INEXFIS
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Variability in environmental factors affecting the recruitment of fish species in the North East Atlantic

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Incorporating extrinsic drivers into fisheries management

IN EX FIS H

Approach

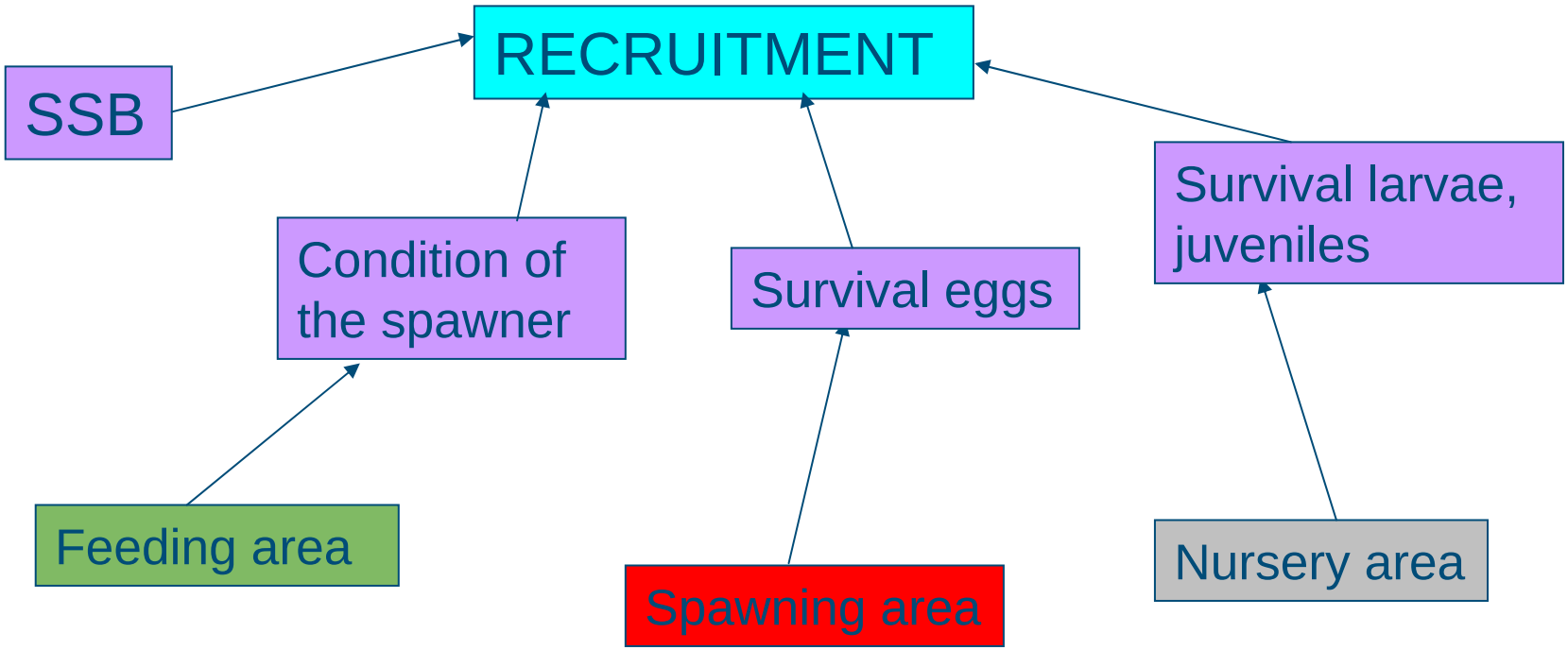
- Recruitment at age 0 or 1
- Spatially explicit drivers
- General additive modelling (GAM)
  - Model selection by AIC
- Comparing with SR-relationships
  - Ricker and Beverton & Holt

Dataset used in the analysis

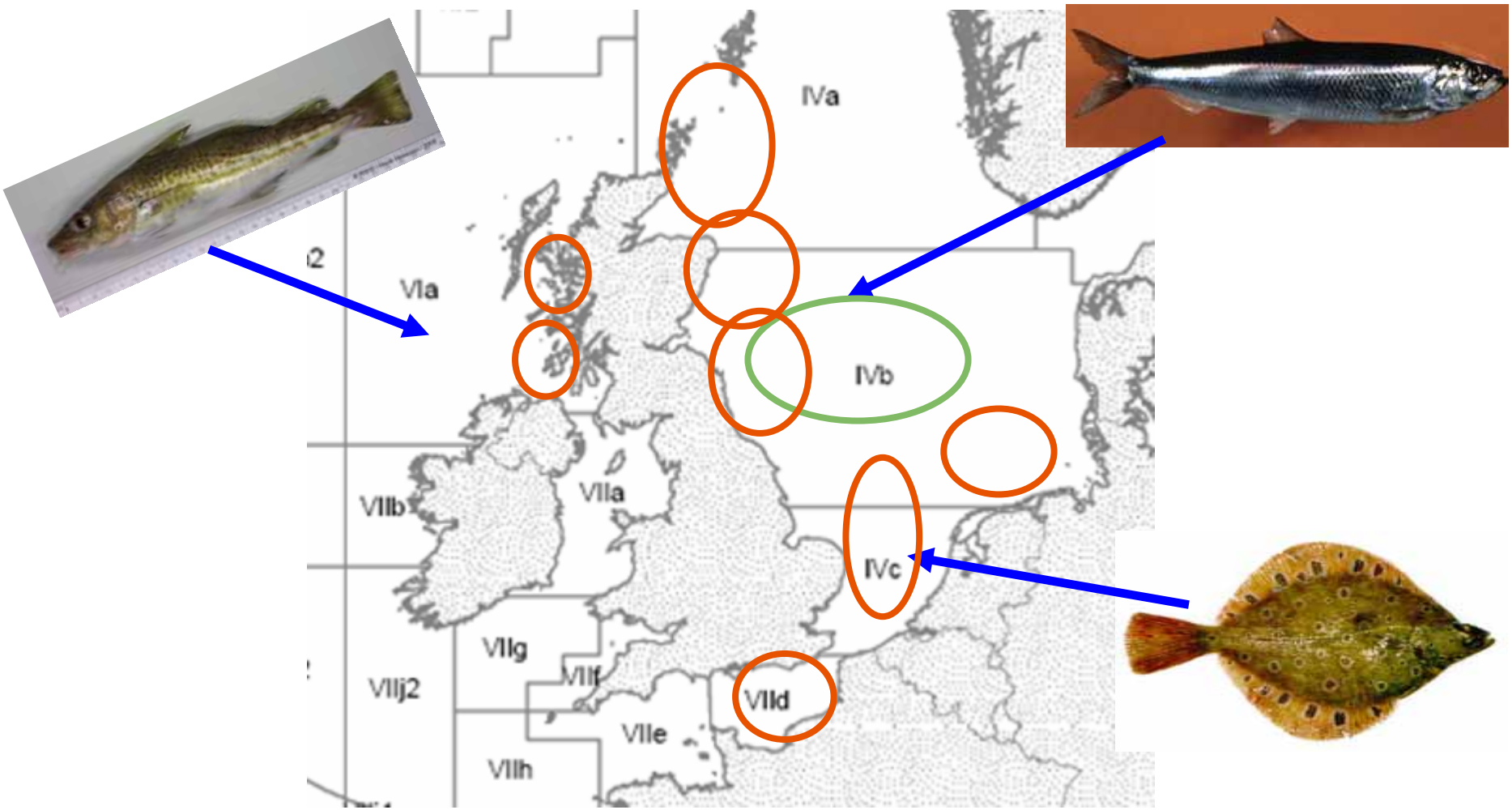
- Recruitment and SSB from ICES Stock assessments
- NAO winter index (CGD, Hurrell)
- North Sea:
  - Bottom temperature and salinity

    ECOSMO model (Schrum & Alekseeva, RECLAIM)
- ICES area VIa:
  - SST satellite images (ICOADS)
  - Plankton data from CPR (SAHFOS)

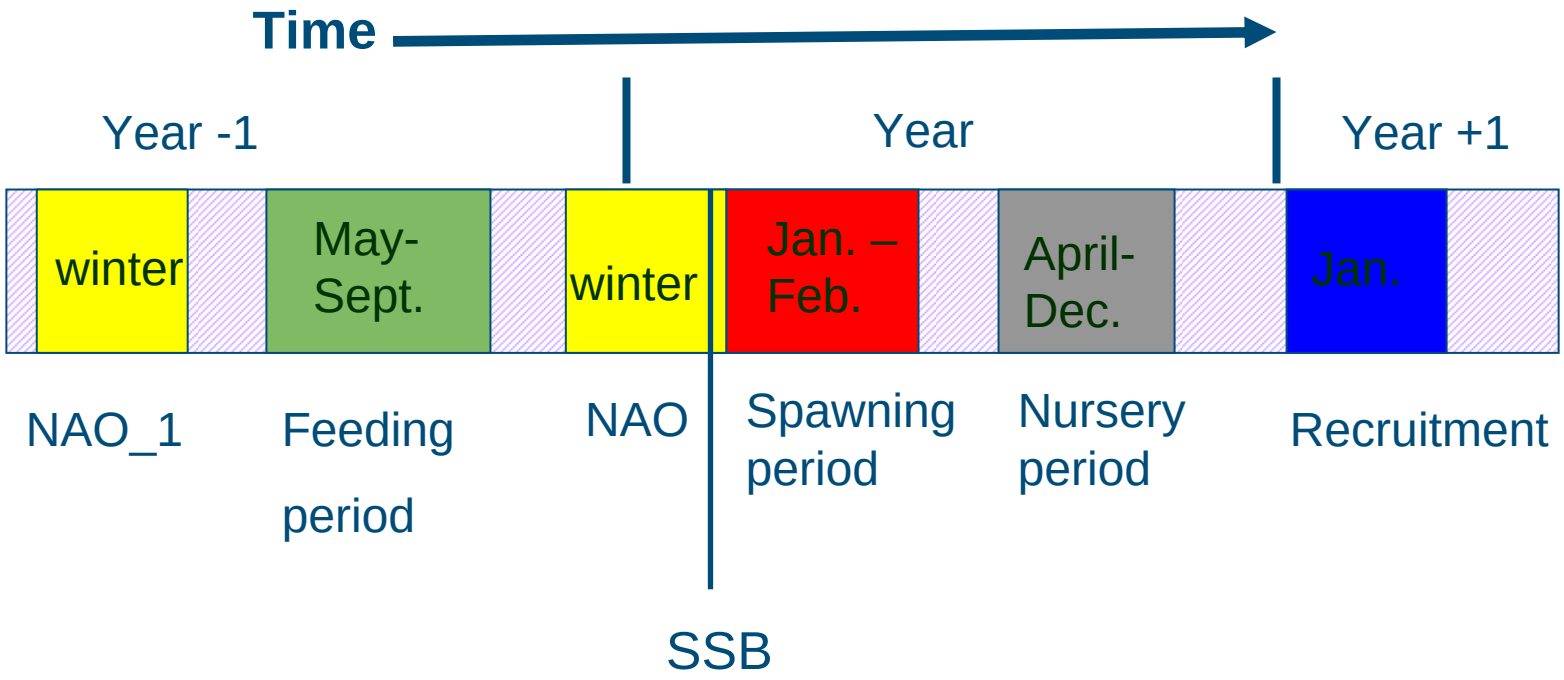
Recruitment hypotheses



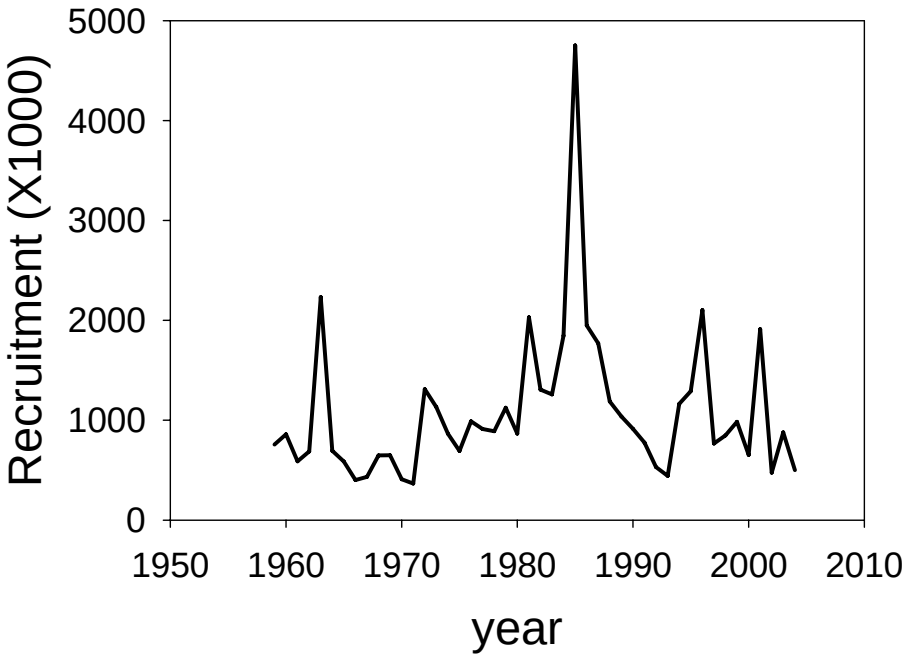
Species and areas

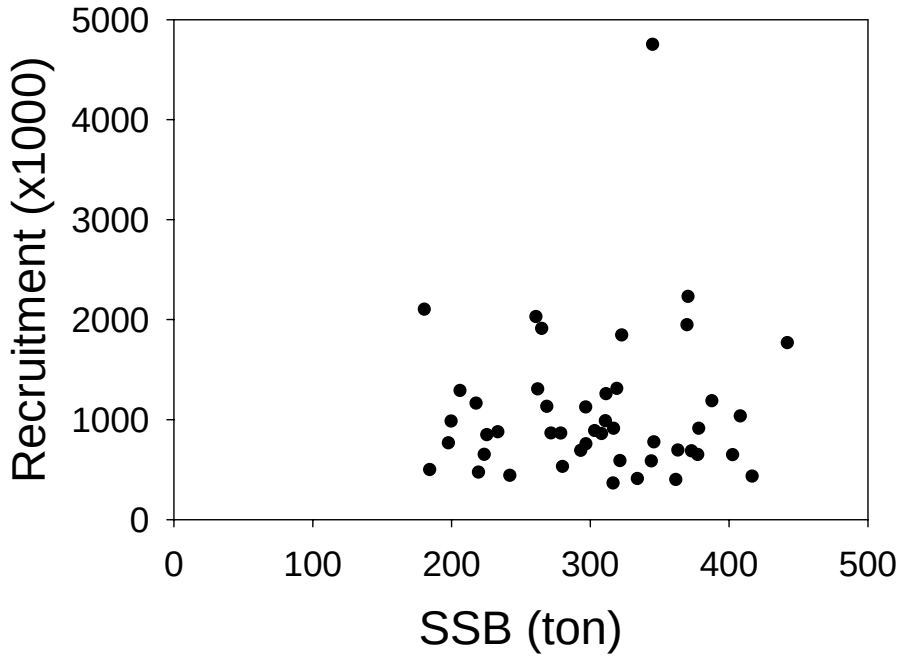


Data used in the analysis, plaice example



Stock vs. Recruitment of plaice

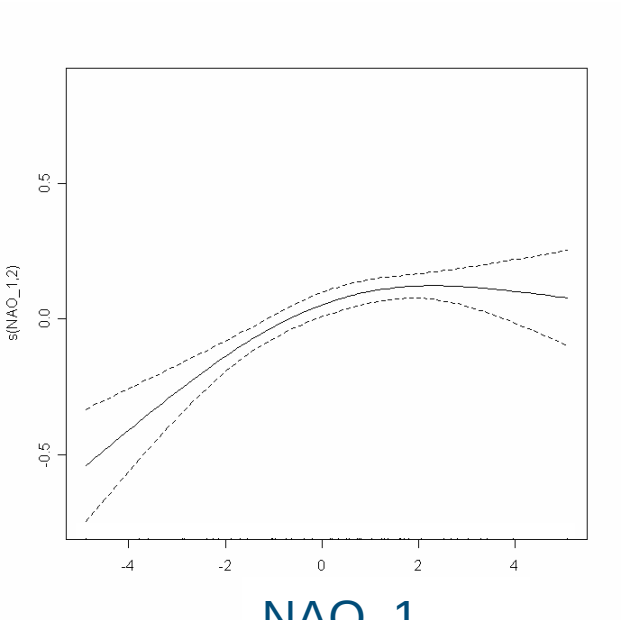




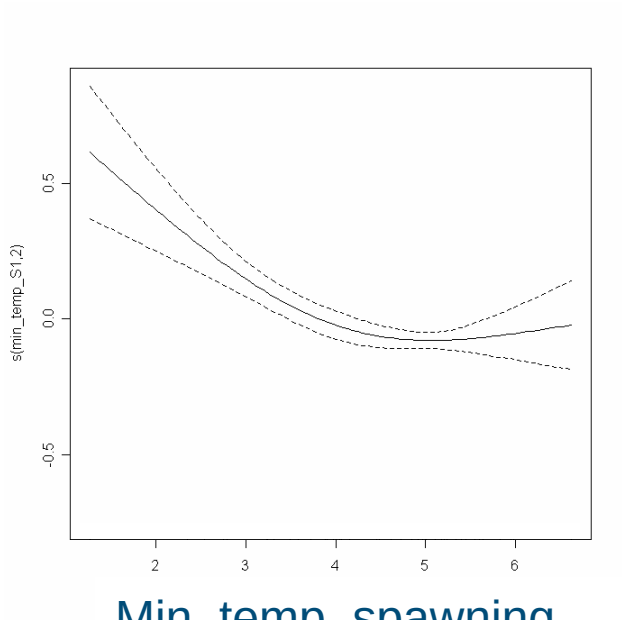
Results for North Sea plaice

- Final model:

Log(Recruitment)~ s(NAO_1) +s(min_temp_spawning) + temp_feeding (neg.)



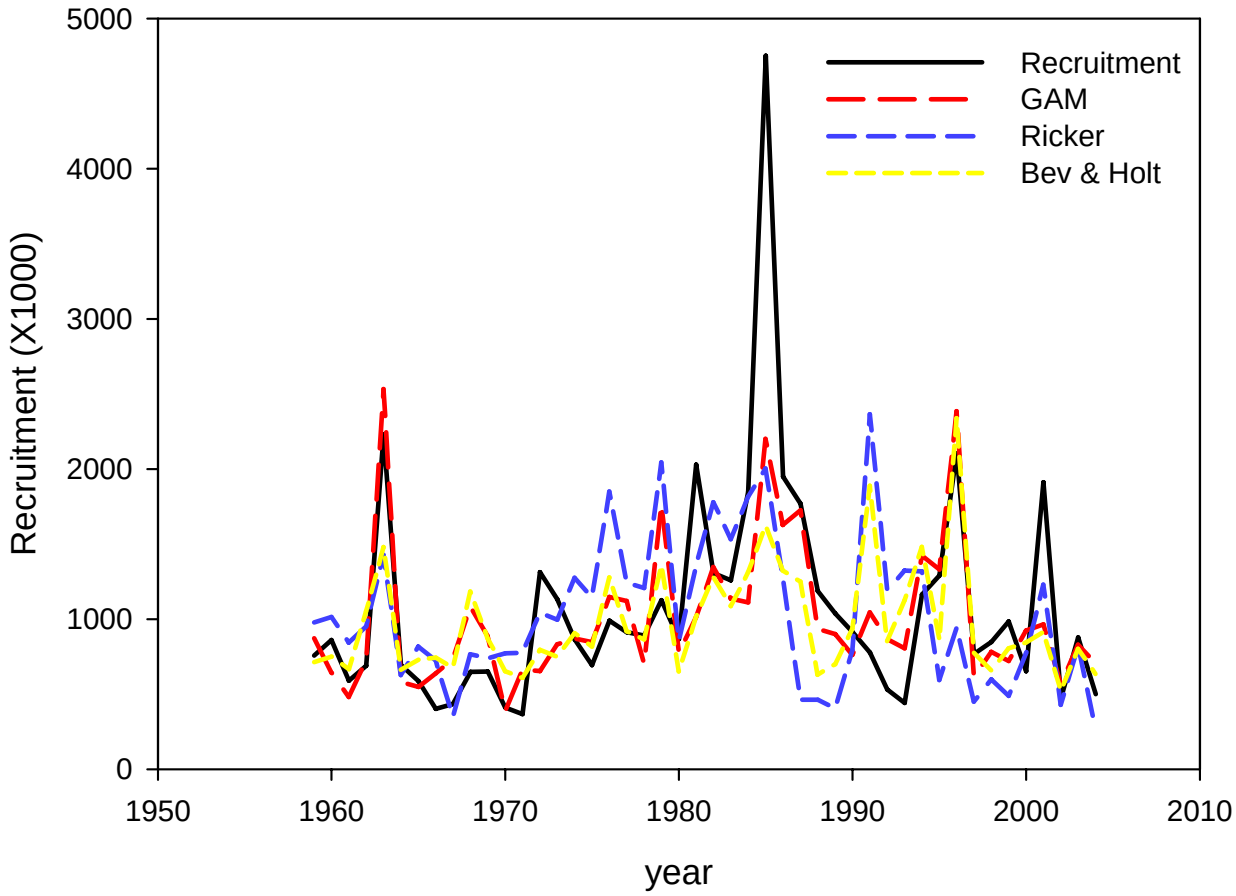
NAO_1



Min_temp_spawning

Comparison with SR-relationships for North Sea plaice

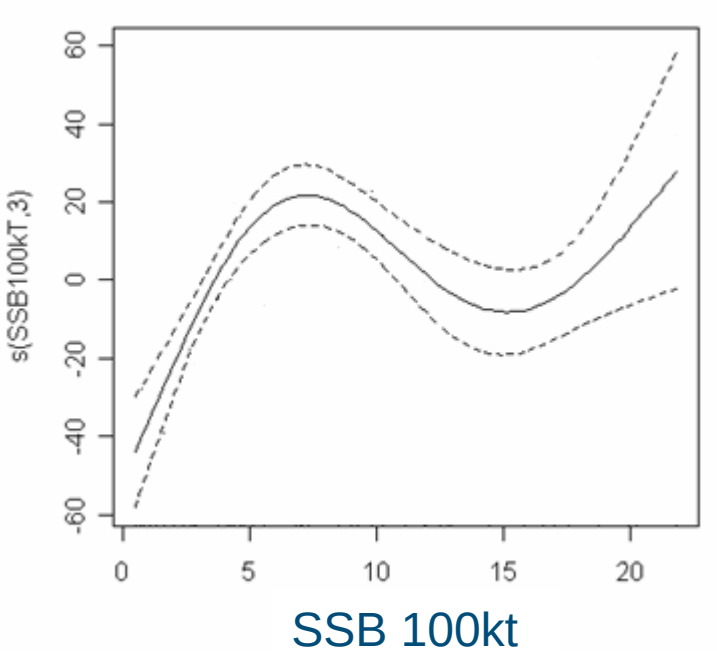
	R^2
Ricker+drivers	0.19
Bev & Holt+drivers	0.32
GAM	0.55



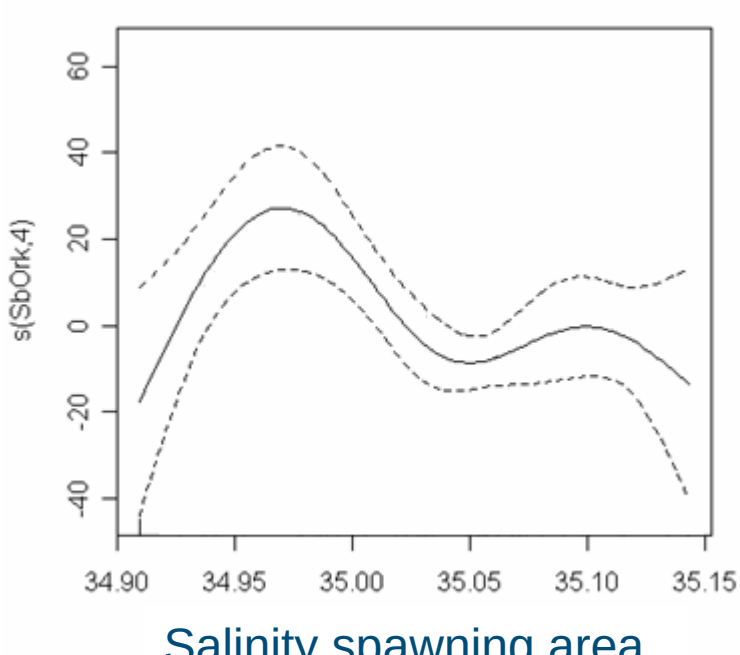
Results for North Sea Herring

- Final model:

Recruitment ~ s(SSB) + s(salinity spawning area)



SSB 100kt

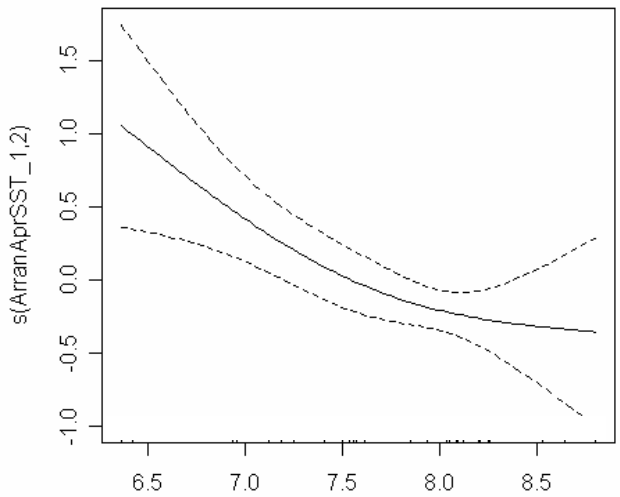


Salinity spawning area

Results for cod in area VIa

- Final model:

Ln(Recruitment) ~ SSB (pos.) +*C. finmarchicus* (neg.) + s(SST in April)

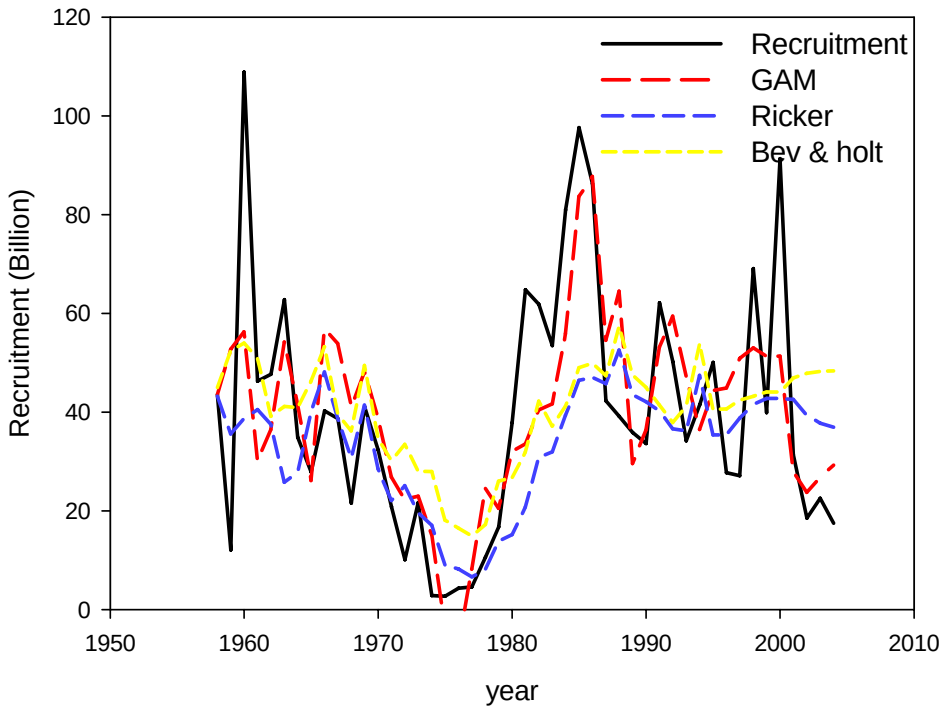


SST in April

Comparison with SR-relationships

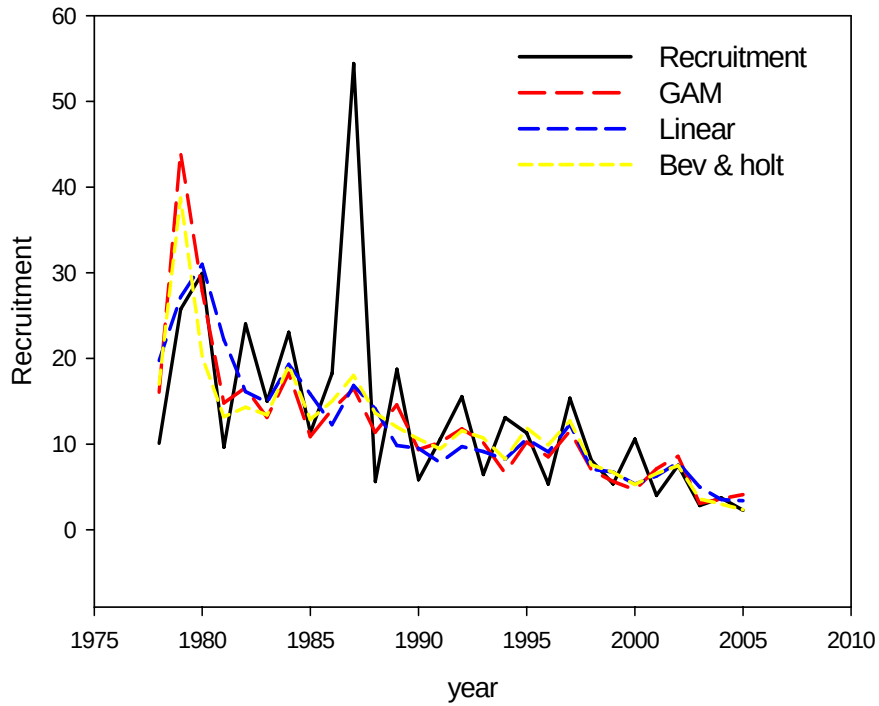
North Sea herring

	R^2
Ricker+drivers	0.27
Bev & Holt +drivers	0.24
GAM	0.55



Area VIa cod

	R^2
Linear	0.36
Bev & Holt +drivers	0.38
GAM	0.40



Discussion on the use of GAM

- GAM only useful for predictions within the boundaries of the data
- GAM will not obey by definition the assumptions of some SR-curves
  - The curve should pass through the origin.
  - The curve should not cross the zero-recruitment axis at non-zero stock size.
  - Recruitment must exceed parental stock over some part of the range of the stock values
  - Recruitment should vary smoothly with stock size.
- No Relationship with SSB
  - Stocks with a limited range of SSB

Conclusions

- GAM models could improve the prediction of recruitment
- Incorporation of extrinsic drivers improves predictions
- Spatially and temporally resolved data are necessary to find biological meaningful relationships

Next steps

- Validation of the models with new data
- Incorporation of the results into a population dynamics model
- Evaluate this model with various fishing scenarios and climate scenarios

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