

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
precipitation, snow
degree days

NAO
baltic regime shifts

ice days
time intervals

Moth guilds with positive biomass trends:

1. Feed on at least three plant genera
2. Feed on herbaceous *and* woody plants
3. Overwinter as imagines
4. Overwinter as eggs



Operophtera brumata

Most important climate factors:

- + = positive effect on biomass
- = negative effect on biomass

- Regime shift 1989/90 +
- NAO-index (summer & autumn) -

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 1975/76 -
- Average snow depth +
- DD>5°C july of last year +

Mesozooplankton functional group biomass trends were all negative:

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



Eurytemora affinis

- Regime shift 1989/90 -

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**