Our results confirm that current extinction rates are higher than would be expected from the fossil record, highlighting the need for effective conservation measures.



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Accelerated modern human–induced species losses: Entering the sixth mass extinction

Gerardo Ceballos[1,*], Paul R. Ehrlich[2], Anthony D. Barnosky[3], Andrés García[4], Robert M. Pringle[5] and Todd M. Palmer[6]
+ See all authors and affiliations

Science Advances 19 Jun 2015:
Vol. 1, no. 5, e1400253
DOI: 10.1126/sciadv.1400253

Article | Figures & Data | Info & Metrics | eLetters | PDF

Abstract

The oft-repeated claim that Earth's biota is entering a sixth "mass extinction" depends on

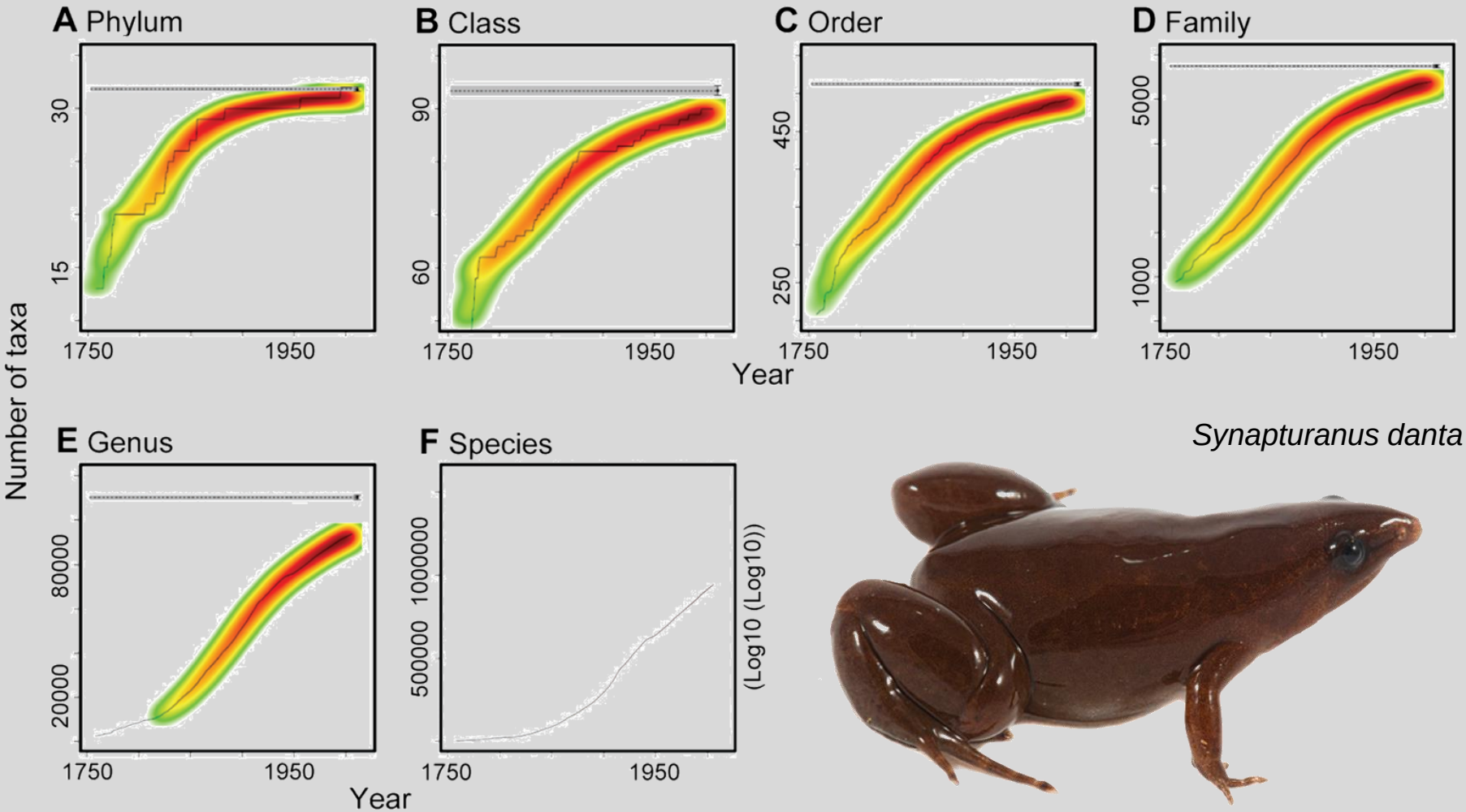
4 – Desmistificar conceitos fixistas que permeiam o discurso **ambientalista**

Perguntas:

1: Sabemos se o número de espécies está mesmo diminuindo?

2: É possível comparar essa possível diminuição com o registro fóssil?

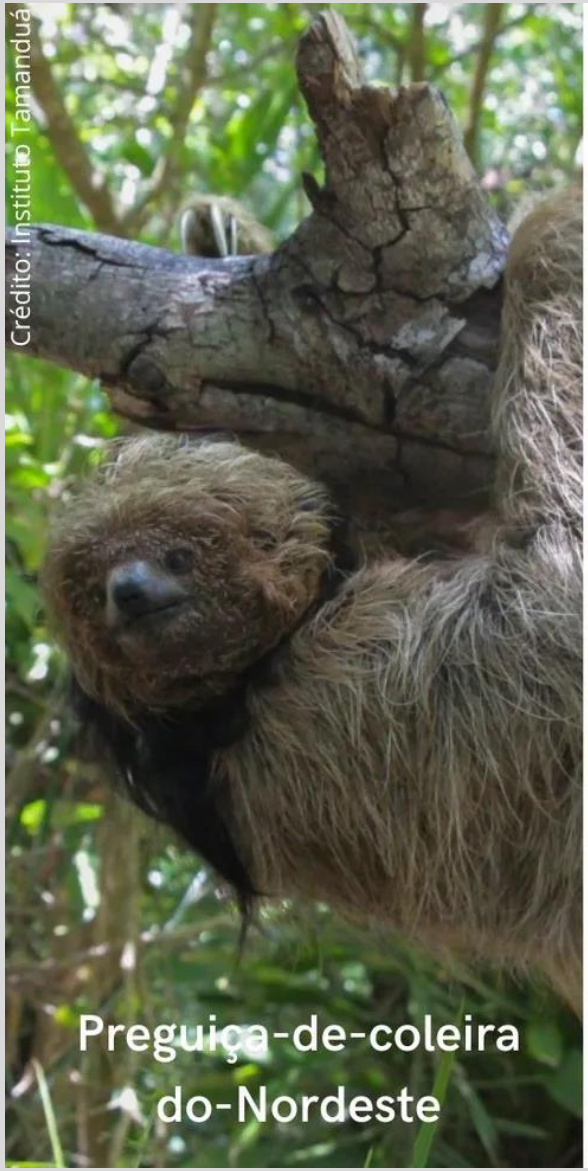
Perda e “surgimento” de espécies

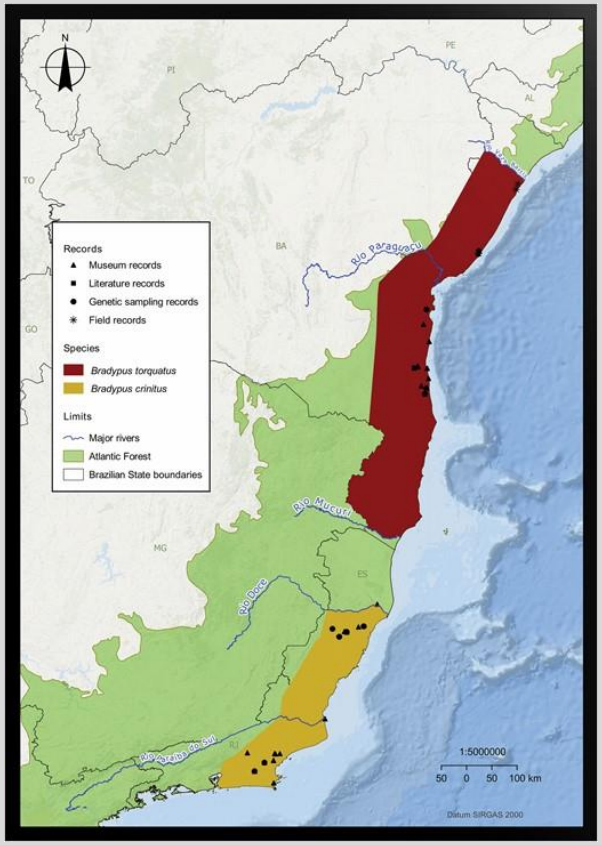


Synapturanus danta

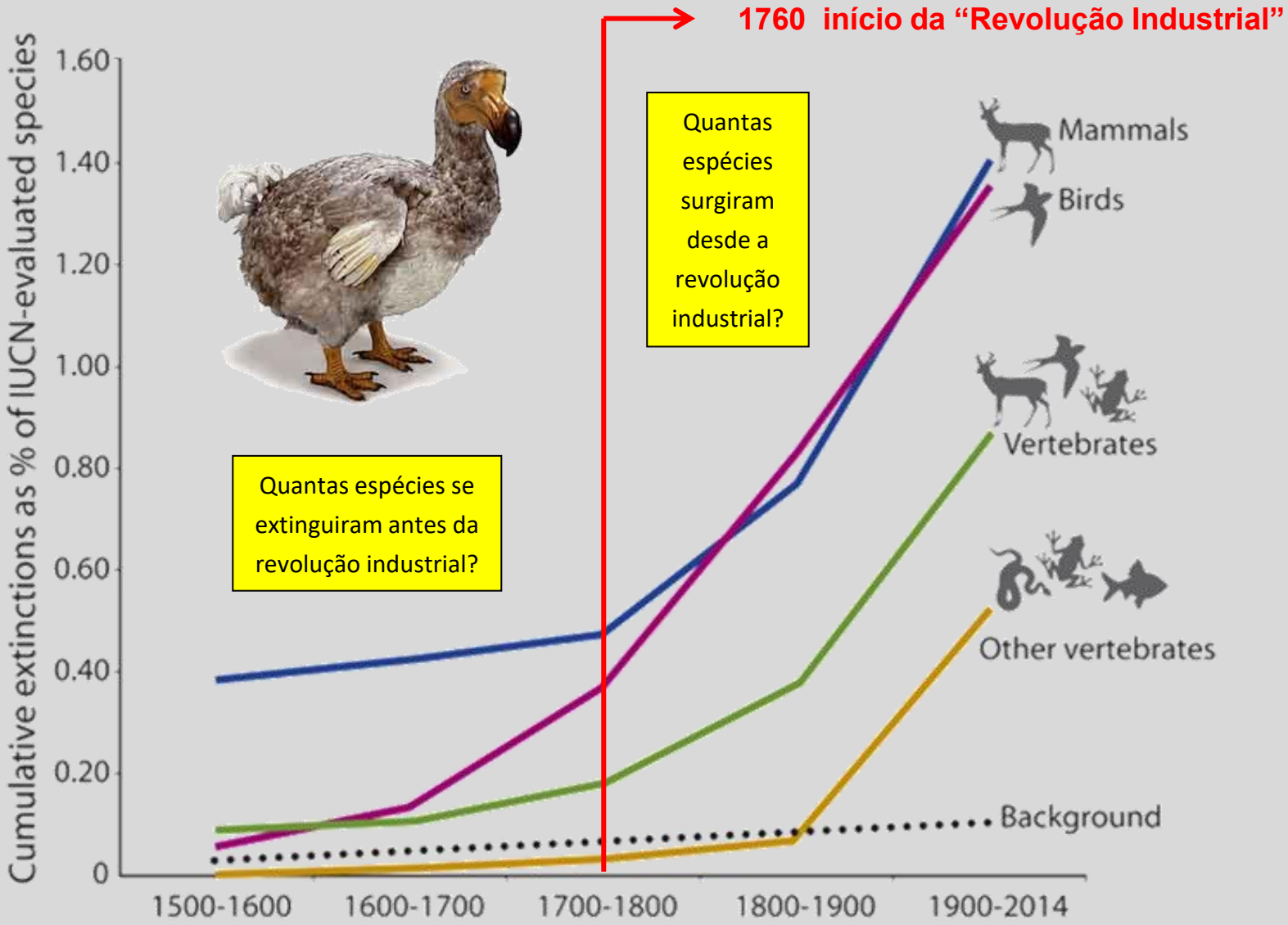
Mora et al. (2011)

Ambientalismo



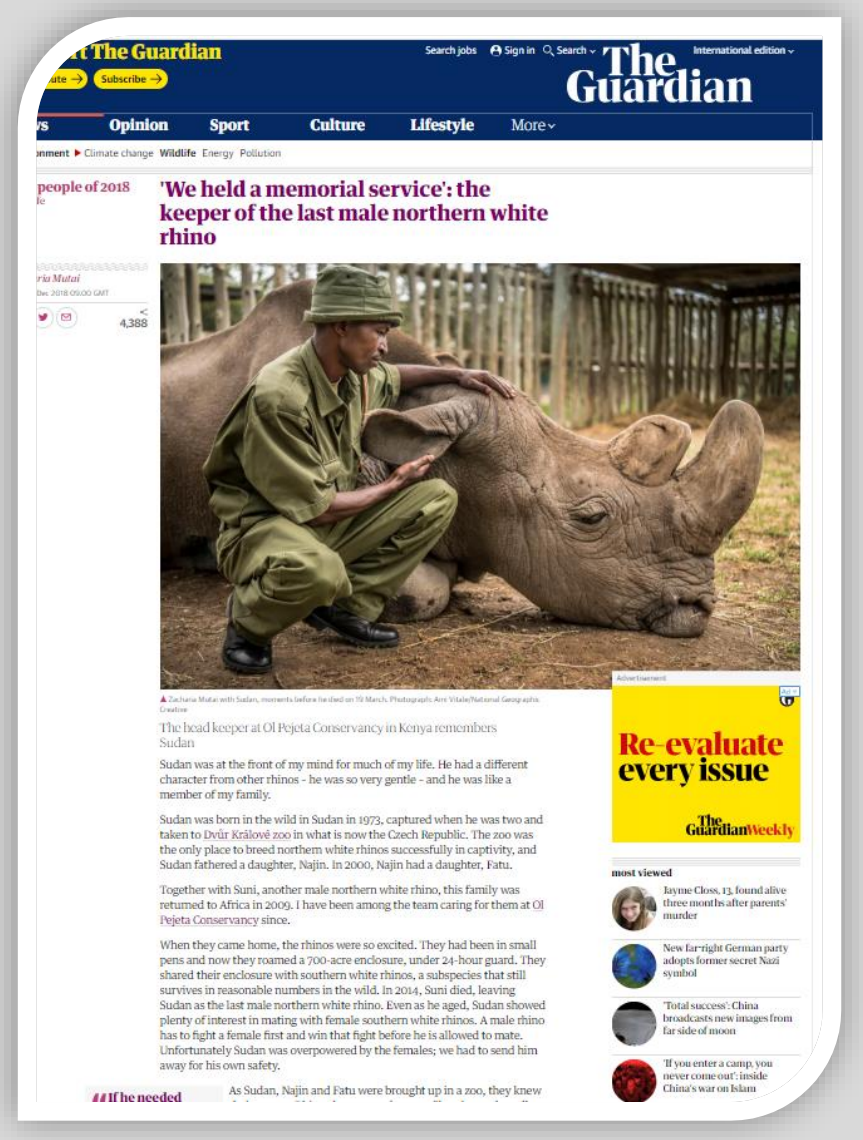


Ambientalismo



Barnosky et al. (2011)

Ambientalismo



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people of 2018

'We held a memorial service': the keeper of the last male northern white rhino

4,388

The head keeper at Ol Pejeta Conservancy in Kenya remembers Sudan

Sudan was at the front of my mind for much of my life. He had a different character from other rhinos – he was so very gentle – and he was like a member of my family.

Sudan was born in the wild in Sudan in 1973, captured when he was two and taken to Dvůr Králové zoo in what is now the Czech Republic. The zoo was the only place to breed northern white rhinos successfully in captivity, and Sudan fathered a daughter, Najin. In 2000, Najin had a daughter, Fatu.

Together with Suni, another male northern white rhino, this family was returned to Africa in 2009. I have been among the team caring for them at Ol Pejeta Conservancy since.

When they came home, the rhinos were so excited. They had been in small pens and now they roamed a 700-acre enclosure, under 24-hour guard. They shared their enclosure with southern white rhinos, a subspecies that still survives in reasonable numbers in the wild. In 2014, Suni died, leaving Sudan as the last male northern white rhino. Even as he aged, Sudan showed plenty of interest in mating with female southern white rhinos. A male rhino has to fight a female first and win that fight before he is allowed to mate. Unfortunately Sudan was overpowered by the females; we had to send him away for his own safety.

As Sudan, Najin and Fatu were brought up in a zoo, they knew

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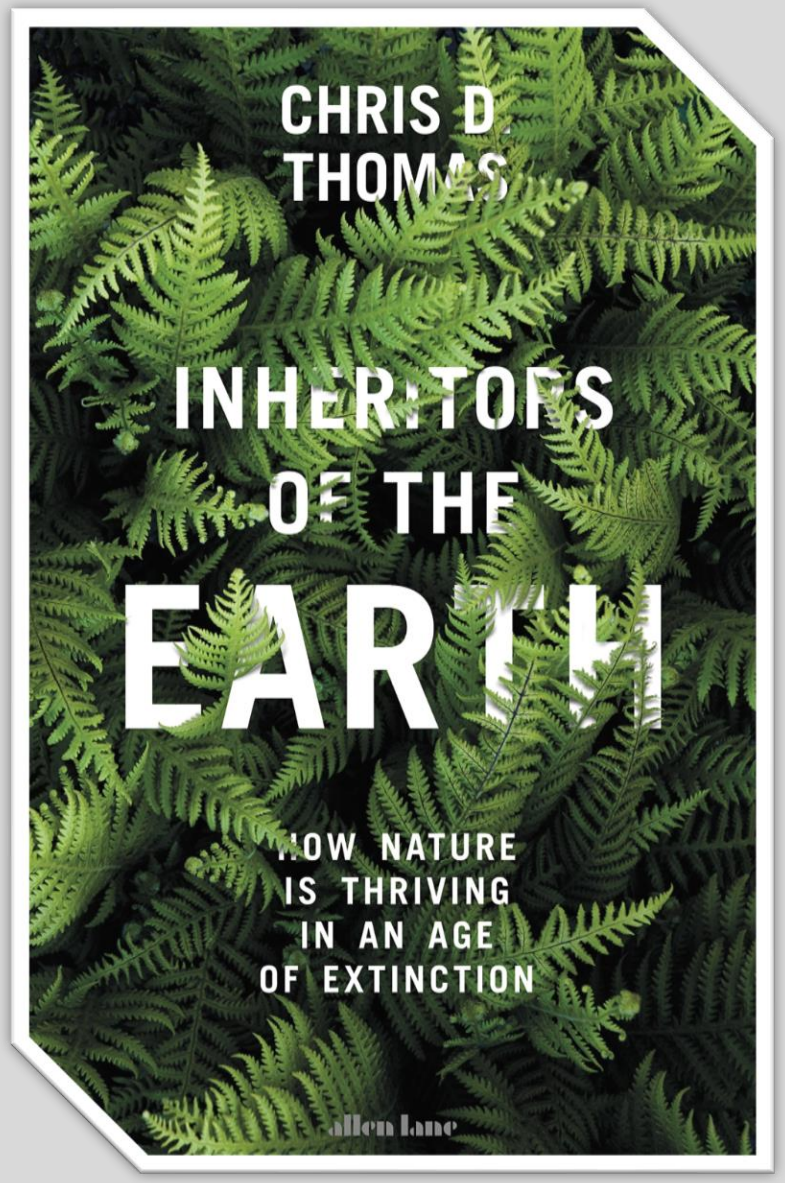


Global meta-analysis reveals no net change in local-scale plant biodiversity over time

Mark Vellend[a,1], Lander Baeten[b,c], Isla H. Myers-Smith[a,d], Sarah C. Elmendorf[e], Robin Beauséjour[a], Carissa D. Brown[a], Pieter De Frenne[b], Kris Verheyen[b], and Sonja Wipf[f]

[a]Département de Biologie, Université de Sherbrooke, Sherbrooke, QC, Canada J1K 2R1; [b]Department of Forest and Water Management, Forest and Nature Lab, Ghent University, BE-9090 Melle-Gontrode, Belgium; [c]Department of Biology, Terrestrial Ecology Unit, Ghent University, BE-9000 Gent, Belgium; [d]School of GeoSciences, University of Edinburgh, Edinburgh EH9 3JW, United Kingdom; [e]National Ecological Observatory Network, Boulder, CO 80301; and [f]WSL Institute for Snow and Avalanche Research SLF, CH-7260 Davos, Switzerland

Edited by Peter M. Kareiva, The Nature Conservancy, Seattle, WA, and approved October 1, 2013 (received for review July 9, 2013)

Global biodiversity is in decline. This is of concern for aesthetic and ethical reasons, but possibly also for practical reasons, as suggested by experimental studies, mostly with plants, showing that biodiversity reductions in small study plots can lead to compromised ecosystem function. However, inferring that ecosystem functions will decline due to biodiversity loss in the real world rests on the untested assumption that such loss is actually occurring at these small scales in nature. Using a global database of 168 published studies and >16,000 nonexperimental, local-scale vegetation plots, we show that mean temporal change in species diversity over periods of 5–261 y is not different from zero, with increases at least as likely as declines over time. Sites influenced primarily by plant species' invasions showed a tendency for declines in species richness, whereas sites undergoing postdisturbance succession showed increases in richness over time. Other distinctions among studies had little influence on temporal richness trends. Although maximizing diversity is likely important for maintaining ecosystem function in intensely managed systems such as restored grasslands or tree plantations, the clear lack of any general tendency for plant biodiversity to decline at small scales in nature directly contradicts the key assumption linking experimental results to ecosystem function as a motivation for biodiversity conservation in nature. How often real world changes in the diversity and composition of plant communities at the local scale cause ecosystem function to deteriorate, or actually to improve, remains unknown and is in critical need of further study.

spatial scale | permanent plots | ecosystem services

A huge number of experiments has investigated the effects of species diversity (typically the number of species) on ecosystem function in small study plots (≤400 m^2), with a general consensus emerging that processes such as primary productivity and nutrient uptake increase as a function of the number of species in a community (1–6). These experiments thus appear to provide a powerful motivation for biodiversity conservation, given that ecosystem functions underpin many ecosystem services from which people benefit, such as forage production and carbon sequestration (1). However, the link between diversity-function experiments and the widespread argument that ecosystem function should motivate biodiversity conservation (7–11) hinges on the untested assumption that global biodiversity declines apply to the small scale (2). Experimental studies typically focus on small spatial scales not only for practical reasons, but also because organisms, plants in particular, typically interact over short distances (12), and so it is at the small scale that biodiversity is most likely to have an important impact on the functioning of ecosystems (13–15).

Habitat loss, invasive species, and overexploitation, among other factors, have accelerated global species' extinction well beyond the background rate (16–18), and it is tempting to assume that a global decline in biodiversity is necessarily accompanied by declines at smaller spatial scales. However, this is not a logical inevitability because, unlike other key variables involved in global environmental change, biodiversity at large scales (often termed gamma diversity) is not an additive function of biodiversity at smaller scales (alpha diversity). If global temperature or atmospheric CO_2 concentrations, for example, are increasing at the global scale, the net change over time within local areas must, on average, be positive. However, because local species losses may be accompanied by immigration of species from elsewhere, decreases in biodiversity at the global scale do not necessarily result in any biodiversity change at smaller scales (16, 19, 20). Here we present a global synthesis testing for directional changes in local-scale biodiversity of terrestrial plants, which have been the focus of most well-replicated biodiversity-ecosystem function (BDEF) experiments. We focus on the most commonly studied component of biodiversity—species diversity—estimated by metrics that reflect the number of species (richness) and/or the equitability of their abundances (indices of diversity or evenness).

Results and Discussion

We conducted a systematic global meta-analysis of plant species diversity change over time in >16,000 plots (median plot area = 44 m^2) from all major vegetation types (Fig. 1), including areas under profound and direct human influence (e.g., urban areas or pastures) and more pristine areas. Effect sizes were calculated as the log ratio of species diversity [e.g., species richness (SR)] in the year of the final survey ($Y2$) and the initial survey ($Y1$) divided by

Significance

A major advance of the last 20 y at the interface of biological, environmental, and conservation sciences has been the demonstration that plant biodiversity positively influences ecosystem function. Linking these results to applied conservation efforts hinges on the assumption that biodiversity is actually declining at the local scale at which diversity–function relationships are strongest. Our compilation and analysis of a global database of >16,000 repeat survey vegetation plots from habitats across the globe directly contradict this assumption. We find no general tendency for local-scale plant species diversity to decline over the last century, calling into question the widespread use of ecosystem function experiments to argue for the importance of biodiversity conservation in nature.

Author contributions: M.V. and I.H.M.-S. designed research; M.V., L.B., I.H.M.-S., S.C.E., R.B., C.D.B., P.D.F., K.V., and S.W. performed research; L.B. and S.C.E. analyzed data; and M.V., L.B., I.H.M.-S., and S.C.E. wrote the paper.

The authors declare no conflict of interest.

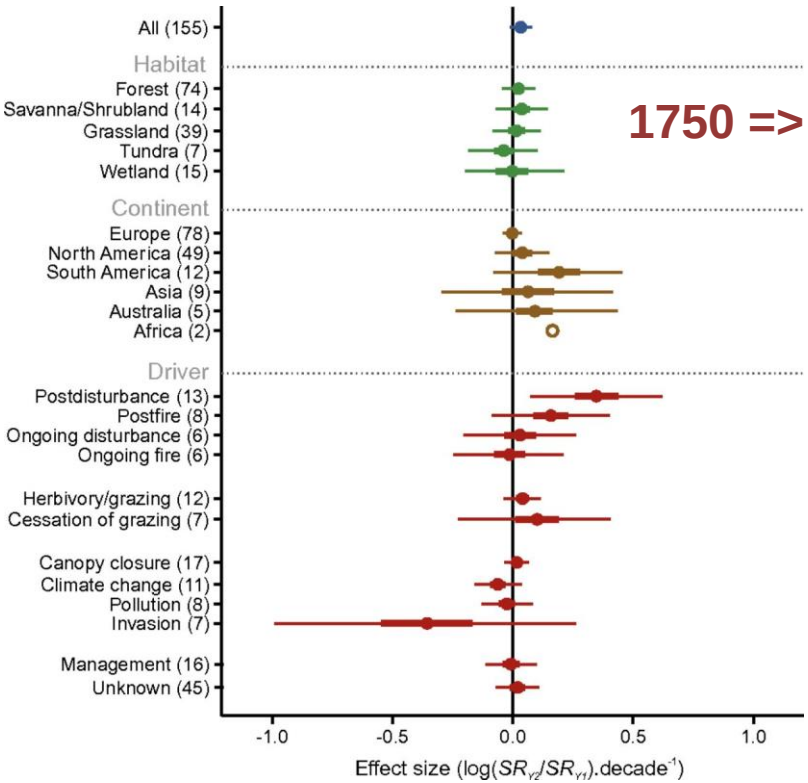
This article is a PNAS Direct Submission.

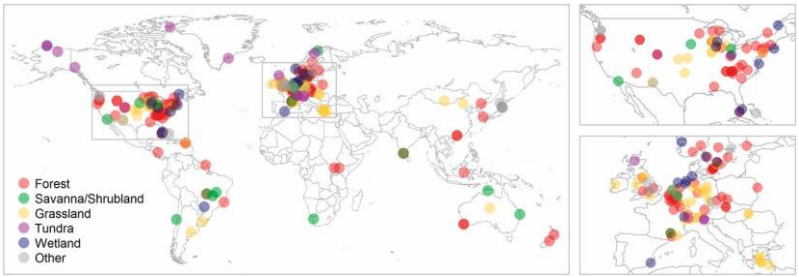
Data deposition: Our database is provided as Dataset S1.

See Commentary on page 19187.

[1]To whom correspondence should be addressed. E-mail: mark.vellend@usherbrooke.ca.

This article contains supporting information online at www.pnas.org/lookup/suppl/doi:10.1073/pnas.1312779110/-/DCSupplemental.





Vellend et al. 2013

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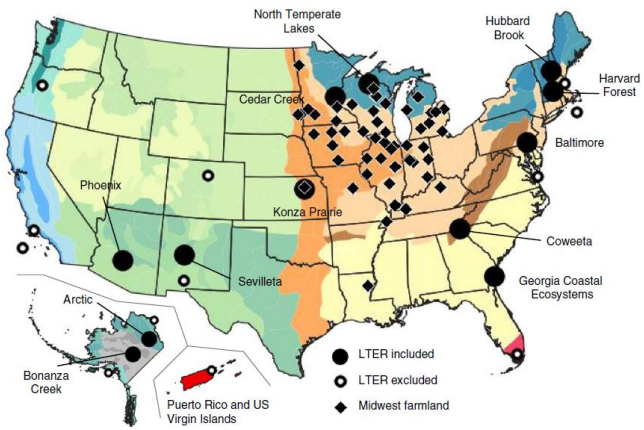
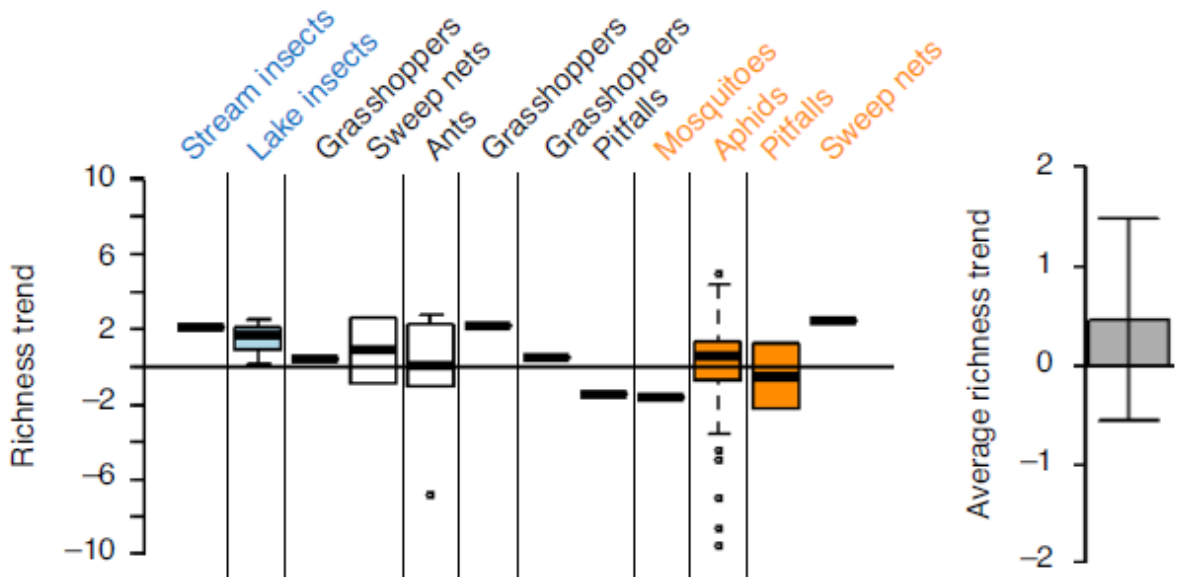
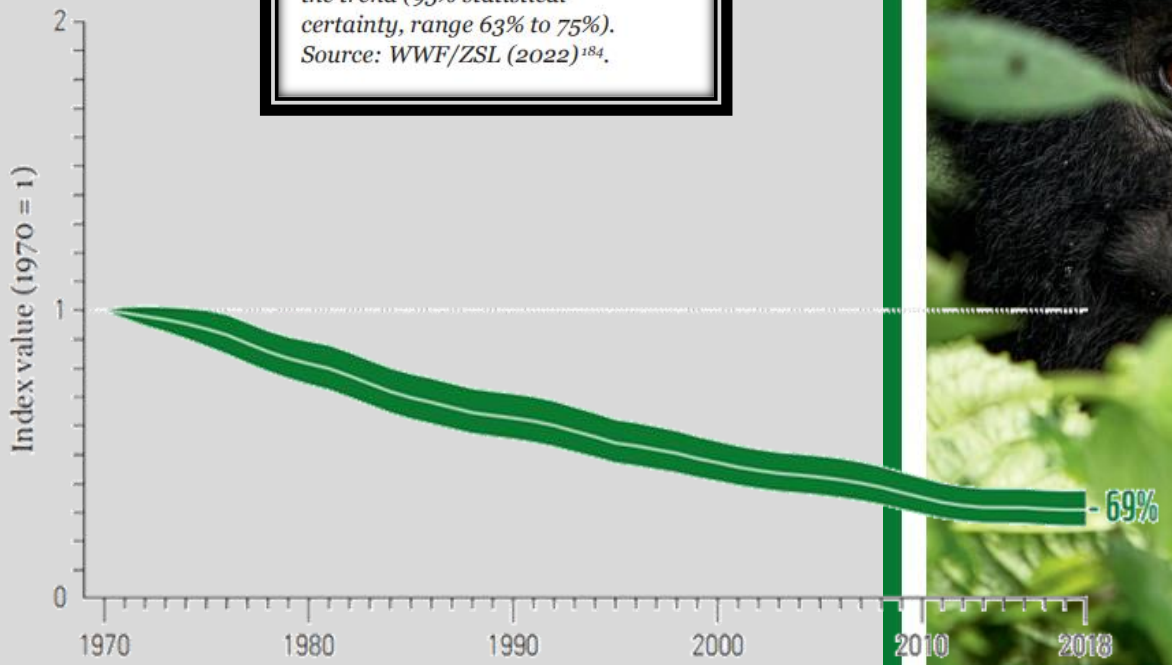




Crossley et al. 2020

Ambientalismo

Figure 3: The global Living Planet Index (1970 to 2018)
The average change in relative abundance of 31,821 populations, representing 5,230 species monitored across the globe, was a decline of 69%. The white line shows the index values and the shaded areas represent the statistical certainty surrounding the trend (95% statistical certainty, range 63% to 75%). Source: WWF/ZSL (2022)[184].



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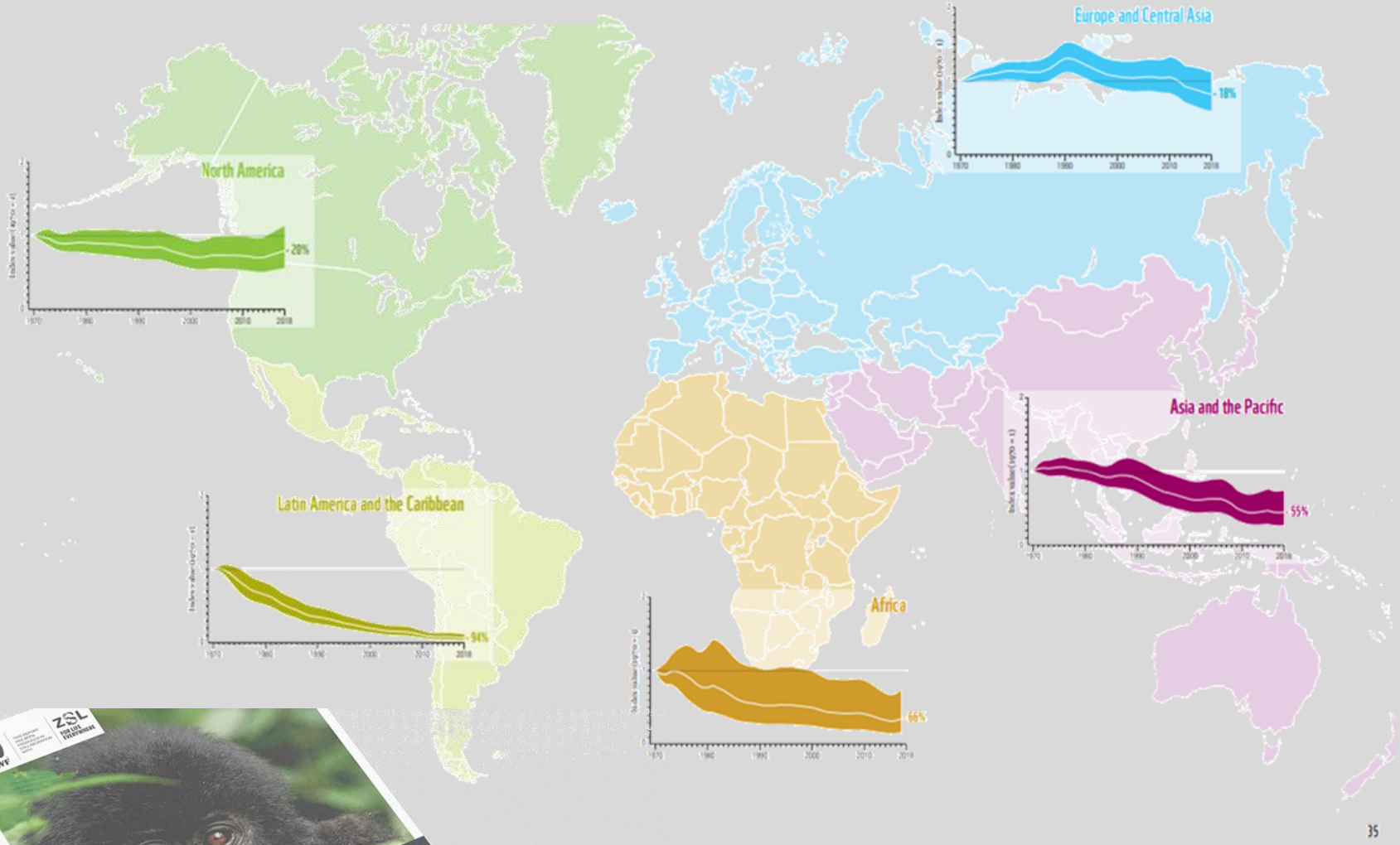


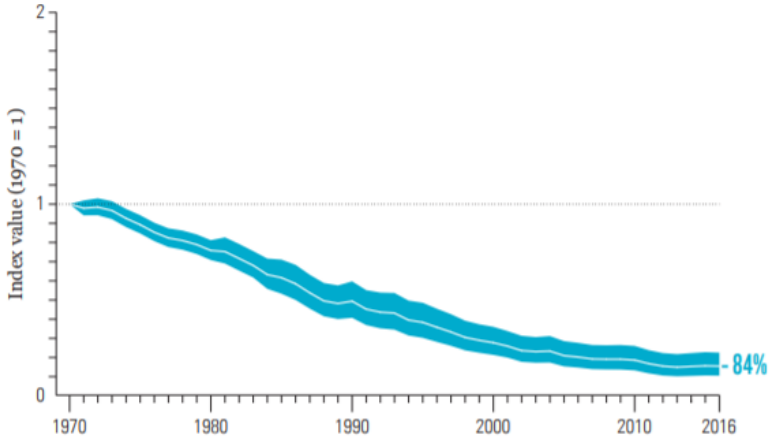
Ambientalismo

Figure 6: The Freshwater Living Planet Index: 1970 to 2016

The average abundance of 3,741 freshwater populations, representing 944 species, monitored across the globe declined by 84% on average. The white line shows the index values and the shaded areas represent the statistical certainty surrounding the trend (range: -89% to -77%)[107].

Key

- Freshwater Living Planet Index
- Confidence limits



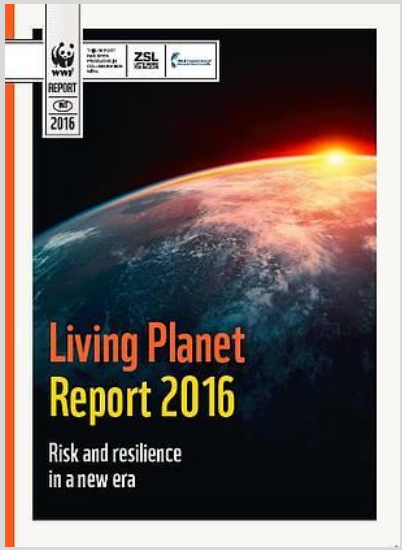


Fig. 9: **TERRESTRIAL LIVING PLANET INDEX,** 1970–2005

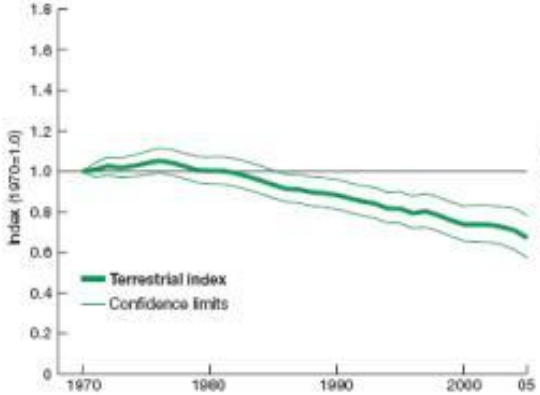


Fig. 10: **MARINE LIVING PLANET INDEX,** 1970–2005

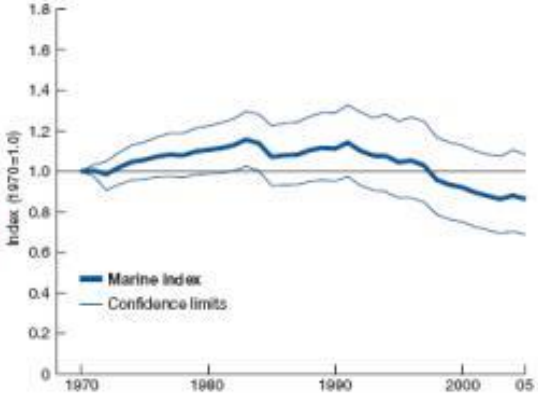
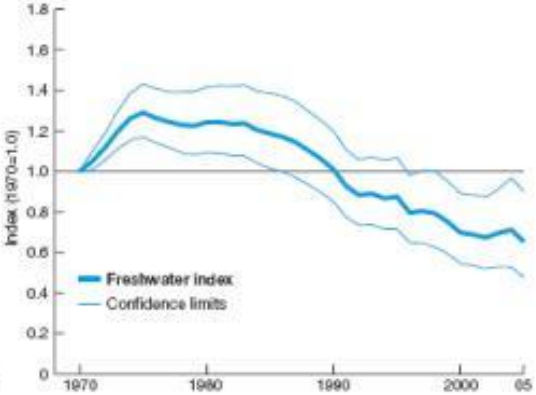


Fig. 11: **FRESHWATER LIVING PLANET INDEX,** 1970–2005



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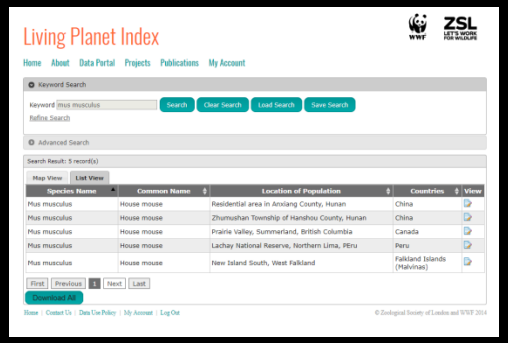

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Advanced Search

Search Result: 5 record(s)

Map View | List View

Species Name	Common Name	Location of Population	Countries	View
Mus musculus	House mouse	Residential area in Anxiang County, Hunan	China	
Mus musculus	House mouse	Zhumushan Township of Hanshou County, Hunan	China	
Mus musculus	House mouse	Prairie Valley, Summerland, British Columbia	Canada	
Mus musculus	House mouse	Lachay National Reserve, Northern Lima, Peru	Peru	
Mus musculus	House mouse	New Island South, West Falkland	Falkland Islands (Malvinas)	

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Refine Search

Advanced Search

Search Result: 50 record(s)

Map View | List View

Species Name	Common Name	Location of Population	Countries	View
Panthera tigris	Tiger	Fujian province and adjacent areas, China	China	
Panthera tigris	Tiger	Malay Peninsula, Malaysia	Malaysia	
Panthera tigris	Tiger	Sumatra, Indonesia	Indonesia	
Panthera tigris	Tiger	India, all States	India	
Panthera tigris	Tiger	Sikhote-Alin Zapovednik, Russia	Russian Federation	
Panthera tigris	Tiger	Russian Far East	Russian Federation	
Panthera tigris	Tiger	Upland Thung Yai Naresuan Wildlife Sanctuary	Thailand	
Panthera tigris	Tiger	Bardia National Park, Nepal	Nepal	
Panthera tigris	Tiger	Chilla Range, Rajaji National Park, India	India	
Panthera tigris	Tiger	Lazovsky Zapovednik, Russian Far East	Russian Federation	
Panthera tigris	Tiger	Lazovski Raion, Russian Far East	Russian Federation	
Panthera tigris	Tiger	Ussurisk Zapovednik, Russian Far East	Russian Federation	
Panthera tigris	Tiger	Iman, Russian Far East	Russian Federation	
Panthera tigris	Tiger	Bikin, Russian Far East	Russian Federation	
Panthera tigris	Tiger	Borisovskoe Plateau, Russian Far East	Russian Federation	
Panthera tigris	Tiger	Sandagou, Russian Far East	Russian Federation	
Panthera tigris	Tiger	Khor, Russian Far East	Russian Federation	
Panthera tigris	Tiger	Botchinski Zapovednik, Russian Far East	Russian Federation	
Panthera tigris	Tiger	Bolsho-Khekhtsirsky Zapovednik, Russian Far East	Russian Federation	
Panthera tigris	Tiger	Tigrini Dom, Russian Far East	Russian Federation	
Panthera tigris	Tiger	Mataiski Zakaznik, Russian Far East	Russian Federation	
Panthera tigris	Tiger	Ussuriski Raion, Russian Far East	Russian Federation	
Panthera tigris	Tiger	Sikhote Alin Zapovednik, Russian Far East	Russian Federation	
Panthera tigris	Tiger	Sineya, Russian Far East	Russian Federation	
Panthera tigris	Tiger	Terney Hunting Lease, Russian Far East	Russian Federation	
Panthera tigris	Tiger	Rajaji, Uttarackhand	India	
Panthera tigris	Tiger	Corbett, Uttarakhand, India	India	
Panthera tigris	Tiger	Dudhwa-Kheri-Pilibhit, Uttar Pradesh, India	India	
Panthera tigris	Tiger	Suhelwa, Uttar Pradesh, India	India	
Panthera tigris	Tiger	Sohagibarwa-Valmiki, Uttar Pradesh, Bihar	India	
Panthera tigris	Tiger	Rajasthan, India	India	
Panthera tigris	Tiger	Madhya Pradesh, India	India	
Panthera tigris	Tiger	Maharashtra, India	India	
Panthera tigris	Tiger	Chhattisgarh, India	India	
Panthera tigris	Tiger	Odisha, India	India	
Panthera tigris	Tiger	Andhra Pradesh	India	
Panthera tigris	Tiger	Karnataka, India	India	
Panthera tigris	Tiger	Tamil Nadu	India	
Panthera tigris	Tiger	Kerala, India	India	
Panthera tigris	Tiger	Assam, India	India	
Panthera tigris	Tiger	Mizoram, India	India	
Panthera tigris	Tiger	Huai Kha Kaeng Wildlife Sanctuaries	Thailand	
Panthera tigris	Tiger	Sumatra, Indonesia	Indonesia	
Panthera tigris	Tiger	Russian Far East	Russian Federation	
Panthera tigris	Tiger	Western sector, Chitwan National Park, Nepal	Nepal	
Panthera tigris	Tiger	Heilongjiang Province	China	
Panthera tigris	Tiger	Nagarahole reserve, Karnataka State, India	India	
Panthera tigris	Tiger	Panna tiger reserve, India	India	
Panthera tigris	Tiger	Bukit Barisan Selatan National Park	Indonesia	
Panthera tigris	Tiger	Huichun National Nature Reserve, eastern Jilin Province	China	

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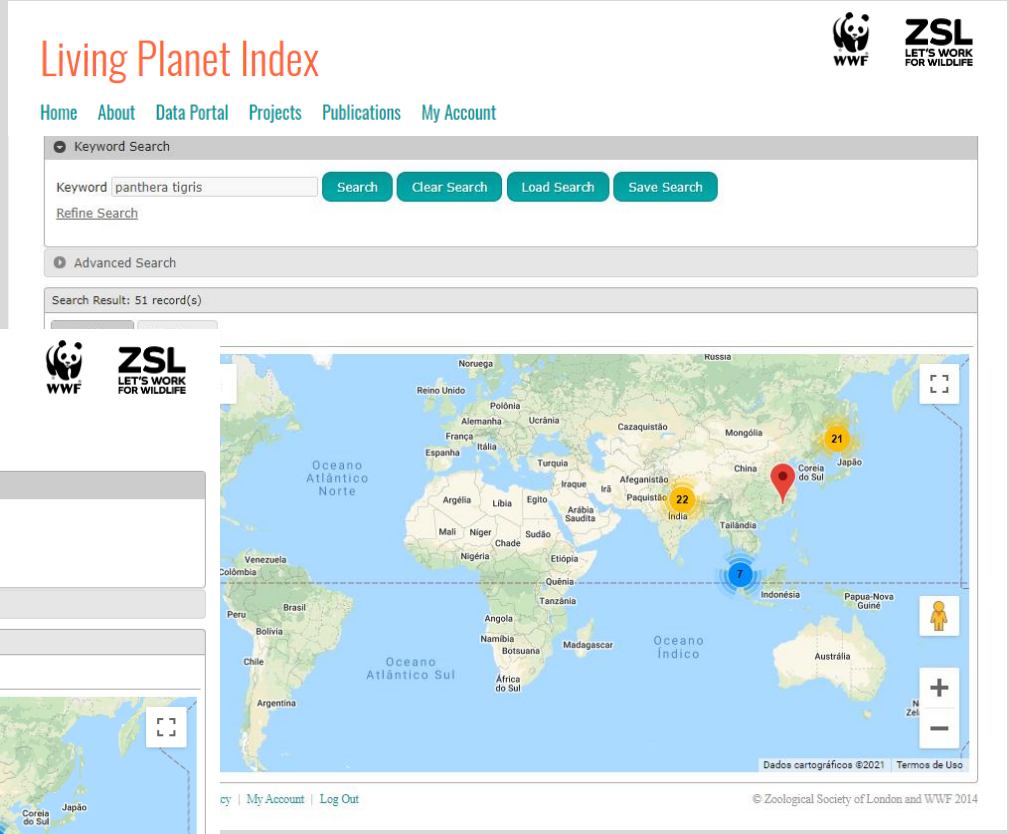
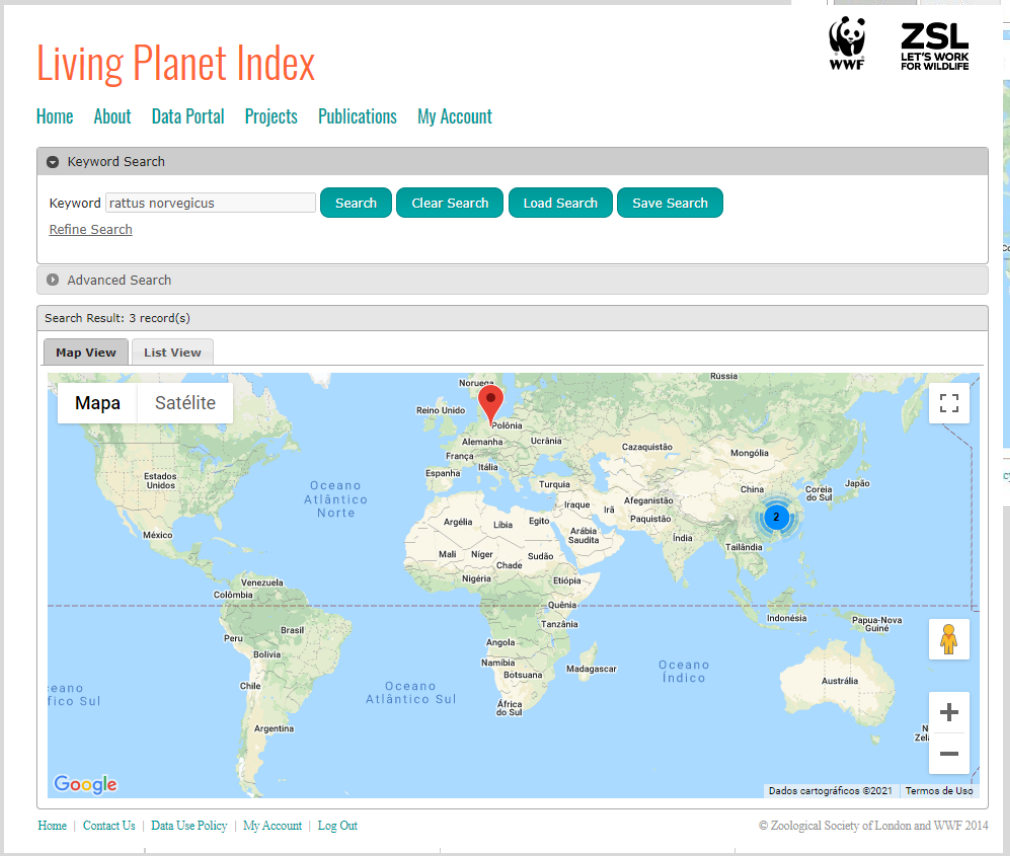
Panthera tigris =>





<= Rattus norvegicus

Ambientalismo

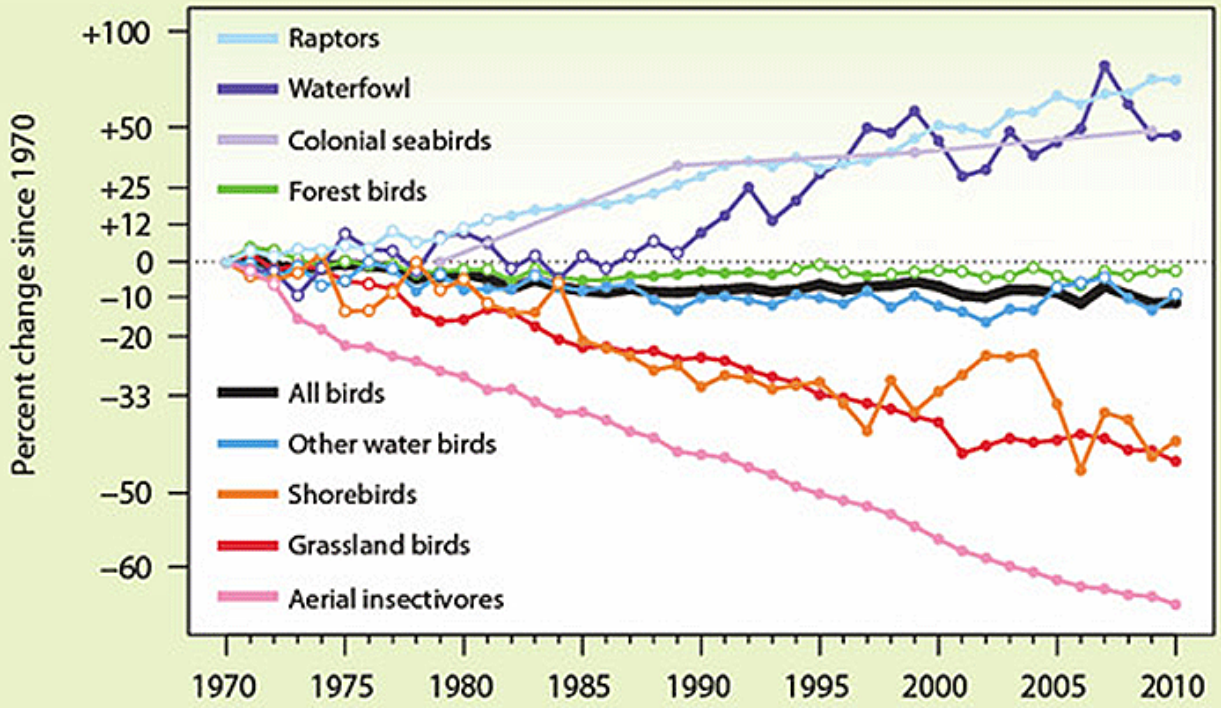
O GLOBO | Um só planeta | ASSINE

Um só planeta

Raias gigantes ameaçadas de extinção vivem na Baía de Guanabara e quantidade em meio a poluição impressiona biólogos

Ainda não existe explicação para tamanha concentração numa área tão castigada por décadas de poluição e descaso.

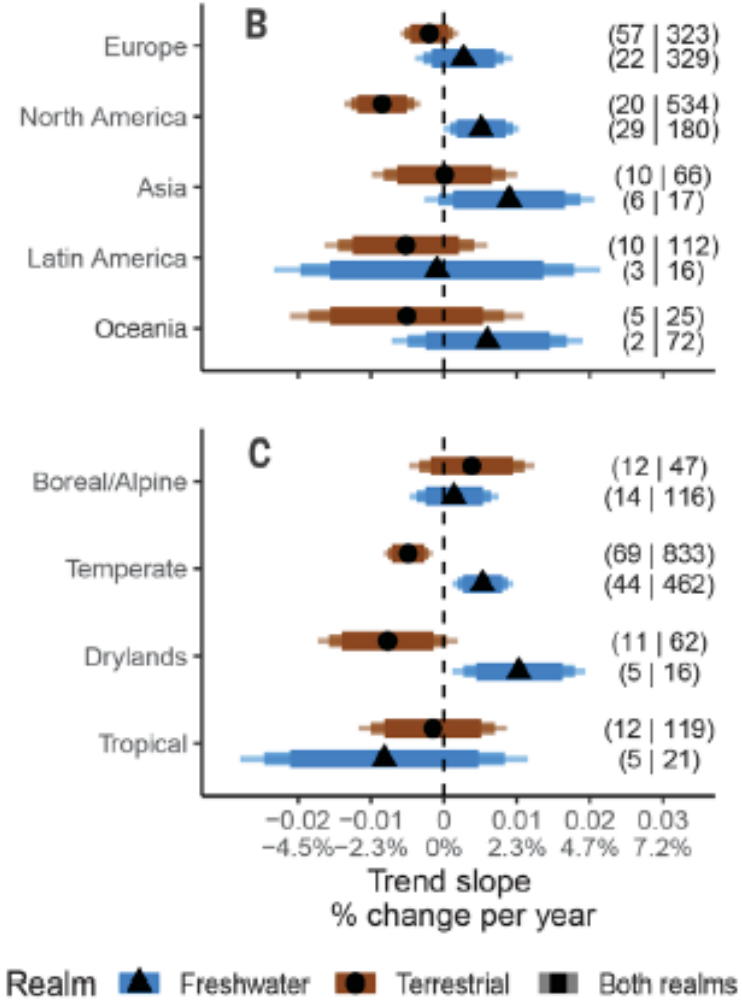
Ambientalismo



Indicators of the national population status of all regularly occurring native bird species in Canada and eight selected subgroups.

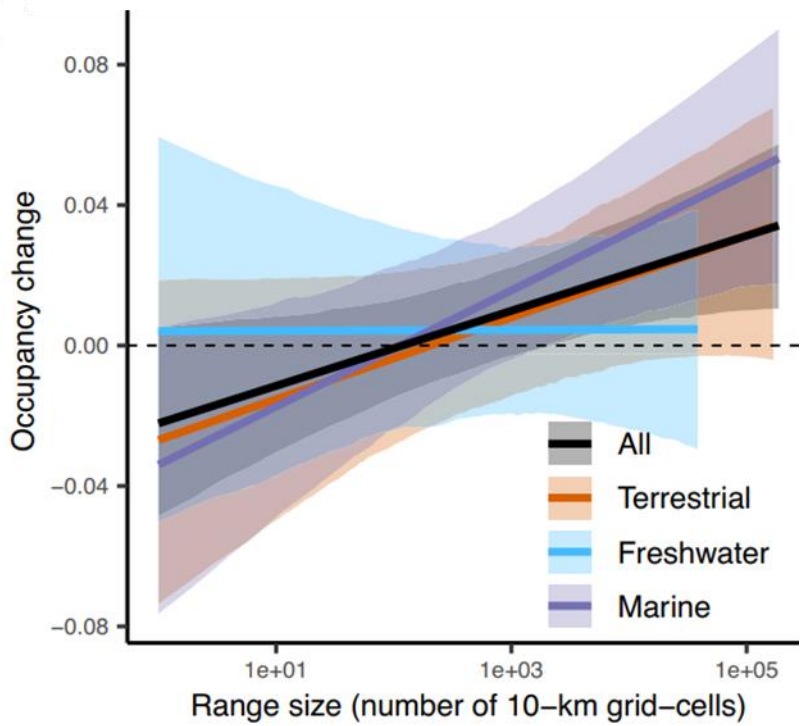
Ambientalismo

Abundância (= biomassa)



van Klink et al. 2013

Ambientalismo



nature communications

Article

https://doi.org/10.1038/s41467-023-37127-2

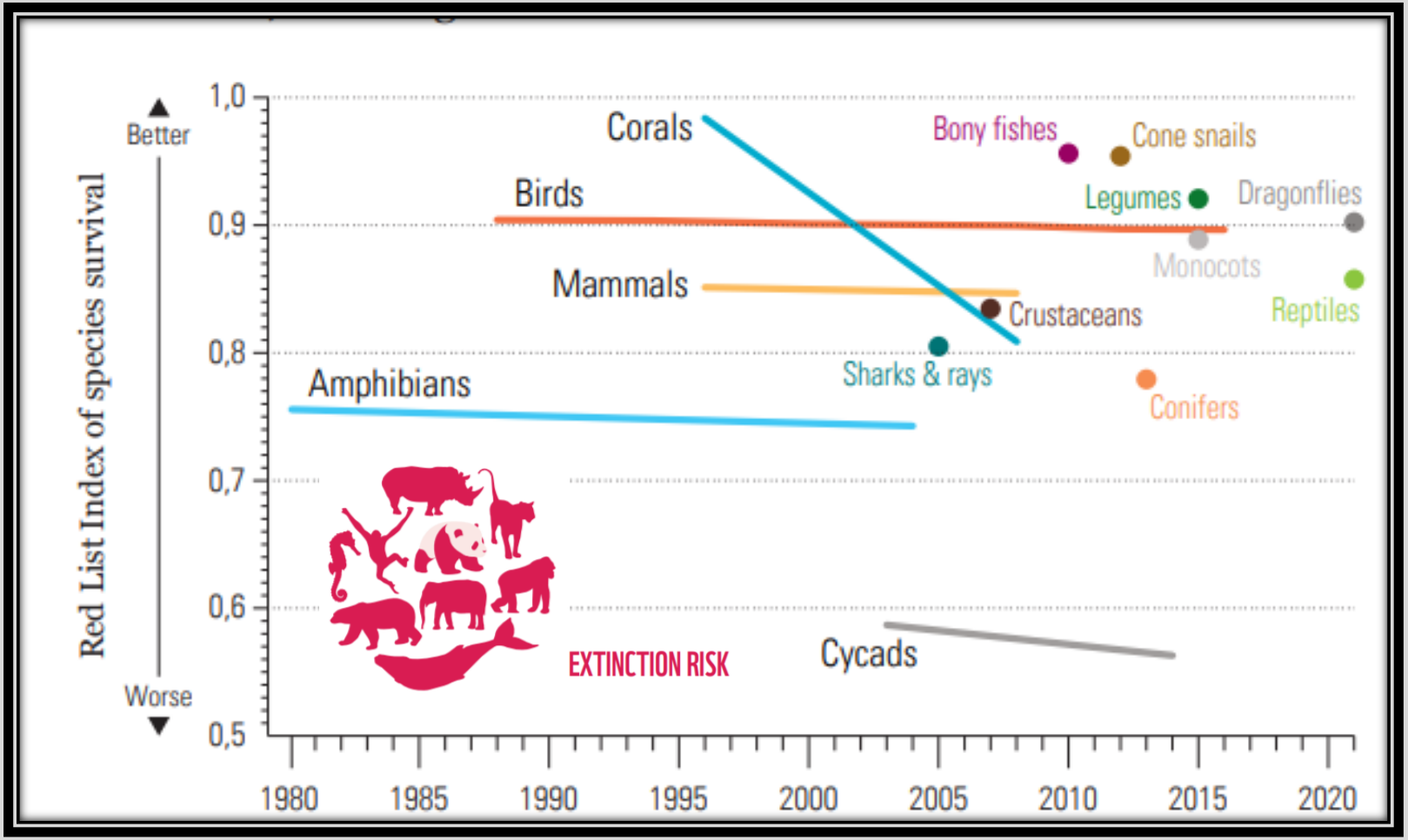
Regional occupancy increases for widespread species but decreases for narrowly distributed species in metacommunity time series

We found that on average, large-ranged species tended to increase in occupancy through time, whereas small-ranged species tended to decrease.

Our findings provide evidence for systematic decreases in occupancy of small-ranged species, and that habitat protection could mitigate these losses in the face of environmental change.

Xu et al. 2023

Red List Index of species survival



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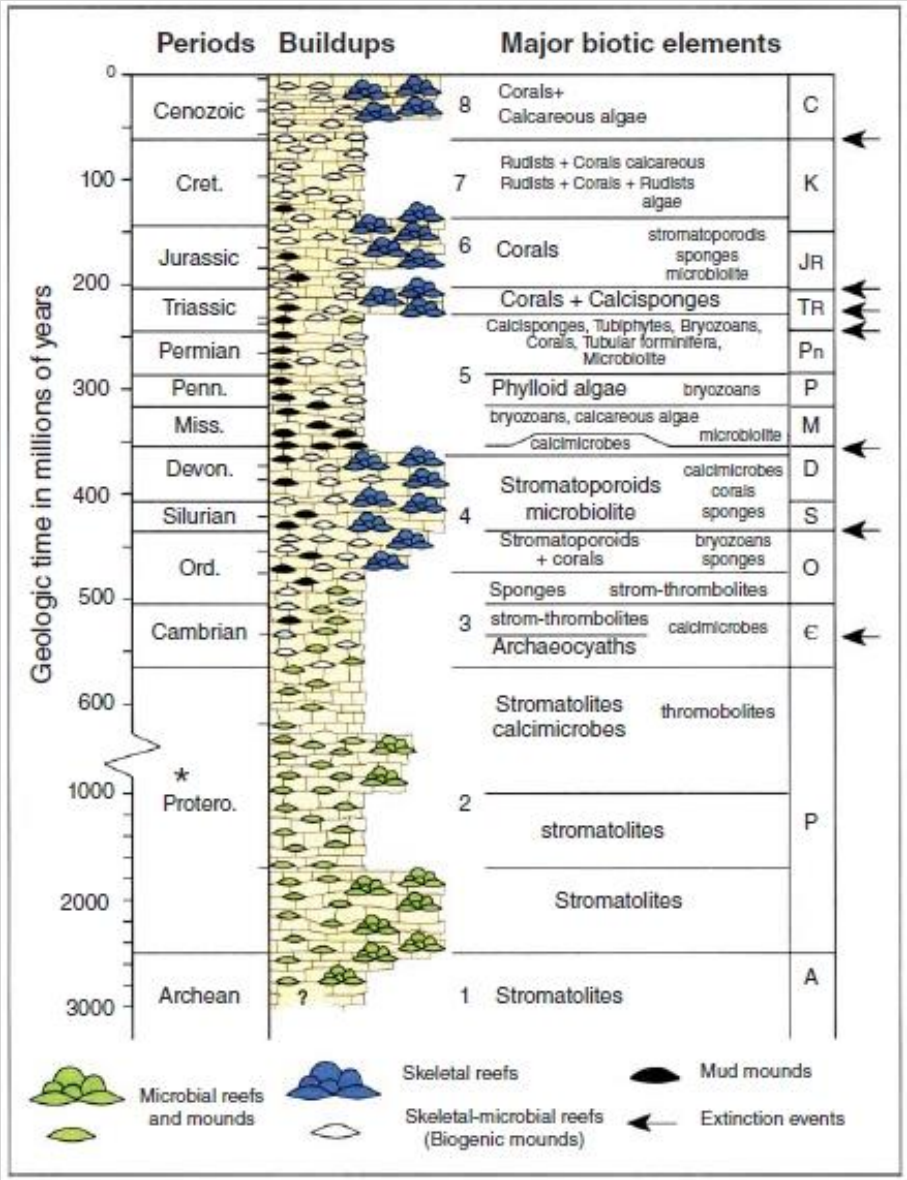

Ambientalismo

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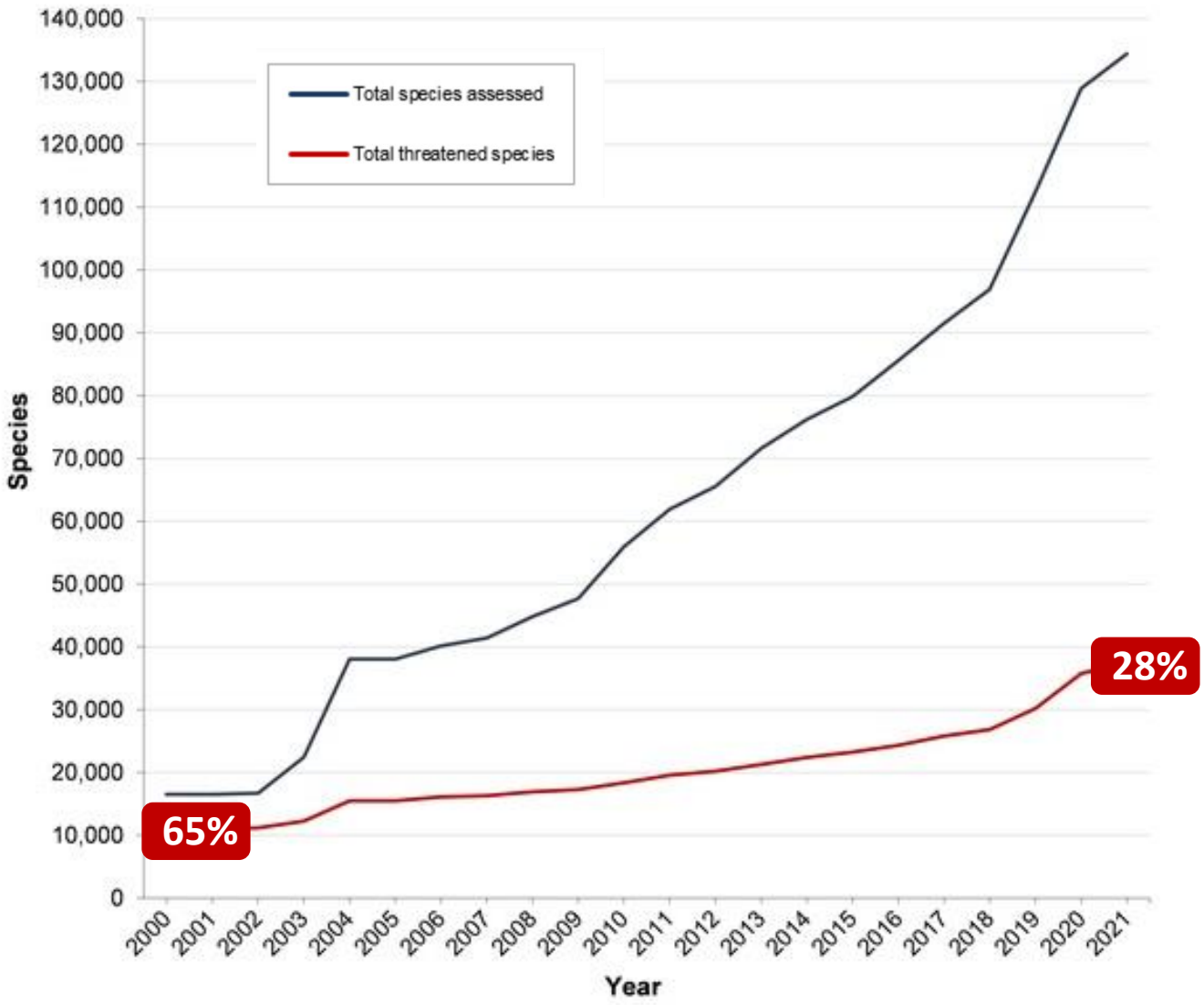
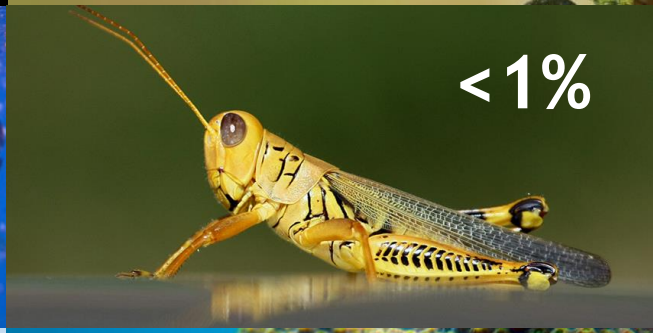


IUCN, Secretariat of the Convention on Biological Diversity (2010). Global Biodiversity Outlook

Ambientalismo



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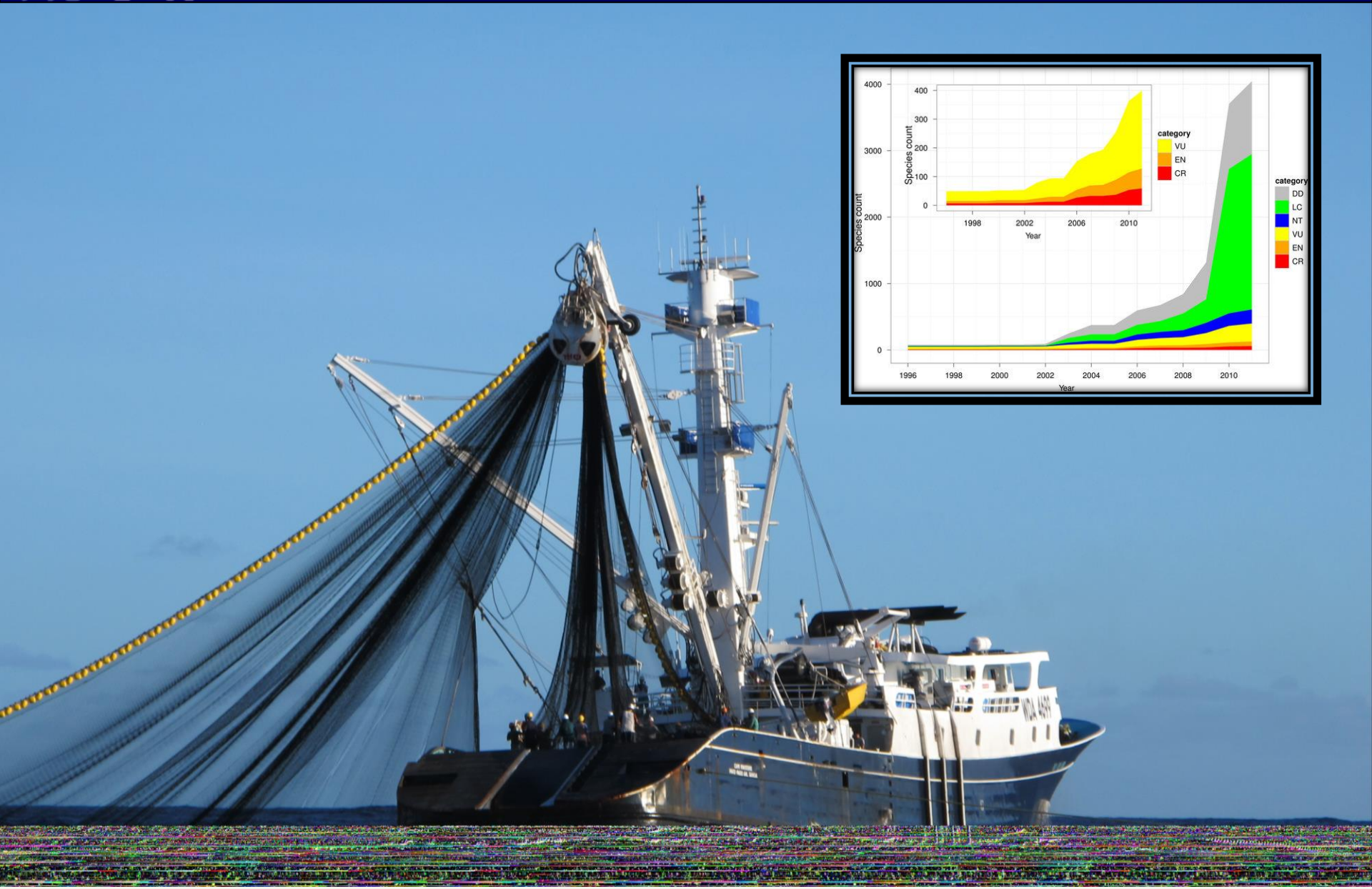
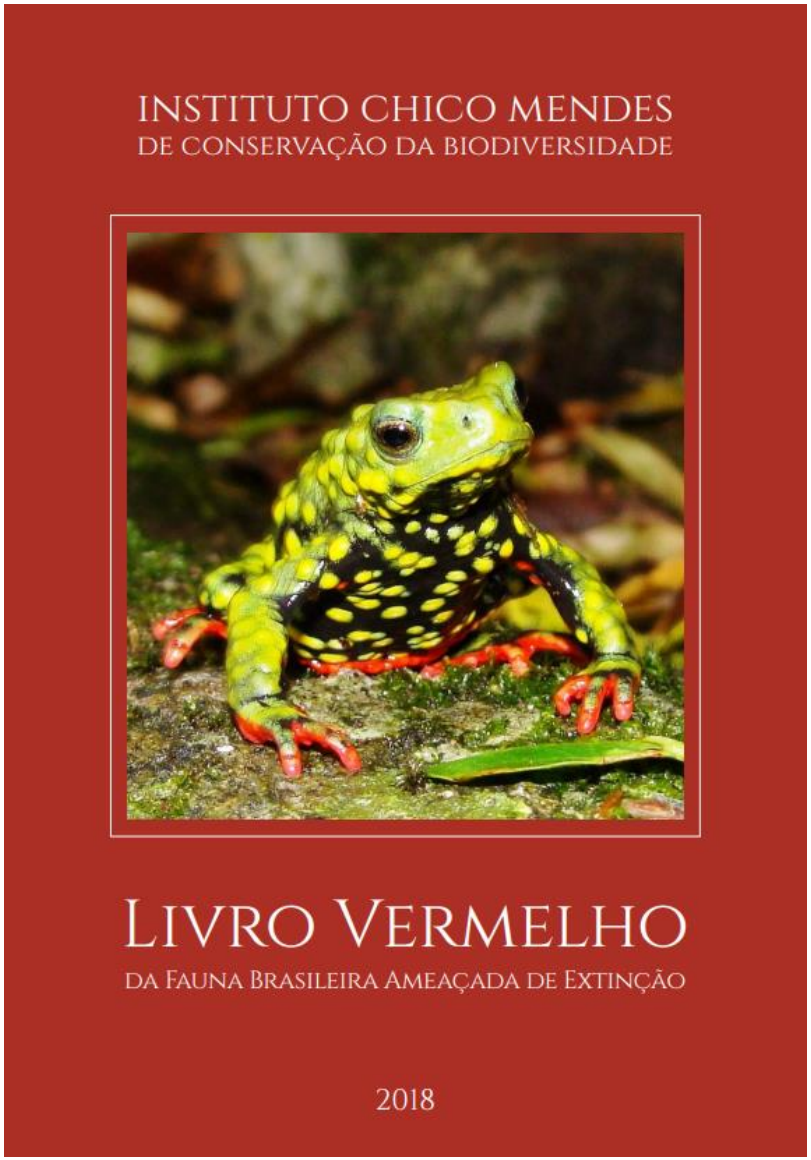
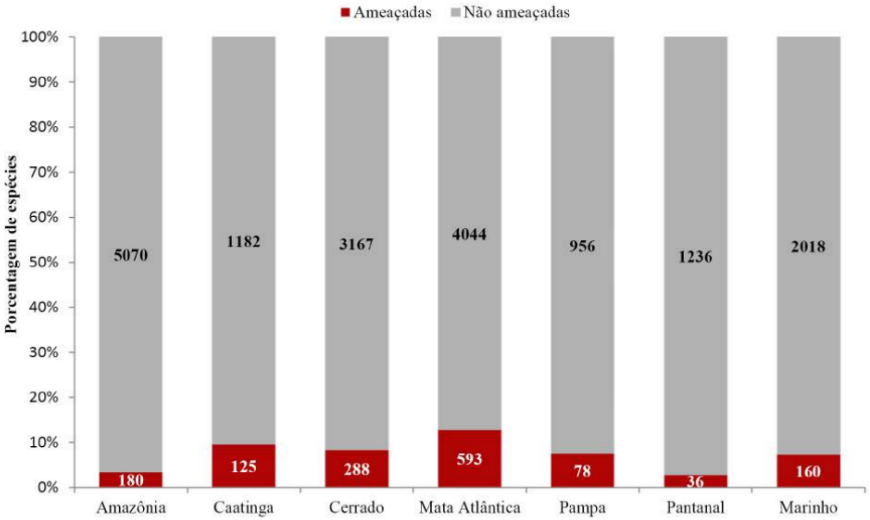


Davis & Baum 2014

Ambientalismo





	Grupo taxonômico	Táxons avaliados	Táxons ameaçados
Vertebrados	**Mammalia**	732	111 (15,1%)
	Aves	1.979	236 (11,9%)
	Reptilia	732	85 (11,6%)
	Amphibia	973	41 (4,2%)
	Actinopterygii (Marinhos)	1.201	43 (3,6%)
	Actinopterygii (Continentais)	3.130	311 (9,9%)
	Dipneusti	1	0
	Elasmobranchii (Marinhos)	146	54 (36,9%)
	Elasmobranchii (Continentais)	17	1 (5,8%)
	Holocephali	6	0
	Myxini	5	1 (20%)
	Total vertebrados	**8.922**	**883 (9,9%)**
Invertebrados	**Marinhos**	661	29
	Águas continentais	248	37
	Terrestres	2.423	233
	Total invertebrados	**3.332**	**299**
	TOTAL	**12.254**	**1.182**

Cycloramphus diringshofeni Bokermann, 1957

Categoria de risco de extinção e critérios

Criticamente em Perigo (CR) B1ab(iii)

Justificativa

Cycloramphus diringshofeni é endêmica do Brasil, conhecida apenas da localidade-tipo, no município de São Bento do Sul, estado de Santa Catarina. Não há registros de coleta da espécie nos últimos 50 anos. Sua extensão de ocorrência estimada é de 4 km^2. Na área onde a espécie ocorre há declínio continuado da qualidade do *habitat* devido, principalmente, à ocupação urbana e à conversão de áreas naturais em plantações de *Pinus* spp. e banana. Por essas razões, *Cycloramphus diringshofeni* foi categorizada como Criticamente em Perigo (CR) pelo critério B1ab(iii).

Outras avaliações

Avaliação nacional anterior[116]	DD
Justificativa para mudança de categoria	Novas ou melhores informações disponíveis
Listas estaduais de espécies ameaçadas	Não consta
Avaliação global[94]	DD

Distribuição geográfica

Cycloramphus diringshofeni é endêmica do Brasil e apresenta distribuição restrita a localidade-tipo, município de São Bento do Sul, estado de Santa Catarina[112]. Sua extensão de ocorrência é de 4 km^2, calculada pelo método do esquadrinhamento, utilizando-se uma *grid* de 2 km de lado.

Species

Our Work

+ The IUCN Red List of Threatened Species
+ Influencing policy
+ Action on the ground
+ Sustainable use and trade
Amphibians
Birds
+ Freshwater biodiversity
Fungi
– Invasive species
  + The Honolulu Challenge on Invasive Alien Species
  EICAT
Mammals
Marine
+ Plants

Invasive species

What is an Invasive Alien Species?

An alien species is a species introduced by humans – either intentionally or accidentally - outside of its natural past or present distribution, however not all alien species have negative impacts, and it is estimated that between 5% and 20% of all alien species become problematic. It is these species that are termed '*invasive alien species*' (IAS).

"An invasive alien species *(IAS) is a species that is established outside of its natural past or present distribution, whose introduction and/or spread threaten biological diversity"* Convention on Biological Diversity.

What are their impacts?

Invasive alien species are a major driver of biodiversity loss. In fact, an analysis of the IUCN Red List shows that they are the second most common threat associated with species that have gone completely extinct, and are the most common threat associated with extinctions of amphibians, reptiles and mammals.

An example is the Micronesian Kingfisher *Todiramphus cinnamominus* which was endemic to the island of Guam, but following predation by invasive alien snakes (Brown tree snake *Boiga irregularis*) it became Extinct in the Wild in 1986 when the last remaining wild birds were taken into captivity for captive breeding. In fact the Brown tree snake has caused many extinctions on Guam, including the local extinction of over half of Guam's native bird and lizard species as well as two out of three of Guam's native bat species.

Links

Invasive Species Specialist Group

Invasive Species of the Week

The Global Invasive Species Database

The Global Register of Introduced and Invasive Species

The IUCN Red List of Threatened Species

Escala local: espécies exóticas não se extinguem?

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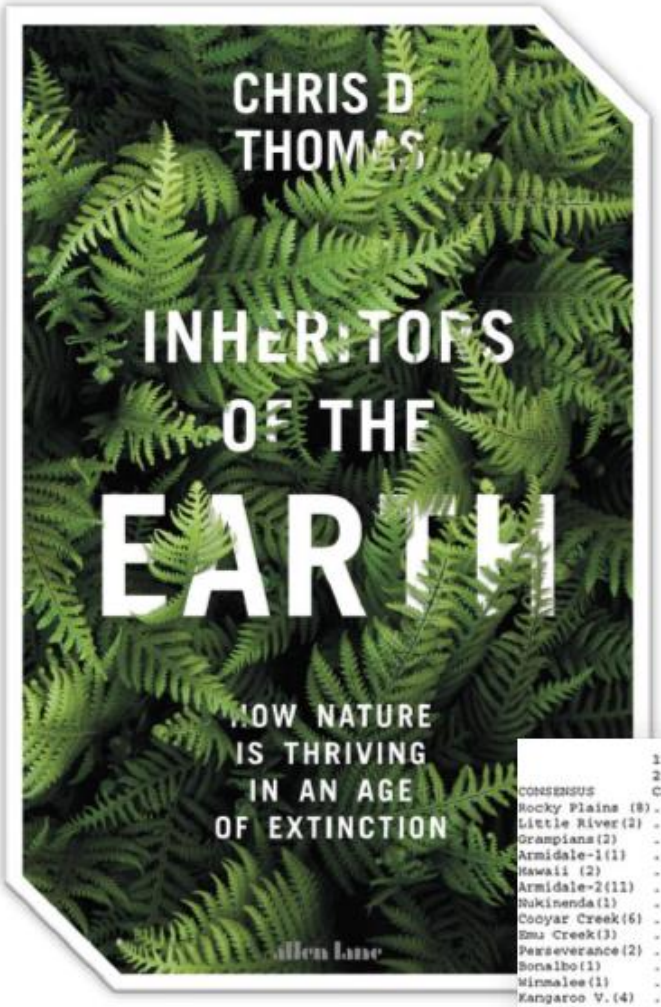
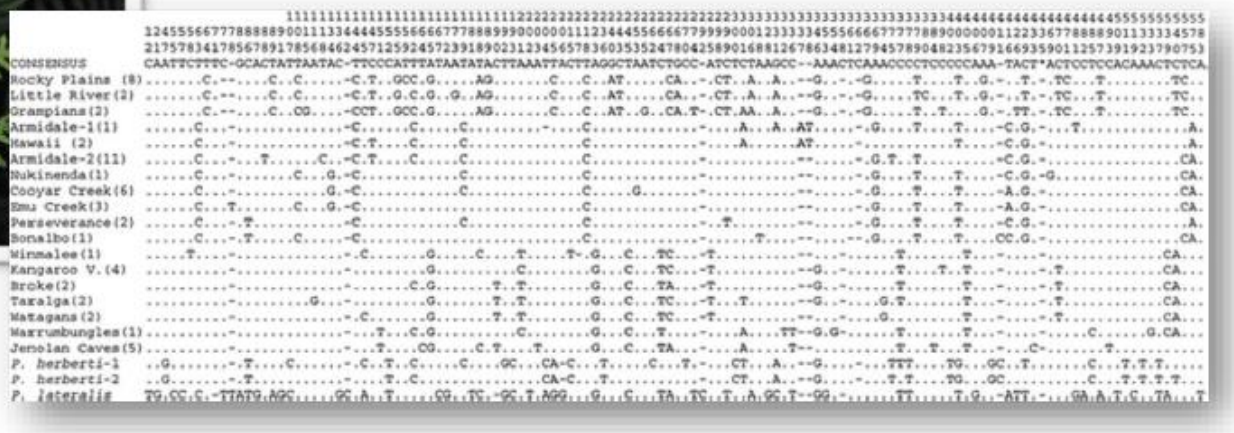
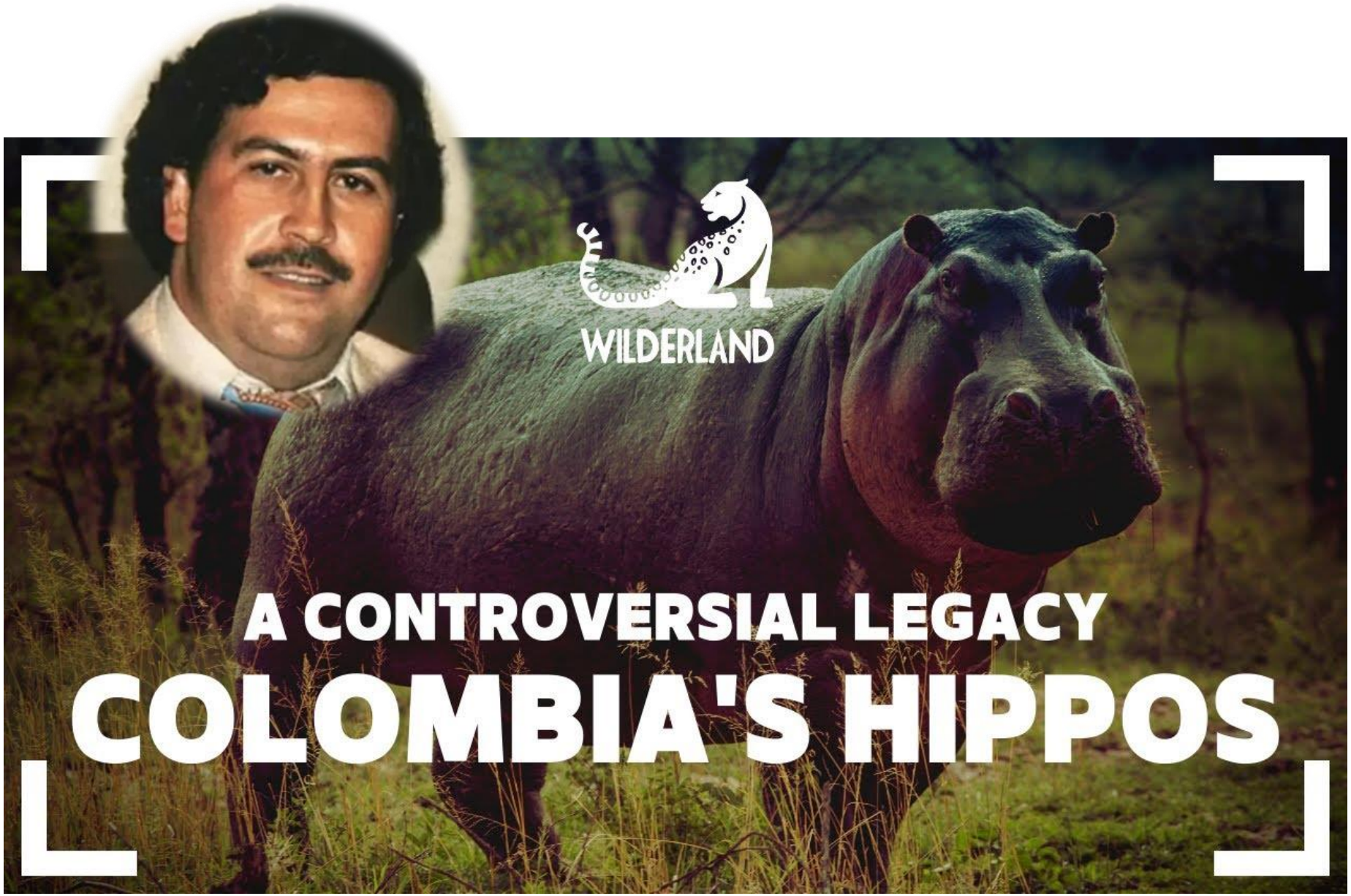




Ambientalismo



4 – Desmistificar conceitos fixistas que permeiam discurso **ambientalista**

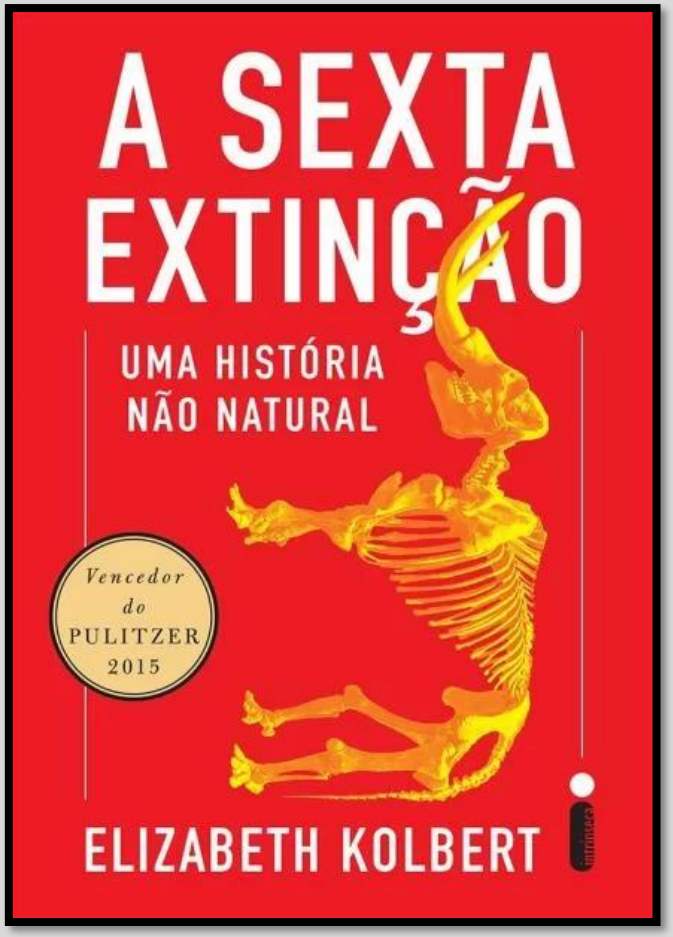
Outras duas perguntas:

1: Por que consideramos a “6ª extinção” algo a ser contido?

2: O que significa conter a “perda” de biodiversidade?

Outras duas perguntas:

1: Por que seria a “6ª extinção” algo a ser contido?



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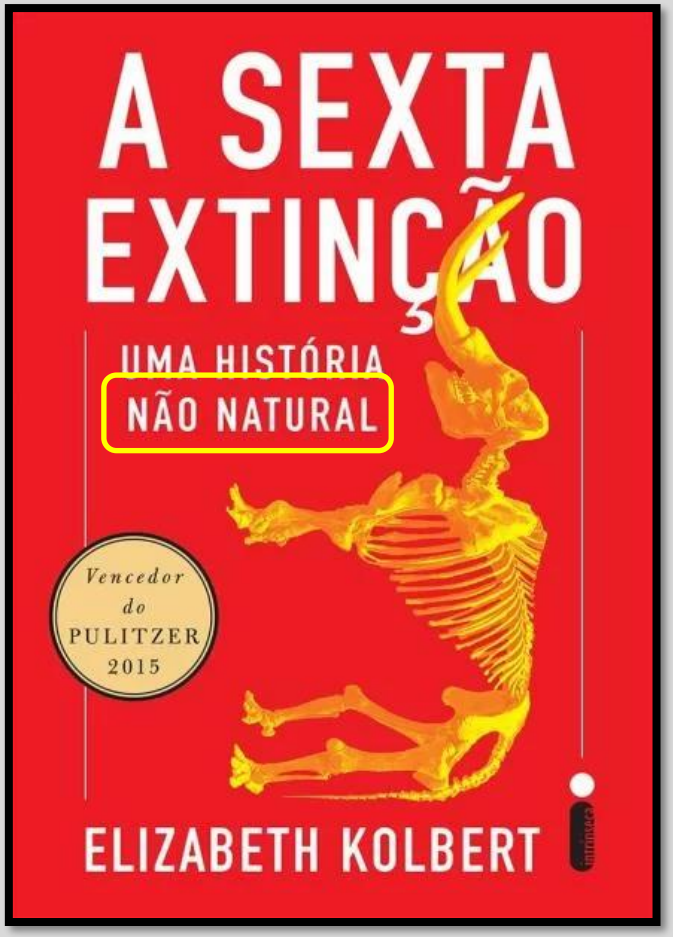

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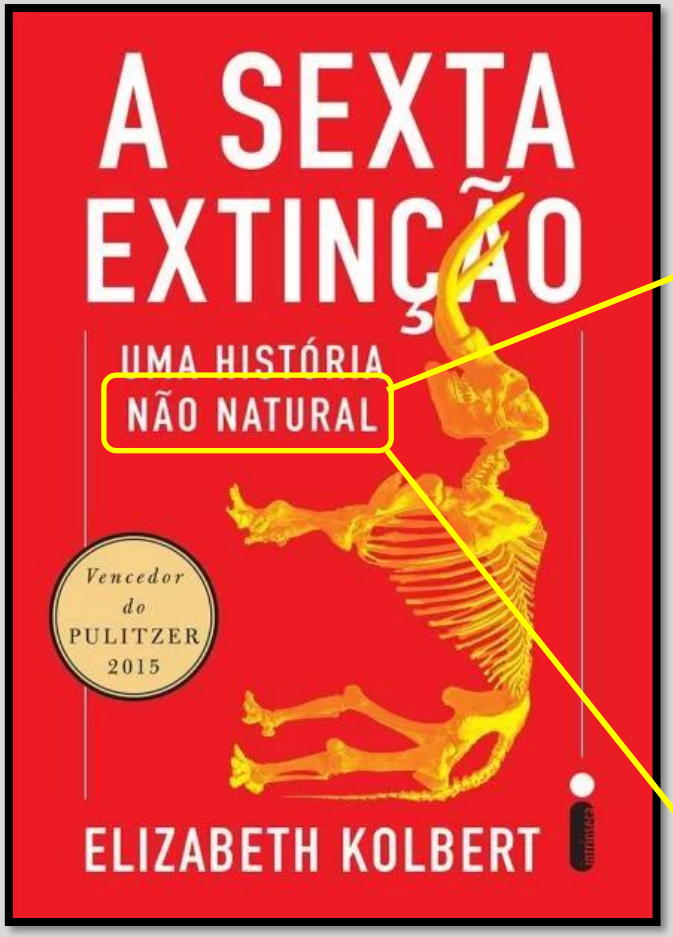

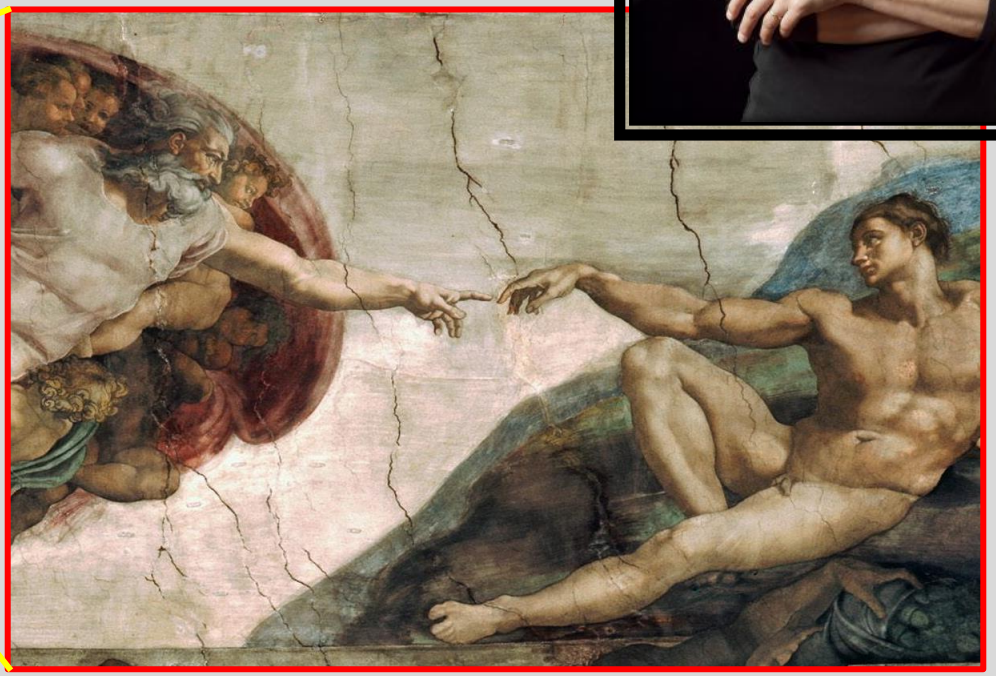

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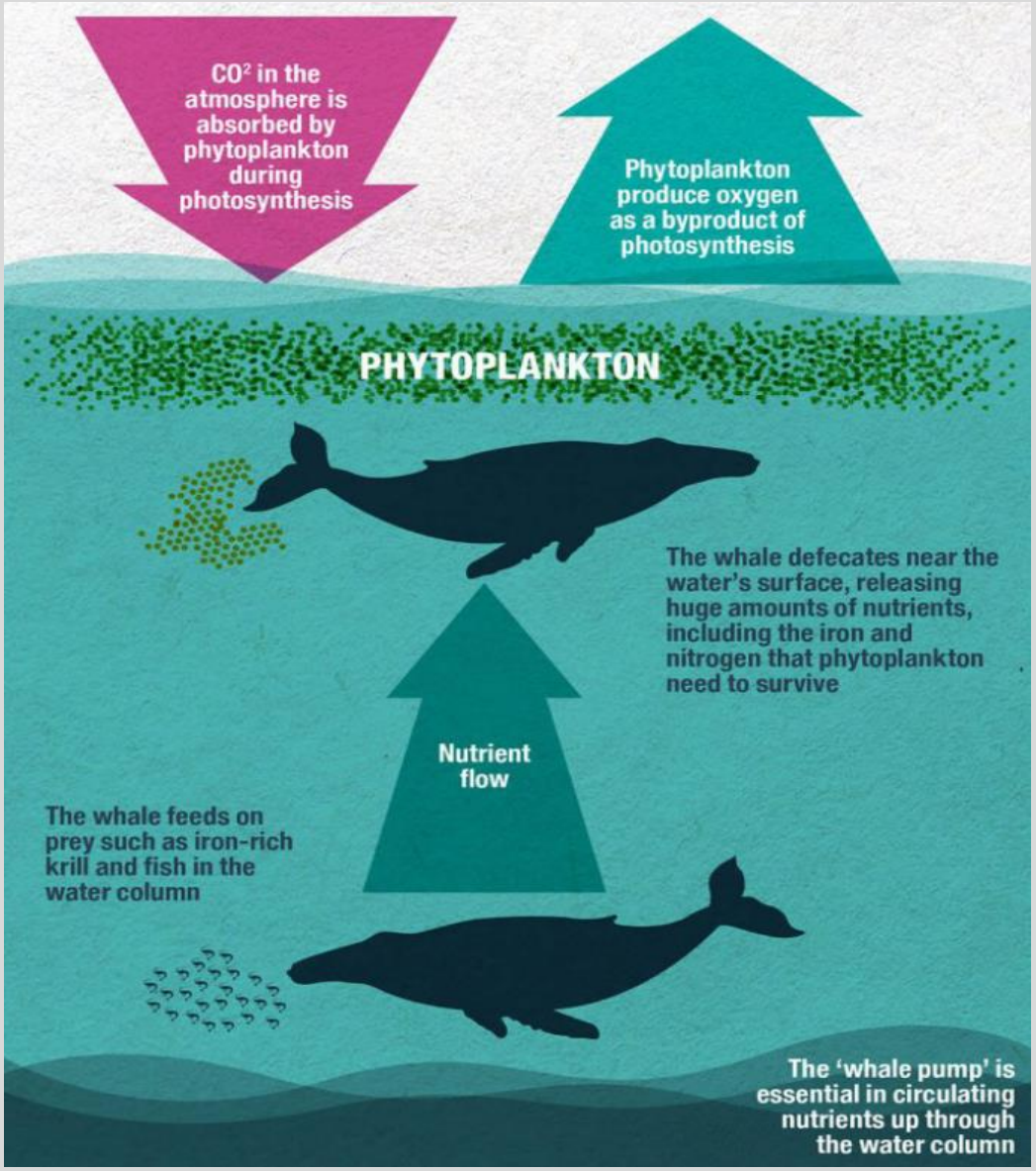
Ambientalismo



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A fumaça das chaminés é o hálito da Rússia soviética

Homo sum, humani a mi nihil alienum

Terêncio

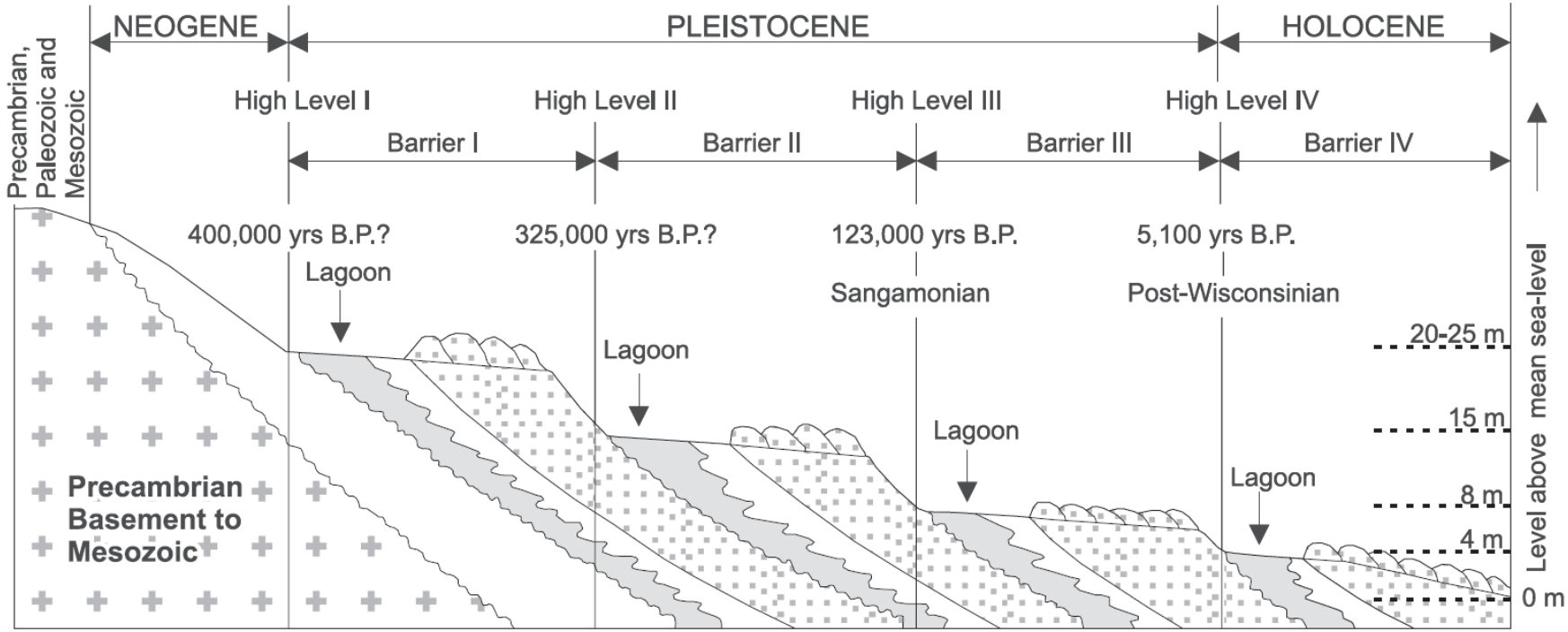
Ambientalismo

Ambientalismo

Ambientalismo

Ambientalismo

Ambientalismo



Ambientalismo

4 – Desmistificar conceitos fixistas que permeiam discurso **ambientalista**

Outras duas perguntas:

2: O que significa conter a perda da biodiversidade?

LUIS FERNANDO VERÍSSIMO

Albert Speer fala com as flores

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Digressão: ambientalismo

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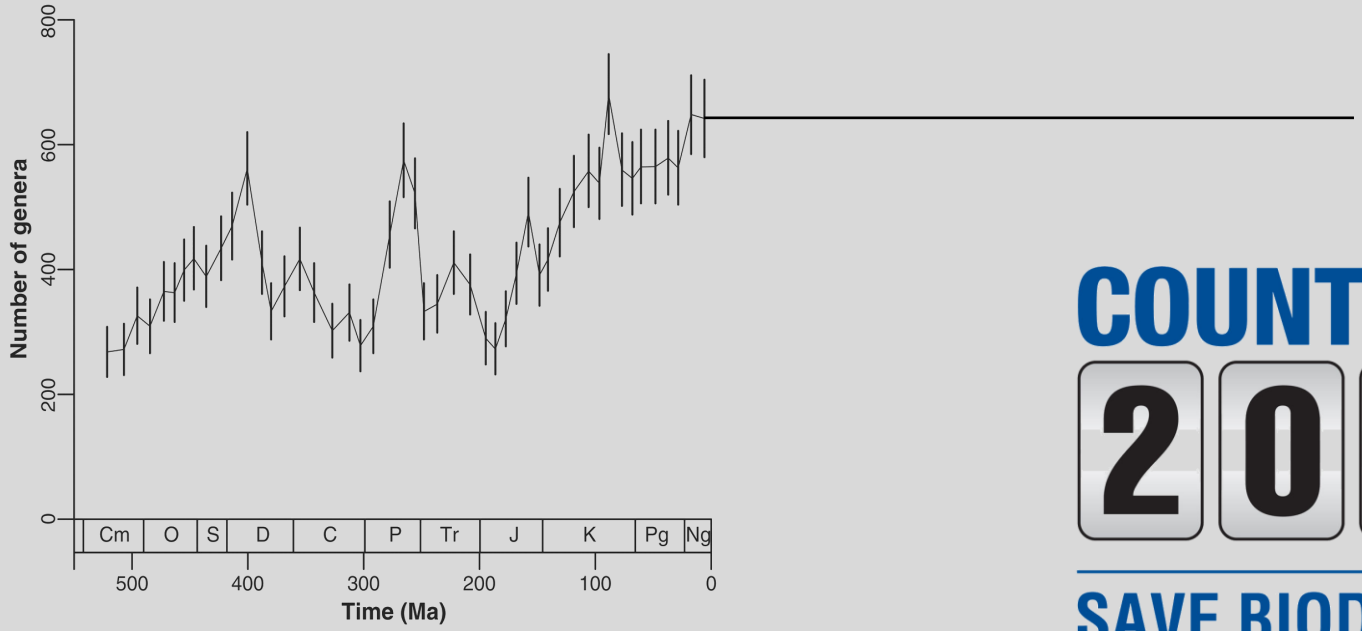
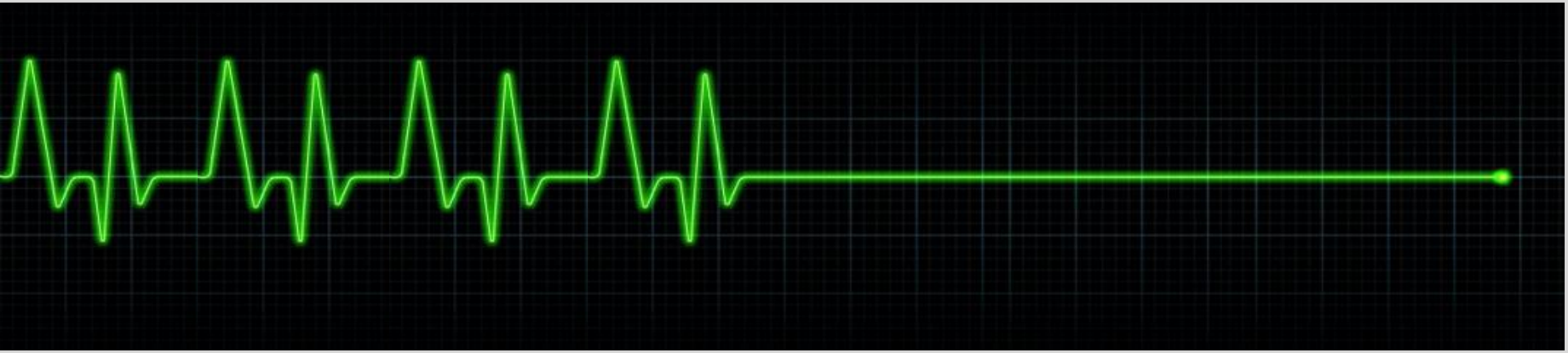


COUNTDOWN 2010
SAVE BIODIVERSITY



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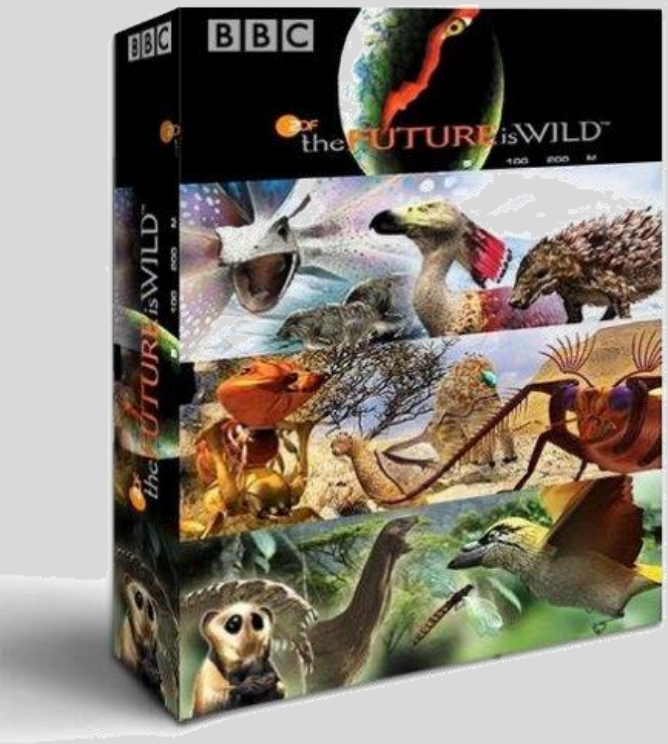

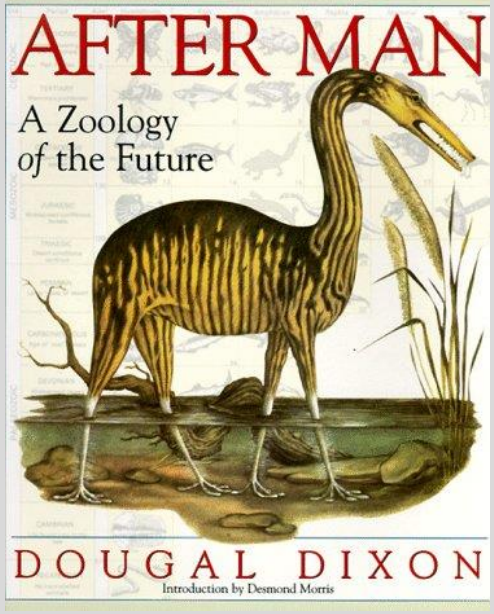

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