

# Acquisition, validation, quality control and access to biodiversity data -

Training course for less experienced users of data products

## A few concepts on biodiversity

Biodiversity at different levels of organisation and their relation

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Why special emphasis to marine biodiversity?

Is marine biodiversity so special that it needs more attention ?

Yes, because firstly, 70 % of the Earth surface is covered by seas.

And secondly, the marine realm has :

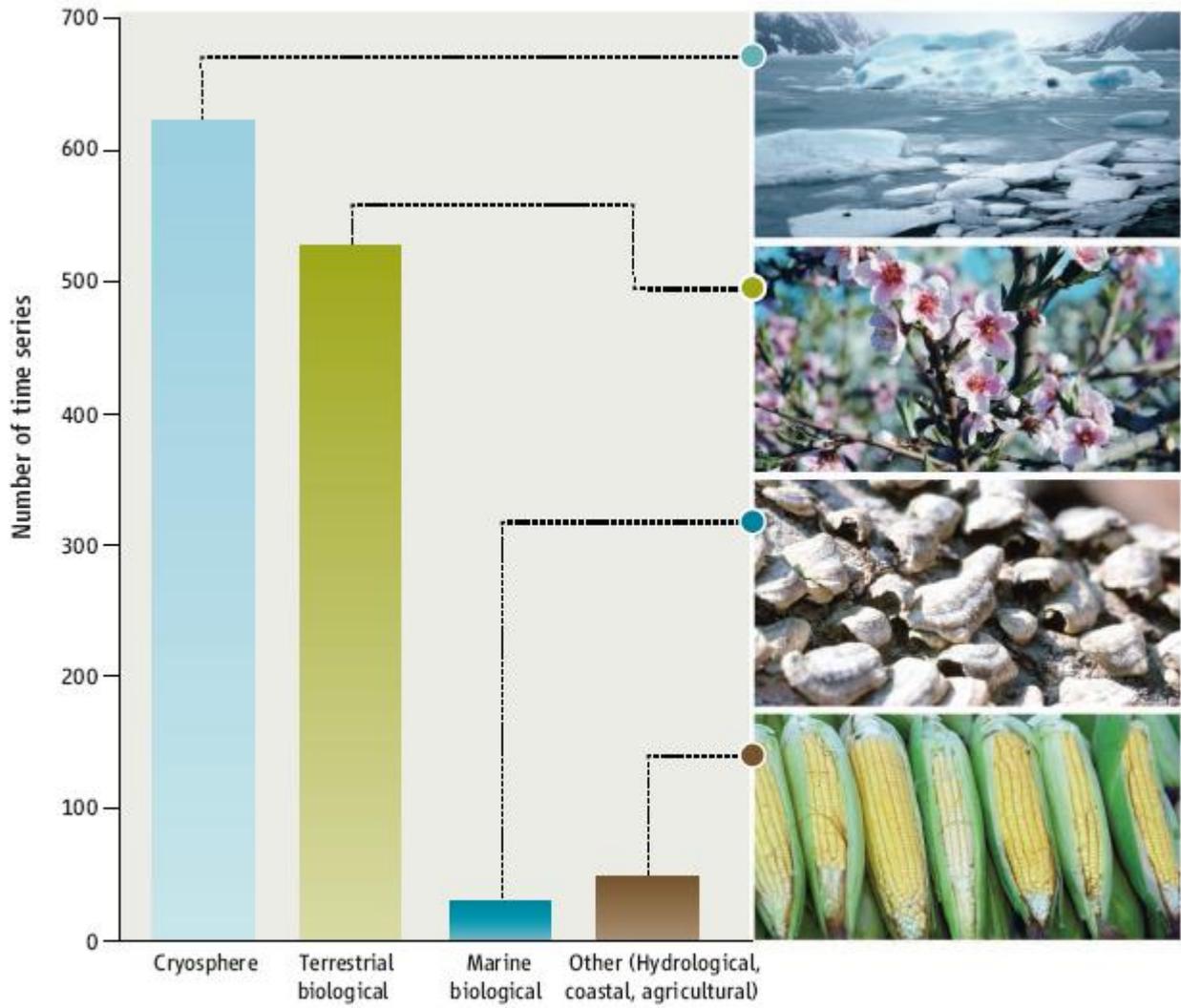
- less species
- but greater phylogenetic diversity than land faunas and floras

	<u>Number of phyla</u>	
	Endemic	Total
Freshwater	0	14
Terrestrial	1	11
<b>Marine</b>	<b>13</b>	<b>28</b>
<b>Total</b>		<b>33</b>

This does provide (and may provide still unknown) goods and services of great value and importance to mankind:

- food
- chemicals
- play crucial roles in biogeochemical processes sustaining the biosphere

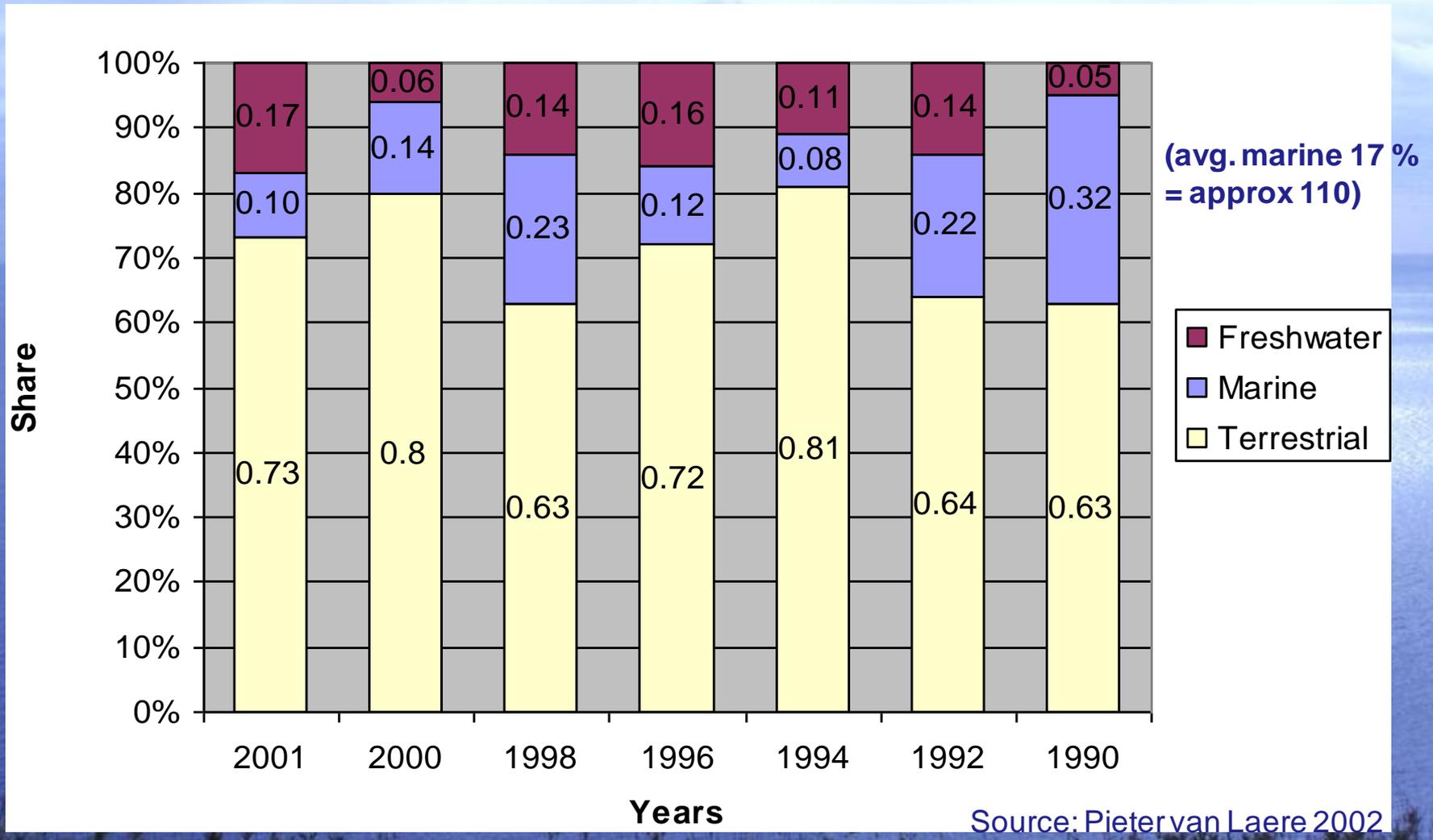
Yet, biological studies, and resulting datasets, were mainly directed towards the 'terrestrial continent'



**Marine undersampling.** The number of time series from different environments included in the recent IPCC (Intergovernmental Panel on Climate Change) Fourth Assessment Report differ widely. Marine systems are vastly underrepresented compared with terrestrial systems (1).

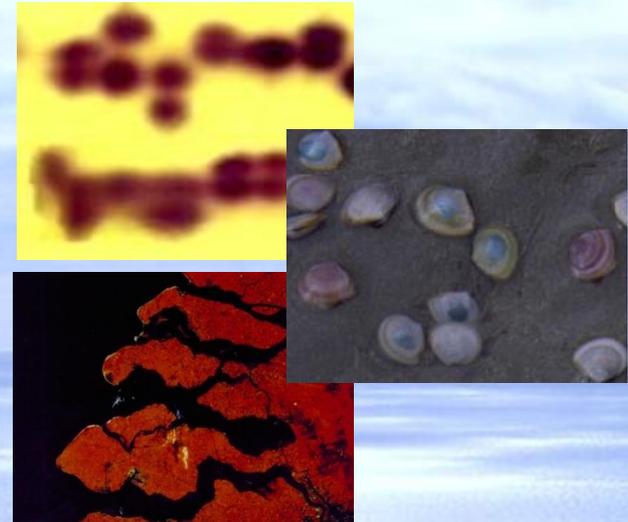
A.J. Richardson & E.S. Poloczanska, 2008. Ocean science: Under-resourced, under threat. *Science* 320: 1294-1295

As also for biodiversity most studies were directed towards the 'terrestrial continent'



The term (bio)diversity has multiple meanings, depending on the biological scale:

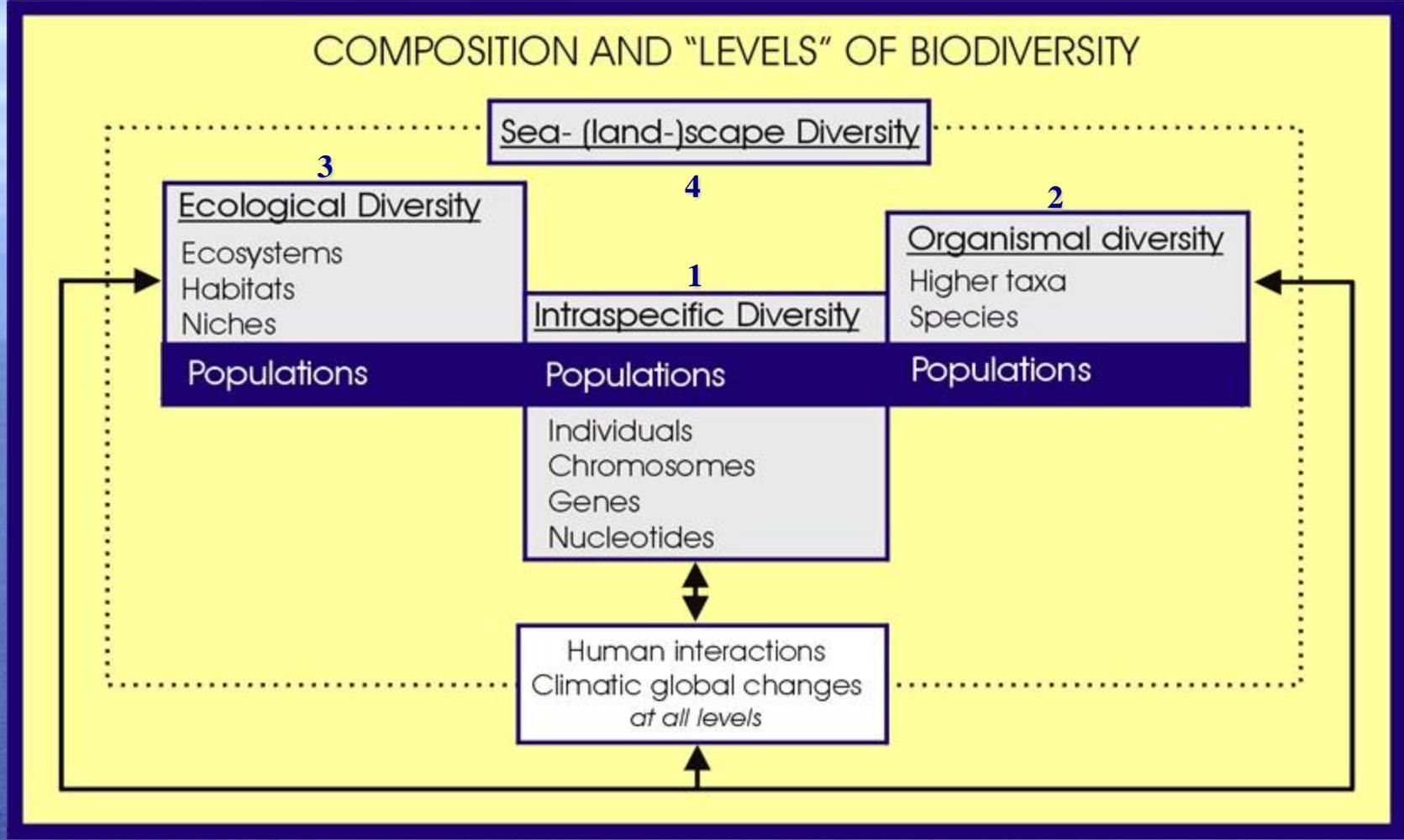
- molecular – genetic diversity
- organism – adaptation diversity
- population – species diversity
- community – habitat diversity
- ecosystem – ecosystem diversity
- region – sea(land)scape diversity



Most commonly biological diversity refers to:

- number of species (incl. viruses, protista, bacteria, fungi, plants, animals),  
i.e. species diversity

# The different levels of Biological diversity can be described in one figure





**Decision makers and the public at large are not used to terms as ecosystem diversity or genetic diversity.**

**Yet, these terms are not less important than species diversity.**

**The continued preservation of biodiversity at all these levels is recognized in the definition of the Convention on Biological Diversity (Rio de Janeiro, 1992):**

***“Biological Diversity is the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems”***

[Article 2] (ISCBD, 1994).

**Feral et al., 2003. European marine biodiversity indicators.**

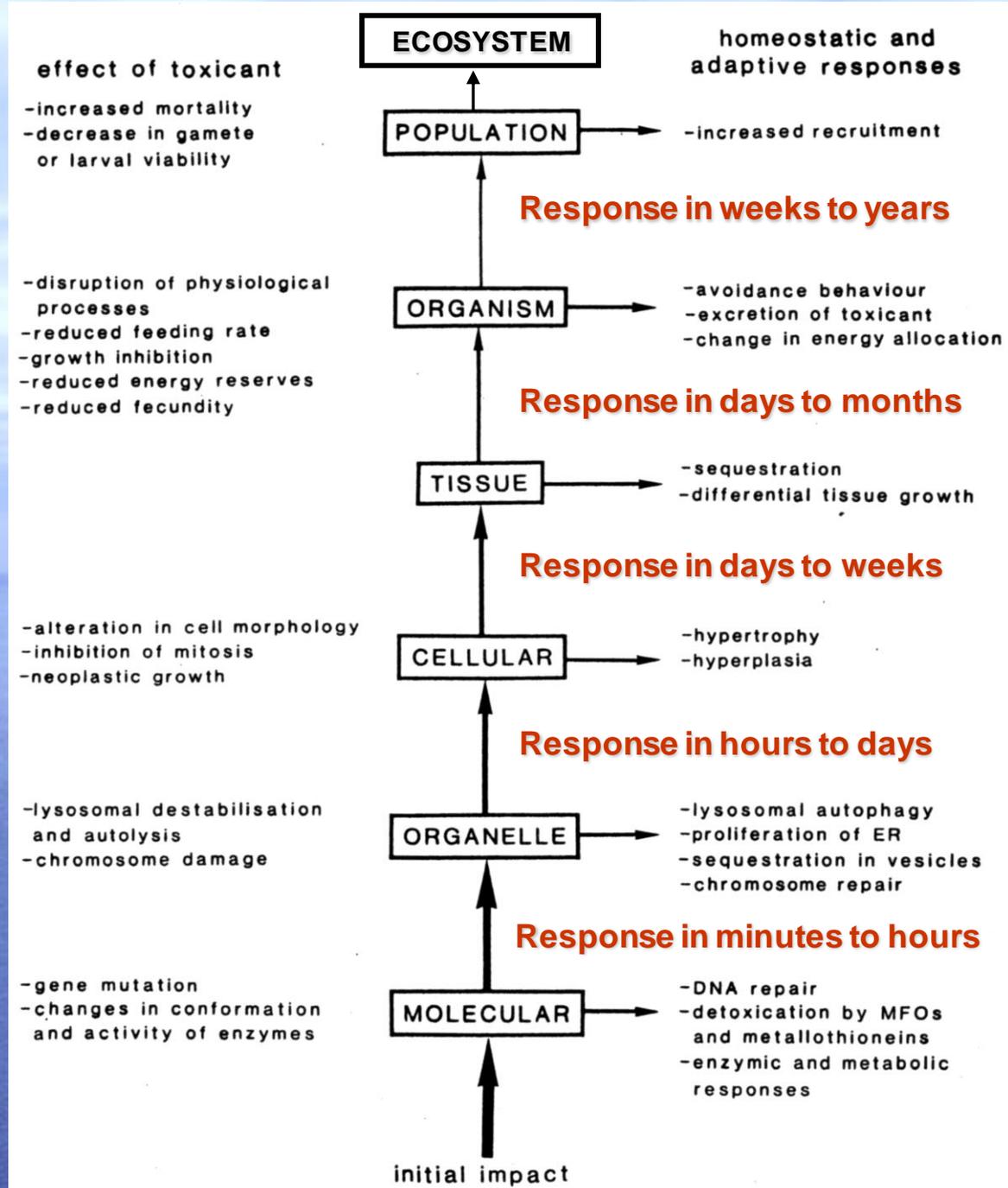
**ISCBD (Interim Secretariat of the Convention on Biological Diversity), 1994. Convention on Biological Diversity: Text and Annexes (UNEP/CBD/94/1). United Nations Environment Programme, Geneva.**

**Genetic diversity is functionally strongly related to the diversity at higher level : genetic diversity causes ecophysiological diversity**

**Yet, take care: changes in genetic diversity may not be visible or detectable at higher organisational level (or only detectable at a too late stage)**

**because of :**

- compensation and adaptation processes,
- long response time



## Relationships between genetic diversity and eco(physio)logical diversity

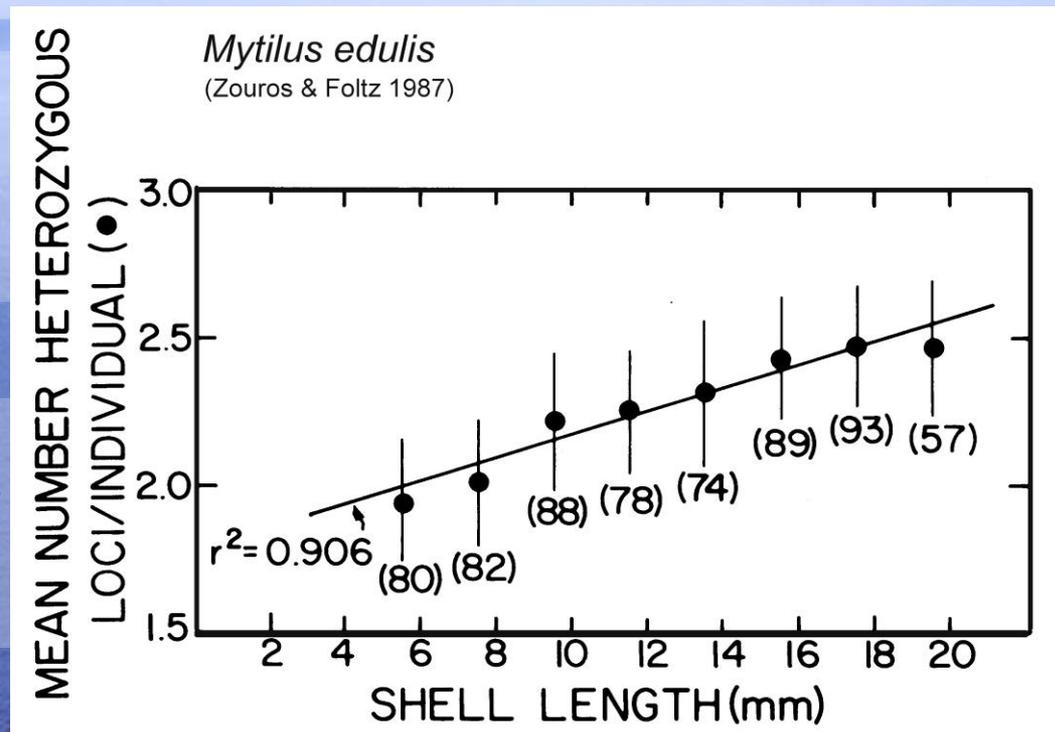
have been found for :

- growth, shell length, weight
- viability, longevity
- fertility
- enzyme activity, respiration
- morphology, fluctuating asymmetry (developmental stability)
- behaviour

The most often found phenomenon is:

- heterozygote over-dominance (heterosis or hybrid vigour)

*Mind that not all changes have an impact starting at the genetic level, but may have their impact at higher level.*

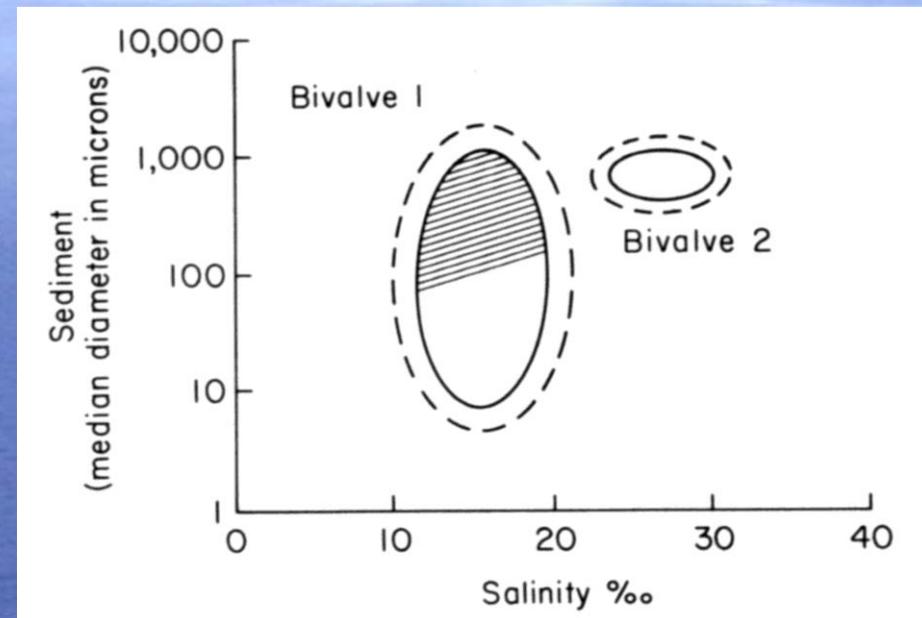


Frequently changing environments, such as intertidal coastal areas and estuaries, require a high diversity of ecophysiological responses in organisms, commonly called adaptive responses of organisms.

Adaptive responses or **adaptations** are: the adjustments (stabilization) of organisms to changes of variables in their environment, which ultimately result in a relative increase in their capacity to survive, reproduce or compete under the new conditions (Kinne 1970).

In ecology the set of (changing) environmental conditions within which a species (or an organism) can adapt, and consequently, survive and reproduce is called the **niche**.

The occupied niche can be smaller because of e.g. competitors requiring the same resources or unfavourable environmental conditions (stress).



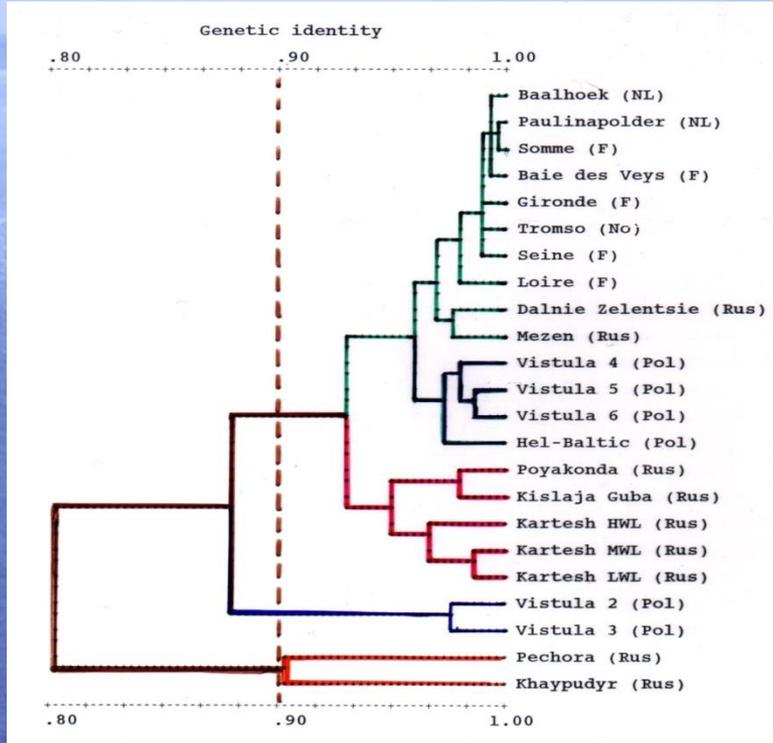
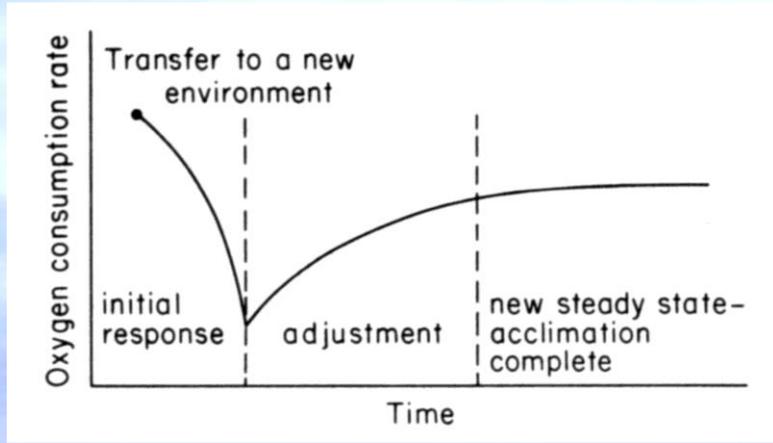
## Adaptation related responses

If the shift of a response curve to a new constant value occurs at short term it is called **acclimation** (compensatory process)

If the change in tolerance coincides with seasonal environmental change it is called **acclimatization**

**Genetic adaptations** involve changes in the genotype, and are the result of speciation and evolution

Genetic adaptation, and thereby genetic diversity, is fundamental to the diversity in ecophysiological responses of organisms, and thereby the basis for (evolution of) species diversity and ultimately ecosystem diversity.



**Stress is :**

**A disturbance of the normal functioning of a biological system by any environmental factor, beyond its tolerance, as detected by departures from a steady state (Hoffmann & Parsons 1991)**

**- stressed or “under stress” = the altered state of the biological system**

**- stressor = the environmental factor causing a potentially injurious change**



**The impact of an stressor, and thereby,**

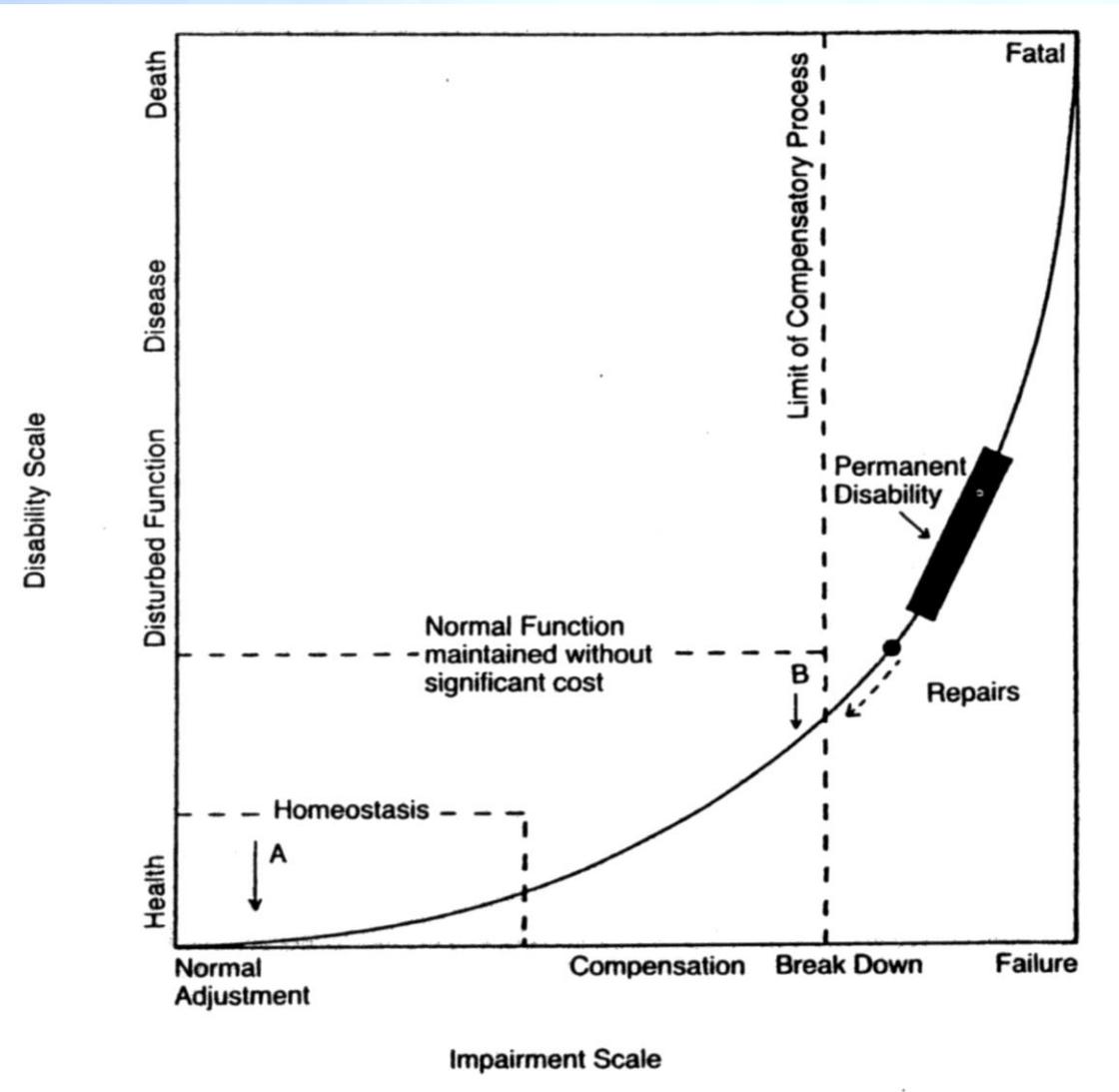
- the degree of disturbance**
- the expression of an effect, and**
- its consequent adaptive response**

**depend on :**

- period of exposure**
- the strength (concentration) of the stressor**
- the level at which a stressor interferes with organisms (from molecular, through the cellular and organismal, to the ecosystem level)**

Compensation and adaptive responses occur till a certain level of stress, beyond which organisms are disabled or killed

N.B. Managers and the public at large in general only react in case a stressor exceeds the limits of compensatory / adaptive processes, and organisms are visibly disabled or killed (and impacts at genetic or physiological level are not visible).





## Selected references

Féral, J-P., M. Fourt, T. Perez, R.M. Warwick, C. Emblow, C. Heip, P. van Avesaath & H. Hummel, 2003. European Marine Biodiversity Indicators. - Yerseke: Netherlands Institute of Ecology, Centre for Estuarine and Marine Ecology, 130 pp. Report of the European Concerted Action: BIOMARE Implementation and Networking of large scale, long term Marine Biodiversity Research in Europe. - ISBN 90-74638-14-7.

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