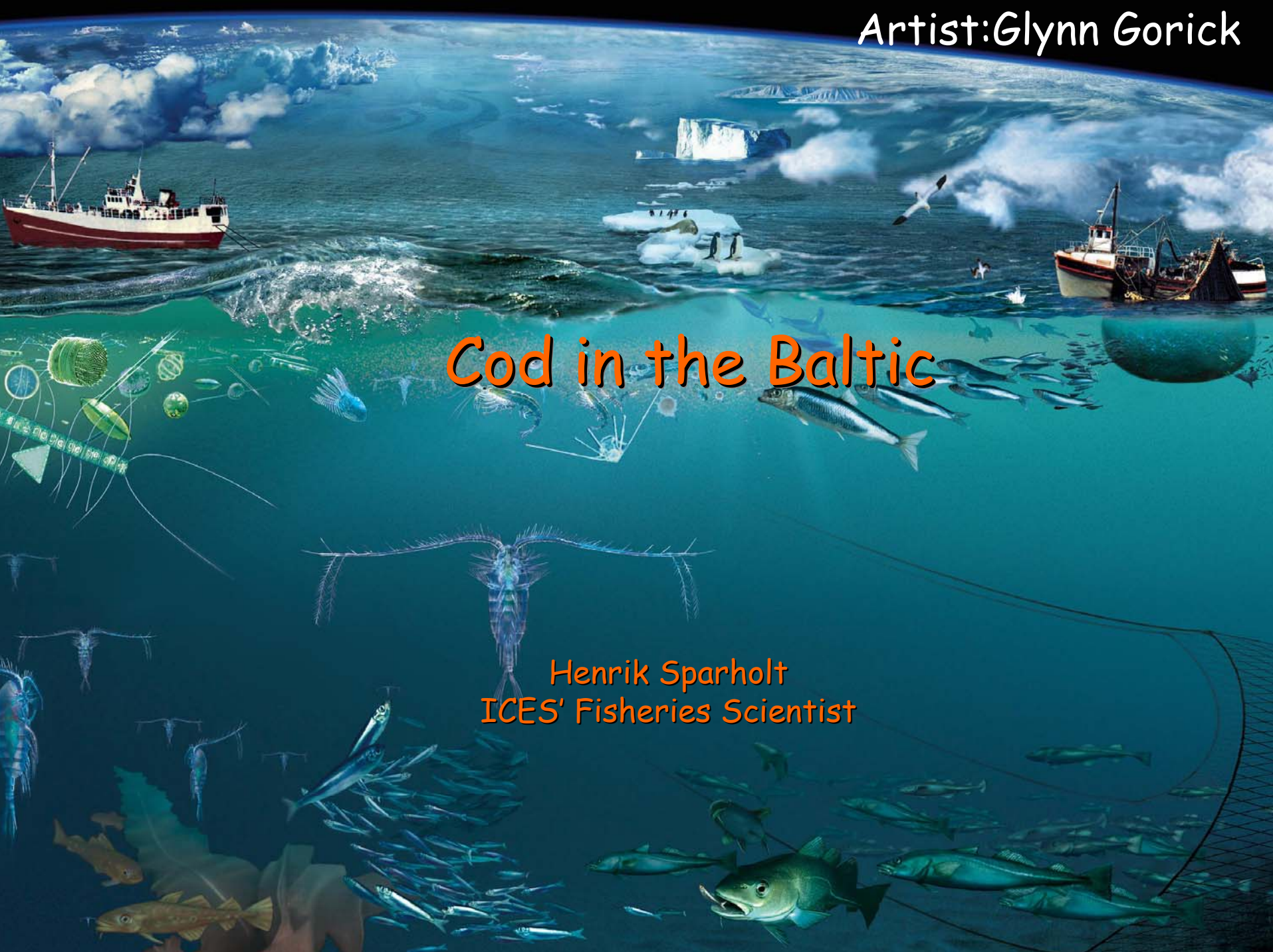
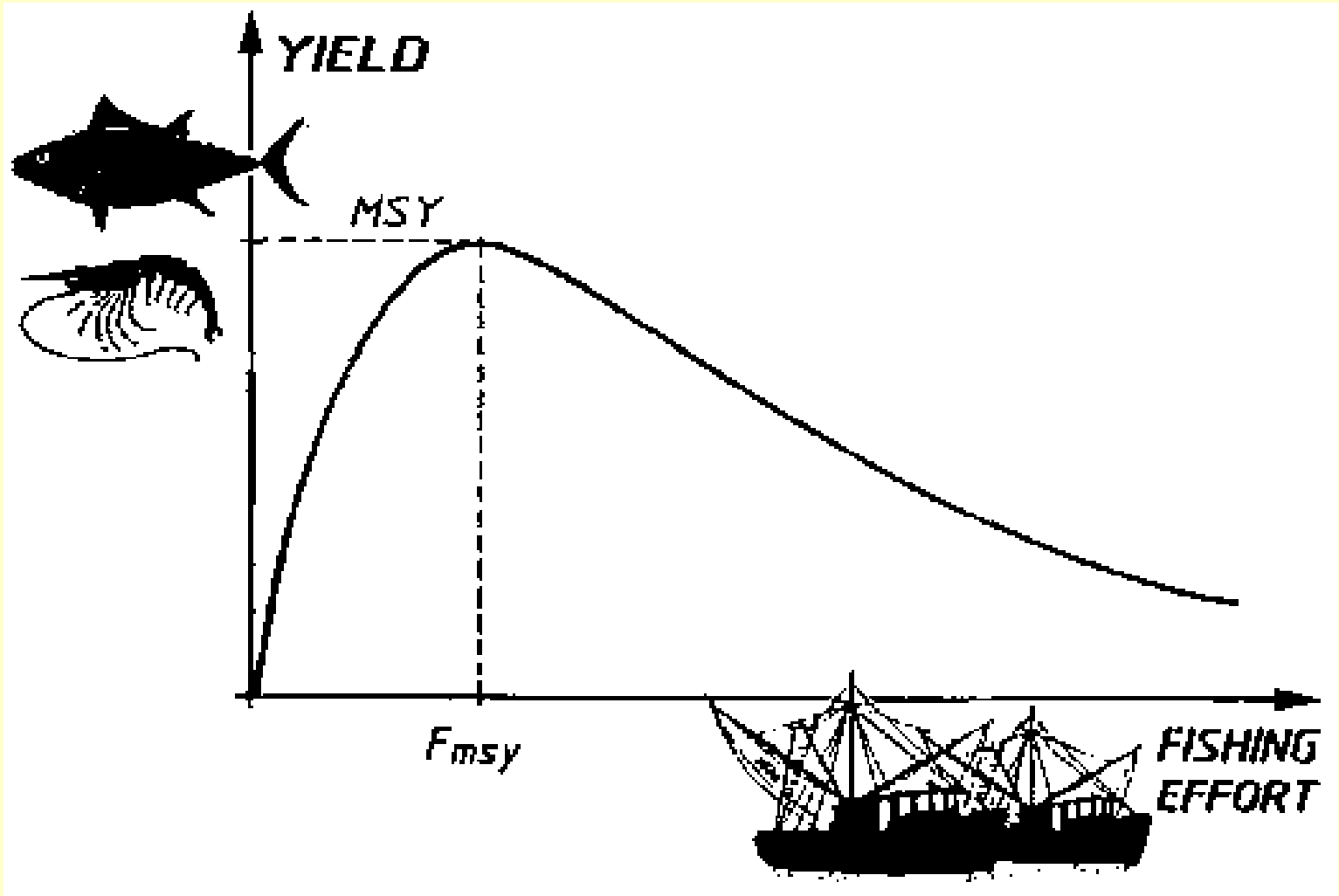


Artist: Glynn Gorick

# Cod in the Baltic

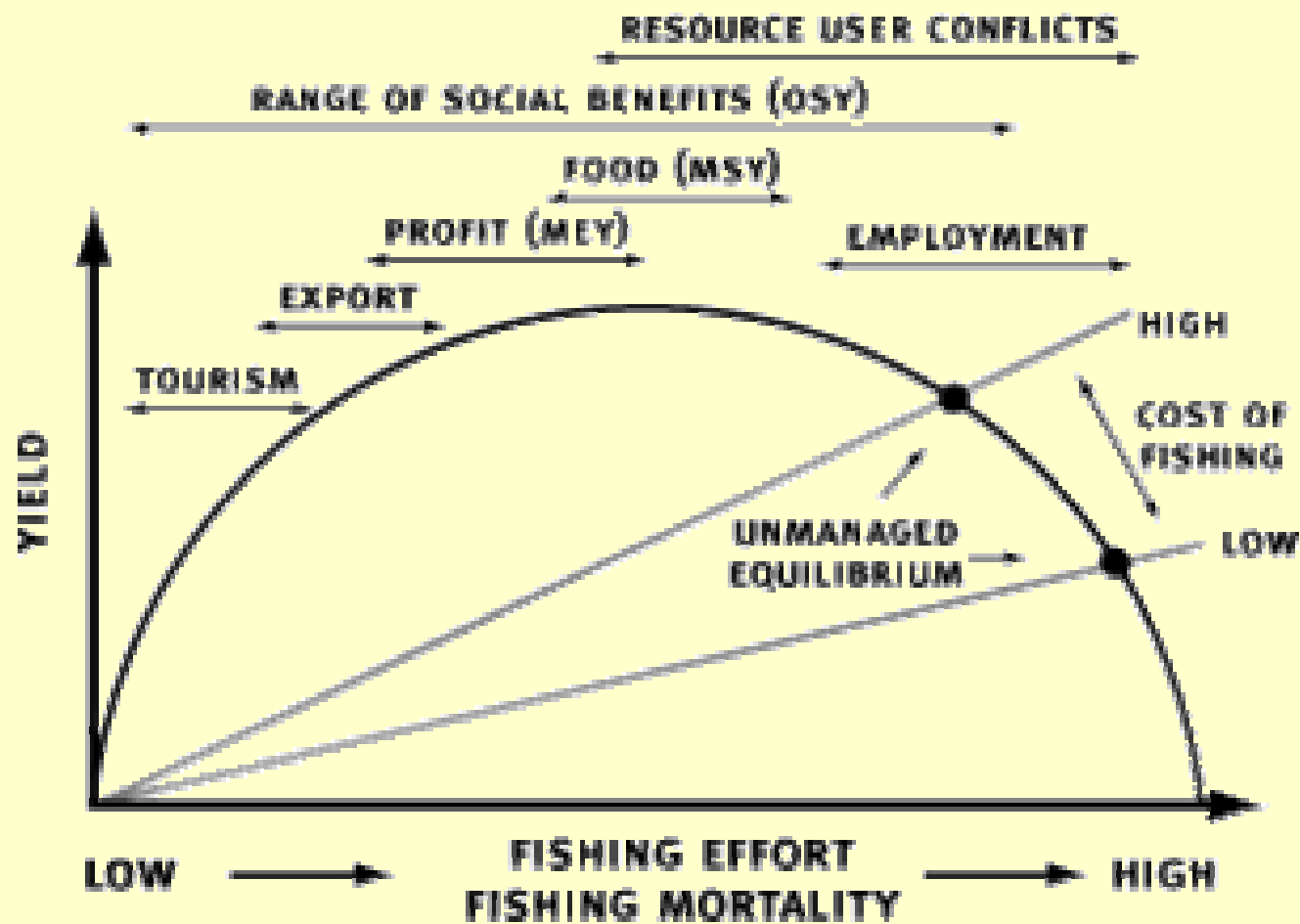
Henrik Sparholt  
ICES' Fisheries Scientist





# Fishing mortality

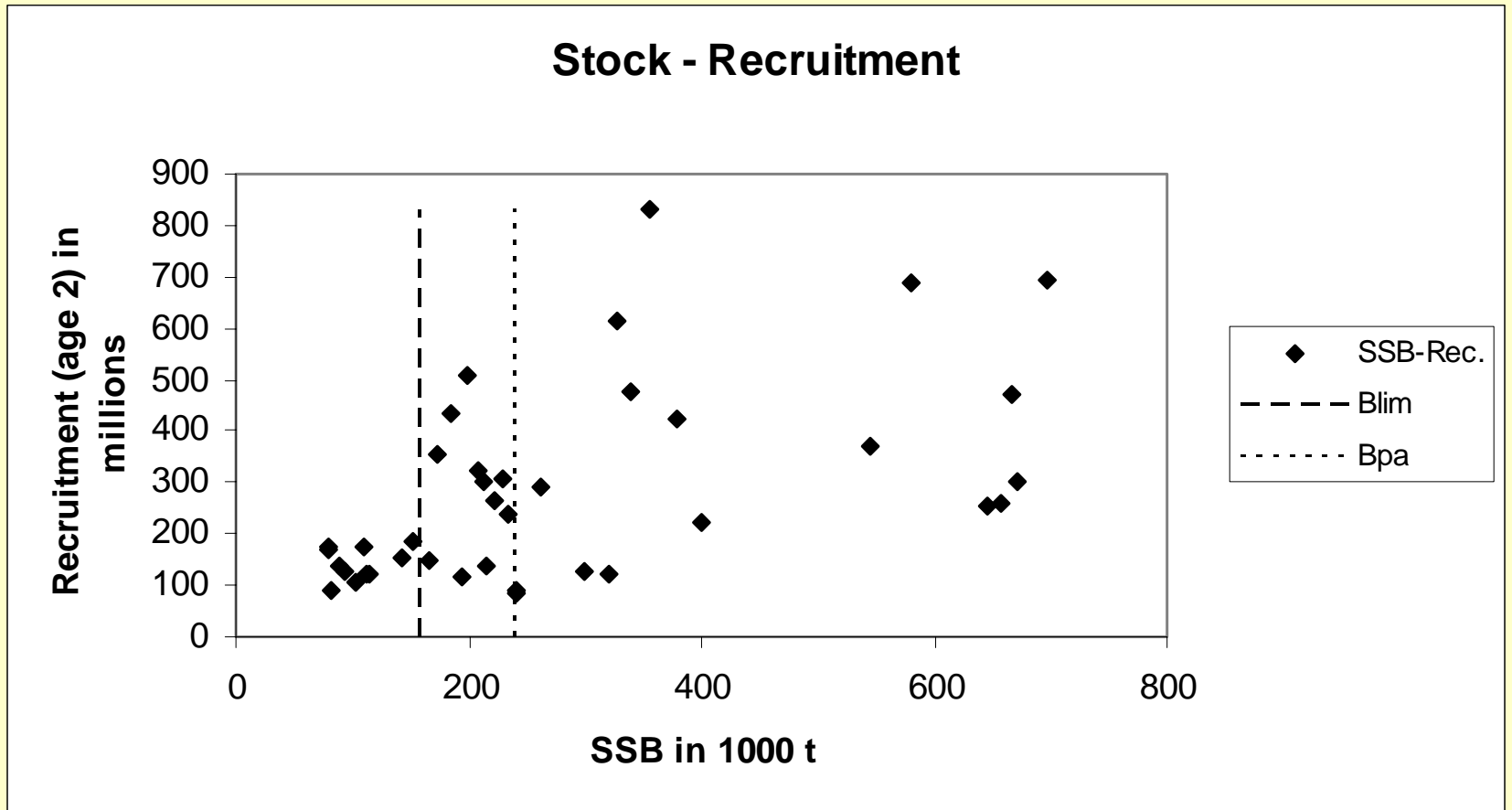
- “Fraction” of fish fished per year
- Proportional to fishing effort



LOW → FISHING EFFORT → HIGH  
 → FISHING MORTALITY →

→  
 LOWER FISH ABUNDANCE  
 LOWER CATCH PER UNIT EFFORT  
 SMALLER FISH IN CATCH  
 LOSS OF SPECIES  
 LOWER VALUE PER UNIT WEIGHT  
 →

# $B_{lim}$ and $B_{pa}$ - Cod 25-32



# Normative basis for ICES advice

(stipulated in international agreements)

- Precautionary Approach
- Marine management shall be based on ecosystem approach by 2010
- Fish stocks shall be maintained or restored to levels that can produce maximum sustainable yield by 2015

# Precautionary Approach for fish stocks (UN Agreements)

- “States shall be more cautious when information is uncertain, unreliable or inadequate”.
- “The absence of adequate scientific information shall not be used as a reason for postponing or failing to take conservation and management measures.”

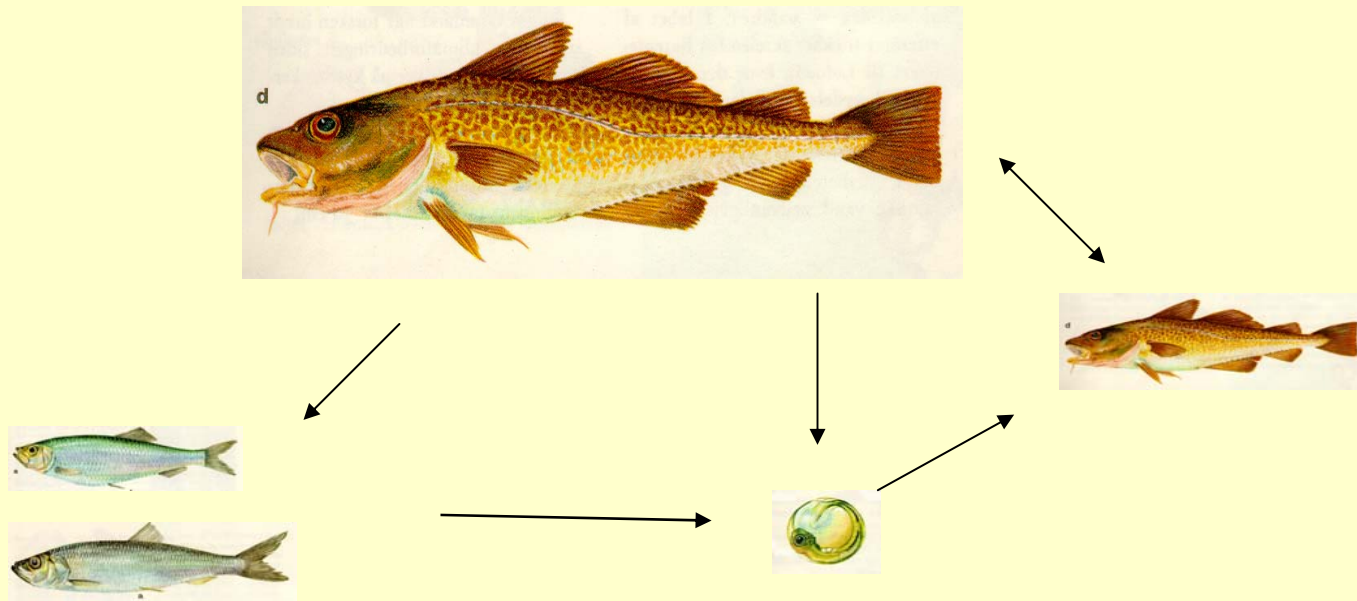
Invert “burden of proof”

# Ecosystem science very advanced for the Baltic

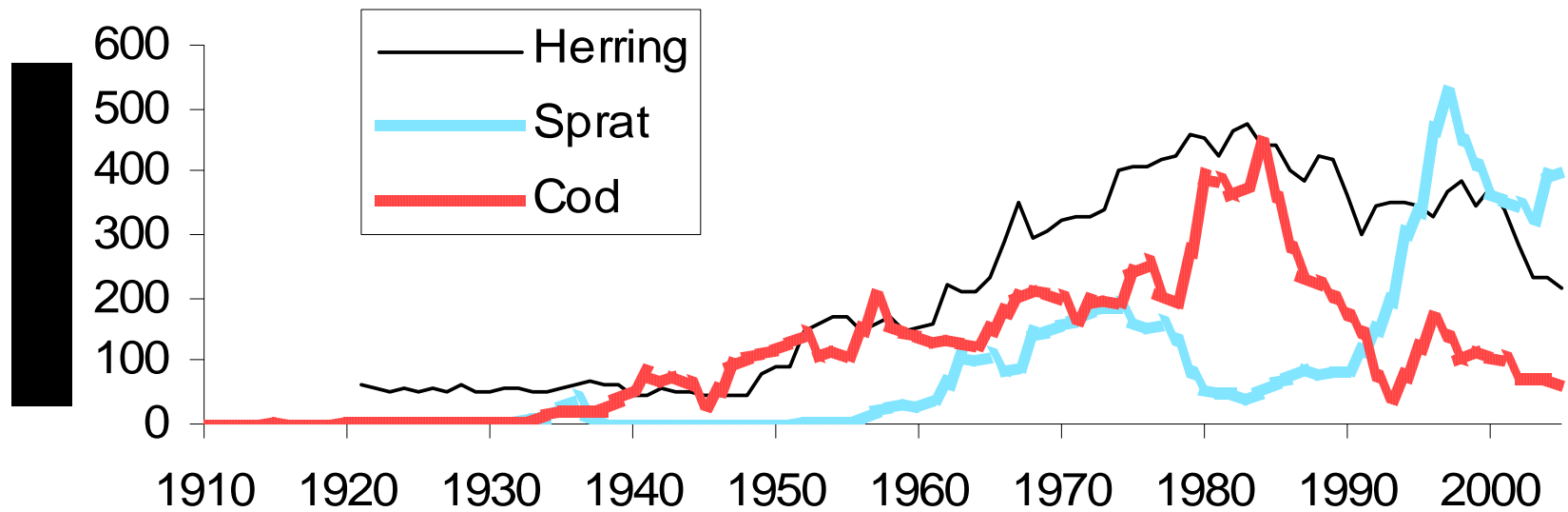
- Fish species interactions
- Inflows
- M74 in Salmon
- Dioxin
- Eutrophication
- Climate changes (temperature)
- Seals and porpoises



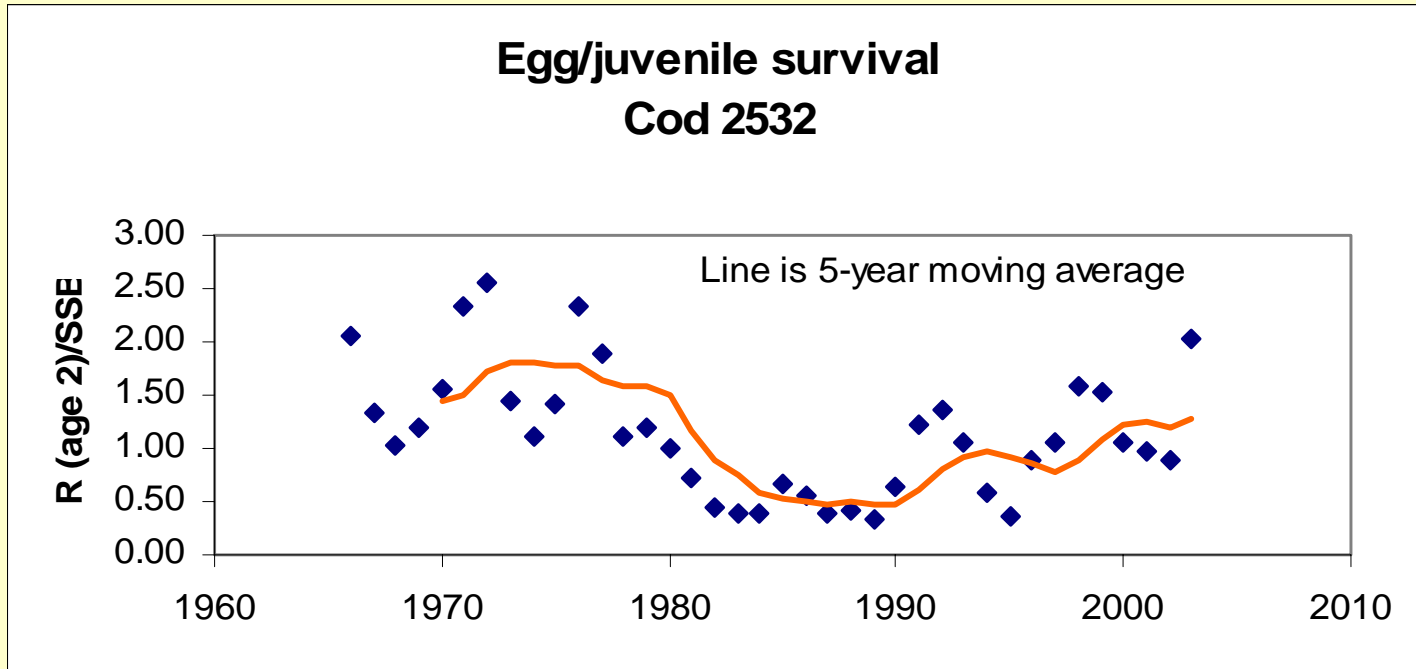
# Interactions between cod, herring and sprat



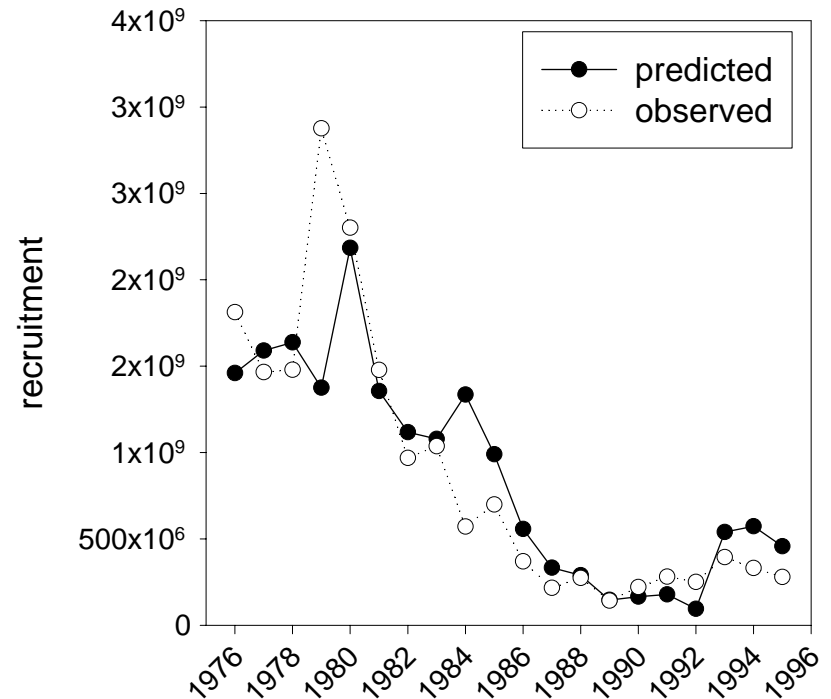
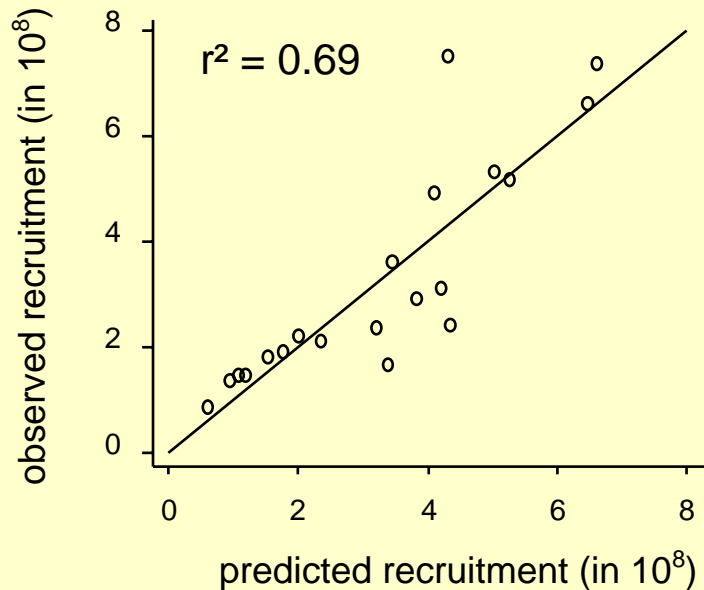
## Catches in the Baltic (Sub-divisions 22-32)



# Environment not too bad for cod



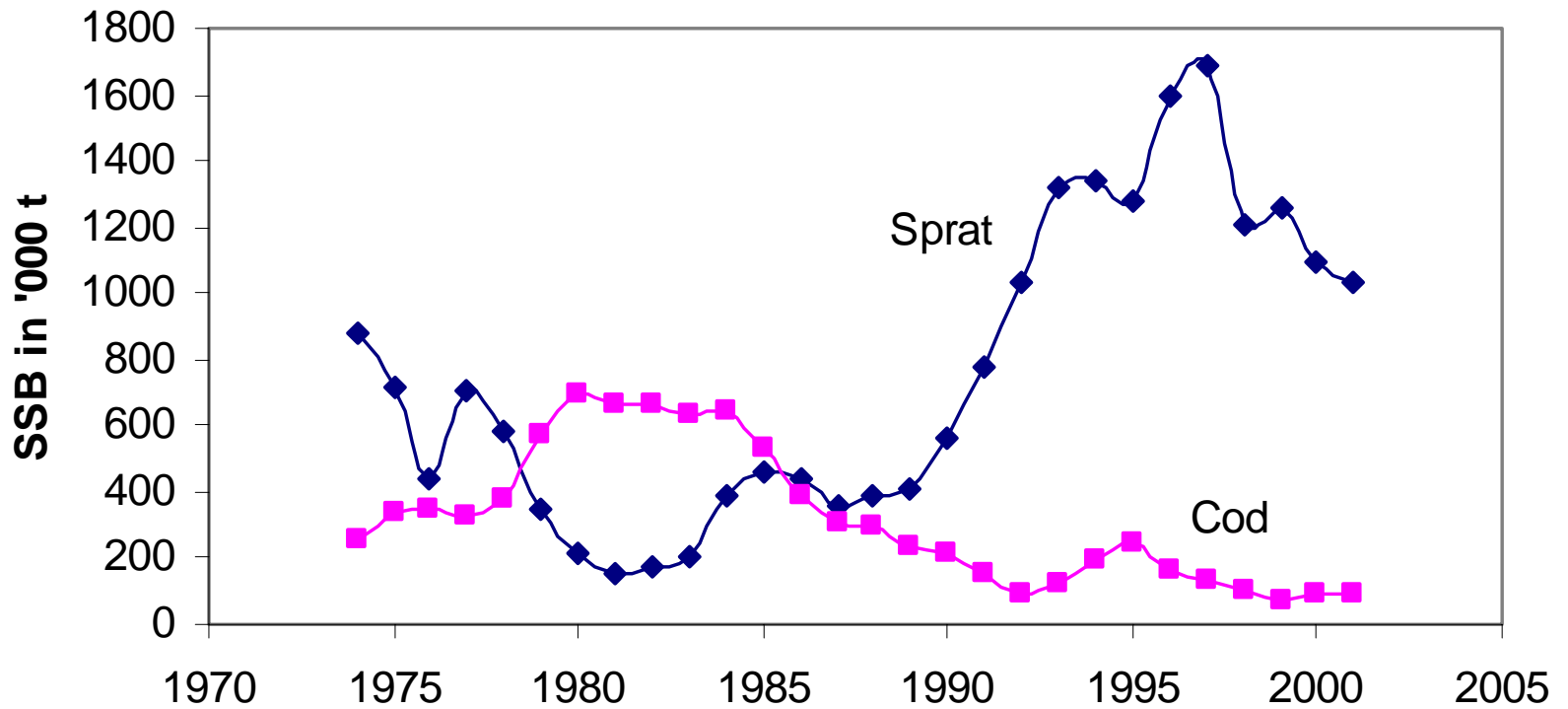
# Cod recruitment



## Variables included:

- Egg production by spawning stock
- Egg consumption by sprat and herring
- Influence of oxygen on egg survival
- Larval transport index

## Cod vs. sprat in the Baltic



Sprat (herring) the problem

# Not possible to get MSY of all species at the same time.

Cod SSB	No of years	Herring SSB	Sprat SSB
50-100	4	576	1443
101-200	6	755	1638
201-300	5	1101	908
301-400	6	1257	638
401-500	0	-	-
501-600	2	1179	467
601-700	5	1169	329

Weights in '000 t/

## Suggestion for target SSBs (SSBs for 2007 in brackets)

- Cod (25-32) 400 kt (80 kt)
- Herring 25-29+32 1200 kt (900 kt)
- Sprat 22-32 600 kt (1450 kt)



The cod stock should not grow  
larger  
because food supply then a  
problem

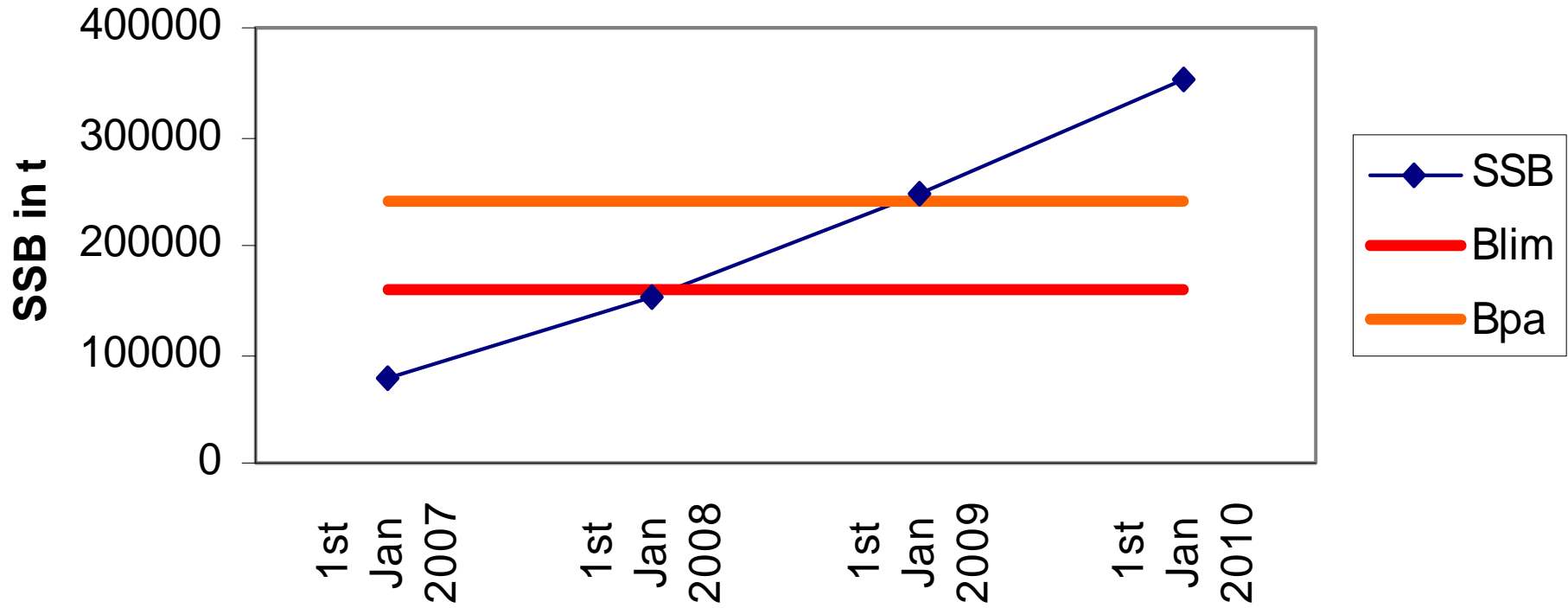
## This means

- Build up:
  - the cod stock to 400 kt
  - the herring stock to 1200 kt
- Accept a reduction in:
  - the sprat stock to 600 kt.

Realistic?

Yes!

**Cod 2532. SSB with no fishing.**



Even ignoring likely higher R due to  
higher SSB:

So, cod SSB can be rebuild within:

- 2 years to safe levels
- 3 years to target

Even with the current low recruitment

# Corresponding annual yield

(based on data from 1977 and 1986 where the stocks were at target size)

	Future catches	
	2010 onwards	2005
Cod	200 kt	55 kt
Herring	250 kt	92 kt
Sprat	100 kt	405 kt

Will vary by year due to inflows, and natural variation in R.

## Likely bonus side-effects (less certain):

- Salmon M74 reduced due to low sprat stocks
- Zoo plankton improved due to low sprat stock
- Herring growth improved due to improved zooplankton
- Algae blooming reduced due to improved zooplankton

# Risk to such a target plan:

- High  $F$  on sprat in the start
- Low  $F$  on cod in the start
- Temptation to fish cod after the TAC has been taken because there are still many cod “out there”

Less risky than now where a low cod stock and a limit on  $F_{\text{sprat}}$  allow sprat to dominate



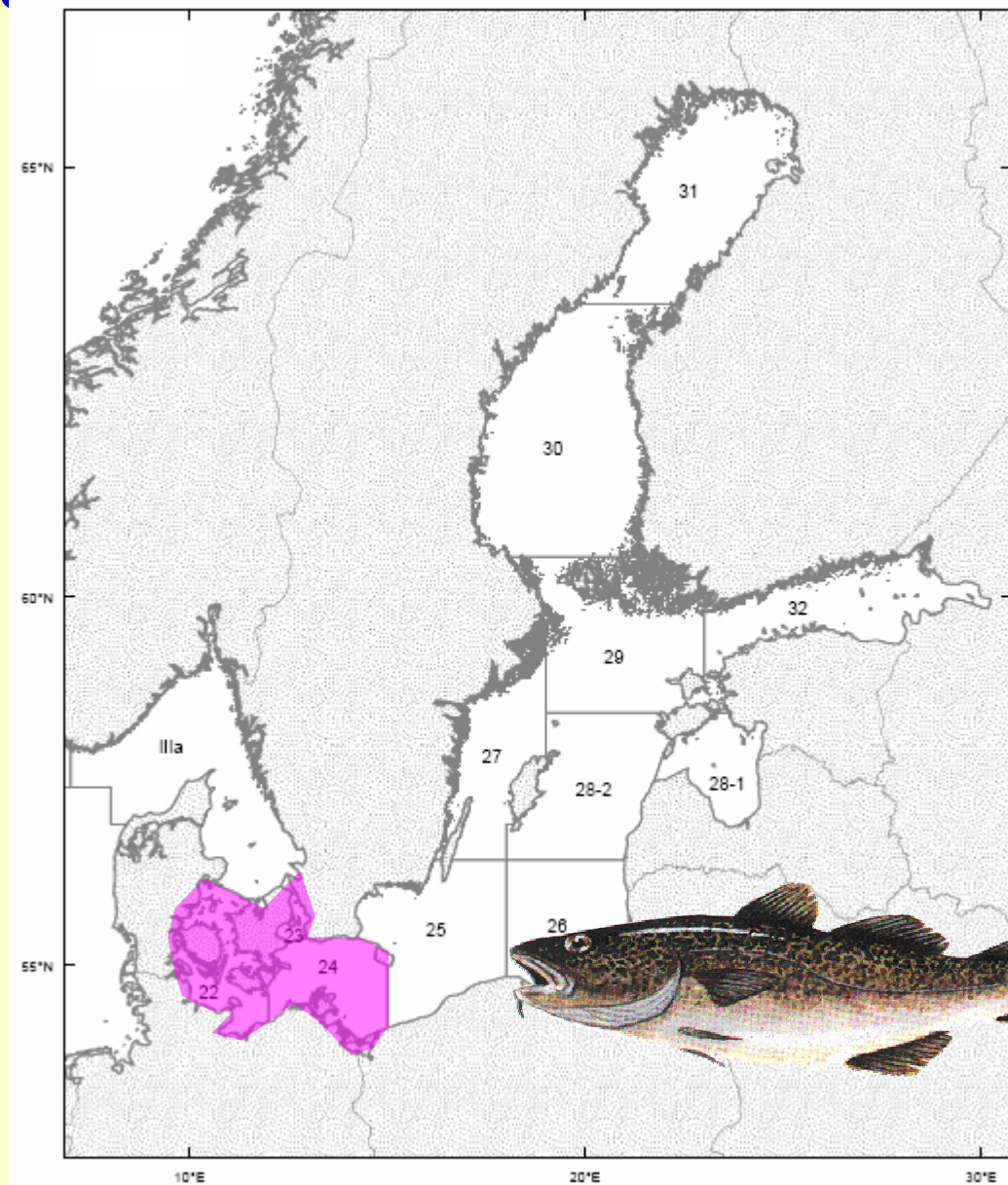
We will never have perfect  
knowledge

Aim for the most promising (and  
low risk) strategy

# Cod management plan

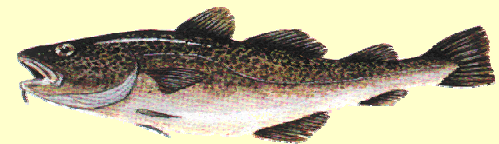
- ICES evaluation in 2005
  - Target F of 0.3 – 0.6 (western Baltic) and 0.3 (eastern Baltic) would be suitable candidates
- During ACFM May 2007
  - No final agreed management plan
- Preliminary evaluation of proposal
  - Initial exploration of the proposed plan:
    - significant scope for interpretation
    - Unclear which F values should be used as reference F for the 10% reduction.
    - ICES proposes that further consultations between scientists, managers, and stakeholders be conducted for clarification of the proposed plan.

# Western Baltic Cod (22-24)



# Western Baltic Cod (22-24)

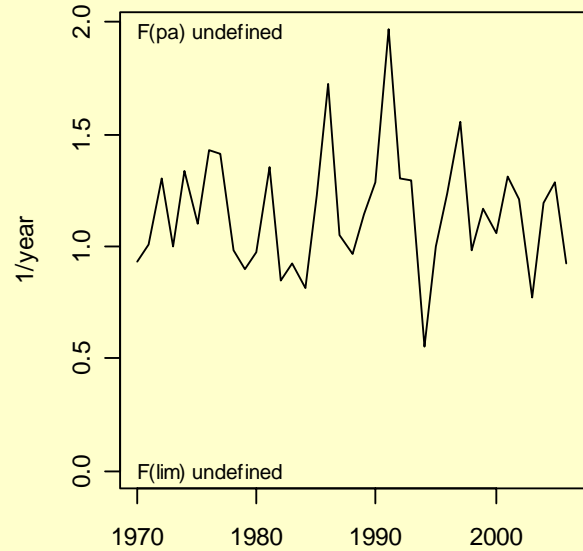
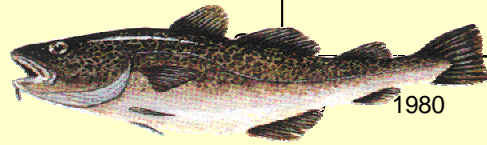
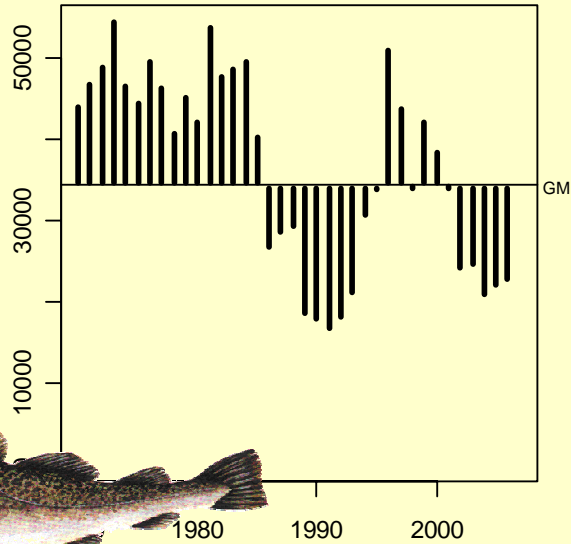
- Issues:
  - Indications for misreporting, but not fully quantified and therefore not included
  - Age reading problems; no major influence on perception.



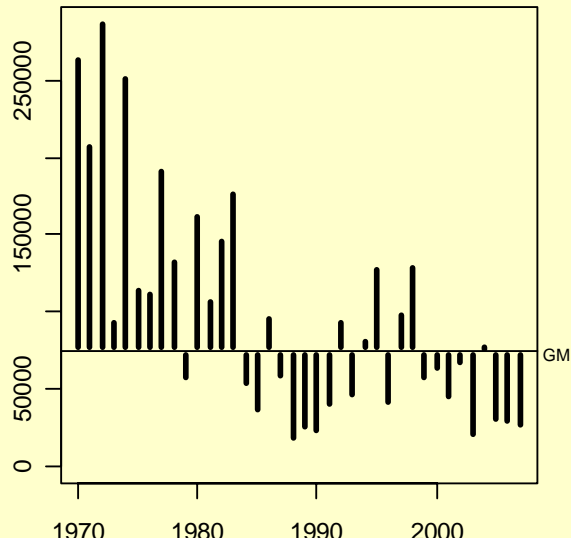
# Western Baltic Cod (22-24)

Mean F (3-6) Cod in Sub-divisions 22 to 24

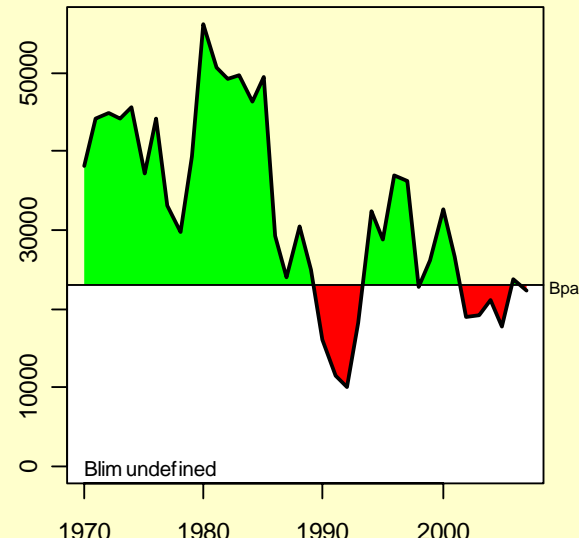
yield



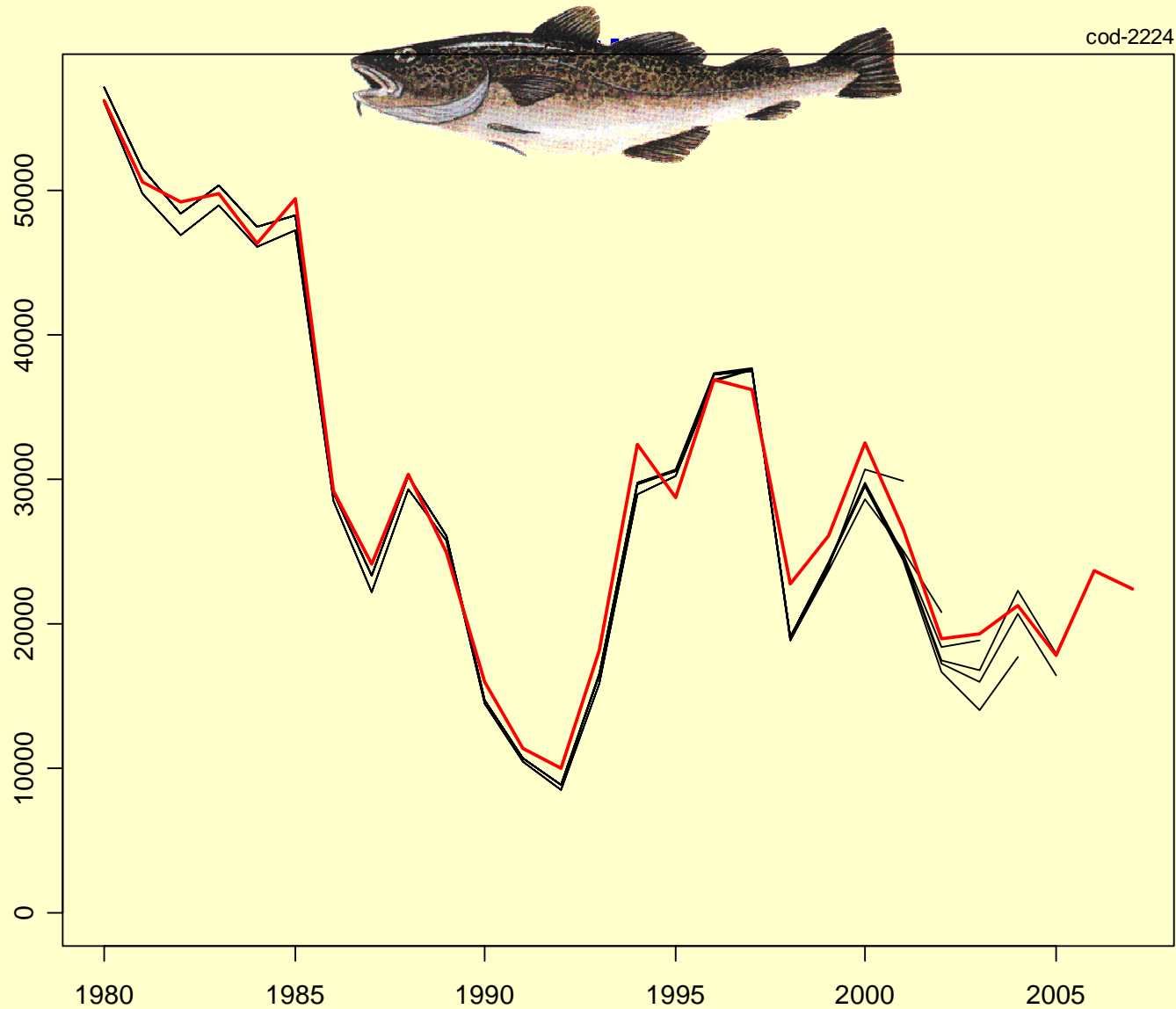
Recruitment age 1



SSB

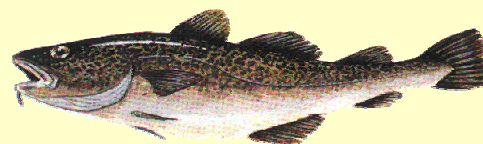


# Western Baltic Cod (22-24):

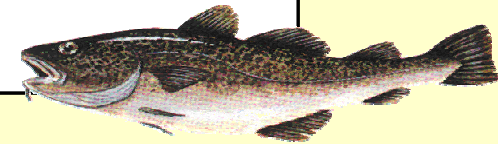
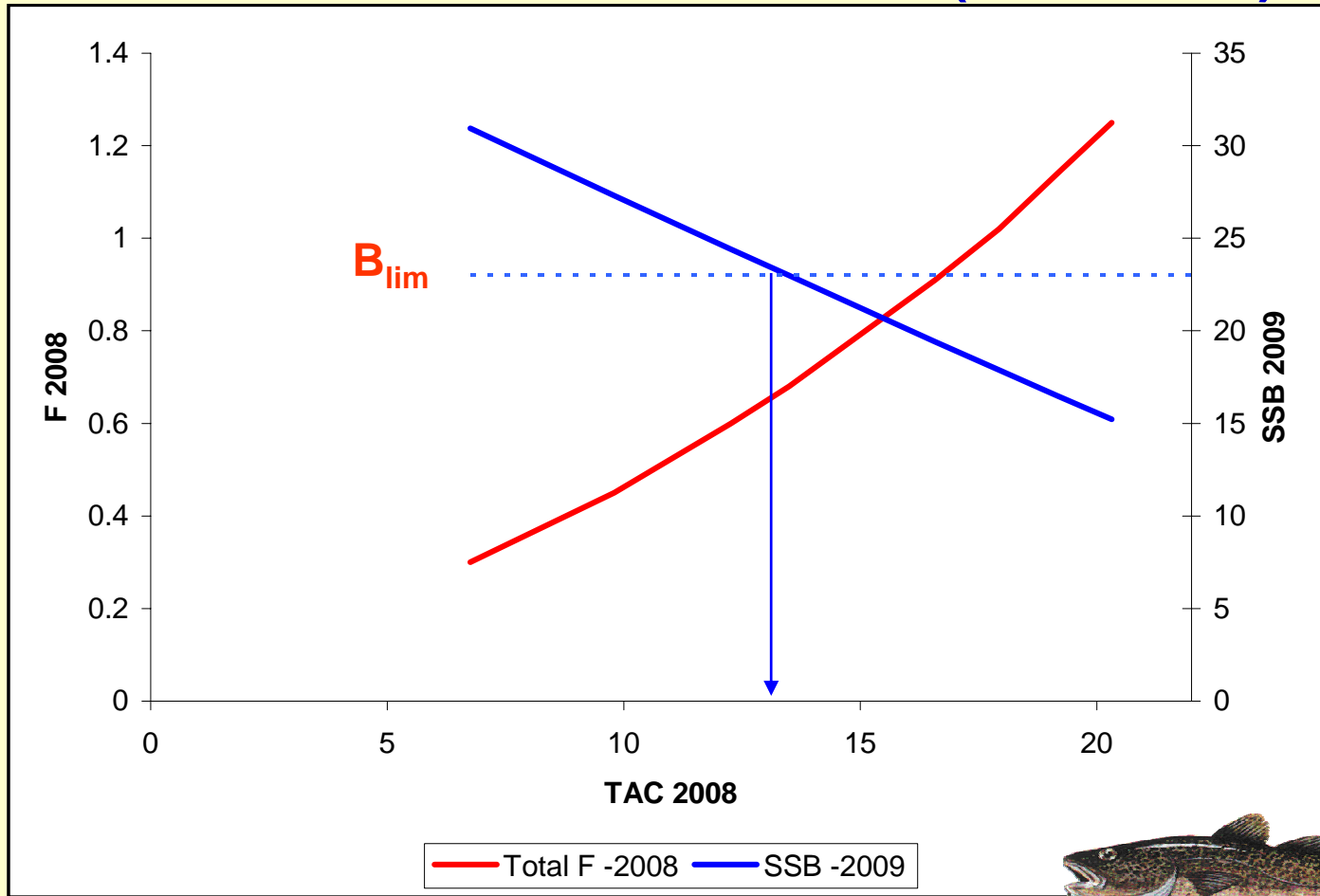


# Western Baltic Cod (22-24)

- Advice
  - Proposed management plan: 22 695 t. (15% change)
  - Advice based on precautionary reference points: bring stock at Bpa in 2009; landings 13 500 t.



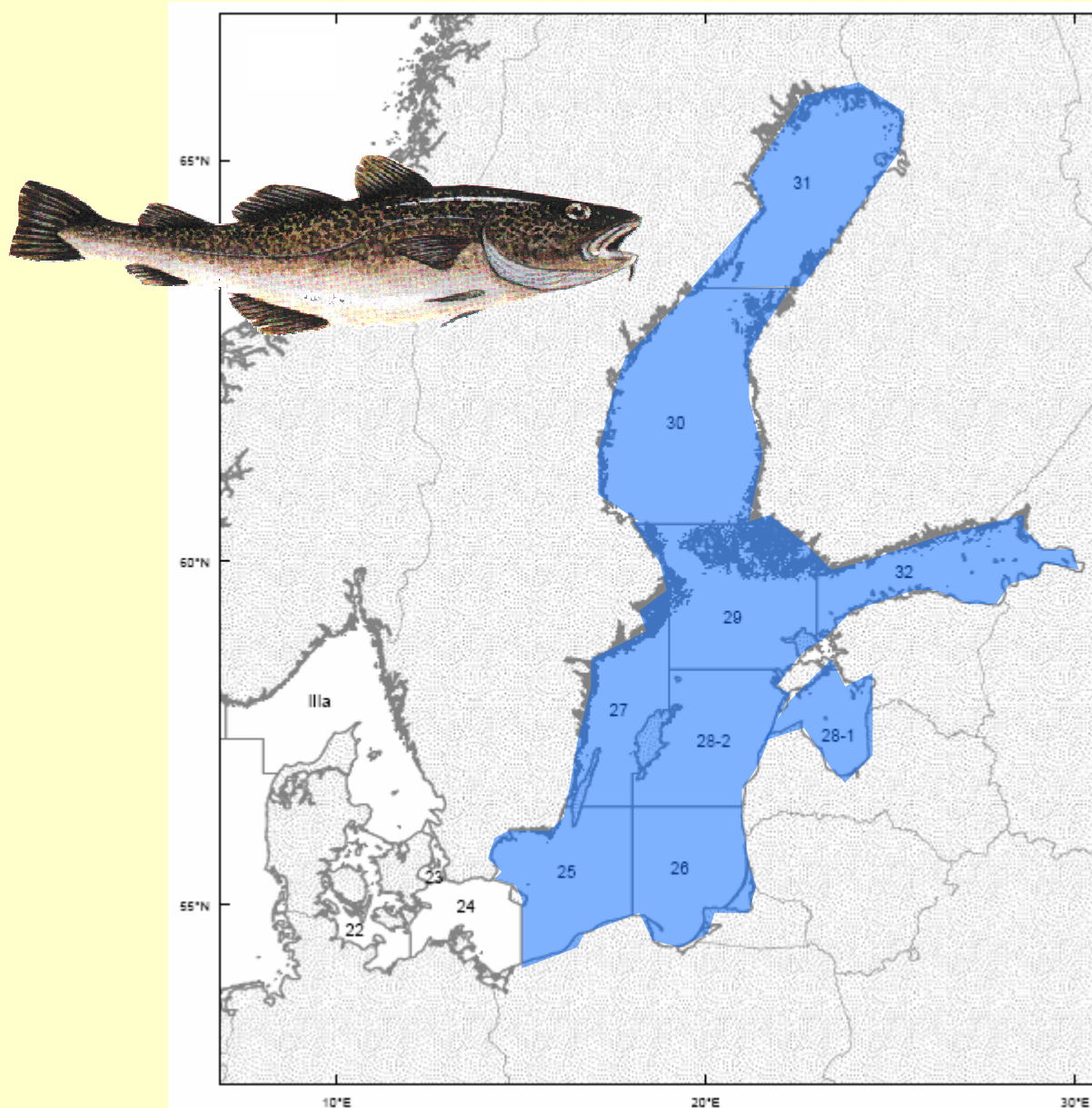
# Western Baltic Cod (22-24)



Short term forecast



# Eastern Baltic Cod (25-32)



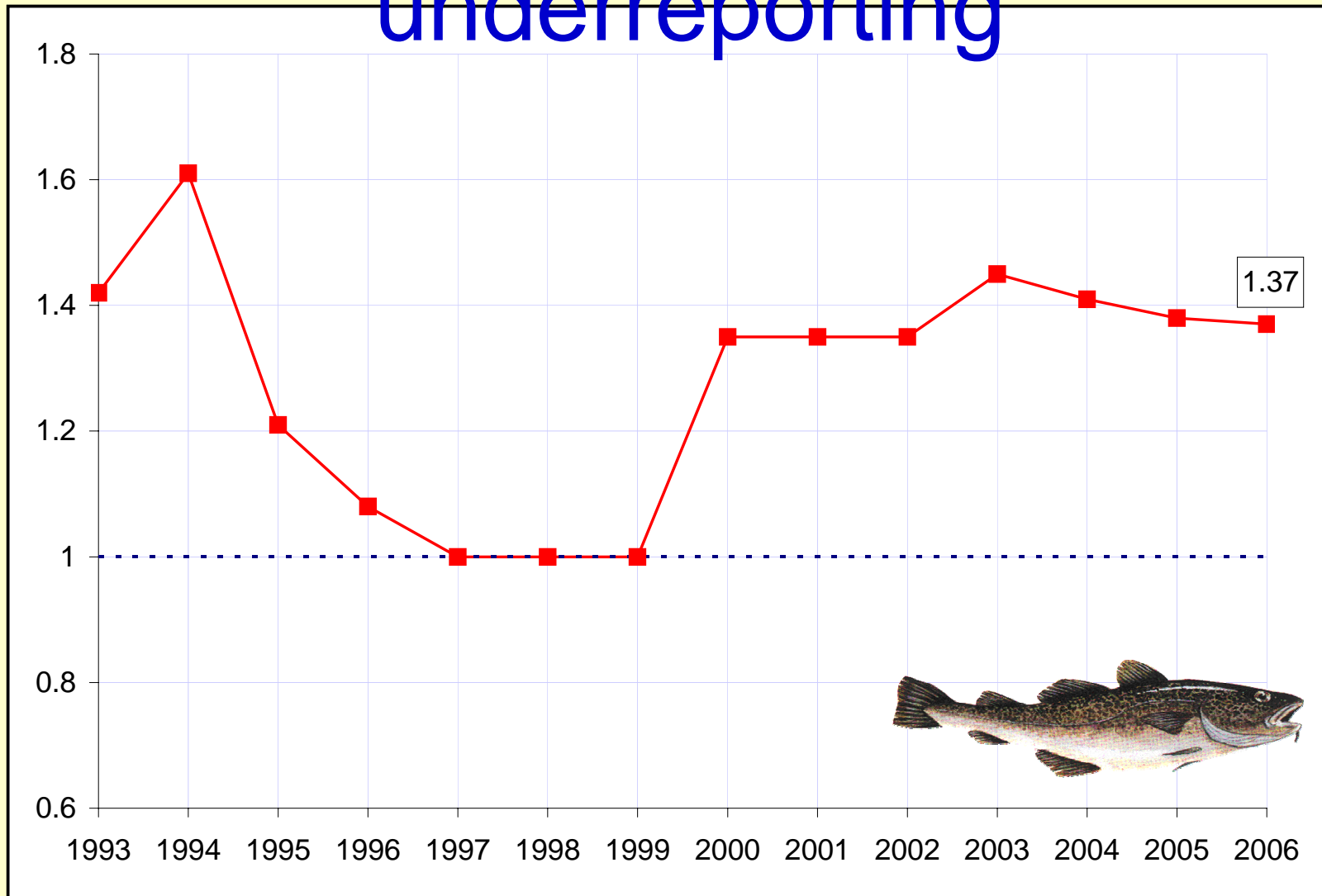
# Eastern Baltic Cod (25-32)

## Issues

- Underreporting (2002-2006: 35-45%)
- Age reading problems; no major influence on perception.
- Environmental conditions likely to remain poor for egg survival



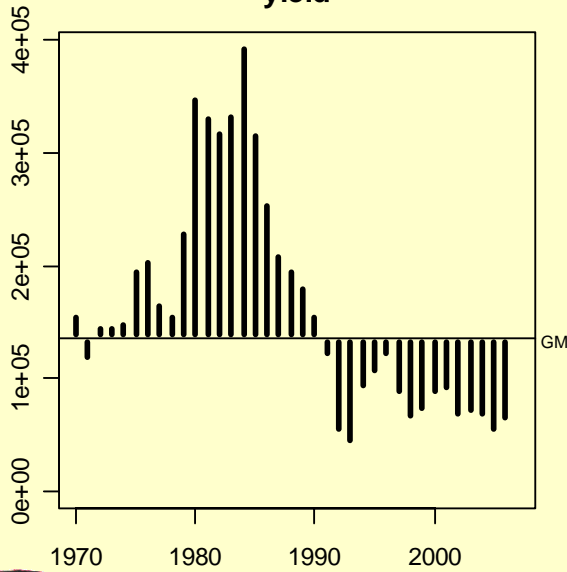
# Eastern Baltic Cod: estimating underreporting



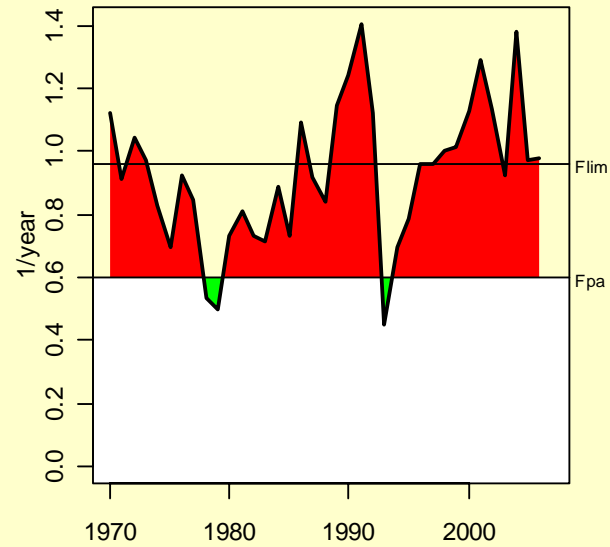
# Eastern Baltic Cod (25-32)

Cod in Sub-divisions 25 to 32

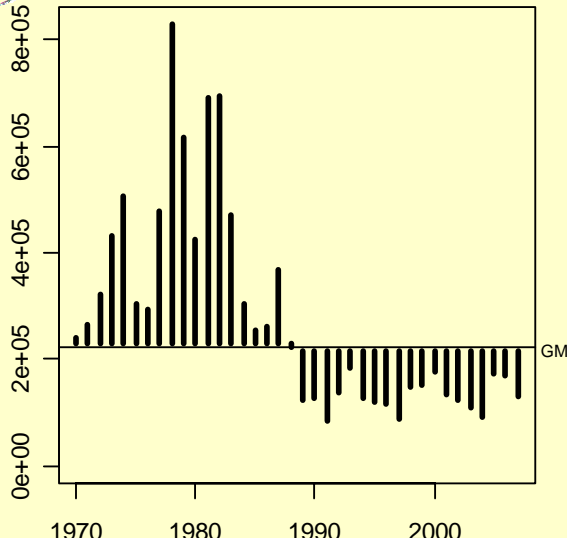
### yield



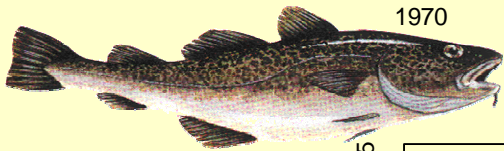
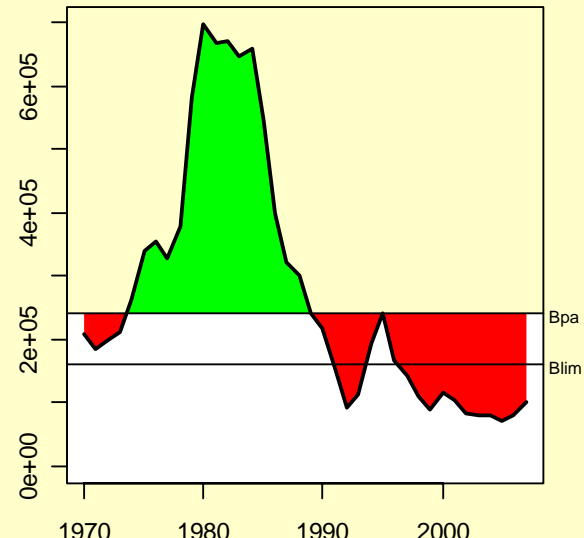
### Mean F (4-7)



### Recruitment age 2



### SSB



# Eastern Baltic Cod (25-32)

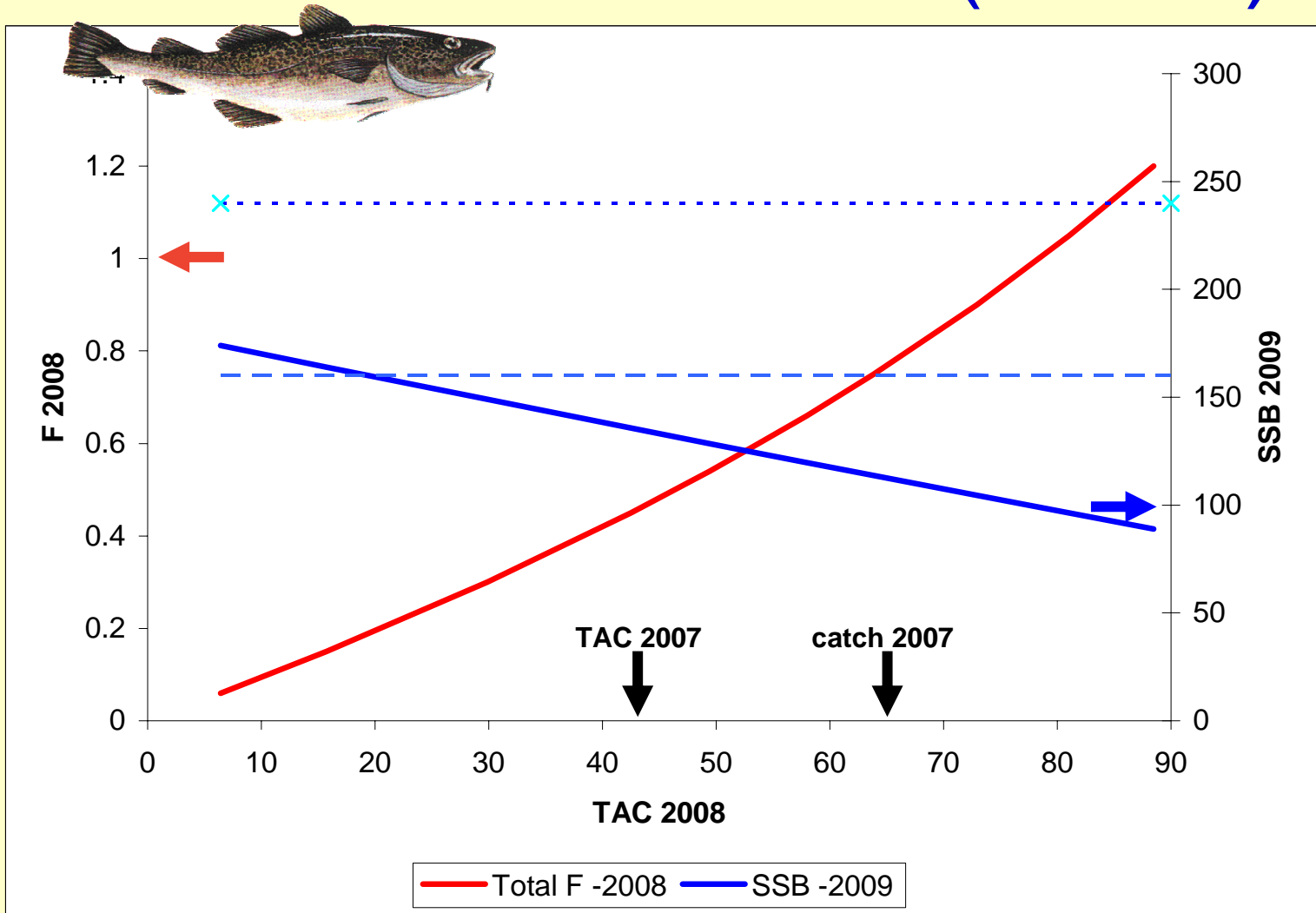
- Advice



- This year

- Management plan under development but not implemented or evaluated
    - Given critical state of stock; advice based on precautionary reference points – no fishing.

# Eastern Baltic Cod (25-32)



**Short term forecast; assuming no implementation error !!**

# New cod plan

The plan shall ensure the sustainable exploitation of the cod stocks concerned by gradually reducing and maintaining the fishing mortality rates at levels no lower !! than:

- 1) 0.6 on ages 3 to 6 years for the cod stock in 22-24
- 2) 0.3 on ages 4 to 7 years for the cod stock in 25-32.

# New cod plan

Paragraph 1:

...the higher of:

- (a) the TAC that would result in a 10% reduction in the fishing mortality rate in its year of application compared to the fishing mortality rate estimated for the preceding year.
- (b) the TAC that would result in the level of fishing mortality rate of 0.6/0.3



# New cod plan

## Paragraph 2:

Where the application of paragraph 1 would result in a TAC that exceeds the TAC for the preceding year by more than 15%, the Council shall adopt a TAC which is 15% greater than the TAC of that year.

# New cod plan

## Paragraph 3:

Where the application of paragraph 1 would result in a TAC that is more than 15% below the TAC of the preceding year, the Council shall adopt a TAC which is 15% less the TAC of that year.

# New cod plan

Paragraph 3 shall not apply where ... the fishing mortality ... will exceed a value of 1.0 ... for the cod stock in 22-24 or a value of 0.6 ... for the cod stock in 25-32.

# New cod plan

Where the fishing mortality rate for one of the cod stocks concerned has been ... at least 10% higher than 0.6/0.3, the total number of days ... shall be reduced by 10% compared to the total number of days allowed in the current year.

# New cod plan

ICES has not yet evaluated the Plan.

This will probably be done in 2008.

# New cod plan

If applied for 2008 TAC it would be 50945t due to a max 15% increase in TAC ( $\rightarrow F = 0.56$ , i.e. a 49% reduction in  $F$ )

If continued in 2009 the TAC should be reduced by 10%, i.e. to 0.50.

If cont. then 0.45 in 2010, 0.41 2011, 0.37 2012, 0.33 2013, 0.30 in 2014.

# Hopefully, the SSB would then be above 240 000t soon?

Ideally!!!

Year	SSB year start	Yield	F
2008	101	51	0.56
2009	127	58	0.51
2010	170	66	0.45
2011	238	76	0.39
2012	350	88	0.34
2013	540	105	0.30
.	.	.	.



SSB and yield in '000 t.

# New cod plan

My guess is that it will be accepted if enforced and adhered to.



Thanks for listening

