

Cons. Sci. Week 8: Threats to Biodiversity and Biodiversity Change

Isla Myers-Smith
Crew Building, School of GeoSciences

Schedule for Today

9:30 - 10:20 Lecture on Biodiversity Change

10:20 - 10:35 Break

10:35 - 11:00 Discussion of biodiversity change papers

11:00 - 11:45 Activity: Biodiversity change - Same Data,
Different Results?

11:55 - 12:30 Debrief of discussion and activity

Is biodiversity declining?

Biodiversity loss and its impact on humanity

Bradley J. Cardinale, J. Emmett Duffy, Andrew Gonzalez, David U. Hooper, Charles

A global synthesis reveals biodiversity loss as a major driver of ecosystem change

David U. Hooper, E. Carol Adair, Bradley J. Cardinale, Jarrett E. K. Byrnes, Bruce A.

Improving estimates of biodiversity loss

Chase D. Mendenhall*, Gretchen C. Daily, Paul R. Ehrlich

Center for Conservation Biology, Department of Biology, Stanford University, Stanford, CA 94305-5020, USA

Despite Progress, Biodiversity Declines

Erik Stokstad

Global Biodiversity: Indicators of Recent Declines

Stuart H. M. Butchart^{1,2,*}, Matt Walpole¹, Ben Collen³, Arco van Strien⁴, Jörn P. W. Scharlemann¹,

Species Coextinctions and the Biodiversity Crisis

Lian Pin Koh^{1,*†}, Robert R. Dunn^{2,*‡}, Navjot S. Sodhi^{1,§}, Robert K. Colwell³, Heather C. Proctor⁴,
Vincent S. Smith^{5,¶}

Biodiversity: Species loss revisited

Carsten Rahbek & Robert K. Colwell

Impacts of Biodiversity Loss Escalate Through Time as Redundancy Fades

Peter B. Reich^{1,2}, David Tilman^{3,4}, Forest Isbell³, Kevin Mueller³, Sarah E. Hobbie³, Dan F. B. Flynn⁵,

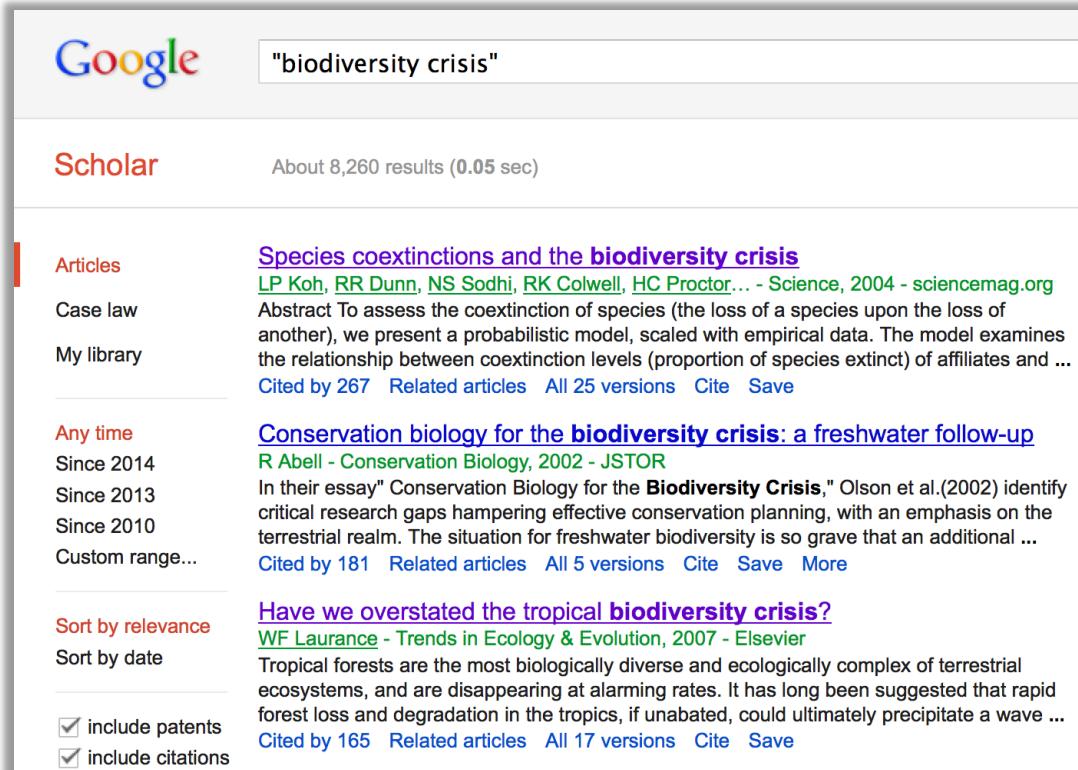
Climate Change, Keystone Predation, and Biodiversity Loss

Christopher D. G. Harley

Consequences of biodiversity loss for litter decomposition across biomes

I. Tanya Handa, Rien Aerts, Frank Berendse, Matty P. Berg, Andreas Bruder, Olaf

Is there a biodiversity crisis?



Google Scholar search results for "biodiversity crisis".

Scholar

About 8,260 results (0.05 sec)

Articles Species coextinctions and the **biodiversity crisis**
LP Koh, RR Dunn, NS Sodhi, RK Colwell, HC Proctor... - Science, 2004 - sciencemag.org
Abstract To assess the coextinction of species (the loss of a species upon the loss of another), we present a probabilistic model, scaled with empirical data. The model examines the relationship between coextinction levels (proportion of species extinct) of affiliates and ...
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Conservation biology for the **biodiversity crisis**: a freshwater follow-up
R Abell - Conservation Biology, 2002 - JSTOR
In their essay "Conservation Biology for the **Biodiversity Crisis**," Olson et al.(2002) identify critical research gaps hampering effective conservation planning, with an emphasis on the terrestrial realm. The situation for freshwater biodiversity is so grave that an additional ...
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Have we overstated the tropical **biodiversity crisis**?
WF Laurance - Trends in Ecology & Evolution, 2007 - Elsevier
Tropical forests are the most biologically diverse and ecologically complex of terrestrial ecosystems, and are disappearing at alarming rates. It has long been suggested that rapid forest loss and degradation in the tropics, if unabated, could ultimately precipitate a wave ...
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Wildlife

World on track to lose two-thirds of wild animals by 2020, major report warns

Living Planet Index shows vertebrate populations are set to decline by 67% from 1970 levels unless urgent action is taken to reduce humanity's impact

Damian Carrington
[@dpcarrington](#)

Thursday 27 October 2016 00.53 BST



    
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Science & Environment

World wildlife 'falls by 58% in 40 years'

By Rebecca Morelle
 Science Correspondent, BBC News

27 October 2016 | [Science & Environment](#) 



Top Stories

Last push before US vote
 Hillary Clinton and Donald Trump are set for their final rallies as the campaign draws to a close.

31 October 2016

Tesco Bank: 20,000 customers lose money

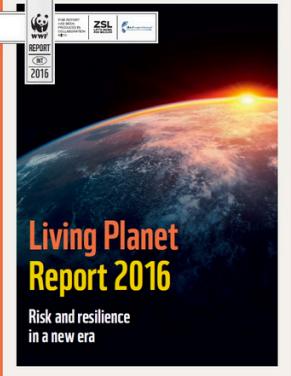
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Inmates removed after prison riot

1 hour ago

Features




Living Planet Report 2016
 Risk and resilience in a new era

The [2016 Living Planet Report](#) has been published. Read about the latest results on global trends in vertebrate species and humanity's pressure on important habitats.

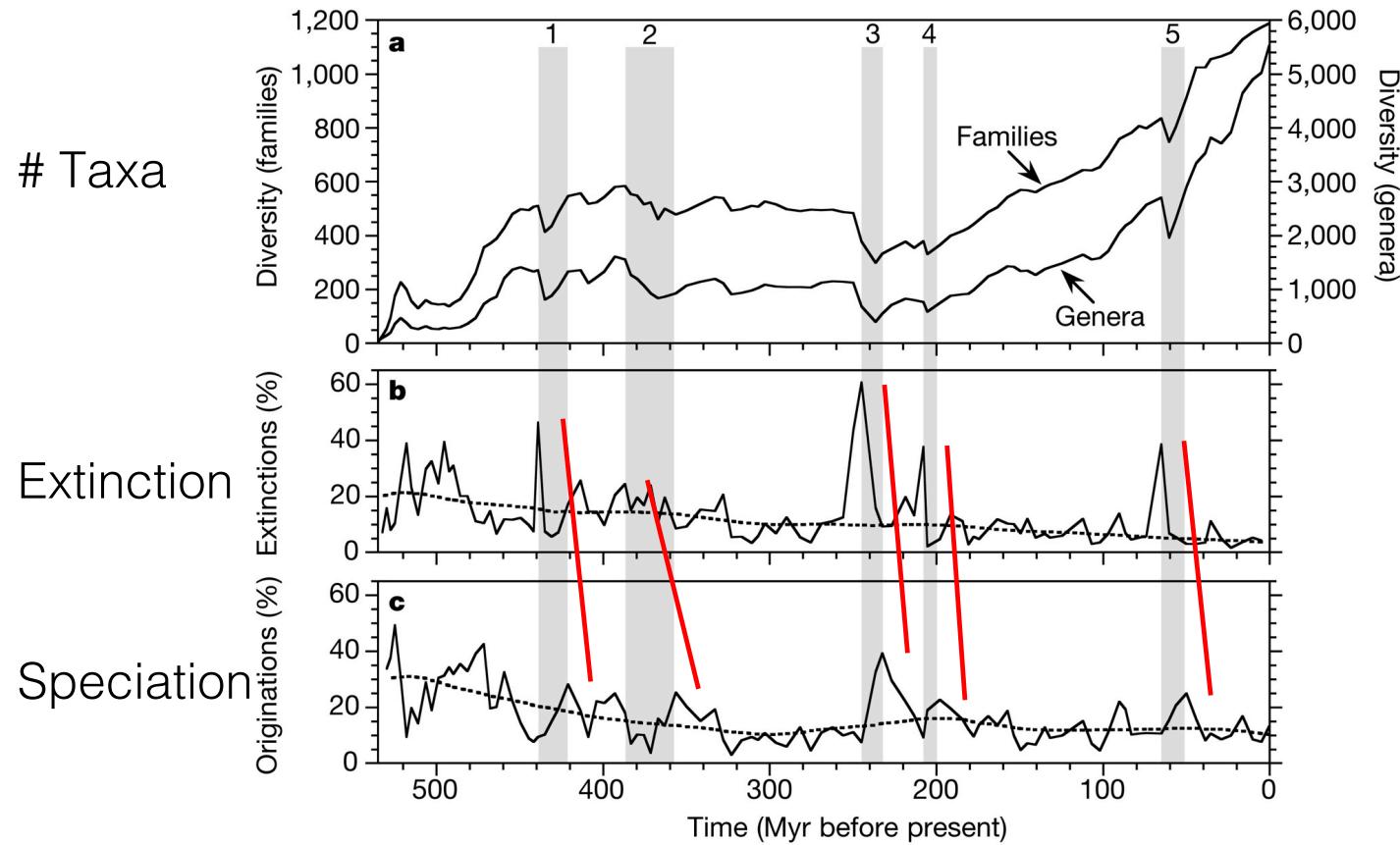
Is there a biodiversity crisis?



How has biodiversity changed
in the past?



Global Diversity of Marine Fossils

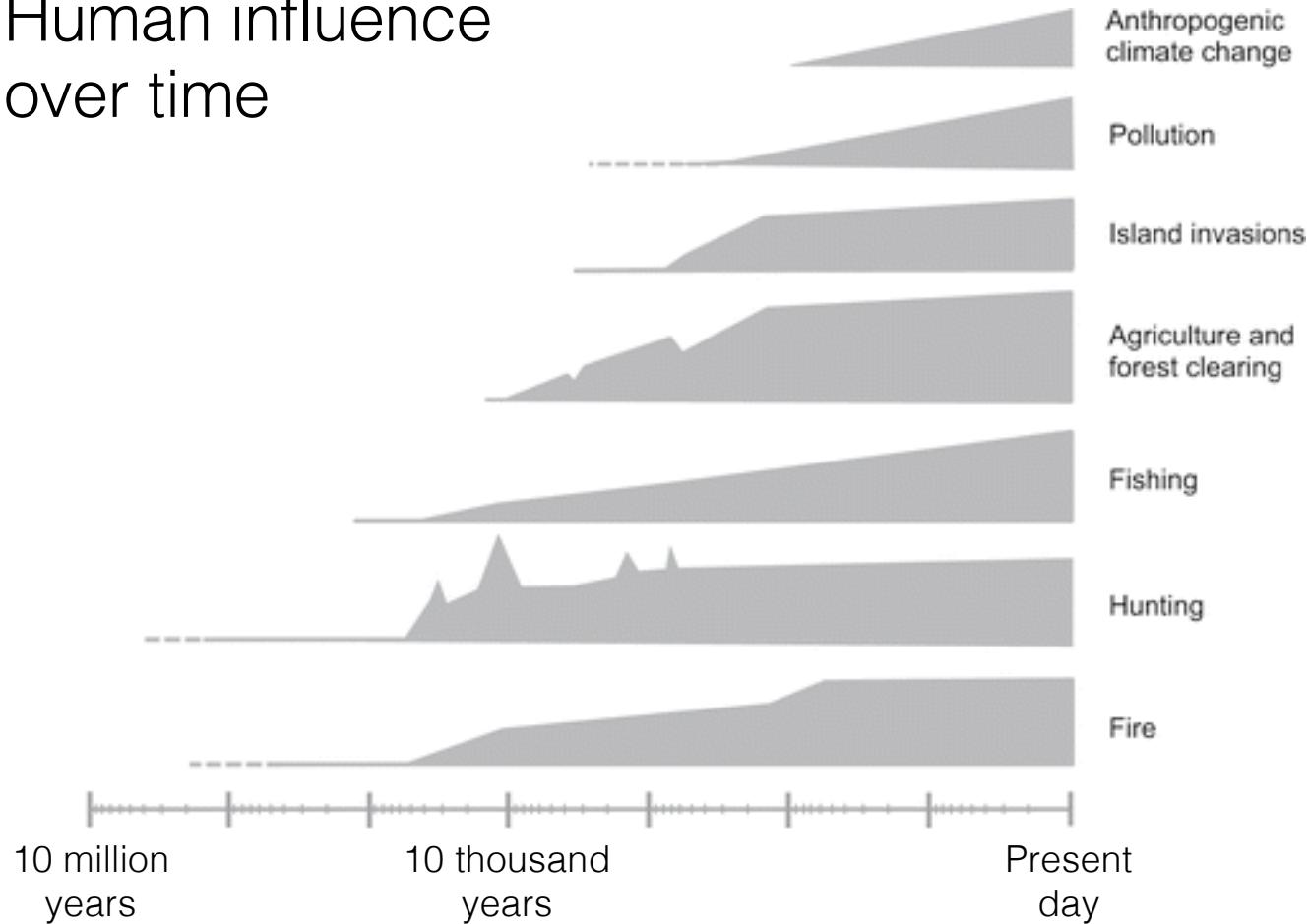


Kirchner & Wiel Nature 2000

How have humans influenced
Biodiversity in the past?



Human influence over time



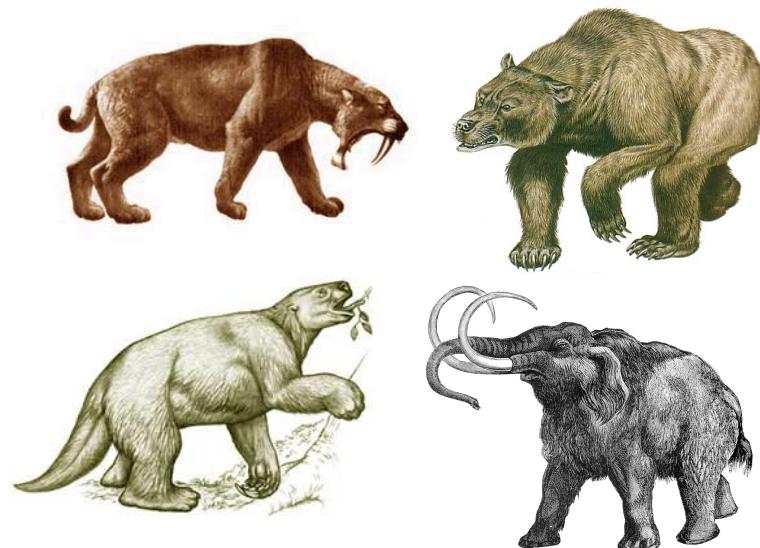
Pereira et al. *Annu. Rev. Environ. Resour.* 2012

Have humans caused extinctions
in the past?



Extinction of Pleistocene megafauna

Overkill hypothesis: naïve prey with a new, efficient predator



- Starting ~11-12,000 years ago, rapid extinction of mammals in the Americas
- Highly size biased (>50kg herbivores + dependent carnivores)
- Extinction wave north to south

Are we in a new mass extinction?

Past:

Estimated from fossil record:

~1 species / million species / year

Contemporary:

Example: Birds since 1500

25-100 species / million species / year

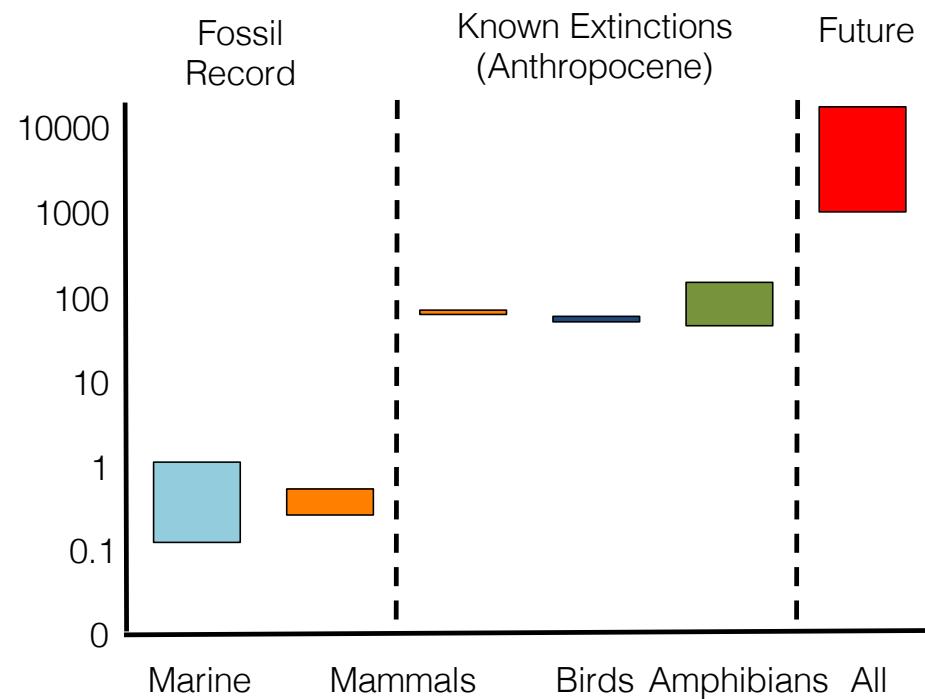
On par with some mass extinctions

Pimm et al. *PNAS* 2000

Are we in a new mass extinction?



Huia



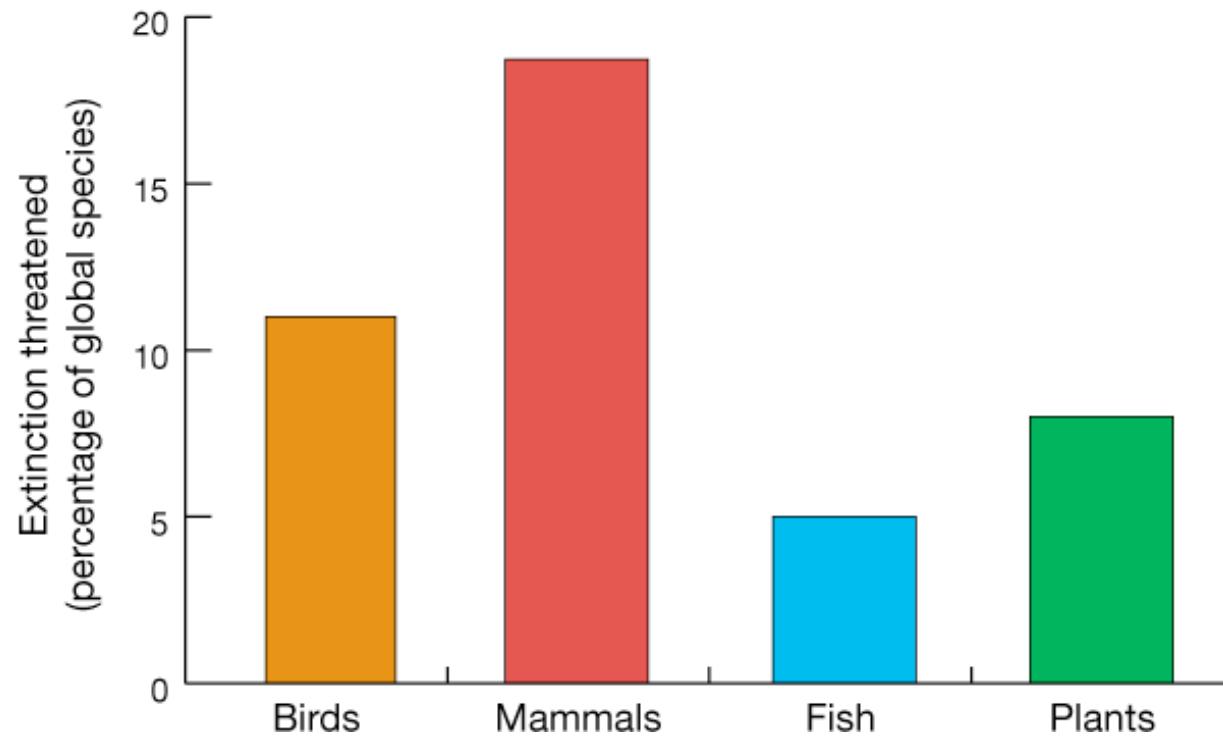
Encephalartos woodii

Pereira et al. Science 2010, Millennium Ecosystem Assessment

Which taxa are going extinct?



Species Extinctions ...at the global scale

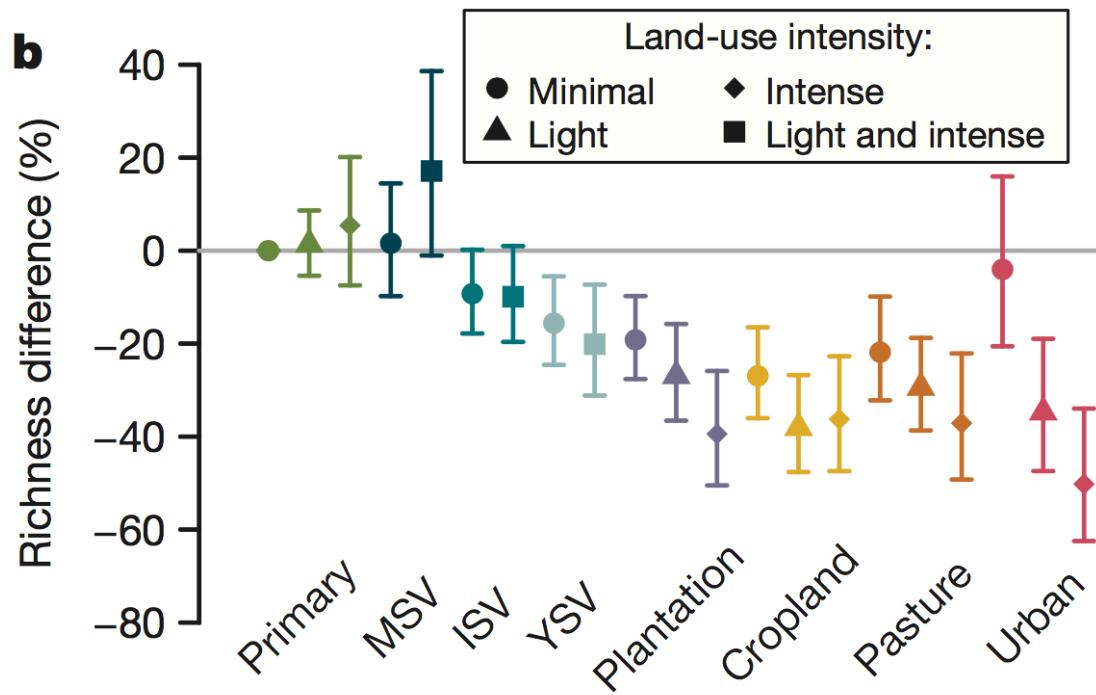


Chapin et al. Nature 2000

Where is biodiversity decreasing?

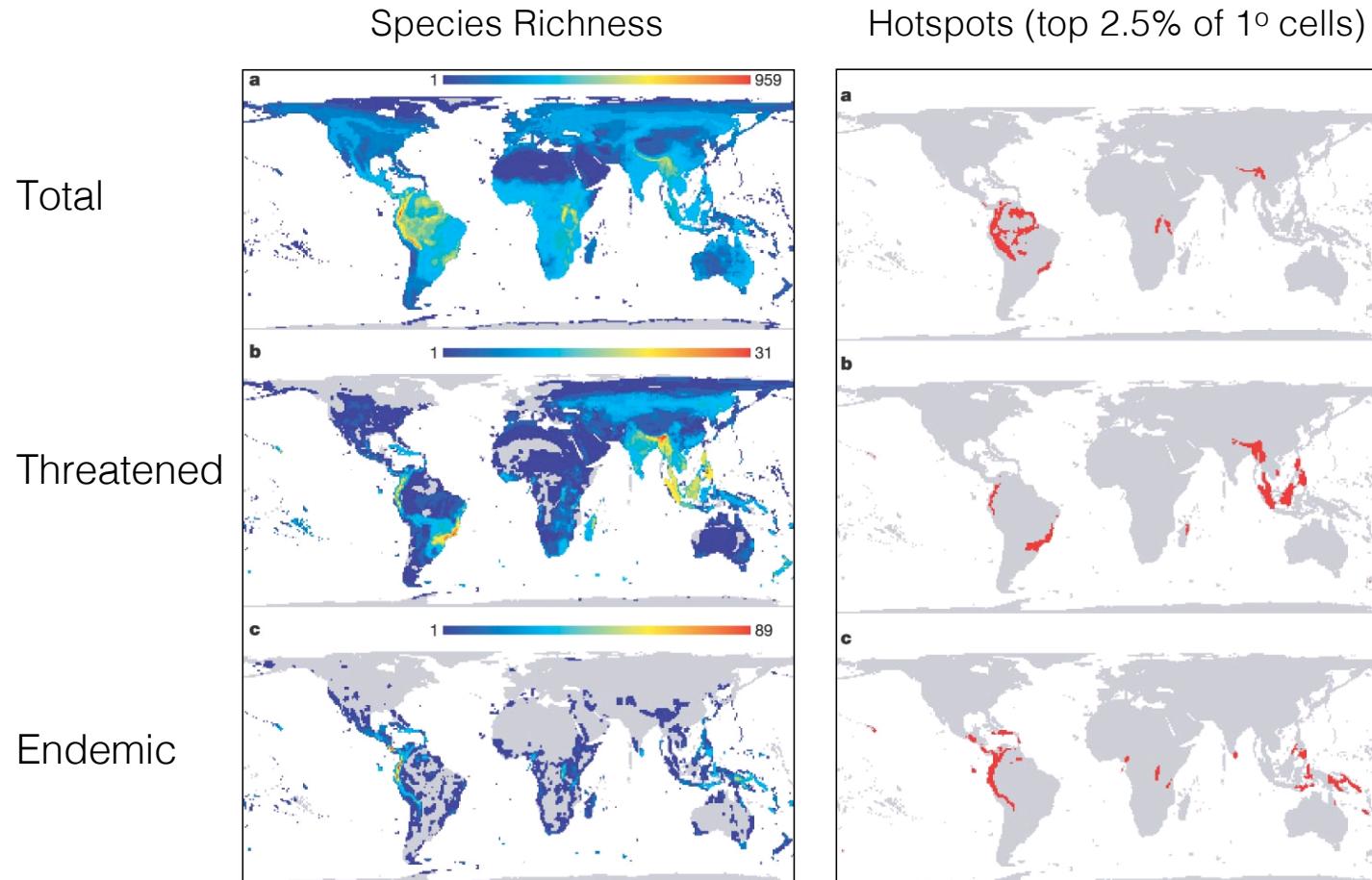


More diversity loss with more intense land-use change



Newbold et al. *Nature* 2015

Incongruence of richness, threat, & endemism hotspots (at least for birds)

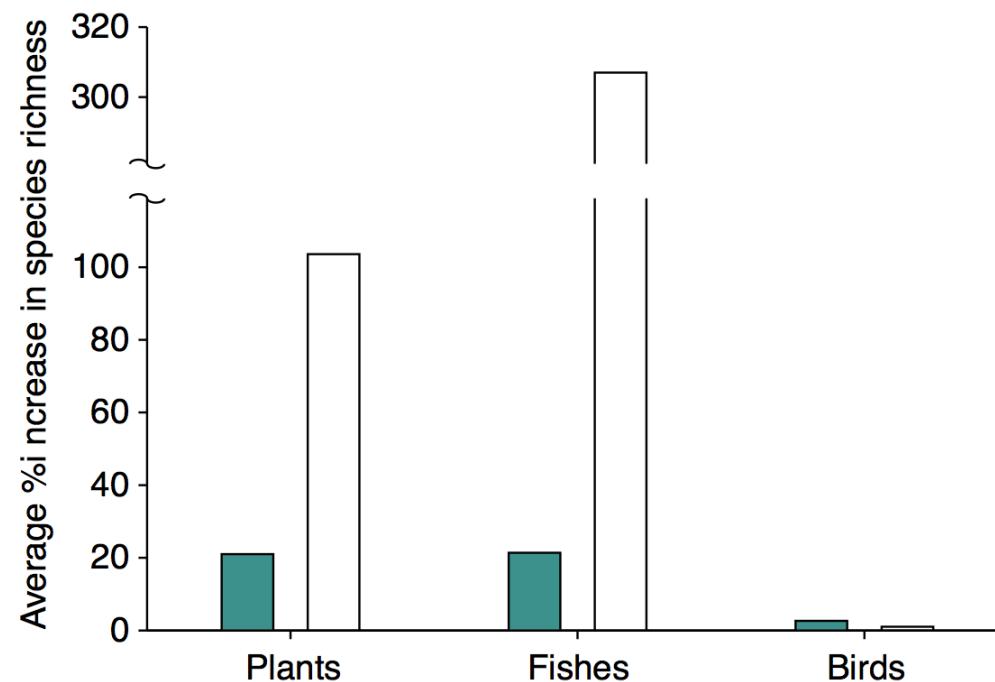


Orme et al. *Nature* 2005

Where is biodiversity increasing?



Biotic Homogenization ... at the regional Scales



Species richness changes on oceanic islands (white) and continental regions (green).

Sax & Gains *TREE* 2003

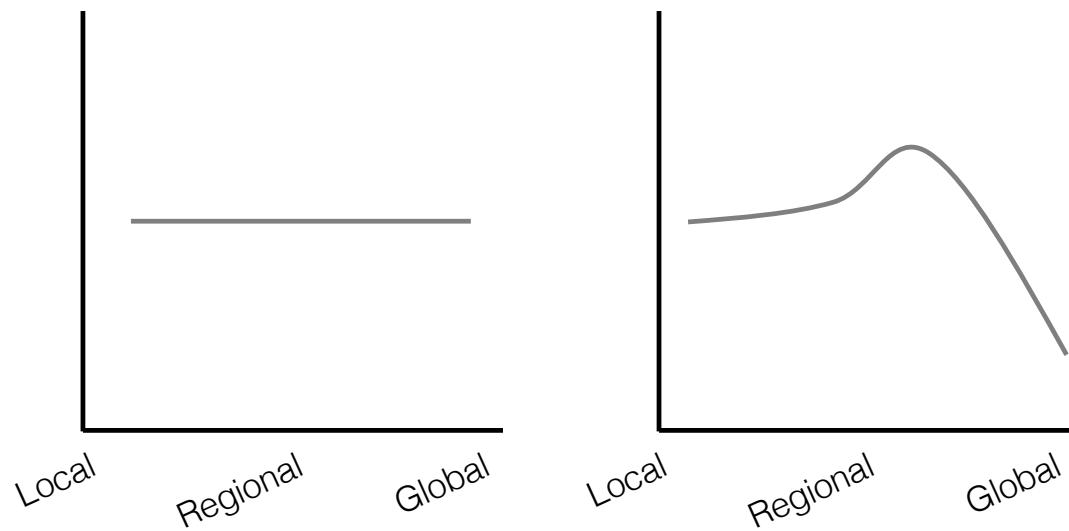
How is species richness changing at
the local scale?



How do ecological processes scale?

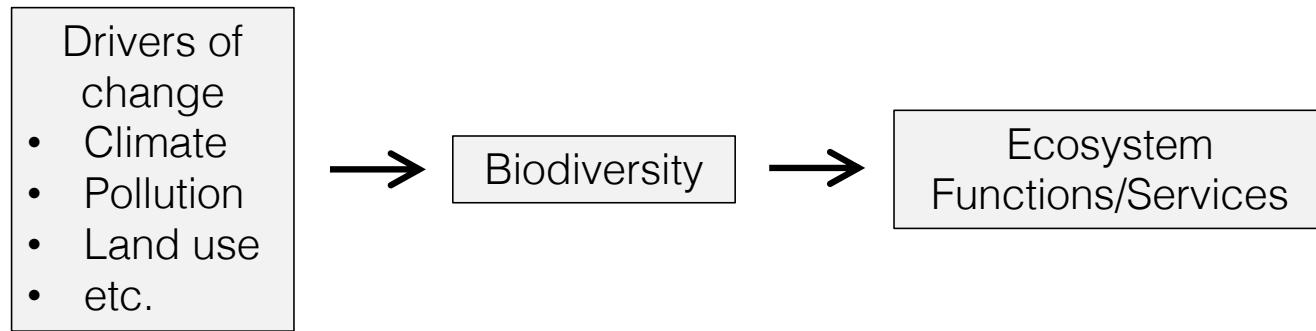
The problem of relating phenomena across scales is
the central problem in biology.

Levin Ecology 1992



How has (plant) biodiversity changed?

In the Anthropocene...



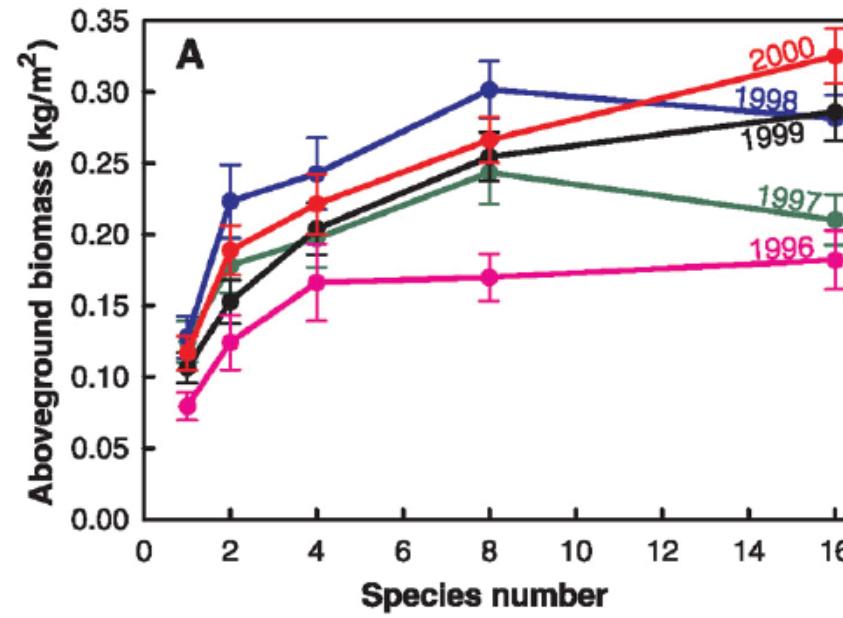
Is biodiversity loss a major driver of ecosystem change?

The screenshot shows the 'nature' journal website. The header includes the word 'nature' in large white letters, followed by 'International weekly journal of science'. Below the header is a navigation bar with links: Home, News & Comment, Research, Careers & Jobs, Current Issue, Archive, Audio & Video, and For Au. A breadcrumb navigation below the header shows the path: Archive > Volume 486 > Issue 7401 > Letters > Article. The main content area features the title 'A global synthesis reveals biodiversity loss as a major driver of ecosystem change' in large black text. Below the title is the author list: David U. Hooper, E. Carol Adair, Bradley J. Cardinale, Jarrett E. K. Byrnes, Bruce A. Hungate, Kristin L. Matulich, Andrew Gonzalez, J. Emmett Duffy, Lars Gamfeldt & Mary I. O'Connor. There are also Japanese language links: 'NATURE | LETTER' and '日本語要約'. On the right side of the content area are three small icons: a share icon, an envelope icon, and a printer icon.

Hooper et al. *Nature* 2012

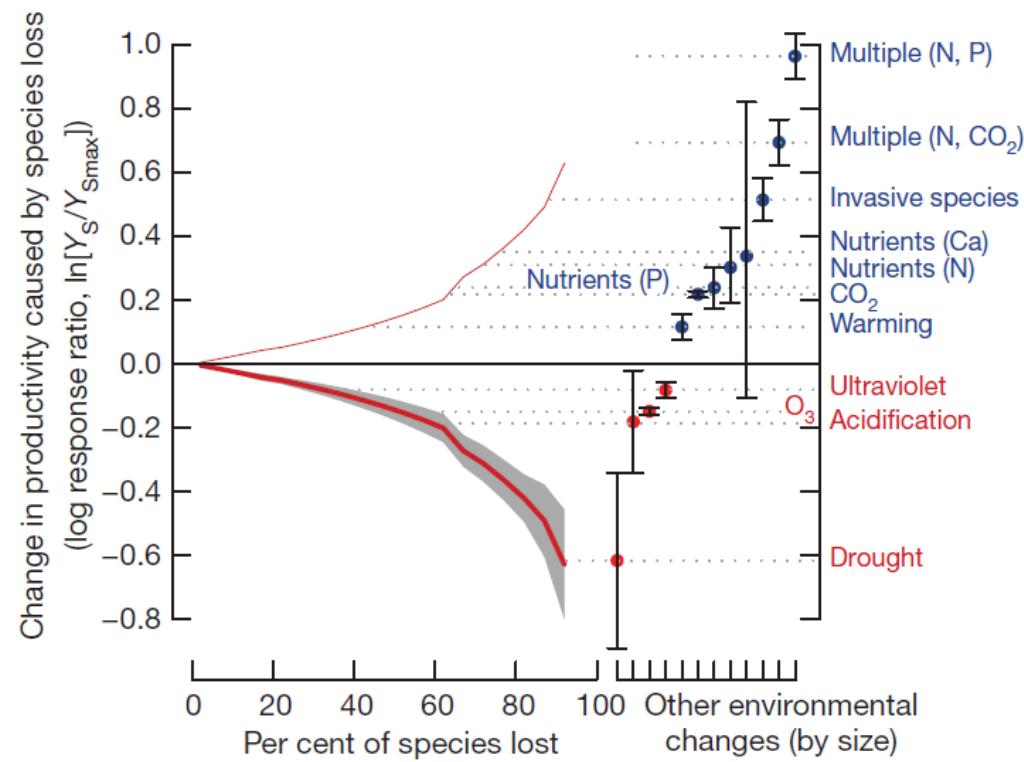
How is biodiversity loss driving ecosystem change?

Through biodiversity-ecosystem function relationships...



Tilman et al. *Science* 2001

So how might biodiversity change link to function?



Hooper et al. *Nature* 2012

What are the real-world implications?

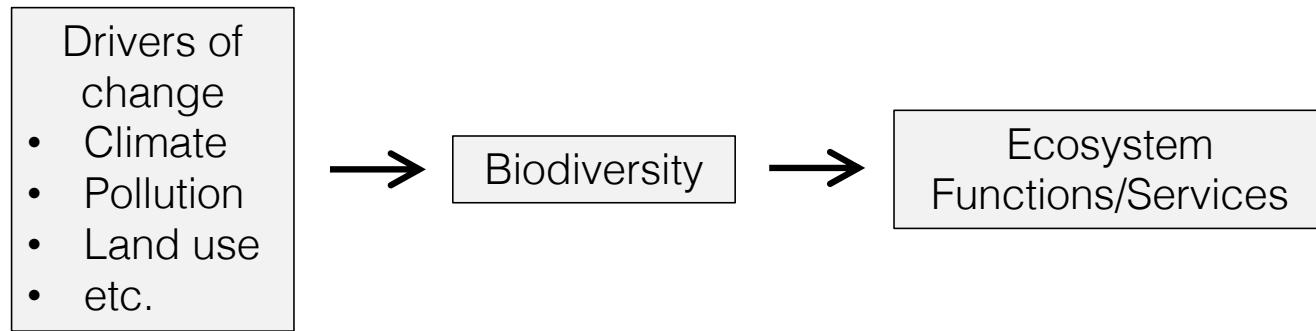
“Our analysis suggests that in areas where local species loss this century falls within the lower range of projections (1–20%), negligible effects on biomass production will result... Where actual losses fall within intermediate projections (21–40%), however, species loss is expected to reduce biomass production by 5–10%...”

“In summary, we have shown that species loss ranks among the major drivers of primary production and decomposition—key processes involved in the carbon cycle and the provisioning of many ecosystem services.”

Hooper et al. *Nature* 2012

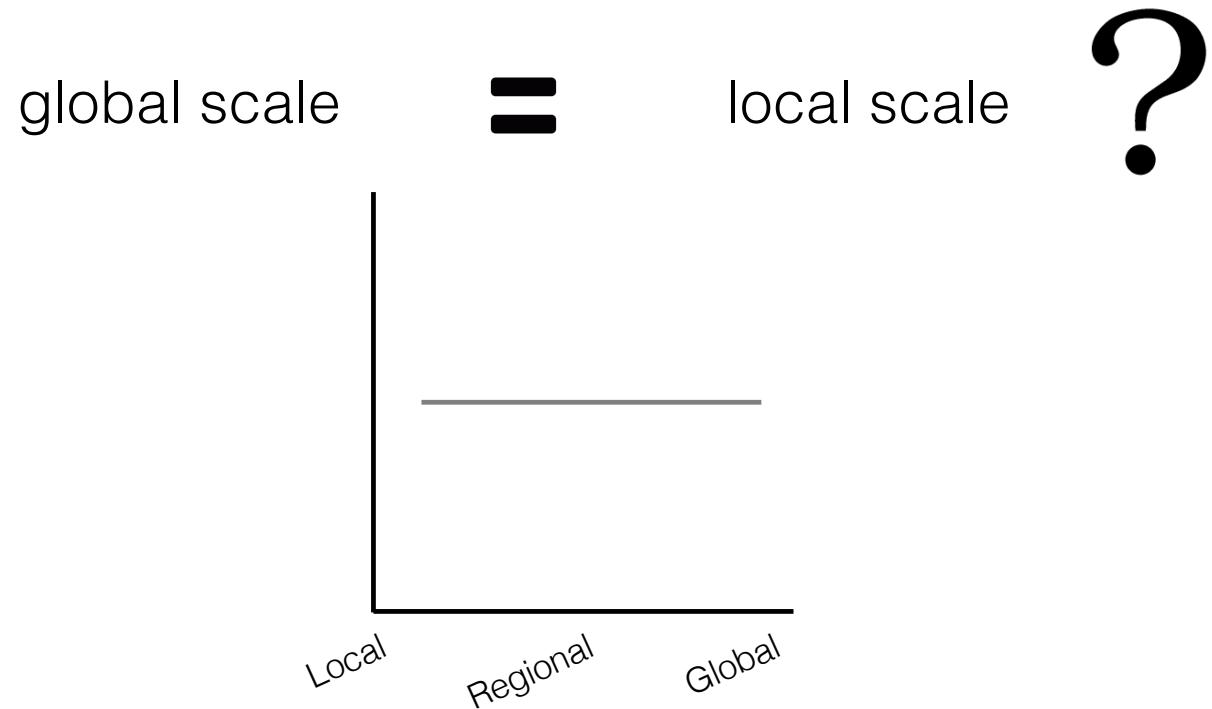
Okay, so is this an impending biodiversity crisis?

In the Anthropocene...



But wait, is there a scale issue here?

For biodiversity change, does...



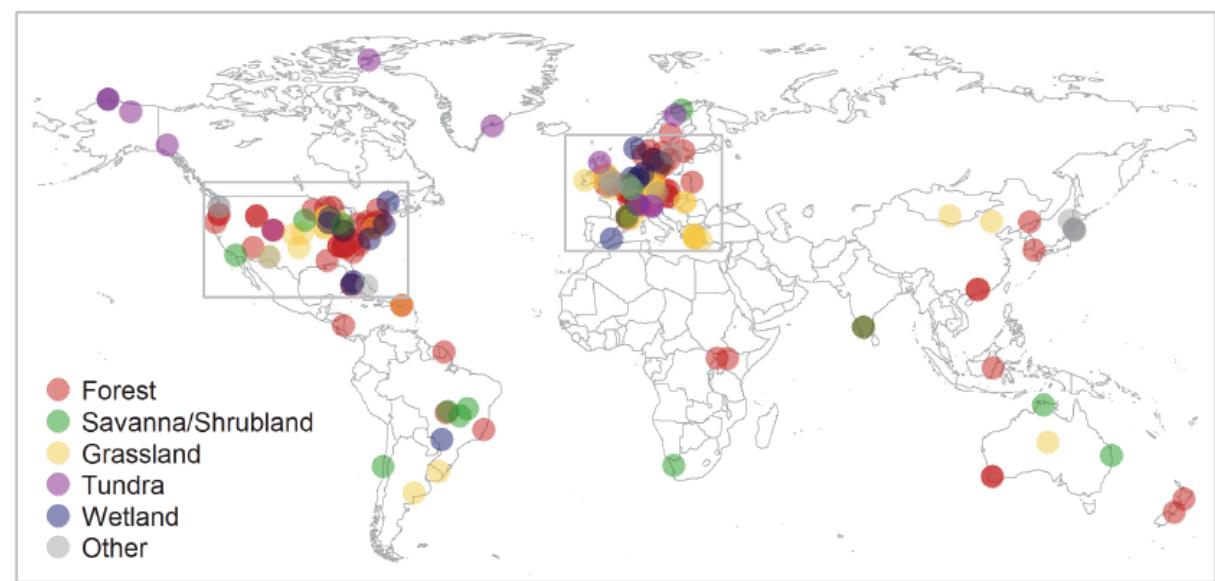
How is species richness changing at the local scale?



1999

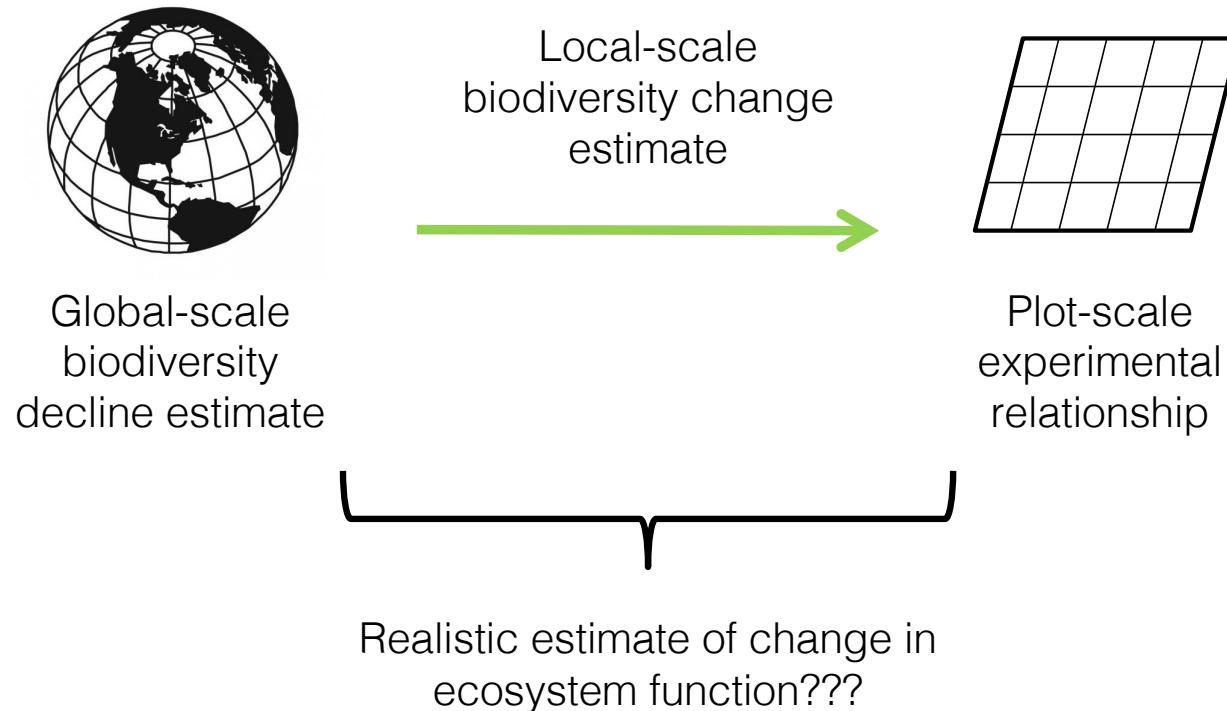


2013



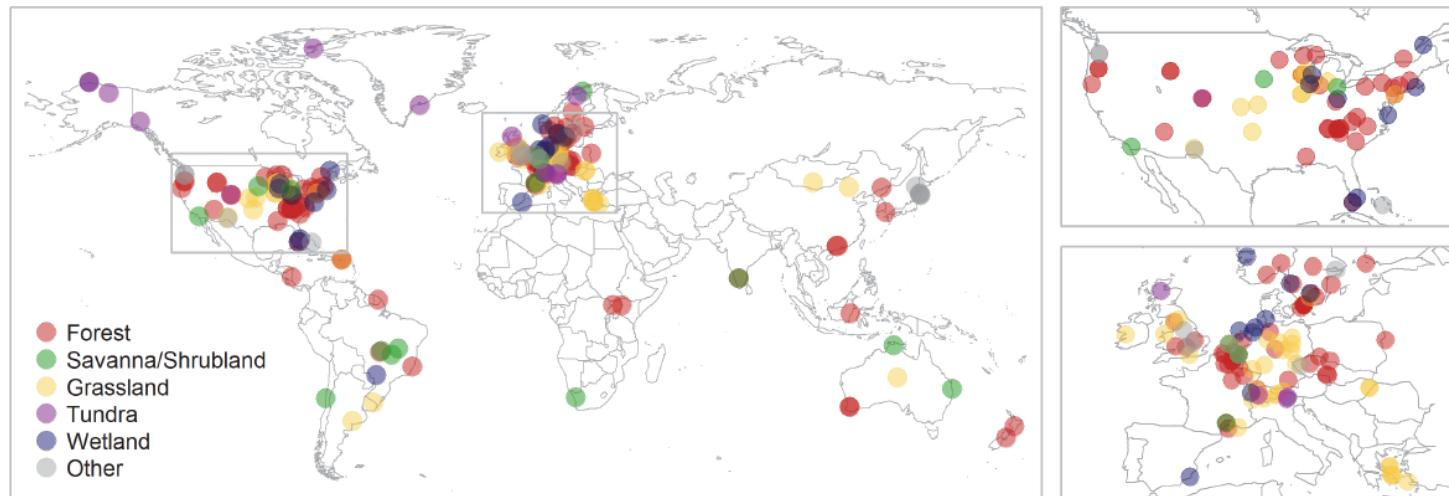
Vellend et al. *PNAS* 2013

Can we scale from the global to the local?



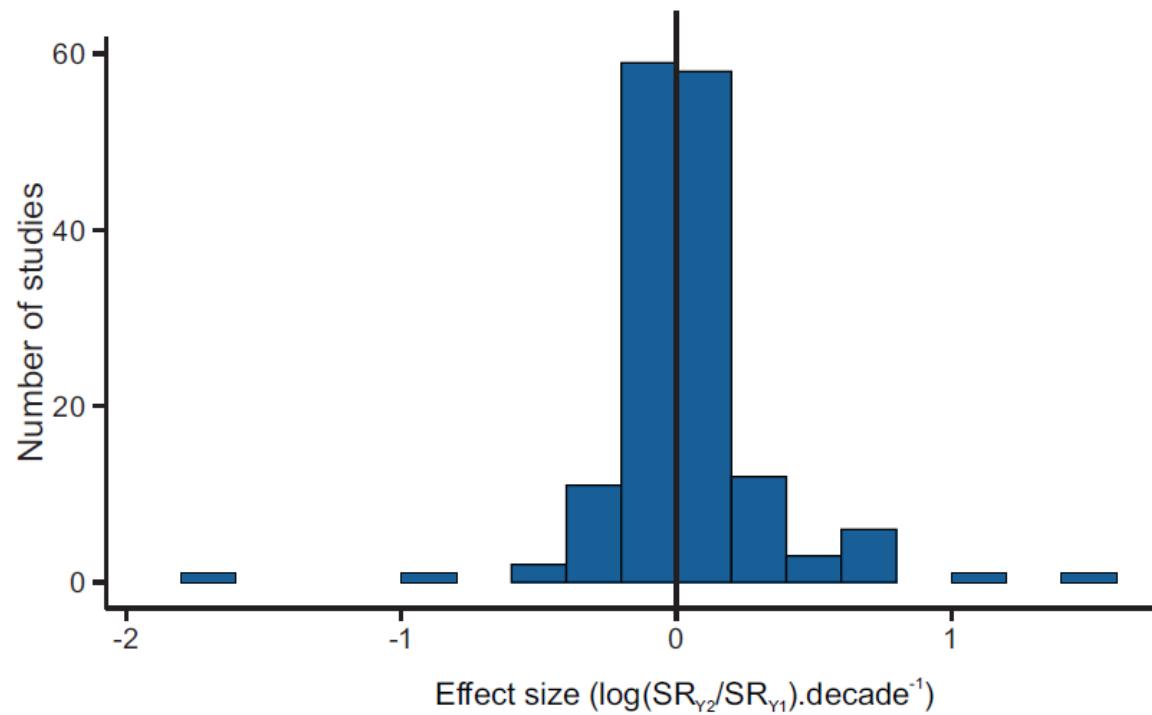
How is biodiversity changing at the local scale?

- leaf 346 data sets (1007 candidate papers)
- leaf 16,000 monitoring plots
- leaf time period of 5 - 261 years



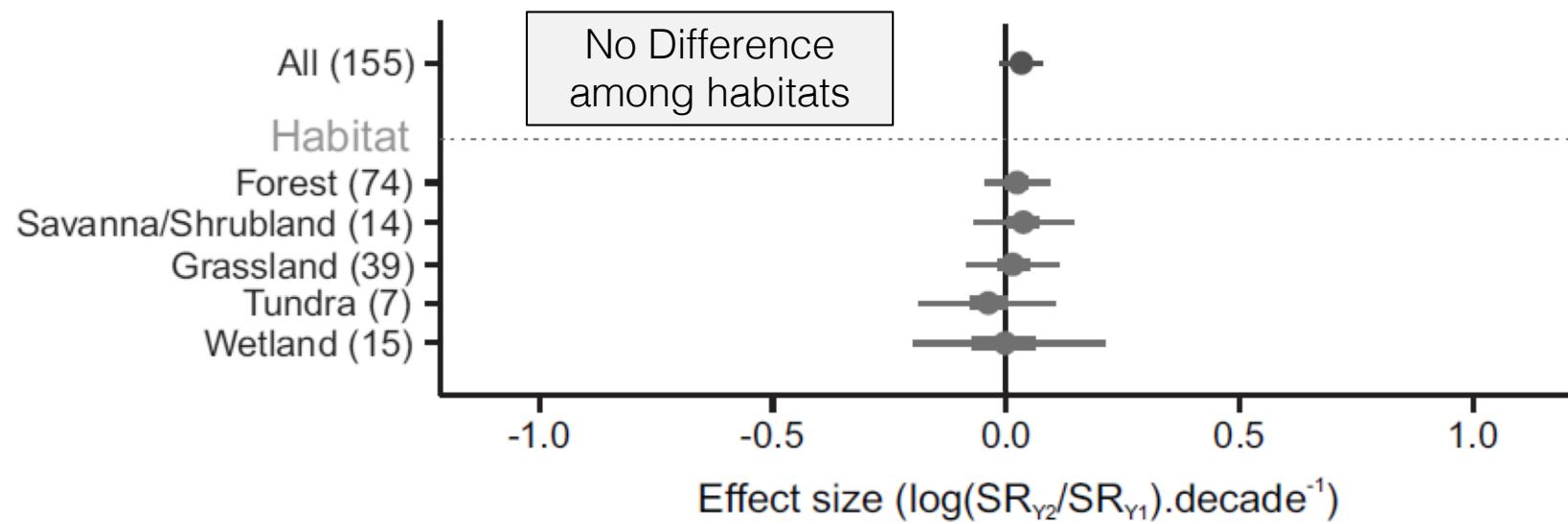
Vellend et al. *PNAS* 2013

No net change in species richness ... at the local scale?



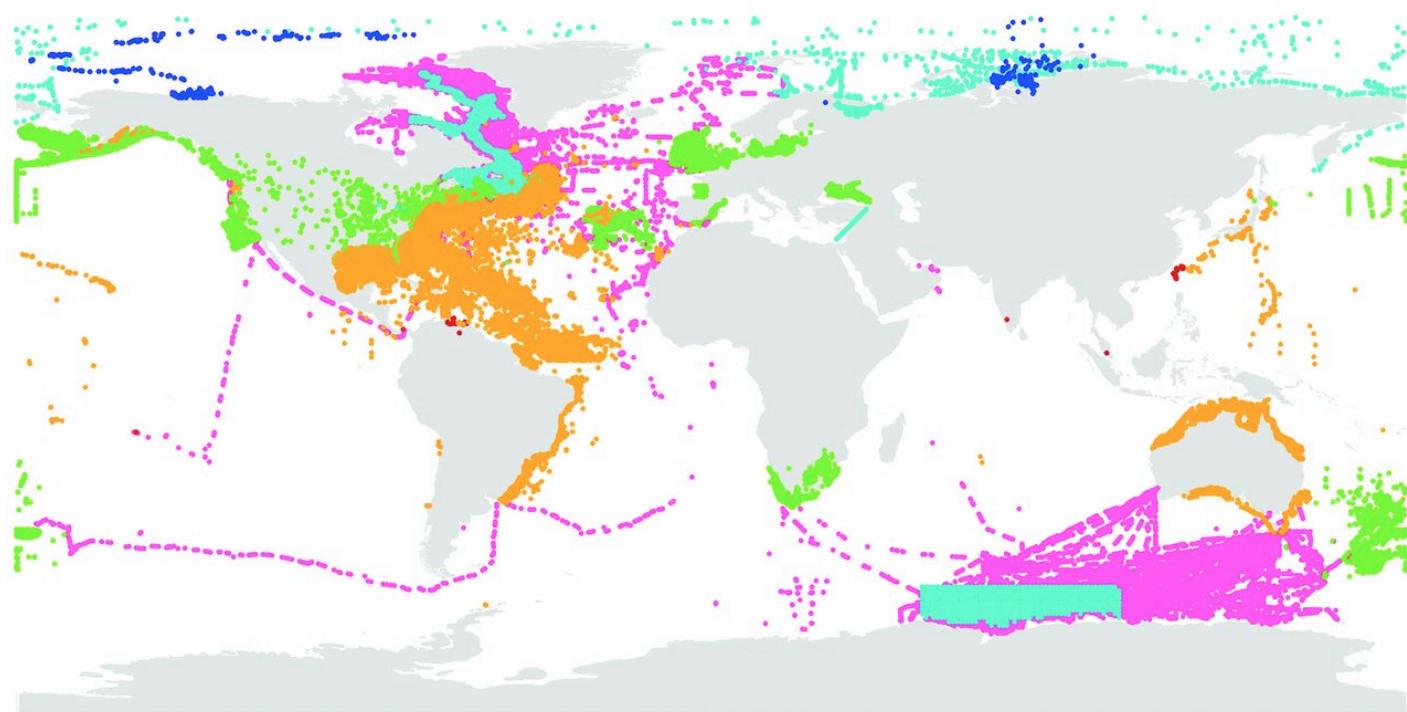
Vellend et al. *PNAS* 2013

How is biodiversity changing at the local scale?



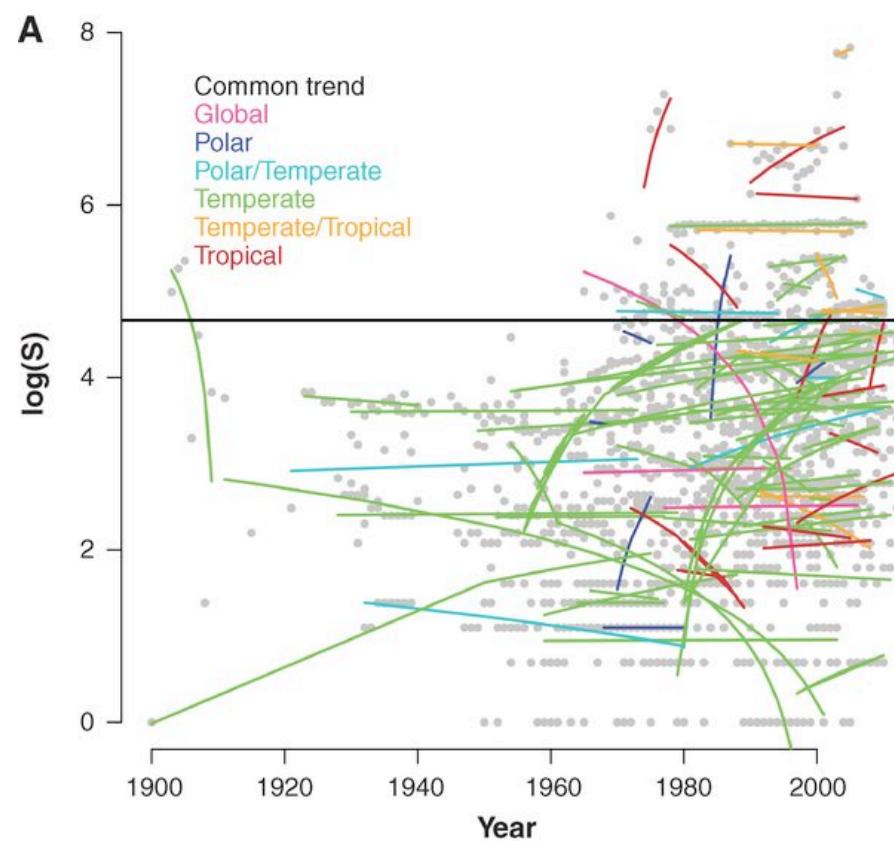
Vellend et al. PNAS 2013

No net change in species richness
... at the local scale?



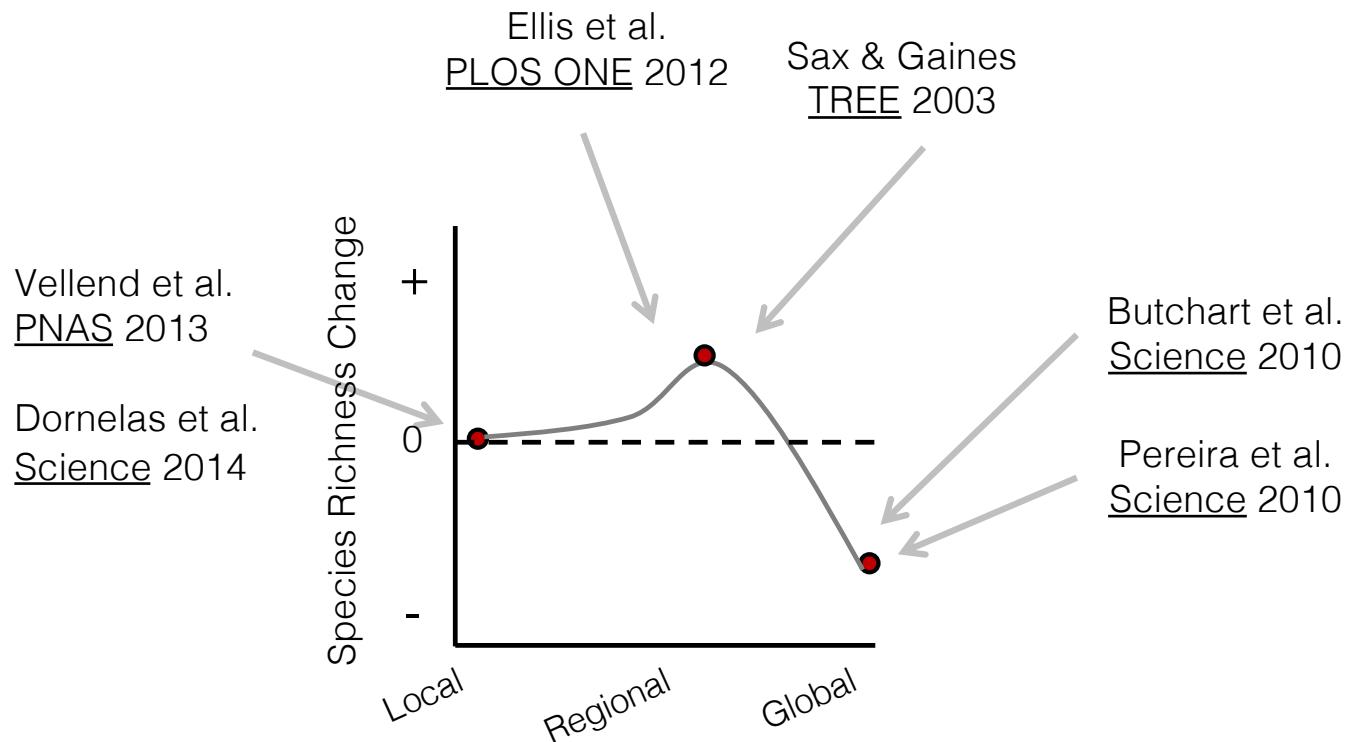
Dornelas et al. *Science* 2014

No net change in species richness ... at the local scale?



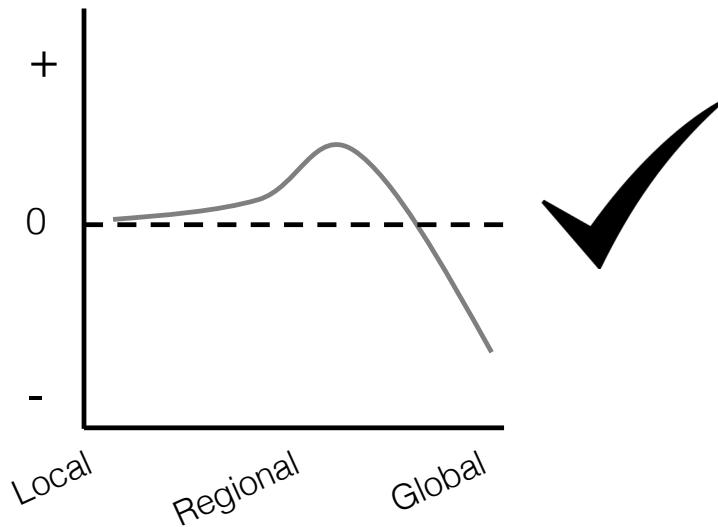
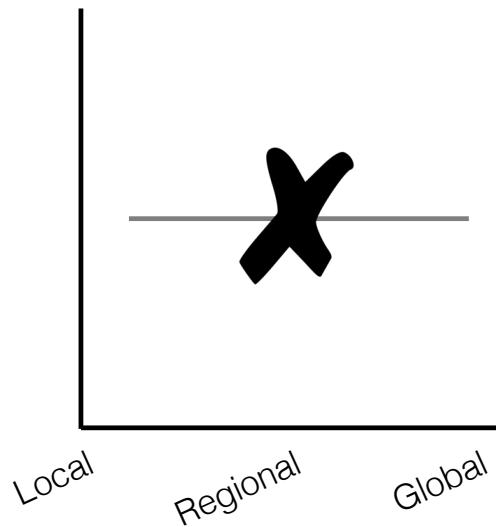
Dornelas et al. *Science* 2014

Across scales



Vellend et al. *ARPB* in press

How is biodiversity changing at the local scale?



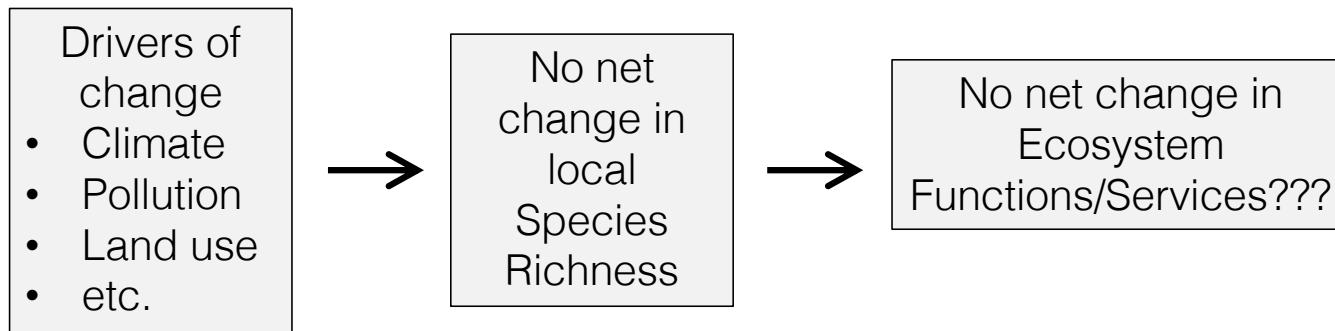
Is there a biodiversity crisis?

Yes at the global scale, but...

Global-scale
biodiversity loss

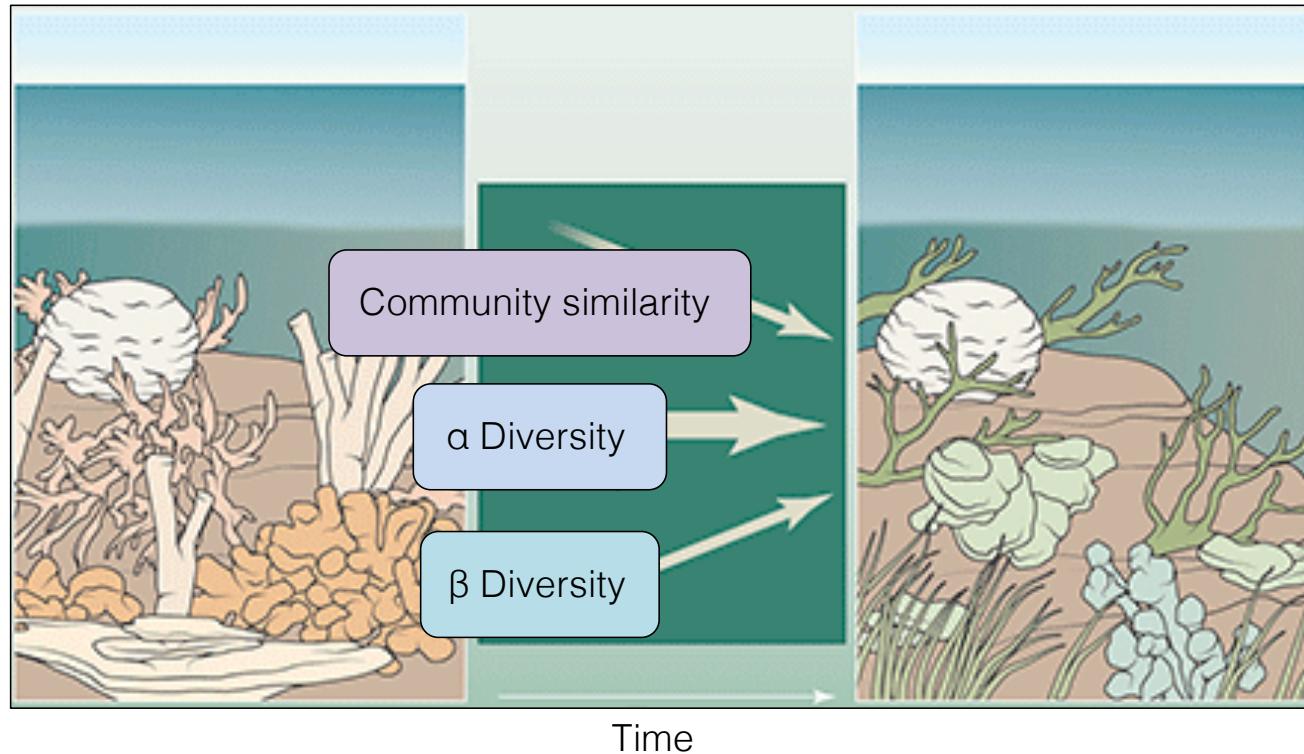


Loss of local-scale
ecosystem function



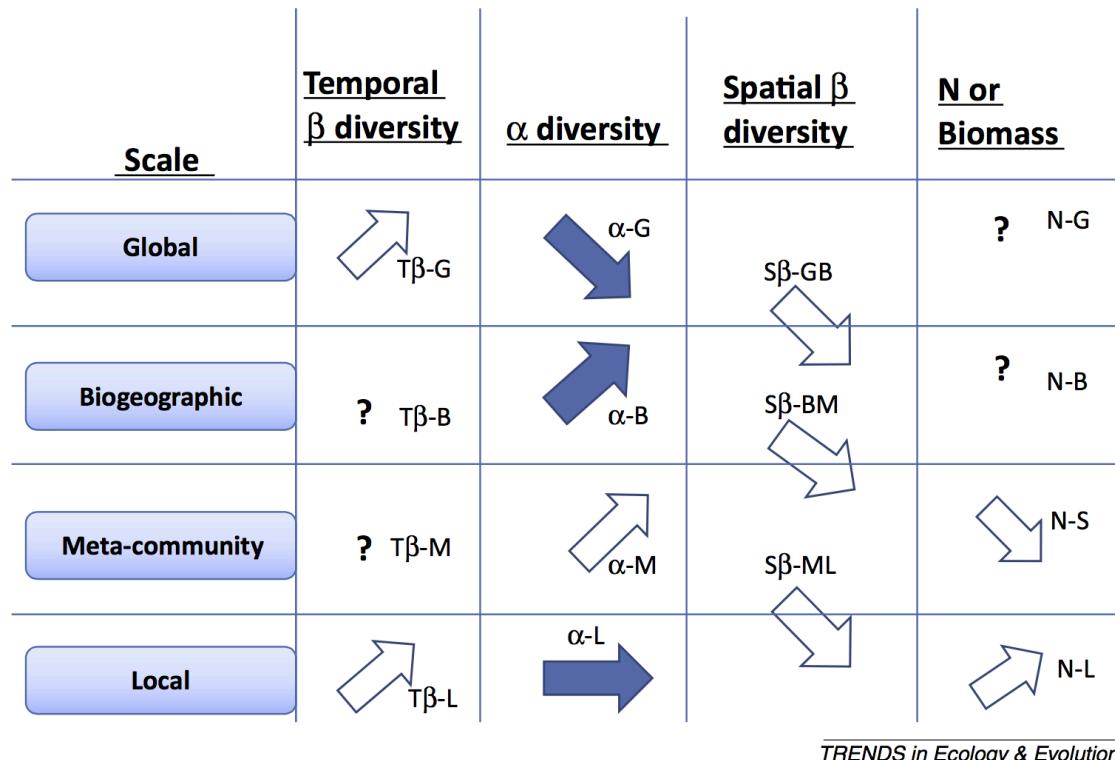
But land-use change, climate, pollution, etc. can all influence ecosystem functions and services directly!

Across metrics



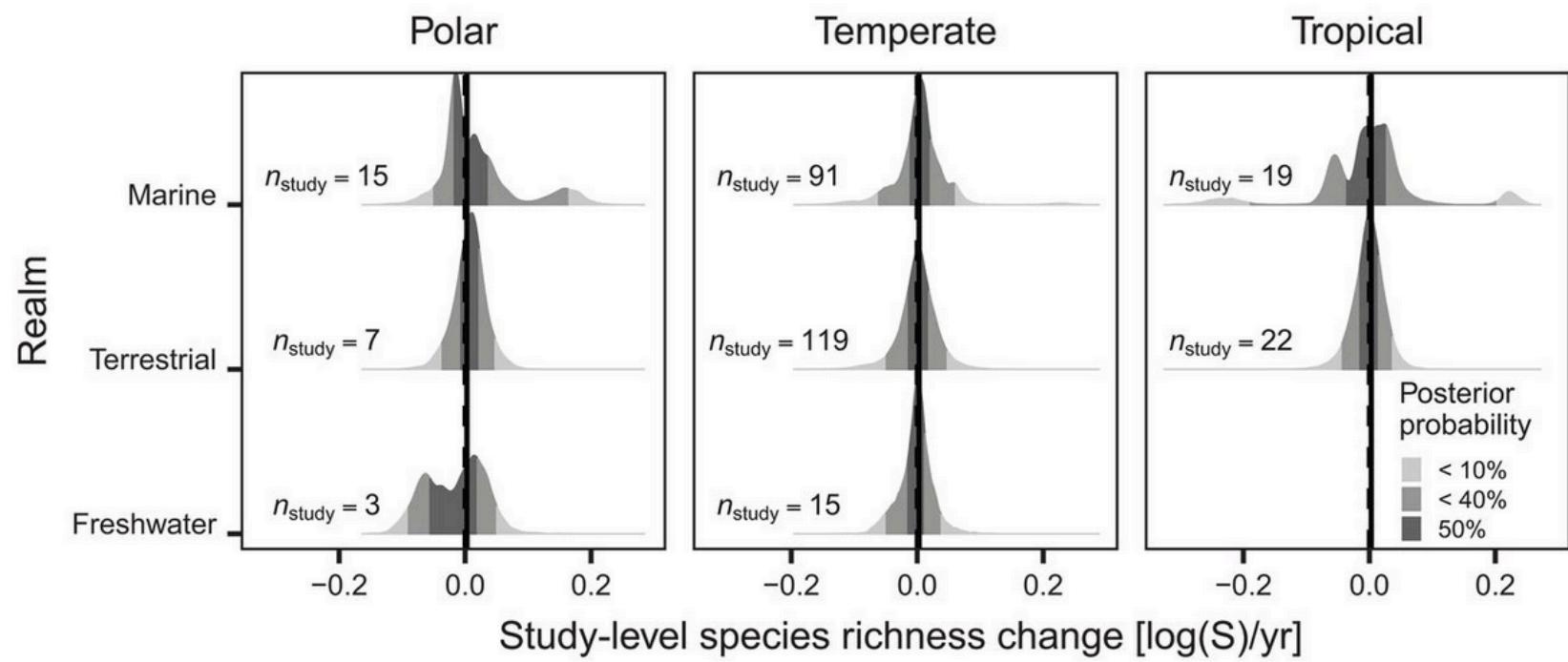
Pandolfi & Lovelock *Science* 2014

Across scales and metrics

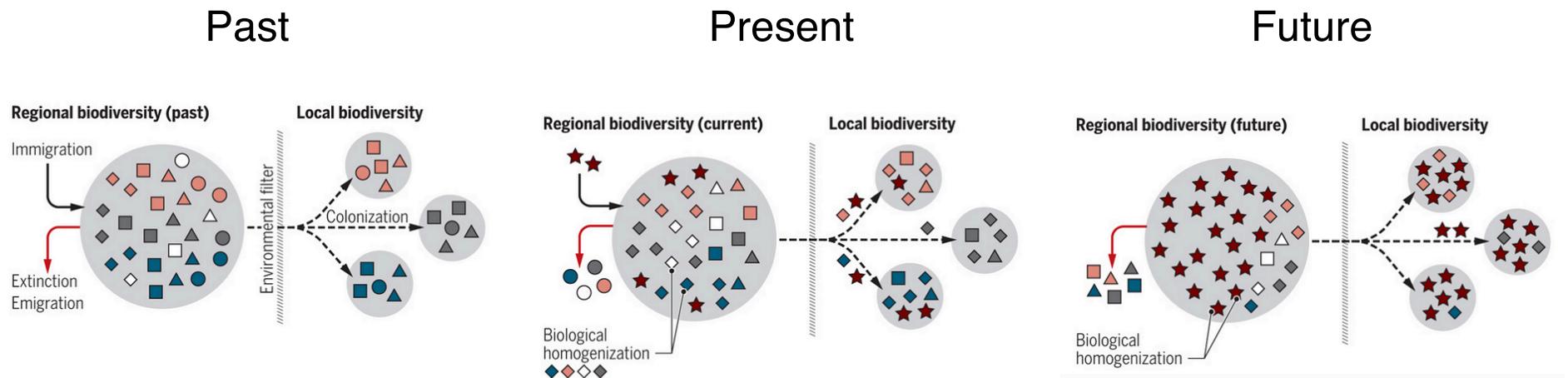


McGill et al. *TREE* 2014

More Data – still no net change



Local – Regional Biodiversity



Blowes et al. *Science* 2019, Eriksson and Hillebrand *Science* 2019

A consensus is reached?

“A key lesson learned from this debate is that biodiversity change represents much more than a change in the average number of species.”

“Their [Blowes et al. 2019] study thus highlights that the global biodiversity crisis, at least for now, is not primarily about decline but, rather, about large-scale reorganization.”

“The study of Blowes *et al.* also has two implications for ecology as a scientific discipline: It brings together authors who originally had highly divergent views on local biodiversity change, and it demonstrates the importance of open access to biodiversity data of sufficient quality.”

How will biodiversity change in the future?

The screenshot shows the official website of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). The header includes the IPBES logo, a search bar, and navigation links for 'Log in' and 'Register'. A prominent banner at the top features a photograph of a sea turtle swimming in an underwater environment with other fish. The banner is overlaid with the text '#GlobalAssessment' on the left and '#IPBES7' on the right. Below the banner, a media release headline reads: 'Media Release: Nature's Dangerous Decline 'Unprecedented'; Species Extinction Rates 'Accelerating''. The main content area on the left is titled 'Welcome to IPBES' and provides a brief description of the platform's purpose. To the right, there are three icons representing 'Assessments', 'Policy Support', and 'Capacity-building'.

ipbes

Science and Policy
for People and Nature

Enter search terms

Log in | Register

About ▾ Work Programme ▾ News ▾ Calendar Documents ▾ Resources ▾

#GlobalAssessment #IPBES7

Media Release: Nature's Dangerous Decline 'Unprecedented'; Species Extinction Rates 'Accelerating'

Media Release: Nature's Dangerous Decline 'Unprecedented'; Species Extinction Rates 'Accelerating'

Welcome to IPBES

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) is the intergovernmental body which assesses the state of biodiversity and of the ecosystem services it

Assessments

Policy Support

Capacity-building

<http://www.ipbes.net/>

How will biodiversity change in the future?

The IUCN website features a large banner at the top with a photograph of a mountain range. Overlaid on the banner is the text "IUCN, International Union for Conservation of Nature". The IUCN logo is located in the top left corner of the page.



In the spotlight

The IUCN Red List has been updated, with over 100,000 species assessed.



Members

IUCN is a democratic membership union – find out about our Members and how to [join IUCN](#).



IUCN Commissions

Find out what volunteer experts worldwide achieve and how to become involved.



IUCN Congress

Take part in the IUCN World Conservation Congress 2020.

<http://www.iucn.org/>

Activity – Biodiversity Change

Files:

Biodiversity data in excel

Meta data in excel

Climate and N deposition data in excel

Maps and repeat photos in ppt

Your task:

Summarize the biodiversity change in these data using simple statistics, figures and point form summaries of the data and imagery.

Figure out why this biodiversity change has occurred by looking at the meta, climate and N deposition data.

Make 1 – 3 slides of your findings to present to the class