

The Baltic cod reproduction volume as a proxy for cod year-class strength

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The paper examines

- whether the dynamics in 'reproduction volume' can explain the fluctuations in recruitment of cod
- can the 'reproduction volume' be used to predict the year-class strength of the Eastern Baltic cod



Kam Baltijas Jūras vajag sālsūdens?

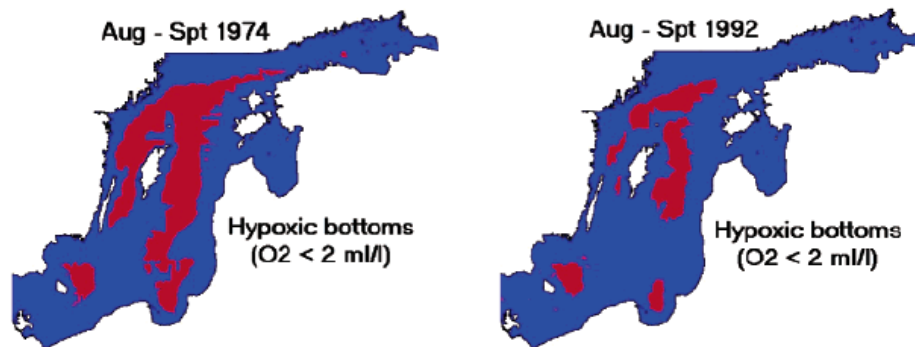
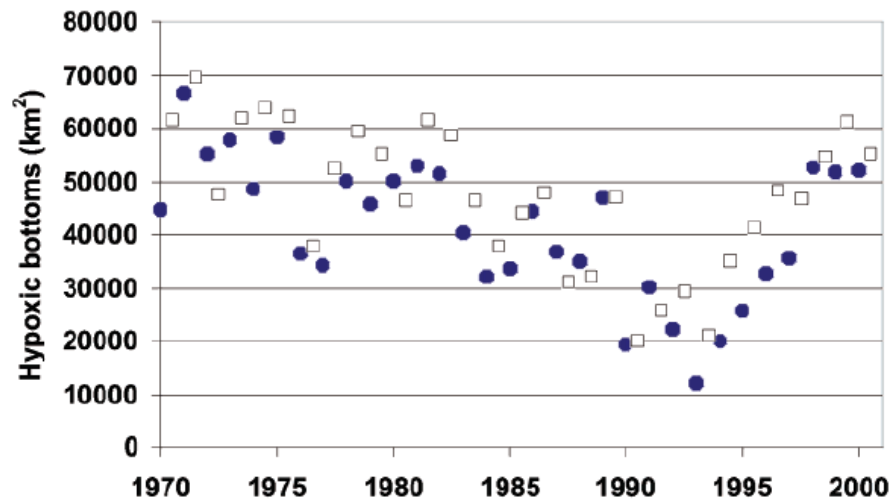


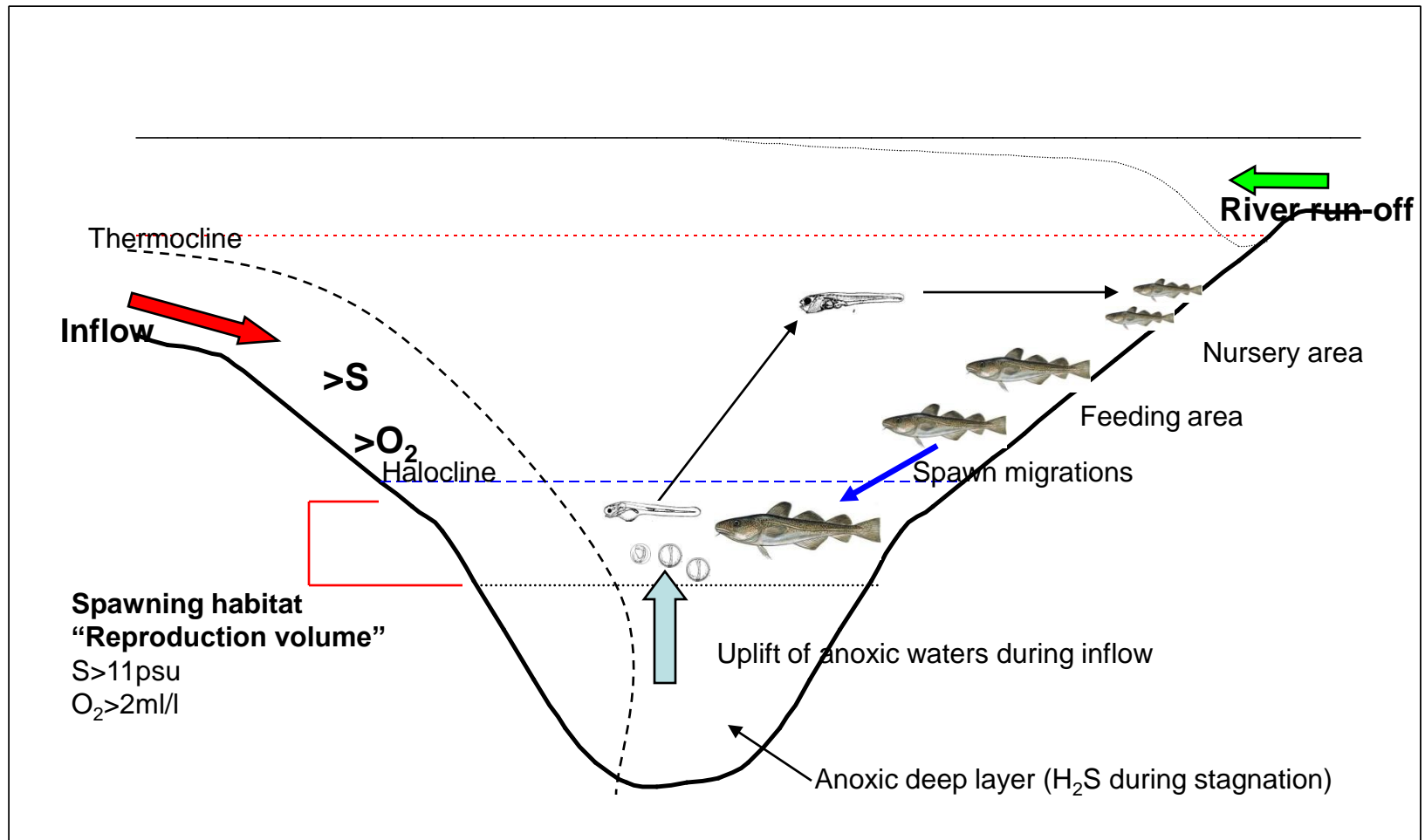
FIGURE 3. Long-term variations of the bottom area covered with waters containing less than 2 mL L⁻¹ oxygen. Oxygen fields were averaged over August–September (open squares) and January–March (closed circles) for each calendar year for the Baltic Proper, which includes the Gulf of Finland and the Gulf of Riga. Spatial distributions for August–September in 1974 and 1992 are shown at bottom.



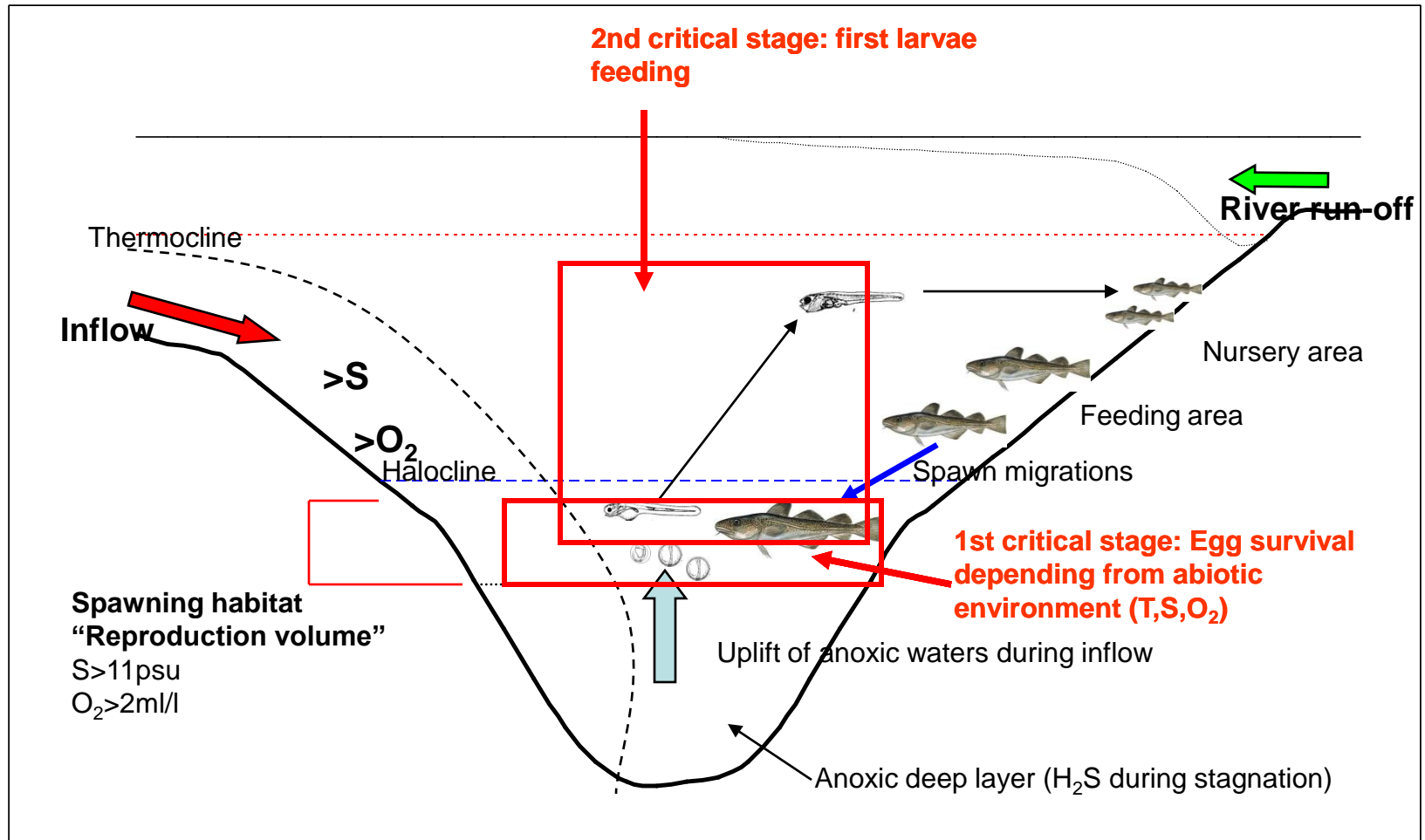
Thank you!



Ecosystem

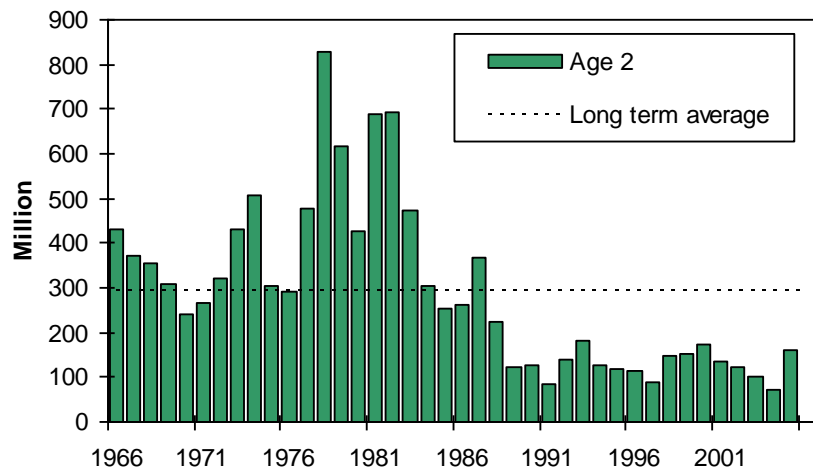


Ecosystem

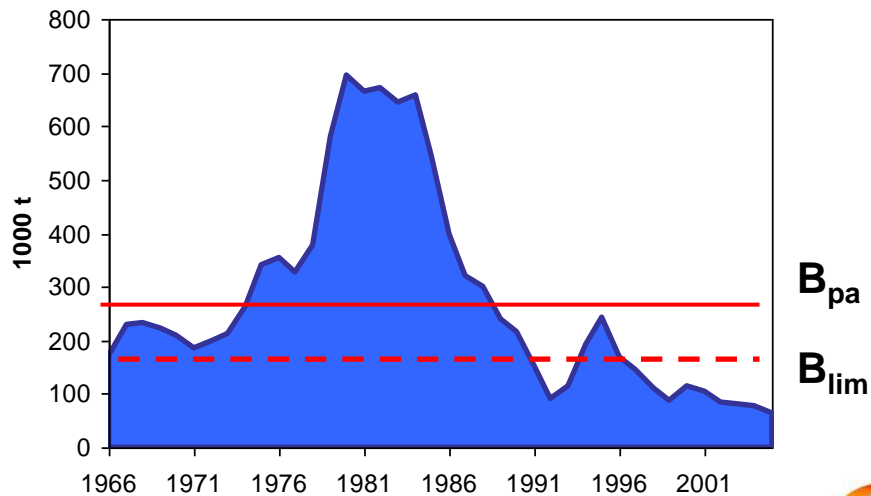


Eastern Baltic cod stock dynamics

Recruitment



Spawning stock biomass (SSB)



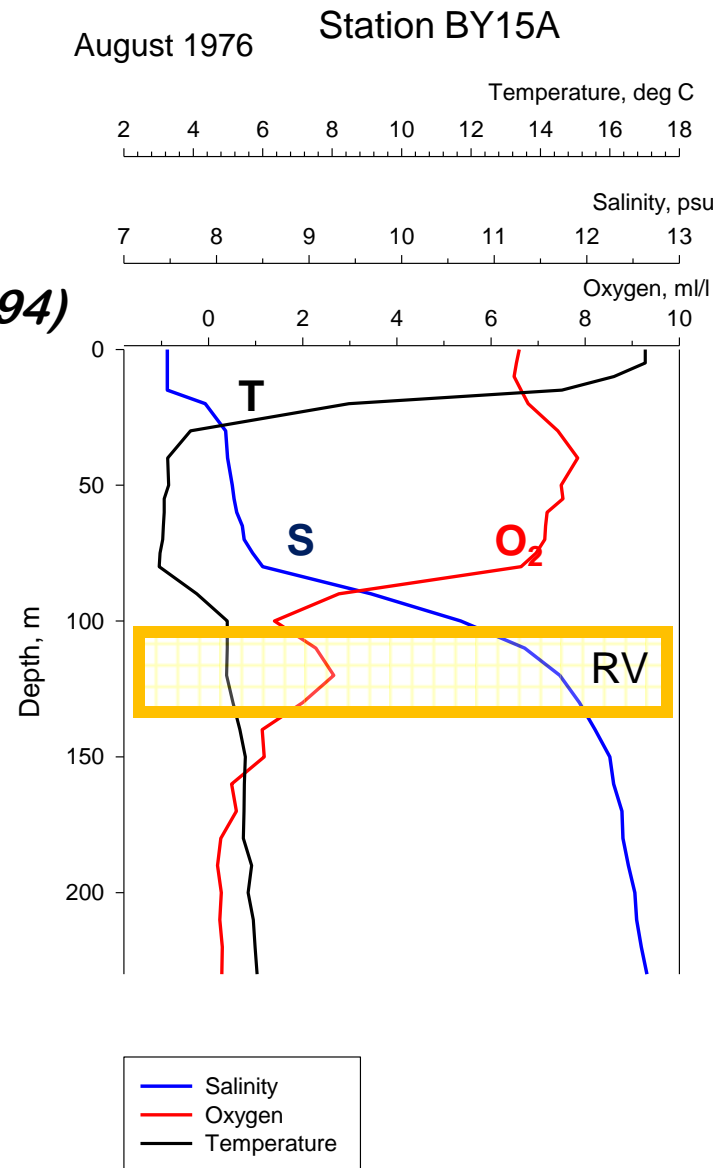
Baltic cod 'reproduction volume'

Concept

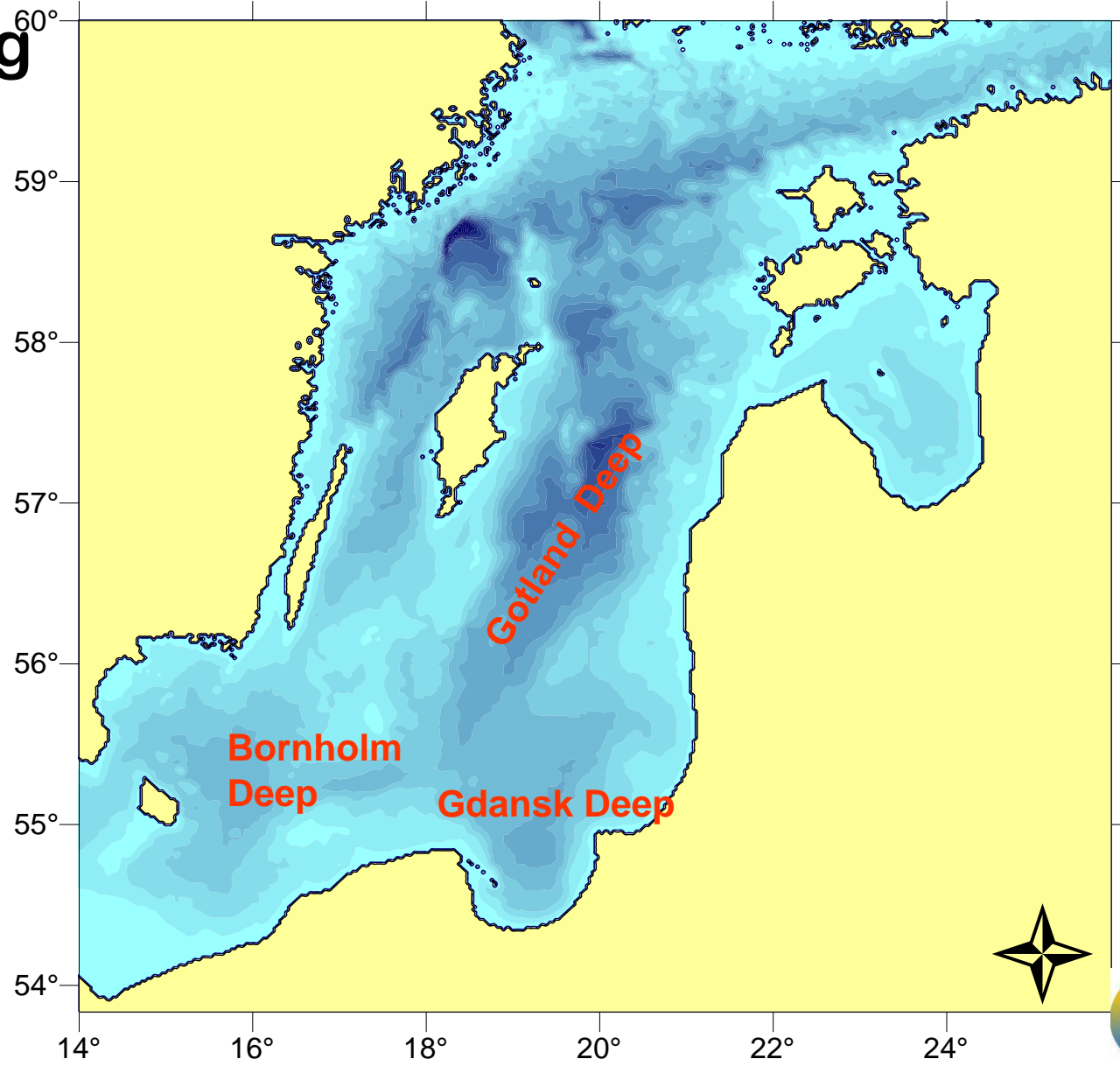
Salinity: > 11psu (*Nissling, 1994*)

Oxygen: > 2 ml/l (*Wieland et al., 1994*)

Temperature: > 2 deg C (*Wieland et al., 1994*)



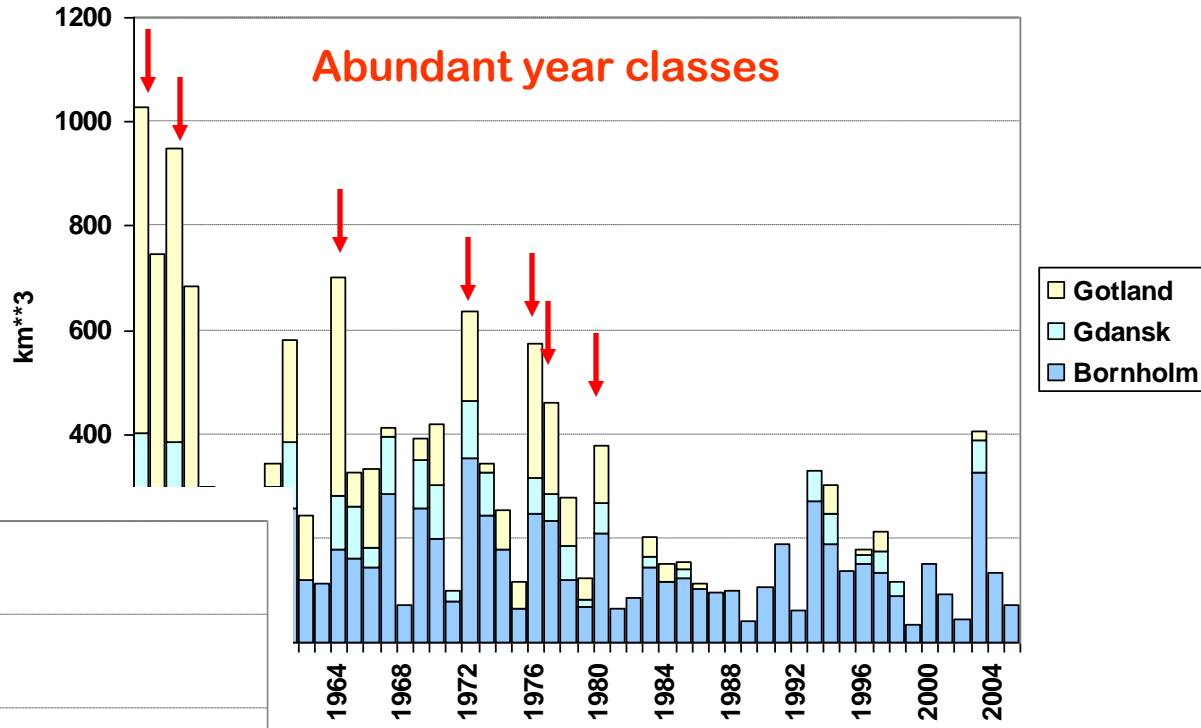
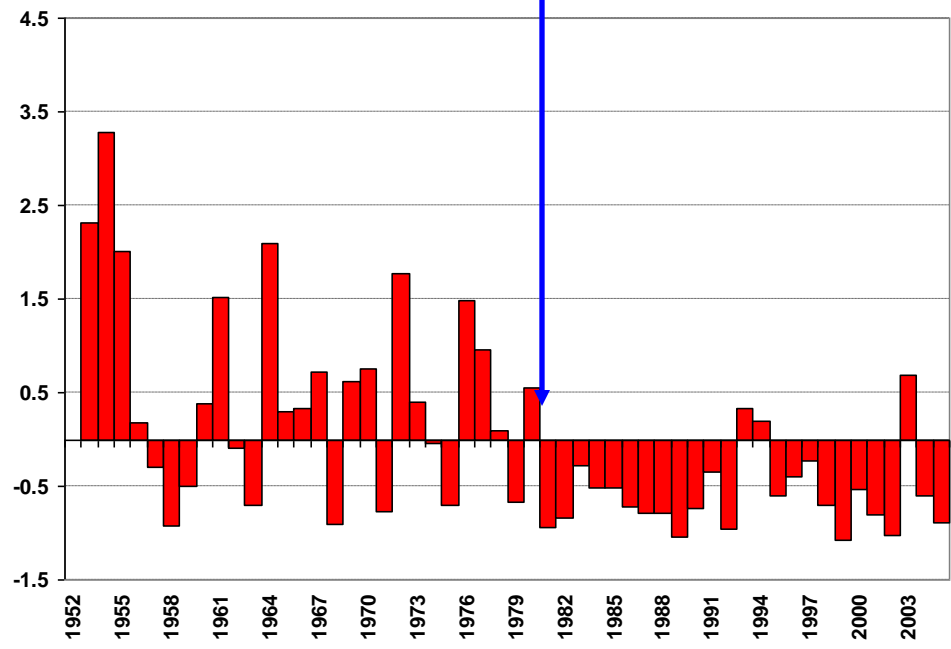
Cod spawning areas



Baltic cod 'reproduction volume'

Dynamics

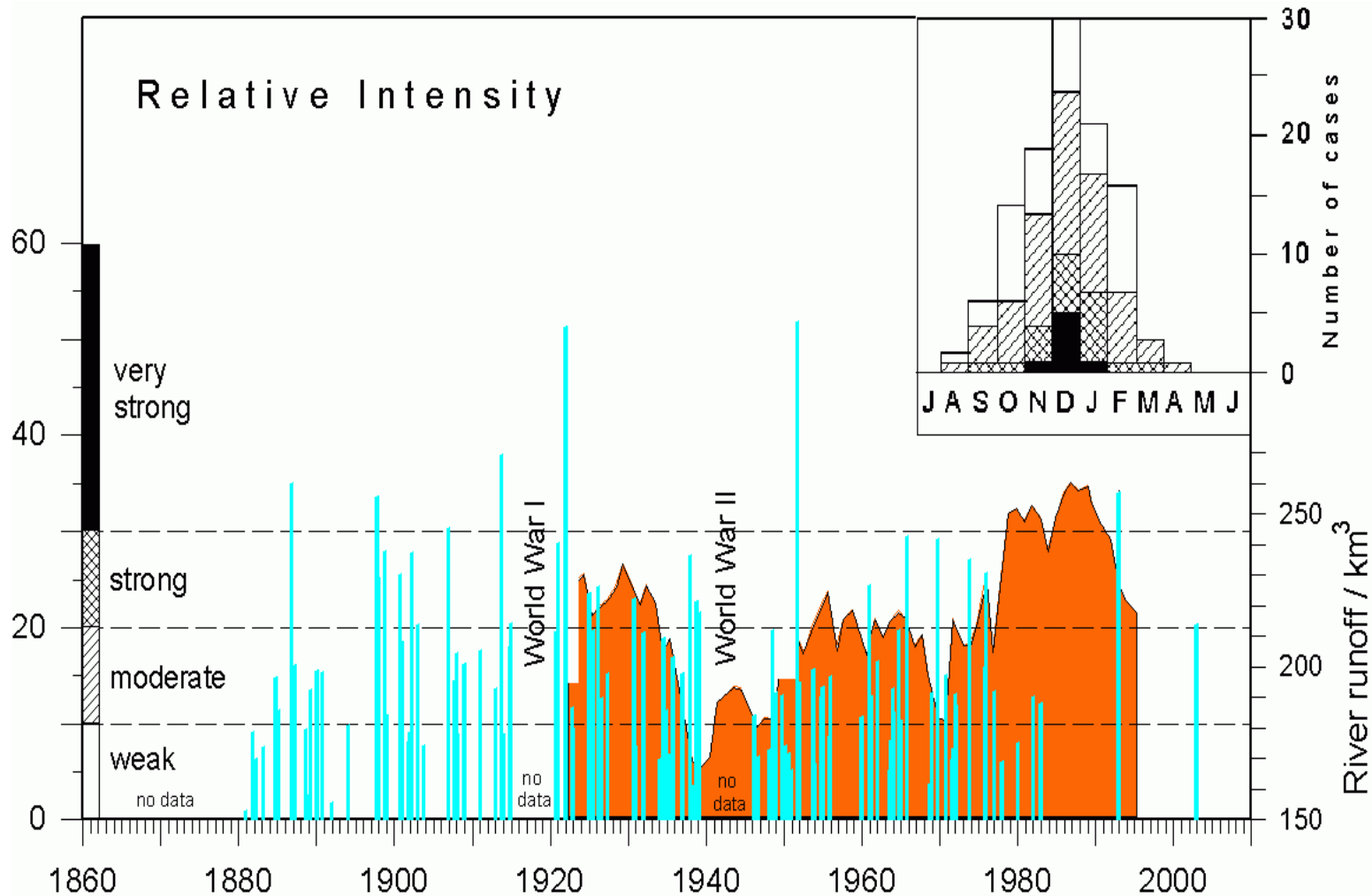
Regime shift?



Anomalies



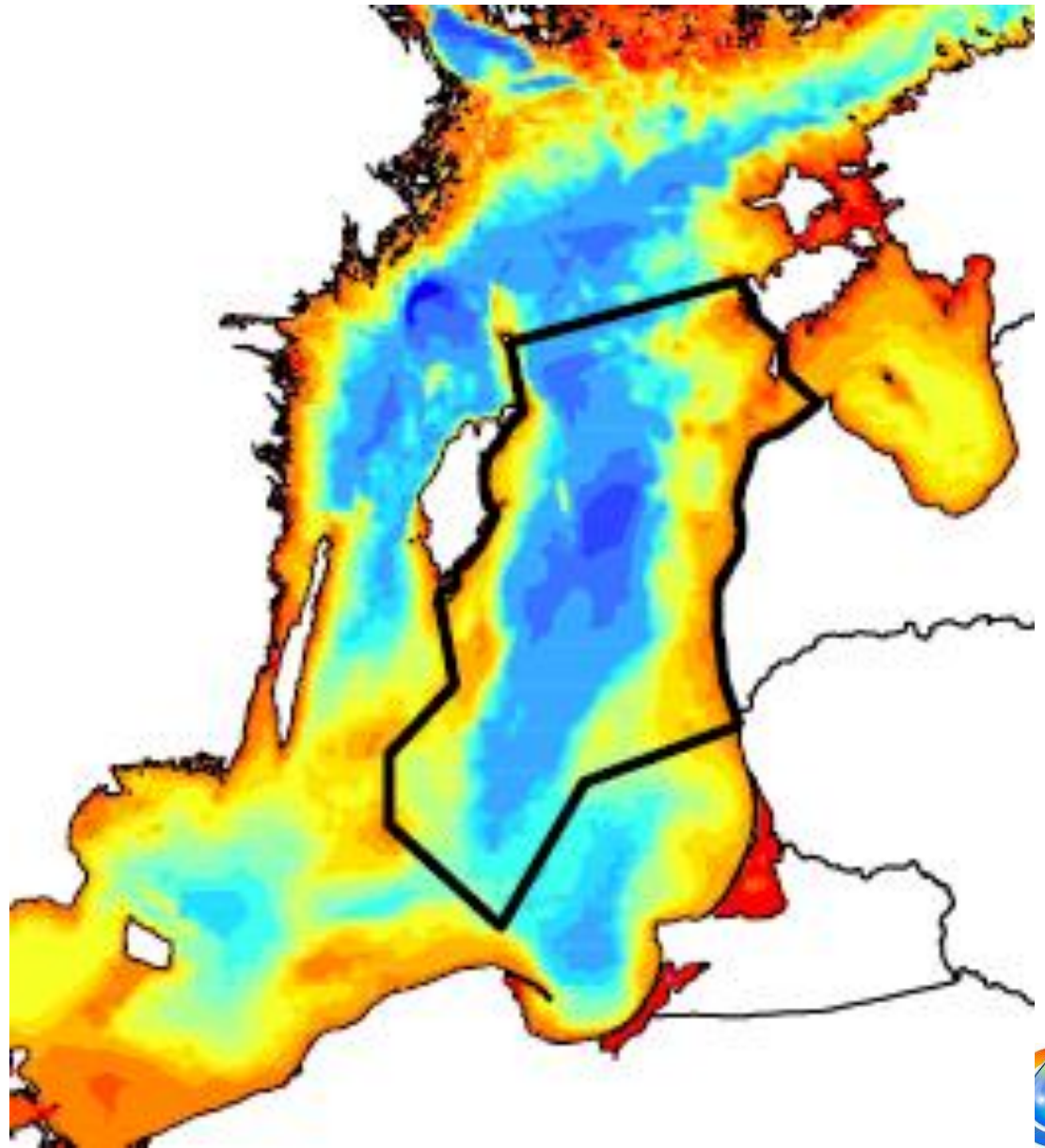
Inflows in the Baltic



(Matthäus, 2003)



**Eastern Gotland
Basin**

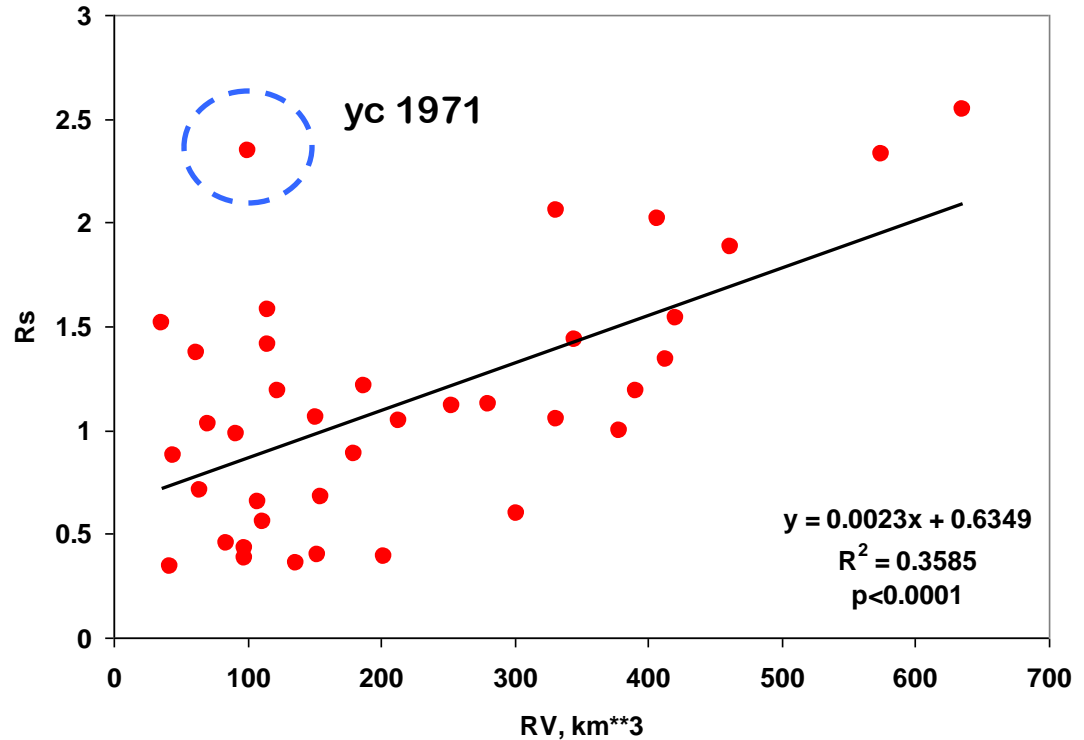


Recruitment dependence from RV

R_s versus RV

R_s – recruits per SSB i.e.
stock recruitment success

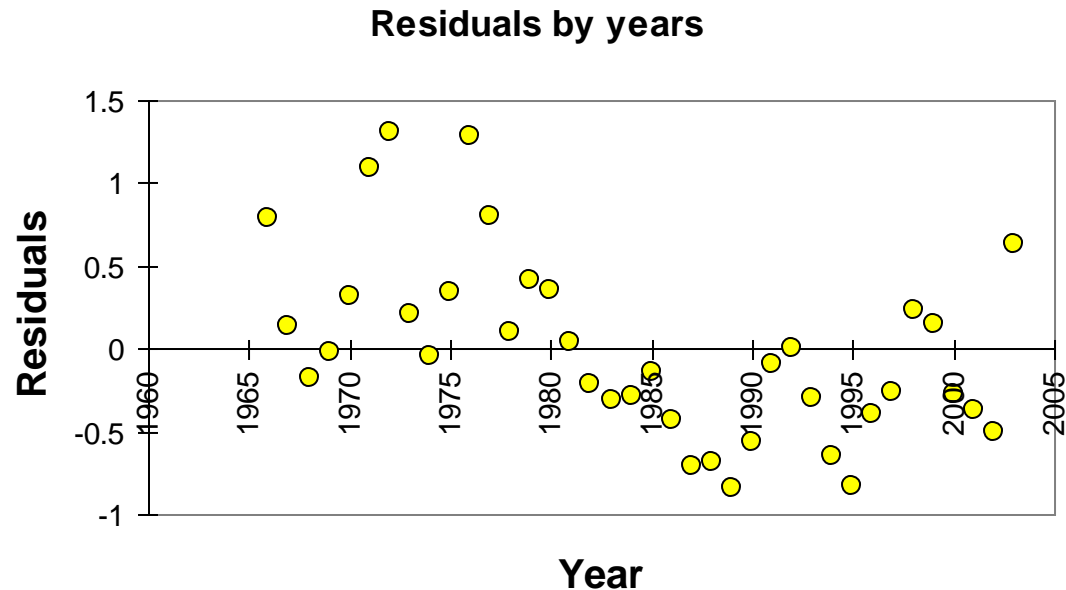
!! Poor recruitment and SSB
estimates during late 1960'ies
and early 1970'ies



Rs versus RV

Residuals:

- Prevalence of positive residuals during regular inflow events till 1980, negative – afterwards



Overestimation of YC in present environmental regime

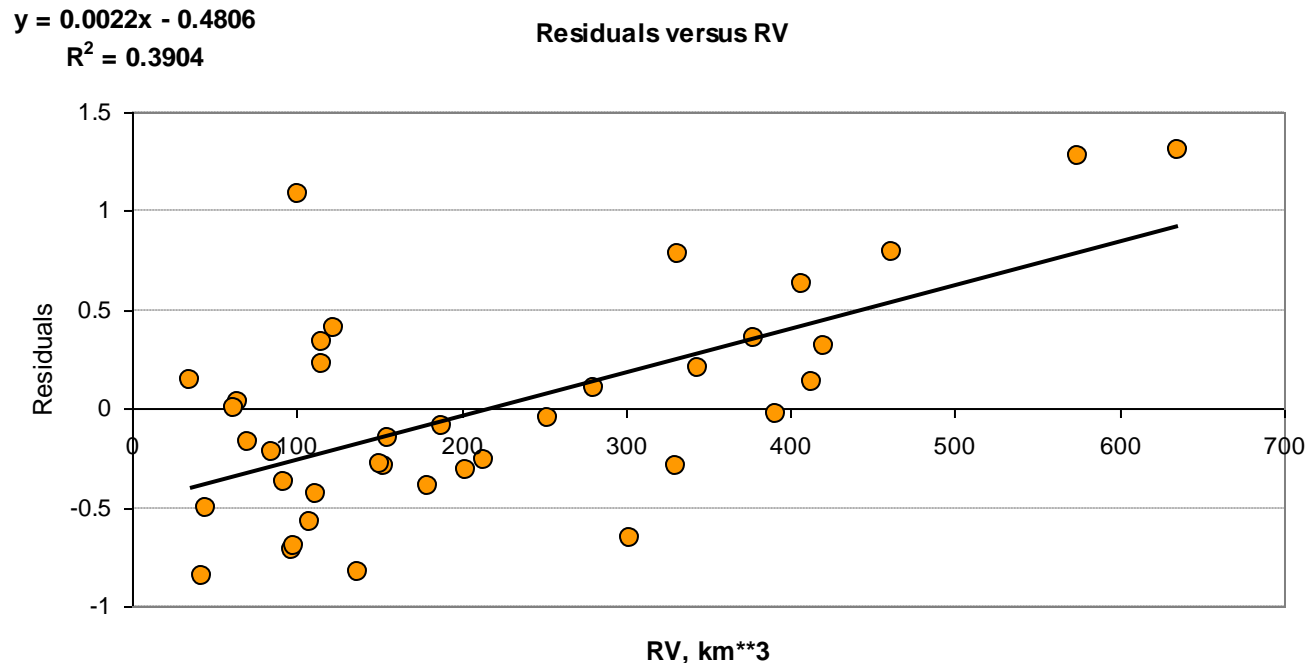
Underestimation of YC in case of inflow events



Rs versus RV

Residuals:

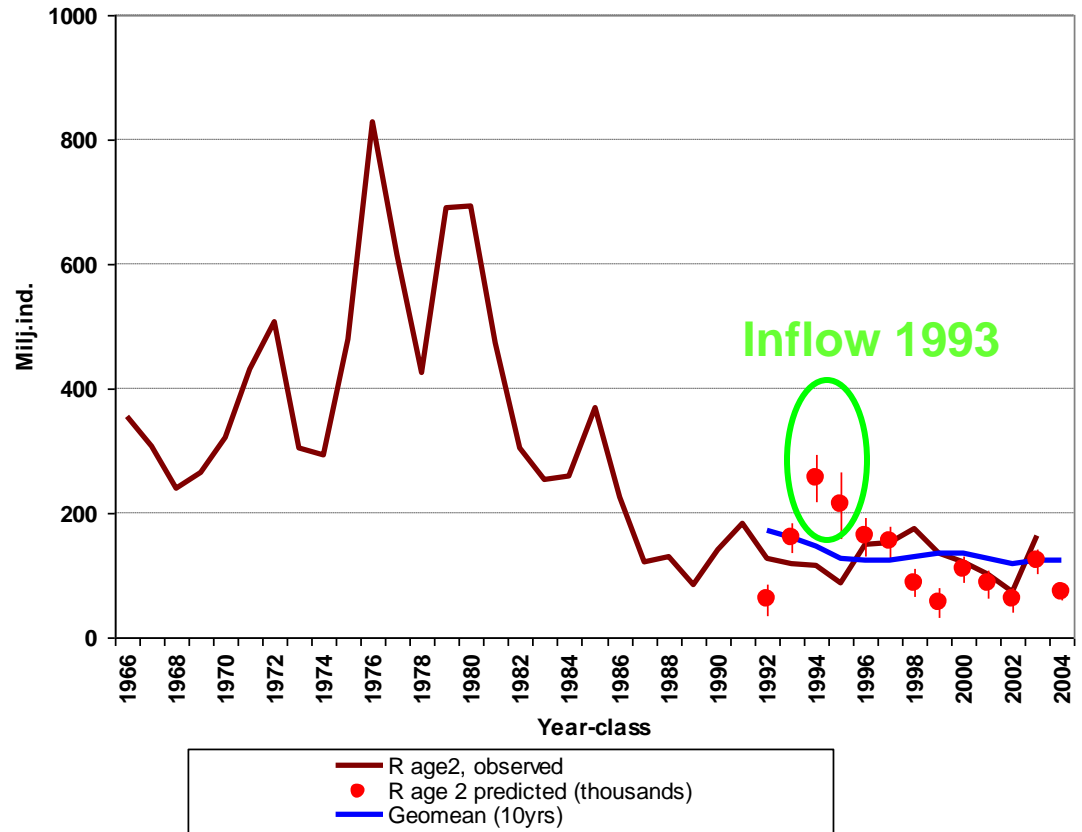
- Trend from negative residuals to positive with increasing RV ($R^2 = 0.39$, $P > 0.001$)



High variation in case of small RV (spawning in one Basin)
Underestimation of YC in case of high RV



Prediction of R



Other interactions neglected, as:

- 1) Cannibalism (*Uzars & Plikshs, 2000; Köster et al 2000*)
- 2) Pelagic fish feeding on cod eggs (*Köster & Möllmann, 2000*)
- 3) Larval survival (*Hinrichsen et al, 2002*)
- 4) SSB structure and spawners quality (*Marshall, 1998; Kraus et al, 2002*)



The 'reproduction volume' is the primary parameter for success of reproduction and recruitment of the Baltic cod

Abundant year classes of cod in the Baltic Sea can only be observed if the conditions for embryonic development are suitable in all principal spawning areas of cod in the Baltic



Recent failure of recruitment is determined by regime shift in the Baltic, i.e. decrease of salinity in the Deep basins and water exchange with North sea

During recent environmental conditions (RV only in Bornholm Basin) obviously high importance have other cod recruitment limiting factors e.g. first larvae feeding

RV can be used in prediction of year-class strength of Baltic cod and performs comparable with the presently used 10 recent year geometric mean



Thank you!

