Marine climate regulation mechanisms also drive terrestrial moth populations

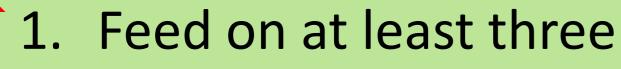
- Subarctic moths
- Light traps 1972–2017
- Baltic Sea mesozooplankton
- Zooplankton nets 1966–2019



- Biomass trends of different functional groups/guilds
- Linear mixed models on climate factors:

temperature	NAO	ice days
precipitation, snow	baltic regime shifts	time intervals
degree days	Daltic regime shifts	time intervals







Most important climate factors:
+ = positive effect on biomass
- = negative effect on biomass



Photo: H. Tanner, Cc-by-sa-4.0

plant genera

- 2. Feed on herbaceous *and* woody plants
- 3. Overwinter as imagines
- 4. Overwinter as eggs

Operophtera brumata

Moth guilds with negative biomass trends

- 1. Feed on other than live plants
- 2. Feed on herbaceous plants only
- 3. Specialized on one plant genus
- 4. Overwinter as larvae
- 5. Shoot/root borers



Xestia alpicola

- Regime shift 1989/90 +
- NAO-index (summer & autumn) –
- Regime shift 1975/76 -
- Average snow depth +
- DD>5°C july of last year +
- Regime shift 1989/90 -



- 1. Marine copepods
- 2. Brackish copepods
- 2. Freshwater copepods
- 3. Marine cladocerans
- 4. Brackish cladocerans
- 5. Rotifers total biomass



Eurytemora affinis

What are Baltic regime shifts?

- Abrupt changes of the Baltic Sea from one stable state to another
- 1975/76: increase in salinity (subsequent loss of marine water inflow events)
- 1989/90: Winter NAO turns predominantly positive

Synthesis:

- Regime shifts explain much of the change in mesozooplankton biomass as well as the biomass change in many subarctic moth guilds
- Other important environmental factors were **Winter NAO** and the **decreasing number of ice days** for zooplankton and **previous summer's temperatures** affecting the parent generation for moths.
- The same climate regulation mechanisms affect invertebrates in water and on land, but often in contrasting ways

Total invertebrate biomasses only tell a part of the truth: biomass trends of different functional groups vary considerably
 Regime shifts and the NAO-index are useful proxies for complex climatic phenomena

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