

## Session 2: Trophic controls on stock recovery

### Lessons for the different case studies

#### Baltic cod:

Important aspect of recovery is cannibalism:

Depleted stock:

- a) Large age classes that are cannibals are rare initially
- b) Juvenile habitats show little overlap with adults

Recovering stock:

Both a) and b) will gradually change and cannibalism will gradually slow down the recovery.

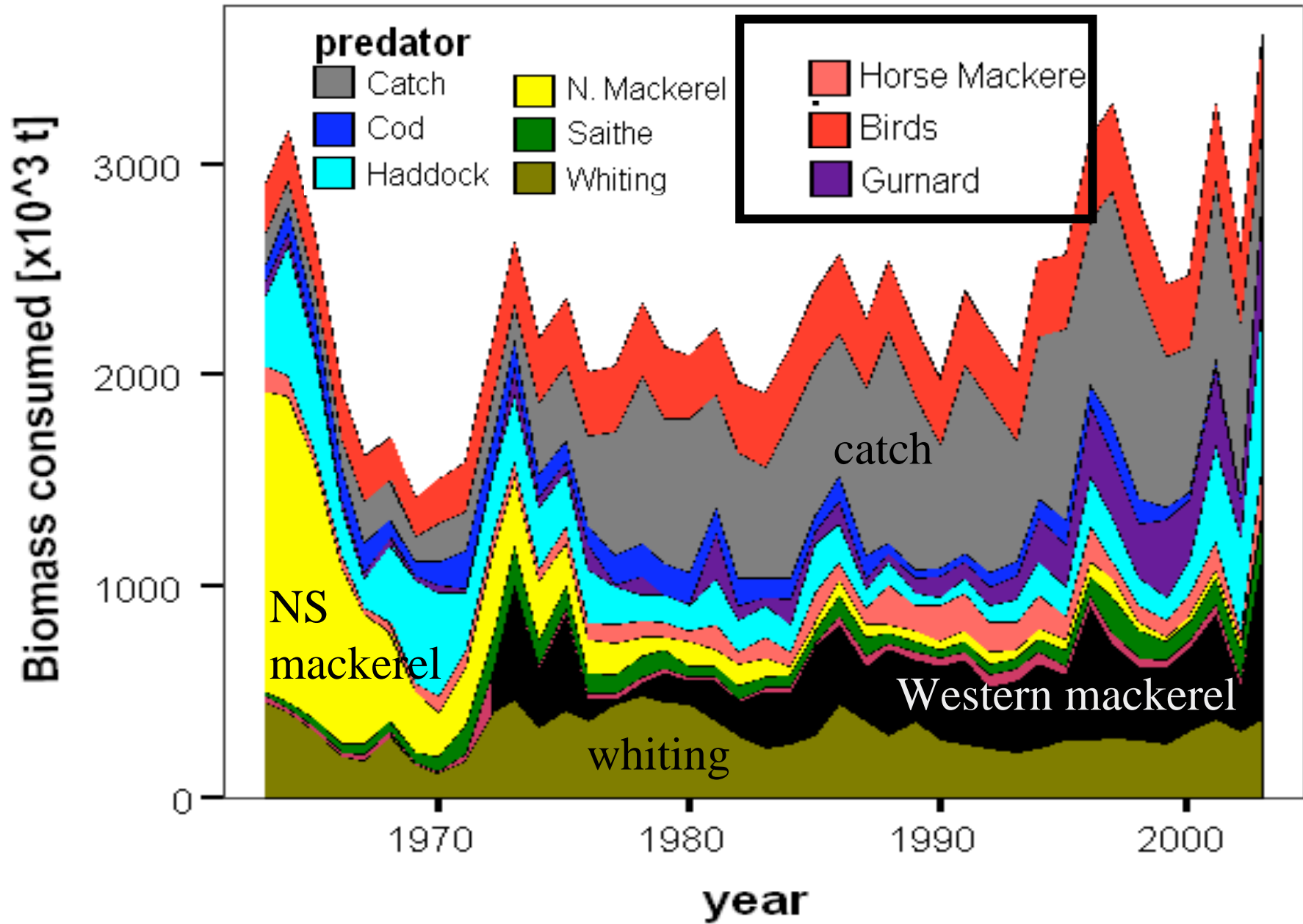
Cannibalism is also important in other regions: e.g. Barents Sea with cod or Bay of Biscay with hake

## North Sea decline of mackerel, cod, whiting

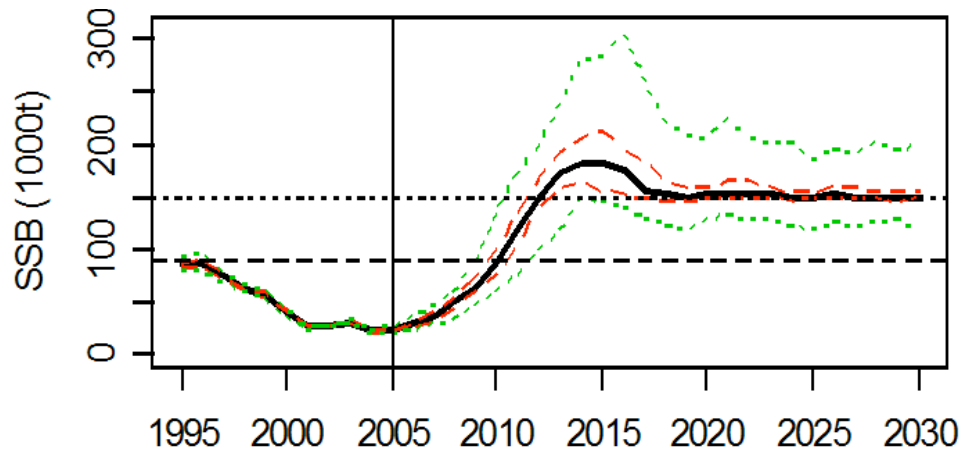
- high diversity of middle sized predators
- New middle predators, grey gurnard and horse mackerel have taken over
- Increasing 0-group predation -> top down control of recruitment

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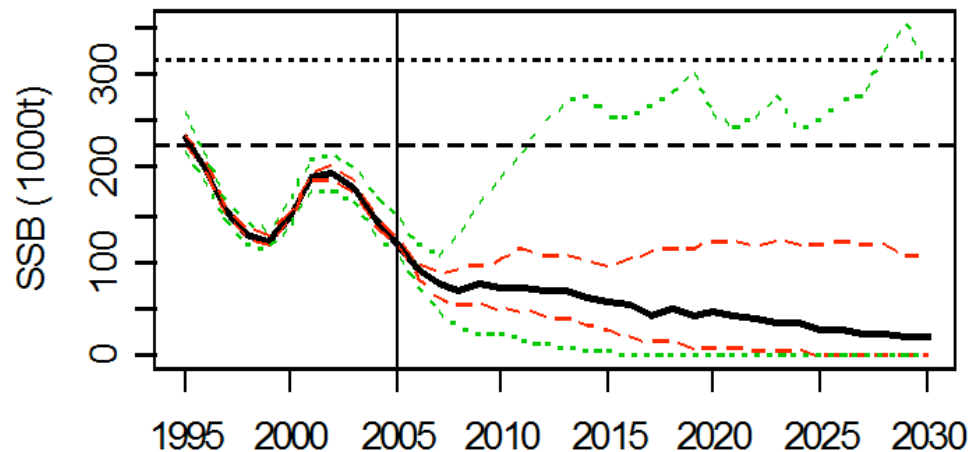
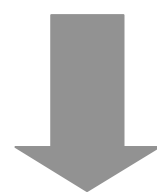
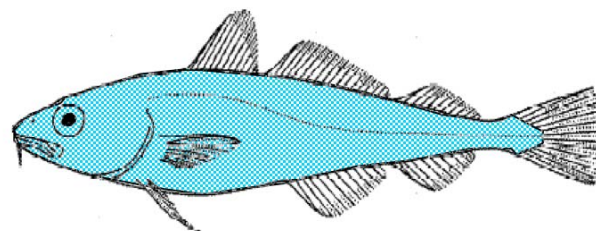
# Sandeel biomass consumed



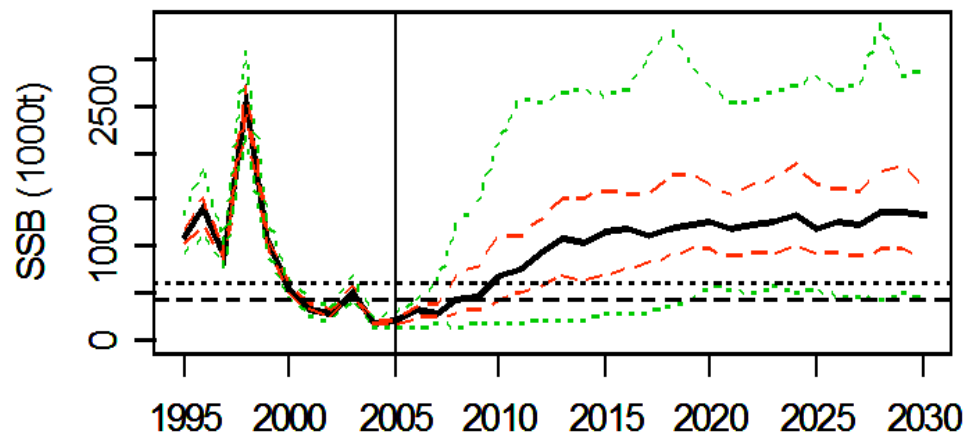
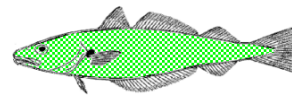
- Recovery simulation with HCR for cod: cod recovers
- Multi-species recovery slower than single species (cannibalism)
- A number of other stocks decline: middle predators whiting, haddock Norway pout and herring, possible also nephrops, crangon
- Spatial overlap of predator and prey is crucial
- Spatial overlap in case of cod and its predators temperature dependent
- Cascading effects occur if cod is recovered



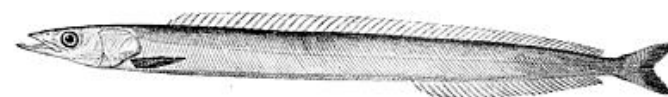
cod



whiting



sandeel



## **Pacific herring stocks in Canada: no recovery**

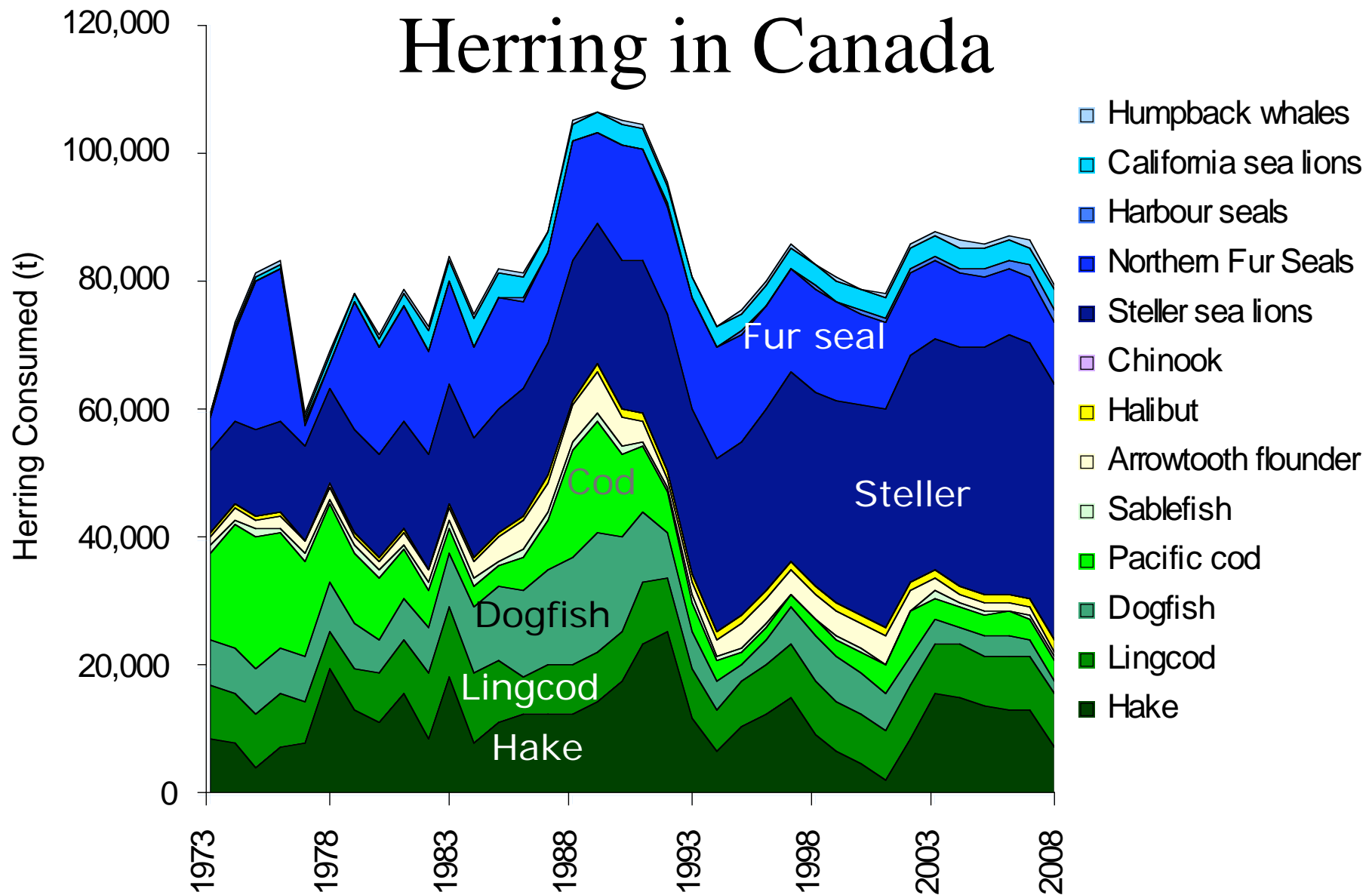
decreased food availability for immature herring over the past two decades.

rebuilding Pacific sardine population may be competing with herring for food

marine mammals are targeting herring

The natural mortality levels remained at a high level

# Predator Consumption of Pacific Herring in Canada



From Schweigert, Bold, Flostrand & Cleary

## **Cod in Eastern Scotian Shelf: no recovery**

stock collapsed around 1990, and has not recovered despite a closure of the fishery,

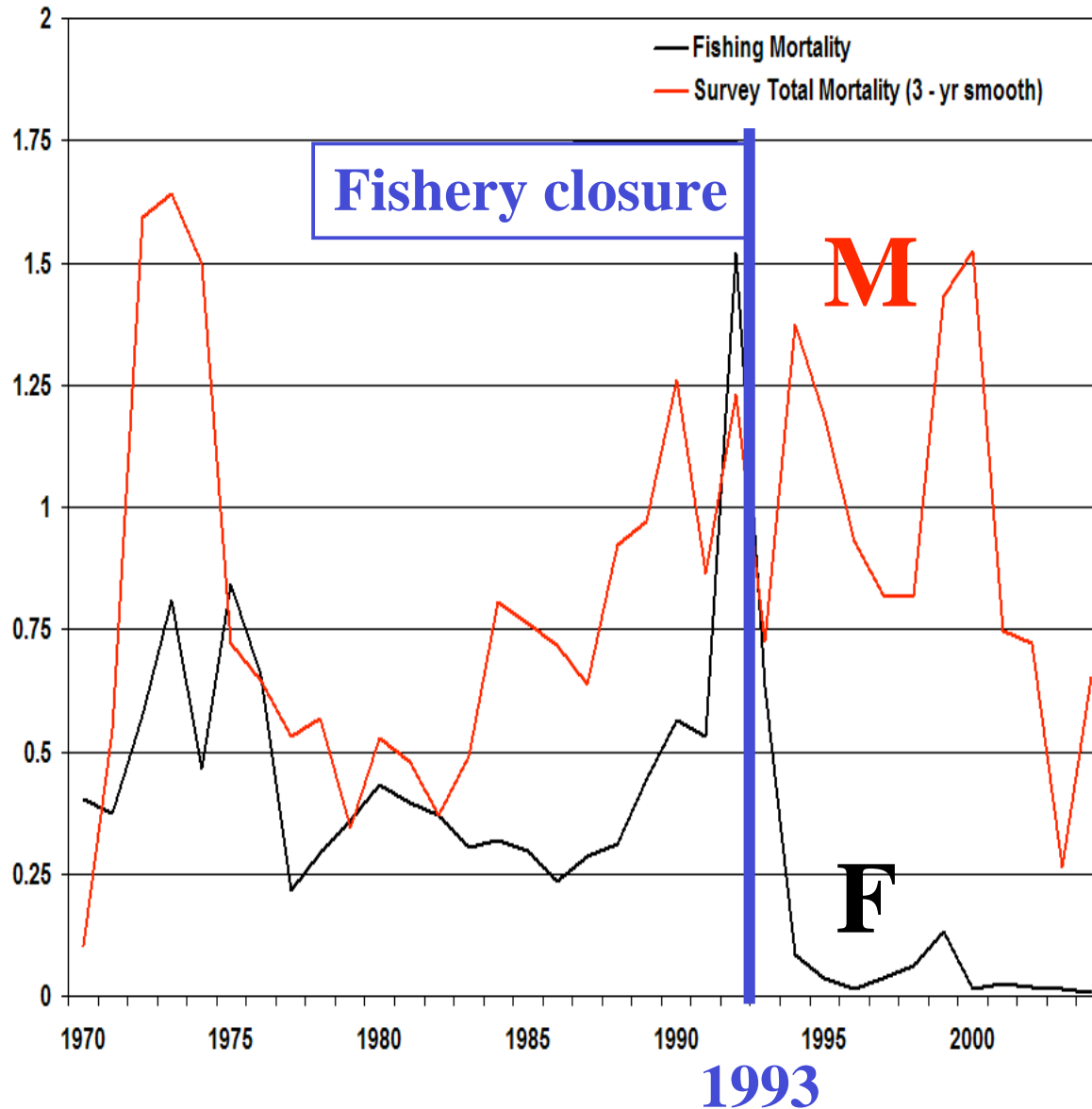
partly due to an increase in natural mortality.

Seal stocks have increased considerably in last 20 years and appear to be limiting rate of cod recovery

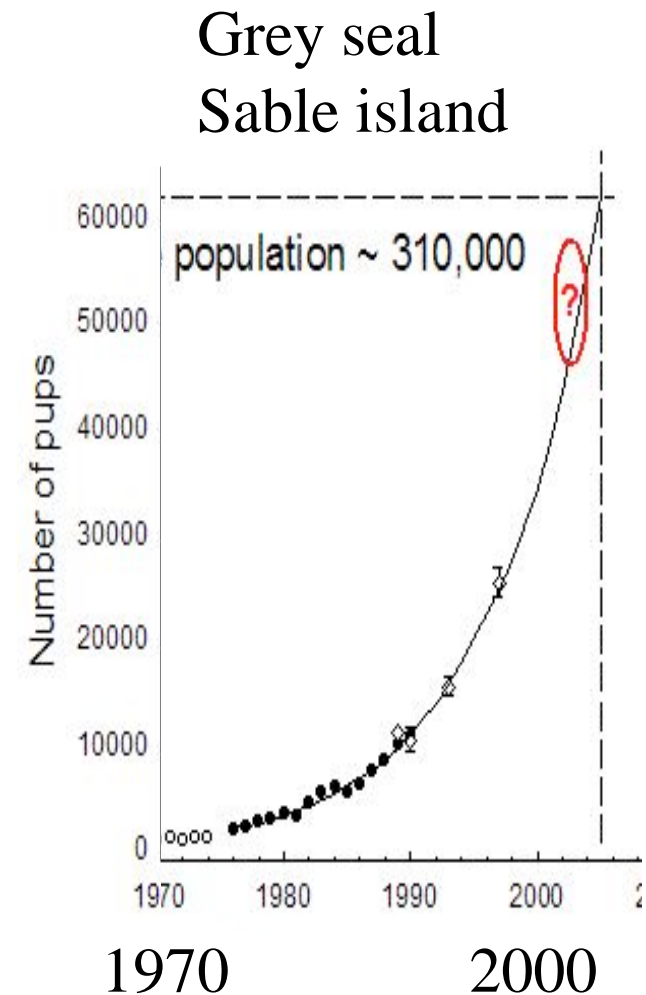
data for the share of cod in the seal diet are contradictory.

At present levels of  $M$ , no cod recovery is expected.

# Cod eastern Scotian shelf, mortality ages 5-7



From R. Boyle & M. Sinclair, modified without permission



## Barents Sea: Cod-capelin-herring interactions

The capelin stock shows strong fluctuations  
(three collapses in the last 25 years),

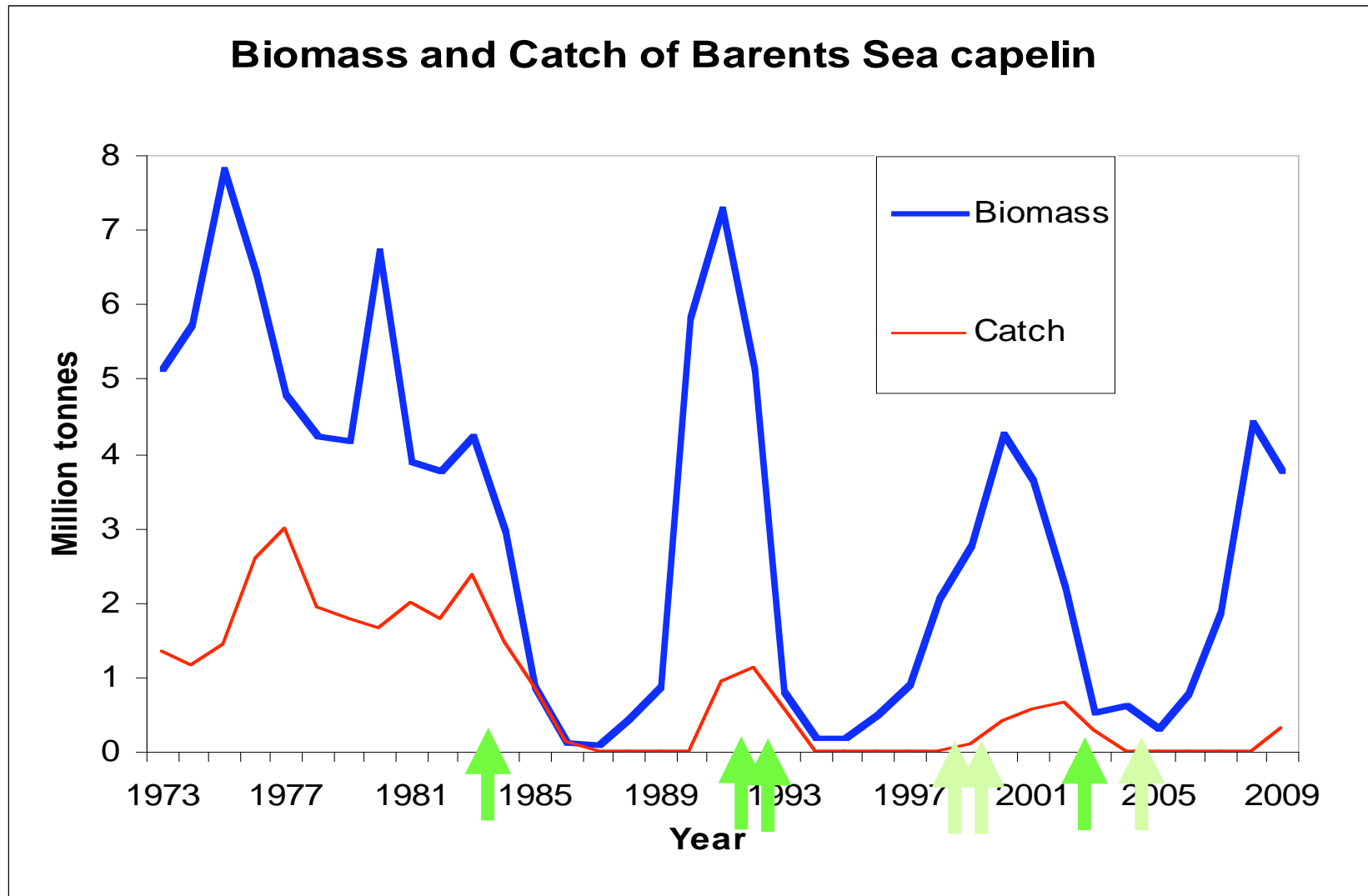
mainly caused by predation by young herring on capelin larvae.

high abundance of young herring does not necessarily lead to  
failure of capelin recruitment.

cascading effects of a capelin collapse have varied:  
mid-1980s had a strong negative influence on capelin predators  
(cod, harp seals, seabirds). cod: increased cannibalism,  
slower growth and later maturation (and possibly skipped spawning)

The cascading effects much weaker during the second and third  
capelin collapses, probably due to higher abundance of other fish  
As alternative prey for cod

# Example for predatory impact on larvae: Juvenile herring as predator



Strong herring year classes: 1983, 1991, 1992, 1998, 1999, 2002, 2004

## General

Complex models may not be able to deliver accurate predictions and this should be communicated clearly.

However, models will give directions as to the difference between alternative scenarios,

For further development in studies of trophic control on stock recovery, it is important to:

- Better resolve spatial structures of populations,
- Obtain additional data to validate model results
- Obtain better process understanding from targeted studies
- Identify and quantify all major sources of natural mortality
- Quantify the sources of uncertainty in modeled scenarios
- Improve the understanding of the interplay between top down and bottom up factors controlling recruitment