

Response Diversity Network Scoping chat

Sam Ross, Okinawa Institute of Science & Technology
(OIST) Graduate University, Japan.

Owen Petchey, University of Zurich, Switzerland.

4. October 2022
9:00 & 17:00 CET
45 mins



Chat outline

- Introductions
- What is response diversity?
- Our ideas about a network
- Discussion and brainstorm
- Summary
- Next steps

Questions at any time, though we have good time reserved for questions and brainstorming.
(And only 45 mins total.)

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What is response diversity?

“...the **range of responses to the environment** displayed among [species in a community]”

- **Insurance Hypothesis:** more biodiversity = declines of one species more likely to be offset by neutral/positive responses of others.
- So response diversity should be a **key driver of ecological stability** (lower temporal variability).
- People think about it **differently...**

What is response diversity?

“...the **range of responses to the environment** displayed among [species in a community]”

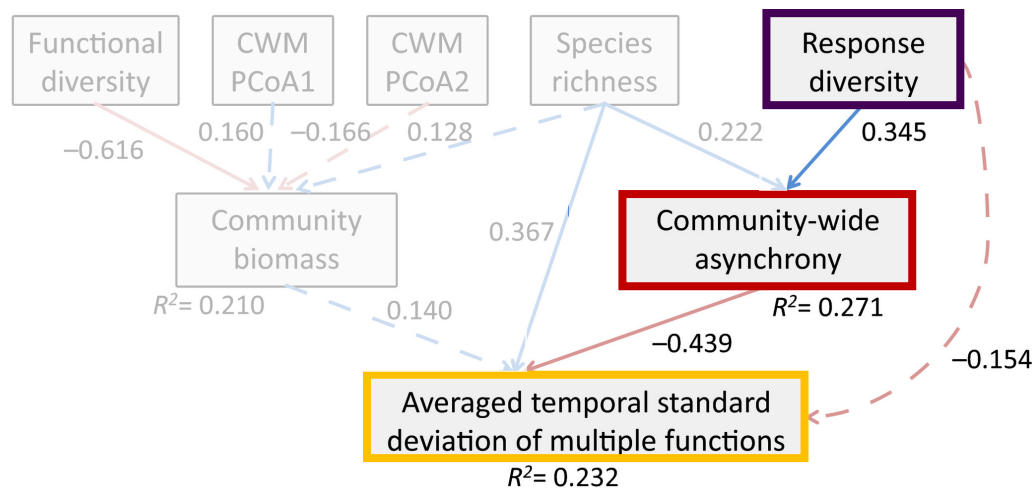
- People think about it **differently**:

Response traits



Species asynchrony and response diversity determine multifunctional stability of natural grasslands

Takehiro Sasaki^{1,2} | Xiaoming Lu^{1,3} | Mitsuru Hirota⁴ | Yongfei Bai^{1,3}



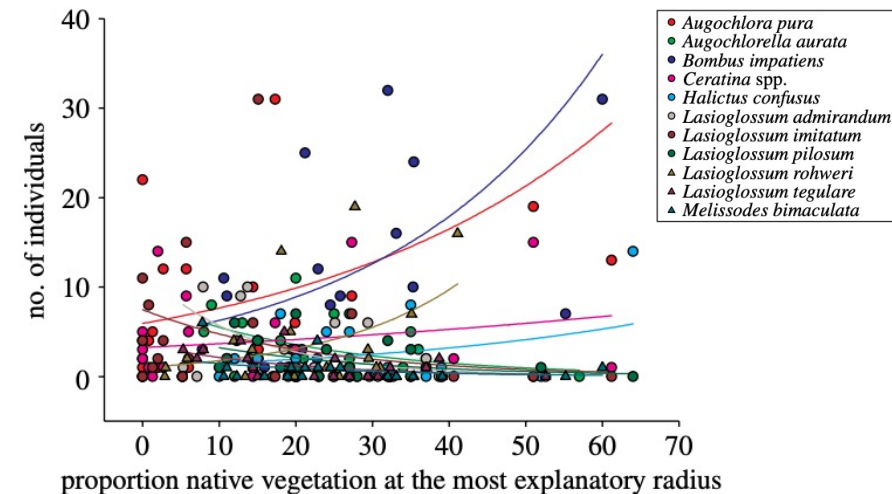
Model interaction terms

Are ecosystem services stabilized by differences among species? A test using crop pollination

Rachael Winfree^{1,2,*} and Claire Kremen²

¹Department of Entomology, Rutgers, The State University, 119 Blake Hall, New Brunswick, NJ 08901, USA

²Department of Environmental Science, Policy and Management, 137 Mulford Hall, University of California, Berkeley, CA 94720, USA



Some response diversity projects



bioRxiv
THE PREPRINT SERVER FOR BIOLOGY

Review of existing methods &
methods development (GAMs for
species-specific responses)

New Results

How to measure response diversity

Samuel R.P.-J. Ross, Owen L. Petchey, Takehiro Sasaki, David W. Armitage

doi: <https://doi.org/10.1101/2022.04.26.489626>



Francesco Polazzo
University of Zurich

Measuring response diversity
to **multiple environmental
stressors** (response surfaces)

Response trait diversity,
functional/compositional
stability (Romanian birds)



Hannah White
Anglia Ruskin University

Last week!



RESEARCH ARTICLE | Full Access

**Functional Response Traits and Altered Ecological Niches
Drive the Disassembly of Cloud Forest Bird Communities
in Tropical Montane Countrysides**

Ian J. Ausprey , Felicity L. Newell, Scott K. Robinson

First published: 26 September 2022 | <https://doi.org/10.1111/1365-2656.13816>

Response diversity to
drought & grazing in
grasslands/rangelands
(including **synthesis** plans!)



Takehiro Sasaki
Yokohama National University

Why so important?

Response diversity is a foundation of ecological stability.

Stability and Variability in Competitive Communities

A. R. Ives,* K. Gross, J. L. Klug

Long-term variability in the abundance of populations depends on the sensitivity of species to environmental fluctuations and the amplification of environmental fluctuations by interactions among species. Although competitive interactions and species number may have diverse effects on variability measured at the individual species level, a combination of theoretical analyses shows that these factors have no effect on variability measured at the community level. Therefore, biodiversity may increase community stability by promoting diversity among species in their responses to environmental fluctuations, but increasing the number and strength of competitive interactions has little effect.

Ives, A.R., Gross, K. & Klug, J.L. (1999).
Stability and variability in competitive communities.
Science (New York, N.Y.), 286, 542–4.

Ecological stability is related to sustainable delivery of ecosystem service delivery.

Table 1 International agreements, organisations and agencies whose policy targets and mission and vision statements we searched for terms associated with ecological stability

Entity	Stability-related term(s) found	Document link
Aichi biodiversity targets (CBD)	'integrity'; 'safe ecological limits'; 'resilience'; 'sustain'; 'conserve'	http://www.cbd.int/sp/targets/
Biodiversity International Birdlife International	'sustain'; 'safeguard' 'sustain'; 'maintain'	http://www.biodiversityinternational.org/about-us/who-we-are/ http://www.birdlife.org/worldwide/partnership/our-vision-mission-and-commitment
Convention on Biological Diversity Conservation International UK Department for Environment, Food & Rural Affairs	'sustain'; 'conserve' 'healthy'; 'sustainable'; 'stable' 'safeguard'	http://www.cbd.int/convention/articles/default.shtml?a=cbd-01 http://www.conservation.org/about/Pages/default.aspx#mission https://www.gov.uk/government/organisations/department-for-environment-food-rural-affairs/about
Diversitas (now rolled into Future Earth) Earthwatch European Environment Agency European Platform for Biodiversity Research Strategy	'secure'; 'conserve'; 'sustain' 'sustain' 'sustainable' 'maintain'; 'sustain'; 'conserve'	http://www.diversitas-international.org/about/mission-and-history http://eu.earthwatch.org/about/earthwatch-mission-and-values http://www.eea.europa.eu/about-us http://www.epbrs.org
Earth System Science Partnership European Union Biodiversity Observation Network	'sustainable' None found	http://www.essp.org http://www.eubon.eu/show/project_2731/
Food and Agriculture Organisation Future Earth Global Environment Facility GreenPeace	'security'; 'sustainable' 'sustainable' 'sustainable' 'protect'	http://www.fao.org/about/en/ http://www.futureearth.org https://www.thegef.org/gef/whatisgef http://www.greenpeace.org/international/en/about/our-core-values/
International Association for Landscape Ecology Intergovernmental platform on biodiversity and ecosystem services	'altered' 'conserve'; sustain'	http://www.landscape-ecology.org/index.php?id=14 http://dx.doi.org/10.1016/j.cosust.2014.11.002

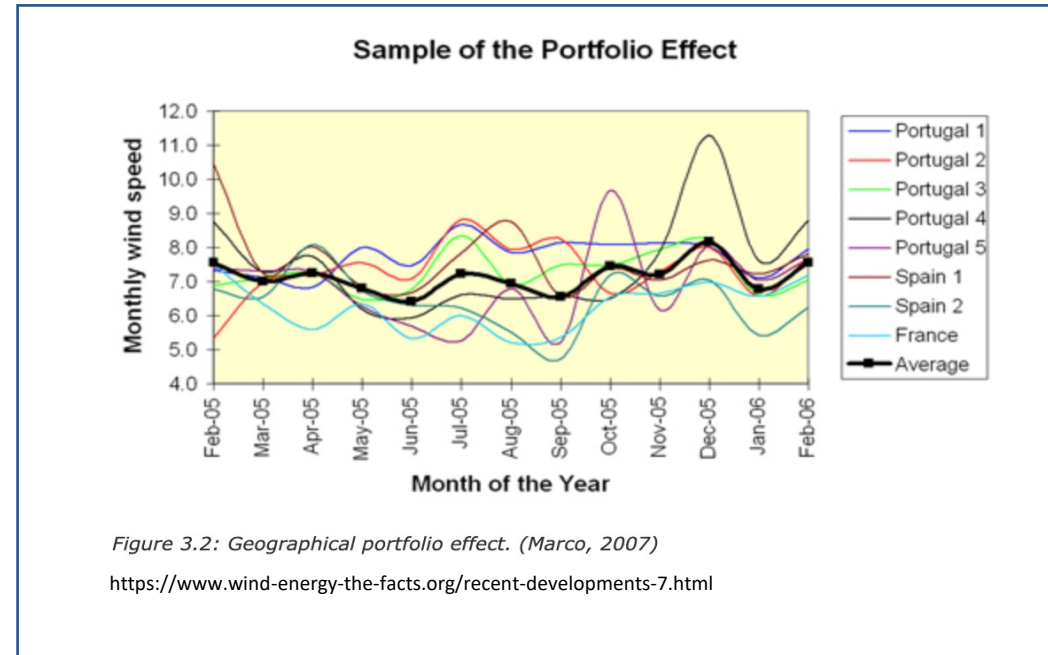
Donohue, I., Hillebrand, H., Montoya, J.M., Petchey, O.L., Pimm, S.L., Fowler, M.S., *et al.* (2016).
Navigating the complexity of ecological stability.
Ecology Letters, 19, 1172–1185.

Why so important?

Response diversity is a foundation of ecological stability.

Ecological stability is related to sustainable delivery of ecosystem service delivery.

Very easy to understand, widely known and applied, and therefore powerful for influencing.



REVIEWS REVIEWS REVIEWS

The portfolio concept in ecology and evolution

Daniel E Schindler^{1*}, Jonathan B Armstrong², and Thomas E Reed³

... it presents a framework for managing risk from inevitable perturbations...

Such approaches may provide effective strategies for managing risks to ecosystems in an increasingly uncertain future

Why are we thinking about a network?

We are concerned that response diversity could be neglected. Ensuring this is not so will be more effective with organisation.

Physiology



Chemical or physical functions promoting organism fitness and responses to environment

Thermal tolerance, disease resistance, stoichiometry (for example, chlorophyll content)

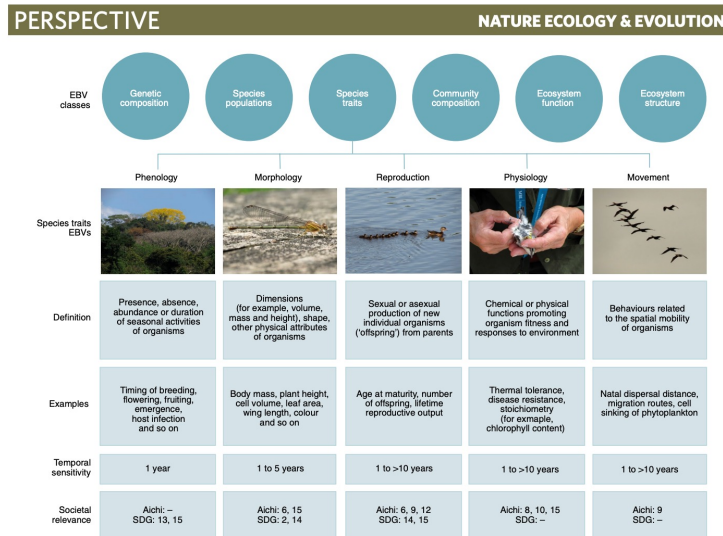
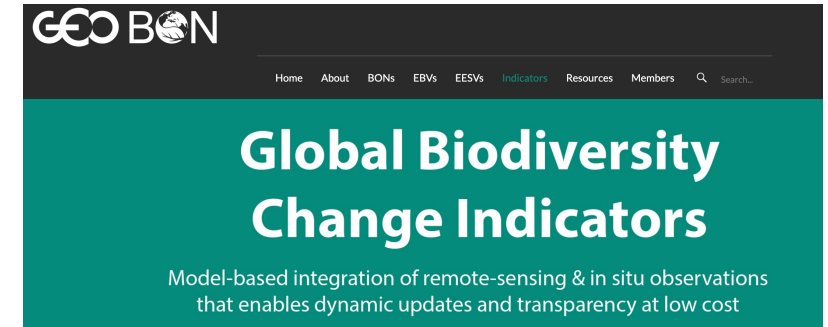


Fig. 1 | A framework for EBVs on species traits. We suggest five EBVs within the EBV class 'species traits', comprising (1) phenology, (2) morphology, (3) reproduction, (4) physiology and (5) movement. For each EBV, a definition, examples of species trait measurements, temporal sensitivity and societal relevance are given. Societal relevance refers to those Aichi Biodiversity Targets and SDGs to which the specific EBV is of highest relevance (for details on societal relevance see Supplementary Note 2 and Supplementary Table 2). Photo credits: Katja-Sabine Schulz.

Kissling, W.D., Walls, R., Bowser, A., Jones, M.O., Kattge, J., Agosti, D., *et al.* (2018). Towards global data products of Essential Biodiversity Variables on species traits. *Nature Ecology & Evolution*, 1.

Why are we thinking about a network?

Response Diversity Network
Scoping chat
4.10.2022

We are concerned that response diversity could get “messy”

bioRxiv preprint doi: <https://doi.org/10.1101/2022.04.26.489626>; this version posted August 25, 2022. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under a [CC-BY-NC 4.0 International license](#).

S.R.P-J. Ross *et al.*

How to measure response diversity

1 How to measure response diversity

2 Samuel R.P-J. Ross^{1*}, Owen L. Petchey², Takehiro Sasaki³, David W. Armitage¹

3

- One technical solution.
- But not a community driven solution.
- Could lead to explosion of many measures.

Why are we thinking about a network?

A benchmarking project to guide development of new measures.

This project is in early stages.

A framework for existing and new empirical studies, and for existing and new measures of response diversity.

Benchmarking response diversity project

03 October, 2022

Response diversity is a component of biodiversity that should predict community and ecosystem stability. For example, a community composed of species that among them have high response diversity should have greater temporal stability of total biomass than a community with low response diversity. Hence, the prediction is of a positive relationship between response diversity and community/ecosystem stability. Furthermore, a measure of response diversity that has a tighter relationship (higher r-squared) with community/ecosystem stability would be preferable to one with a looser relationship. The aim of this project is to assemble tests of this prediction across a range of studies, and if sufficient number of studies are available, to test what features of response diversity measures, of ecosystem type, of organisms, and of measures of stability (and perhaps other features) explain variation in the predictive power of response diversity for community and ecosystem stability.

The project aims to standardise and document methods, so that comparisons can be as valid and clear as possible. Therefore, quite some effort needs to be put into design of individual studies, organisation of data and processing, and each individual study needs to be carefully inserted into the provided analysis framework.

The benchmarking relies upon:

- a collection of individual studies. These are listed in the file `overall/data/study_metadata.csv`.
- a collection of metrics of concepts such as community stability and response diversity. These are listed in the file `overall/data/metrics_metadata.csv`

[The content and structure of the two datasets are described here.](#)

For each individual study:

- Data must be carefully processed and arranged in a set of three or four datasets (traits, environment, composition, and community). [The content and structure of these datasets are described here..](#)
- The data in the three or four datasets must be processed to produce a single dataset containing information about the stability and response diversity of each community. [The content and structure of this datasets are described here..](#)

Example outcome:

[Draft results within and across studies are here..](#)

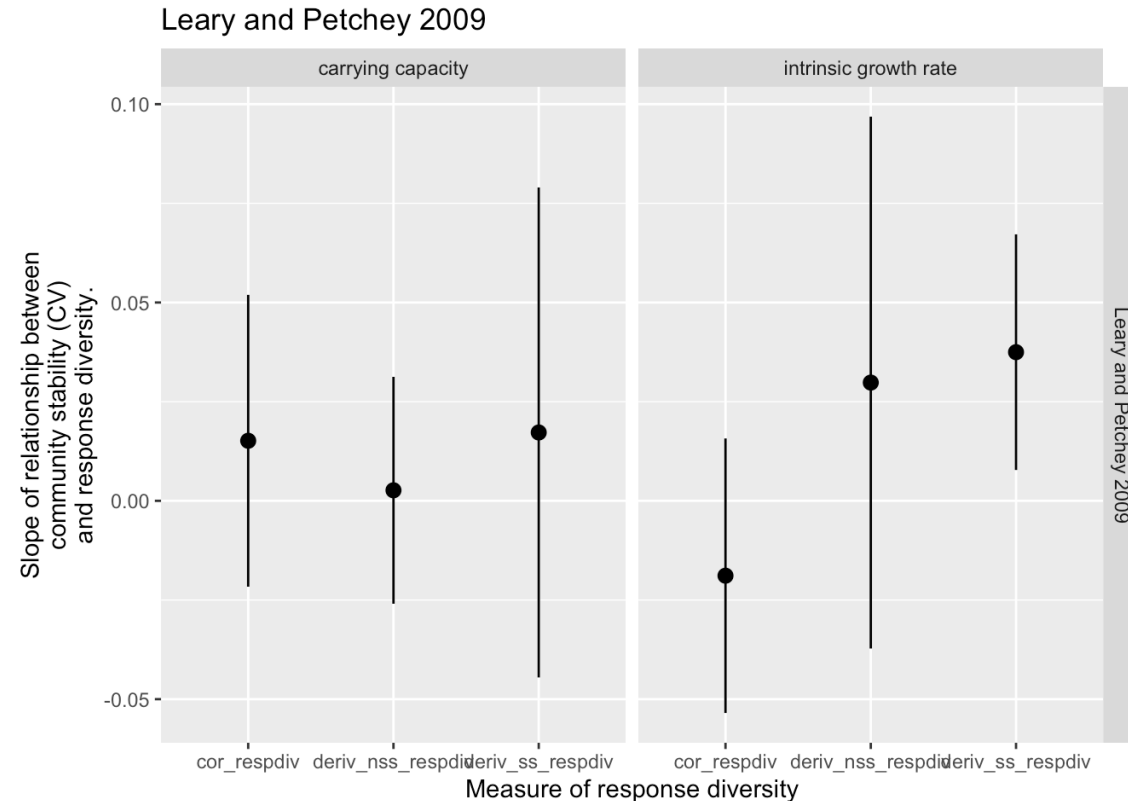
https://opetchey.github.io/response_diversity_benchmarking/

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https://opetchey.github.io/response_diversity_benchmarking/

All very well, but how can people engage?

Our ideas about a response diversity network

Response Diversity Network

03 October, 2022

1 Draft

A scoping exercise is underway to see if there is interest in and need for a network of individuals concerned by response diversity and its implications. This page is suggesting possible themes and activities. Everything is draft and to be discussed and decided upon.

2 Introduction

Response diversity is variation in how organisms respond to environmental change. A diversity of responses ensures that when some organisms are negatively affected, others experience positive effects. This will lead to greater stability of ecological communities and ecosystems.

The possible aims of the Response Diversity Network are:

- To organise and accelerate scientific advances about response diversity.
- To promote the inclusion of response diversity in monitoring and assessment of biodiversity change.
- To provide clear and accessible information about response diversity to relevant individuals, organisations, and processes.

3 Possible activities

- Assembling and organising researchers working on response diversity.
- Providing a standard approach to response diversity research projects, via the [Benchmarking Response Diversity Project](#).
- Organising sessions at scientific meetings, and dedicated meetings and workshops.
- Hosting monthly meetings of network members.

4 Possible services

- Providing clear and accessible lay accounts and summaries of response diversity concepts, research, and implications.
- Consultation with conservation, management, and restoration projects that wish to consider sustainability via ecological resilience and response diversity.
- Review of research proposals and reports concerning response diversity.

5 Possible products

- Research reports, research summaries, working group reports.
- ...

6 Contact

Question about getting involved and requesting services please send to ...

Response Diversity Network
Scoping chat
4.10.2022

<https://opetchey.github.io/ResponseDiversityNetwork/>

Discussion and brainstorm

Response Diversity Network
Scoping chat
4.10.2022

- What have we overlooked?
- What did we get wrong?
- What did we get right?
- Do you feel it is worthwhile to pursue?
- What should we prioritise?
- From where would funding come?
- Should we have a core of 5-6 people that guide, govern, lead the network?

Summary

Next steps

Outcome of this meeting:

- Two weeks to collect additional inputs.
- Send written summary and access to recording to everyone on "the list".
- Request for expressions of interest and level of commitment.

Decision: go, hold, no-go

If go:

- Logo 😊
- (?) Form a steering committee
- Clarify goals, activities, and priorities of Network.
- (?) Write "announcement" paper (including benchmarking project?).