

**ECO EVO DEVO framework for the  
understanding of biodiversity: moving  
from pattern to process orientated view**

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# Biological diversity

“Biological diversity means 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.” (Rio 1992)

**The concept of DIVERSITY is fundamental to our understanding of nature and its value**

# Biological diversity

- The diversity concept has strong philosophical roots in how we understand nature based on the *difference* or *change* we experience and observe in *space* and *time* (Plato)
- In biology we use terms like *pattern* and *process* to grasp this both theoretically and empirically (e.g. Watt 1949, Endler & McLellan 1988)

# Biological diversity

- Diversity is a *relational* concept: something is *different* or *changes – diversifies* - from something else
- „Without differentiation of parts there can be no differentiation of events or functioning“ (Bateson 1979)
- Development and evolution is based on the *relationship* between the organism and its environment (Simpson 1953, Lewontin 2000; Sultan 2015)
- Thus, *patterns and processes* are intertwined, providing a realistic view of biodiversity and its value
- And it is also another way to see the world

Is it possible to think of this organism except  
in relation to its environment?



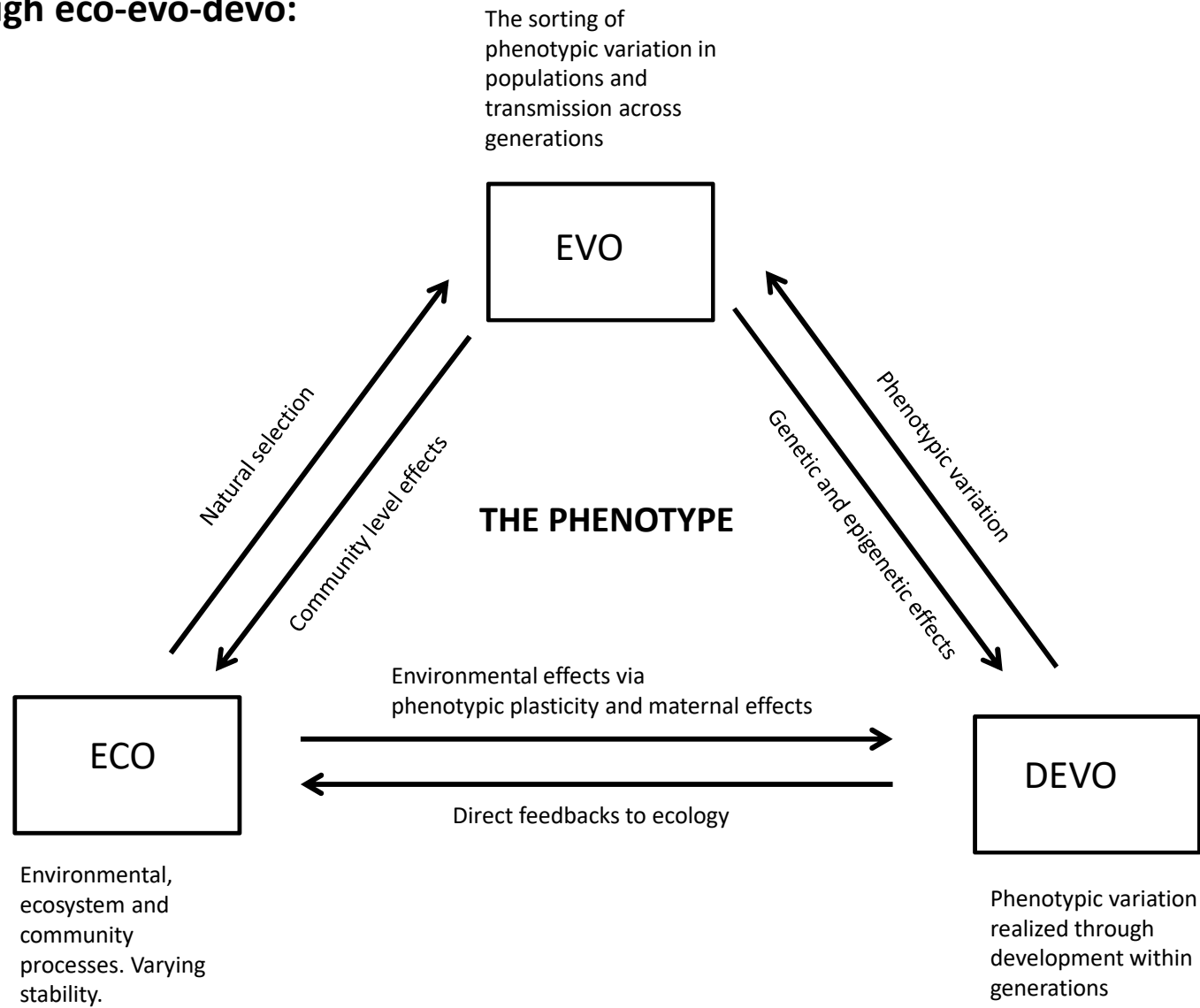
# The problem

- The strong mechanical, reductionistic – and anthropocentric - view of nature in our culture has promoted a *static pattern* evaluation of diversity
- This characterizes public understanding, as well as our policies and conservation programs
- The need for a more *dynamic - process* based - view, especially where ecological and evolutionary *changes* are rapid, has been advocated (e.g. Smith et al. 1993, 1997; Etheridge et al. 2008, 2010; Santamaría & Méndez 2012; Brodersen & Seehausen 2014; Mee et al. 2015; Merilä & Hendry 2015; Adams et al. 2016; Campbell et al. 2017; Benítez 2018; Des Roches et al. 2018)

## A more process based view

- Explores simultaneously the ecological, evolutionary and developmental patterns and processes that shape biodiversity and its generation
- Thus, diversity among species, within species and within and among ecosystems is studied and applied at equal footing
- This is in accordance with the relational foundation of the biodiversity concept

## Intergrative approach through eco-evo-devo:





# This is highly relevant in the Arctic and Sub-Arctic

- Freshwater systems:
  - have relatively few species, but intraspecific diversity is high, e.g. in fishes
  - intraspecific diversity and rapid evolutionary processes determine ecosystem function
  - are under rapid threat and require realistic conservation and management policies
- **We emphasize the need to value the intraspecific diversity and foster a process view of these systems**

# Polymorphic northern freshwater fishes



**Repeated evidence for processes of recent local divergence**