Marine Biodiversity, ecosystem research and ecosystem services

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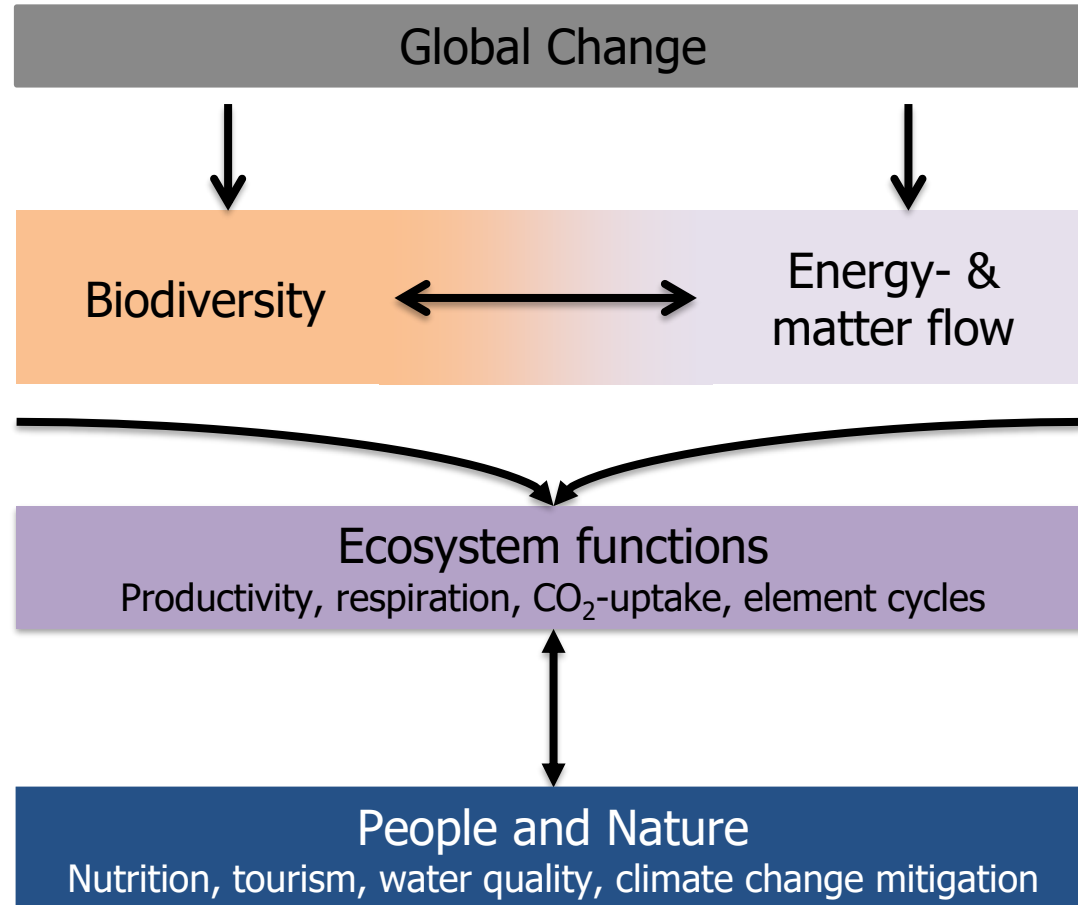Carl-von-Ossietzky University Oldenburg

Marine biodiversity research…

Carta Marina

Olaus Magnus

Library
Uppsala Univ.

… has advanced from discovering species and
understanding their occurrence…

Marine biodiversity research...


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┌─────────────────────────────────────────────────┐
│                 Global Change                   │
└─────────────────────────────────────────────────┘
         │                              │
         ▼                              ▼
┌─────────────────────┬───────────────────────────┐
│    Biodiversity   ←─────→   Energy- &            │
│                             matter flow          │
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                      │
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┌─────────────────────────────────────────────────┐
│           Ecosystem functions                   │
│ Productivity, respiration, CO₂-uptake, element cycles │
└─────────────────────────────────────────────────┘
                      ↕
┌─────────────────────────────────────────────────┐
│            People and Nature                    │
│ Nutrition, tourism, water quality, climate change mitigation │
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Global Change

Biodiversity ←→ **Energy- & matter flow**

Ecosystem functions
Productivity, respiration, CO_2-uptake, element cycles

People and Nature
Nutrition, tourism, water quality, climate change mitigation

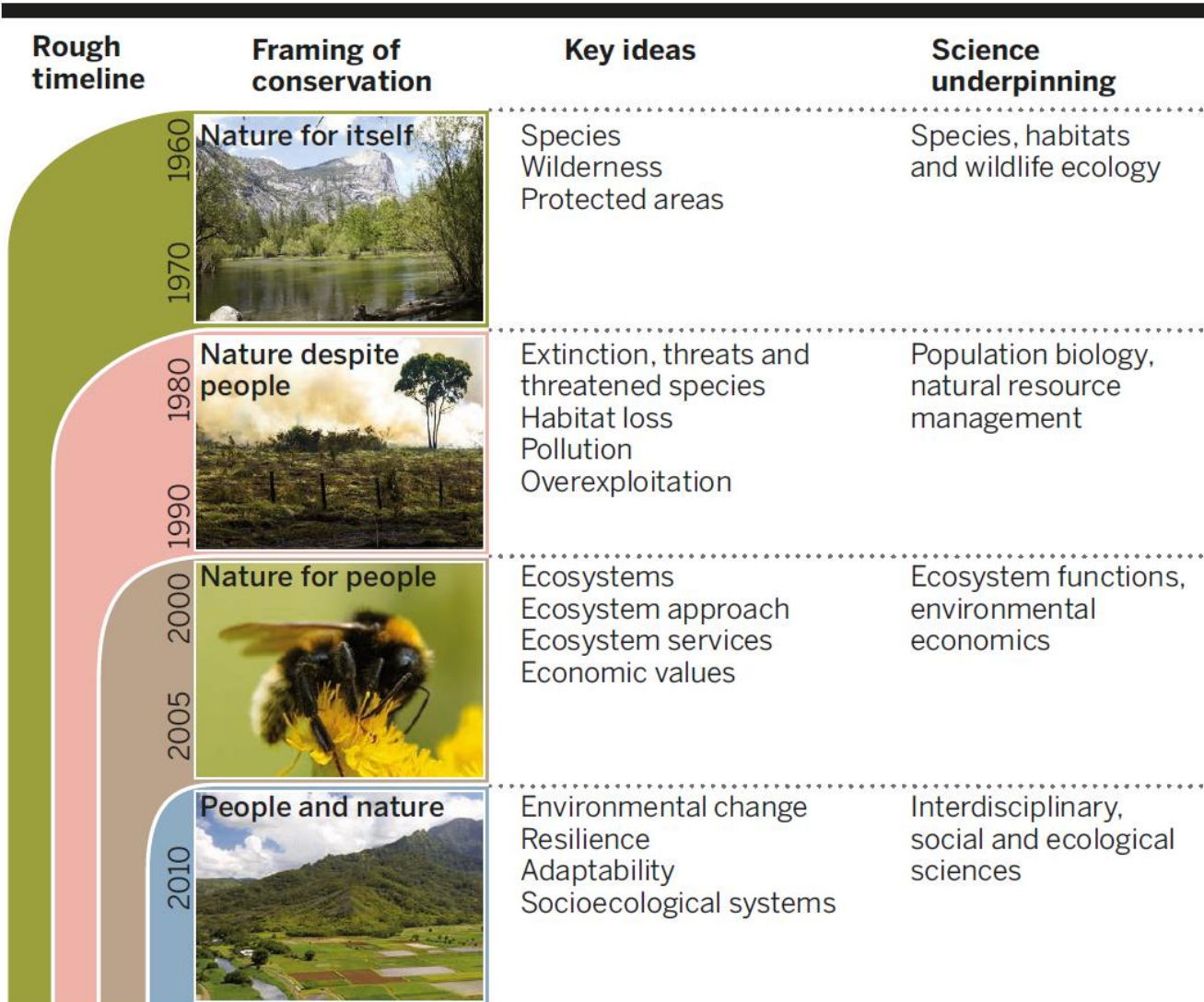... has advanced from discovering species and understanding their occurrence...

... towards seeing biodiversity as an integral component of ecosystem research.

Marine biodiversity research...

... faces fundamental knowledge gaps (a.k.a. „challenges")

Rough timeline	Framing of conservation	Key ideas	Science underpinning
1960 – 1970	Nature for itself	Species Wilderness Protected areas	Species, habitats and wildlife ecology
1980 – 1990	Nature despite people	Extinction, threats and threatened species Habitat loss Pollution Overexploitation	Population biology, natural resource management
2000 – 2005	Nature for people	Ecosystems Ecosystem approach Ecosystem services Economic values	Ecosystem functions, environmental economics
2010	People and nature	Environmental change Resilience Adaptability Socioecological systems	Interdisciplinary, social and ecological sciences

- Uncertainty of marine biodiversity estimates
- Insecurity about trends
- Unclear functional diversity in marine ecosystems

Mace 2014 Science

Marine biodiversity research...

... faces fundamental knowledge gaps (a.k.a. „challenges")

	Mountains, moors, heaths			Enclosed farmland			Semi-natural grassland			Woodsland			Freshwaters			Urban			Coastal margins			Marine		
	Qun	Qua	Spa	Qun	Qua	Spa	Qun	Qua	Spa	Qun	Qua	Spa	Qun	Qua	Spa	Qun	Qua	Spa	Qun	Qua	Spa	Qun	Qua	Spa
Food																								
Fibre																								
Energy																								
Clean water																								
Cleand air																								
Recreation																								
Aesthetics																								
Hazard protection																								
Wildlife																								
Equable climate																								

Mace, J Appl Ecol 2015

Status good, trend 0/+   Status bad, trend -

- We have good indications that globally biodiversity declines in marine ecosystems over long-time scales

- But we lack this knowledge for the relevant local scale

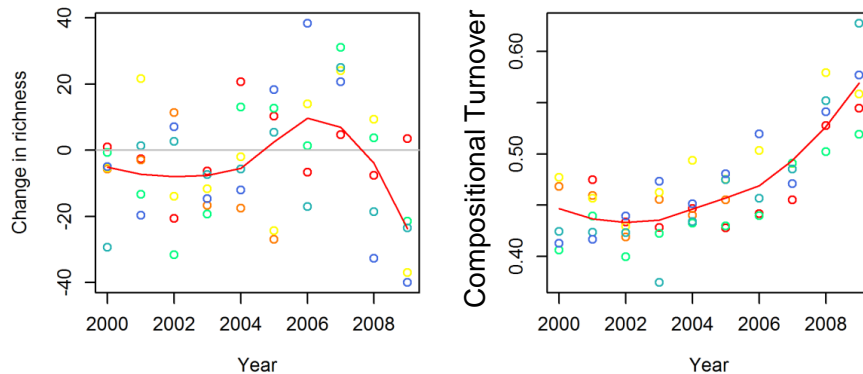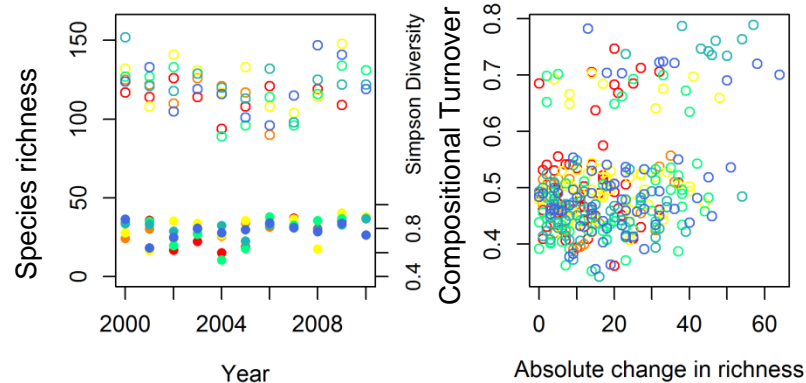**What is the null expectation for a change in local richness if habitat quality improves or deteriorates?**

Cultural period

Lotze et al. 2006 Science

Hillebrand et al., in prep.
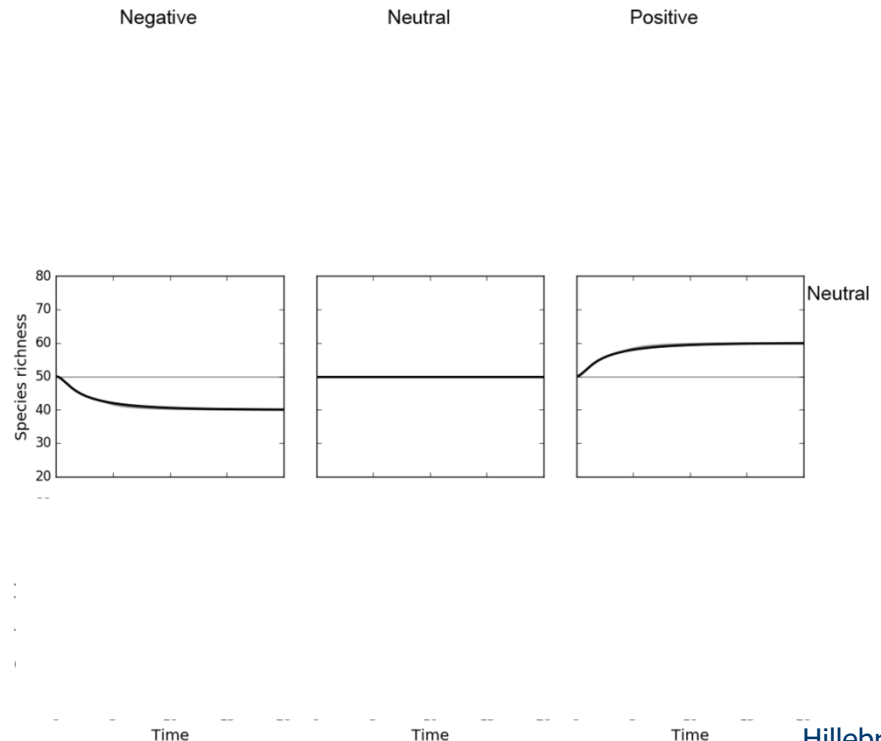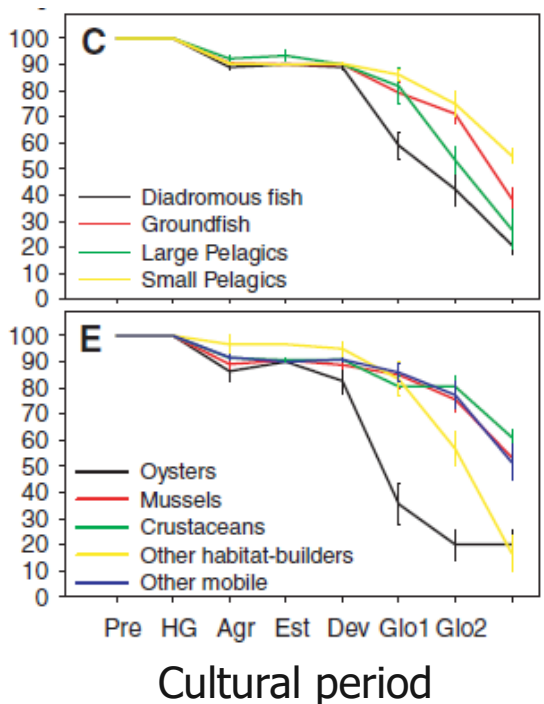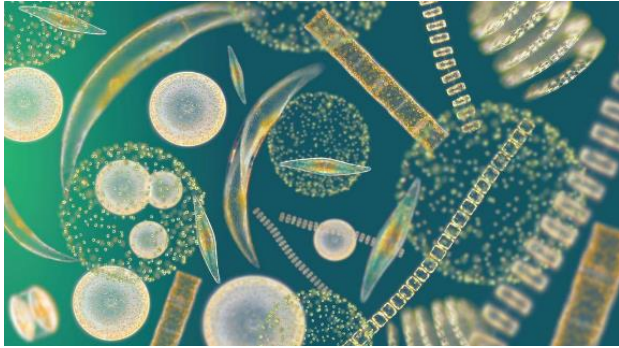
Dutch coastal phytopankton

- But we lack this knowledge for the relevant local scale

What is the null expectation for a change in local richness if habitat quality improves or deteriorates?

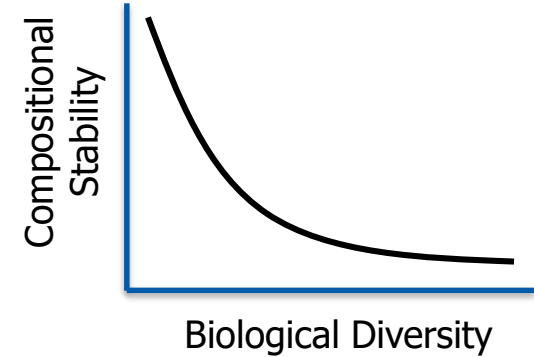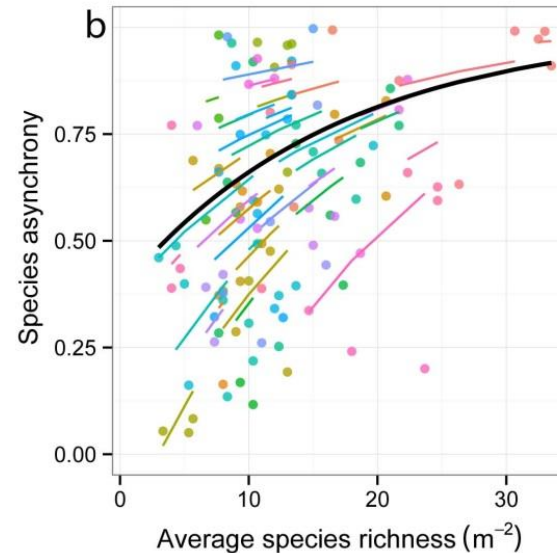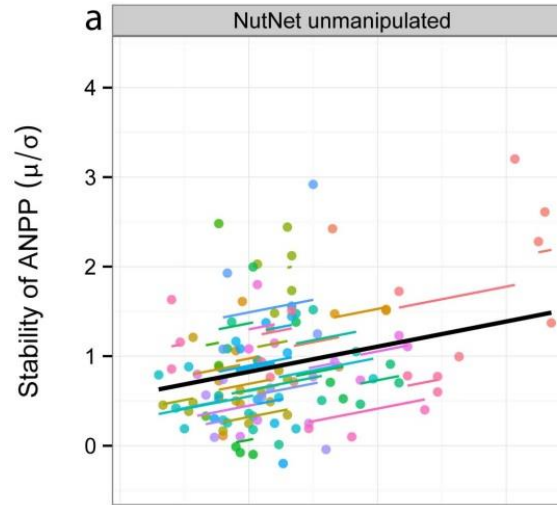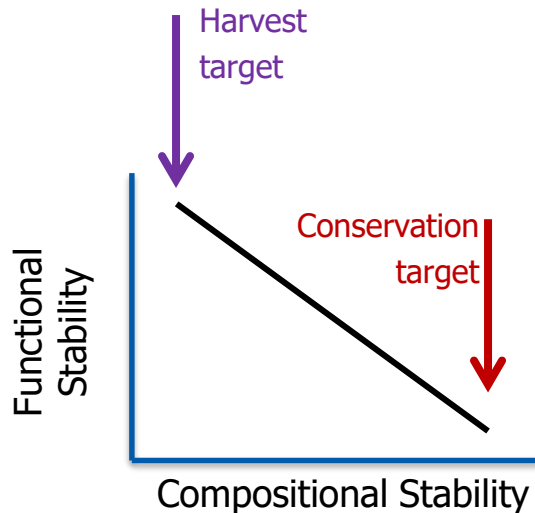Infrastructure for high throughput molecular techniques & bioinformatics

Infrastructure for long-term biodiversity observation

Theory underpinning for assessment analyses

Hillebrand et al. , in prep.

Challenges: biodiversity & stability

Biodiversity functions
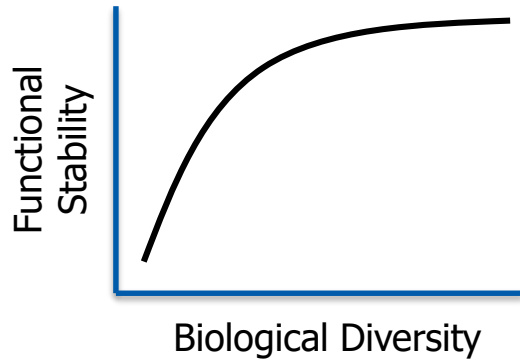
Functional Stability vs Biological Diversity

Functional Stability vs Compositional Stability
- Harvest target
- Conservation target

Compositional Stability vs Biological Diversity

a NutNet unmanipulated
Stability of ANPP (μ/σ) vs Average species richness (m^{-2})

b
Species asynchrony vs Average species richness (m^{-2})

Experimental infrastructure for biodiversity manipulation on relevant scales

Hautier et al. 2014 Nature

Summary

ICBM

Infrastructure

- **Theory underpinning for assessment analyses**

- **Infrastructure for high throughput molecular techniques & bioinformatics**

- **Infrastructure for long-term biodiversity observation**

- **Experimental infrastructure for biodiversity manipulation on relevant scales**

Tasks

Strengthen university biodiversity education

Foster joint projects with theory, ecology and evolutionary biology in the marine sciences

Improve access to and usage of [meta]-omics

Integrate bioinformatics and data storage into research projects

Secure finances for existing and novel long-term observations

Develop autonomous biodiversity sampling and analysis procedures

Establish and maintain versatile mesoscale experimental infrastructure

Create experimental facility networks