Exploratory assessment of anchovy 27.9a-west using a surplus production model

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Objective

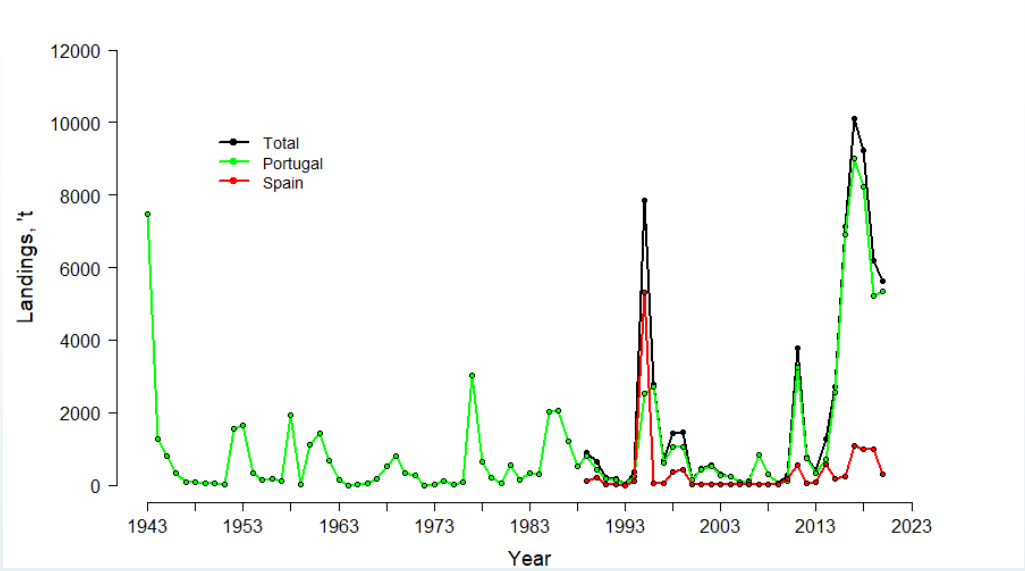
- Explore surplus production models using SPiCT to assess the anchovy 9a.west component
- several combinations of catch data and survey indices
- Several assumptions (priors): from simple to complex models

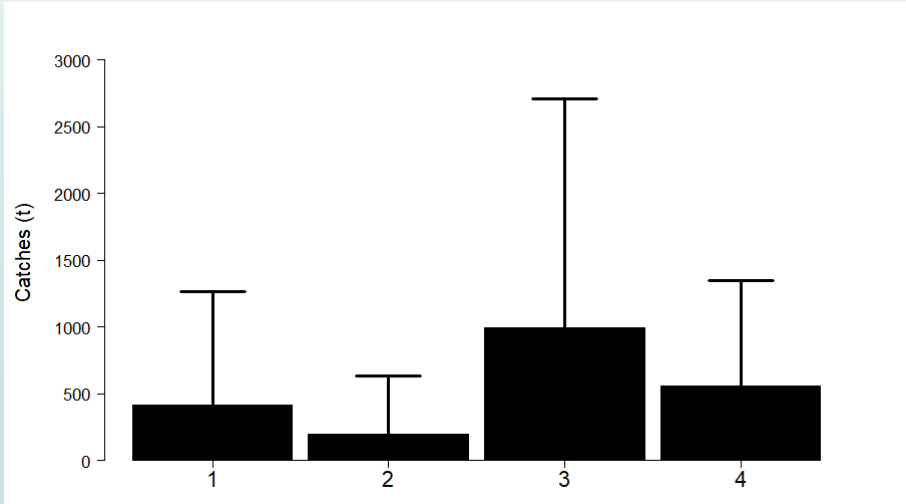
WORK IN PROGRESS

TO BE DISCUSSED ON A BENCHMARK

Data

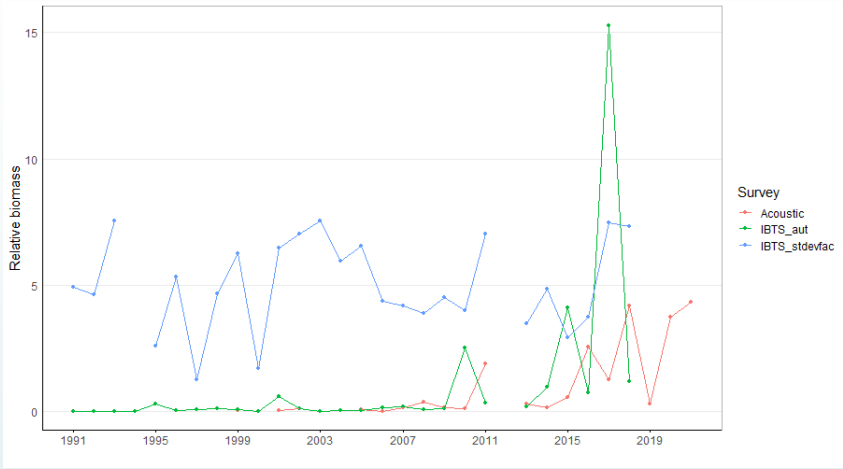
- CATCHES
  - DATA: catch biomass, t, per quarter or semester from the beginning of the first quarter of 1991 to the end of the second quarter of 2021
  - No signs of intense exploitation in the past
  - Seasonal catches; 67% in the second semester

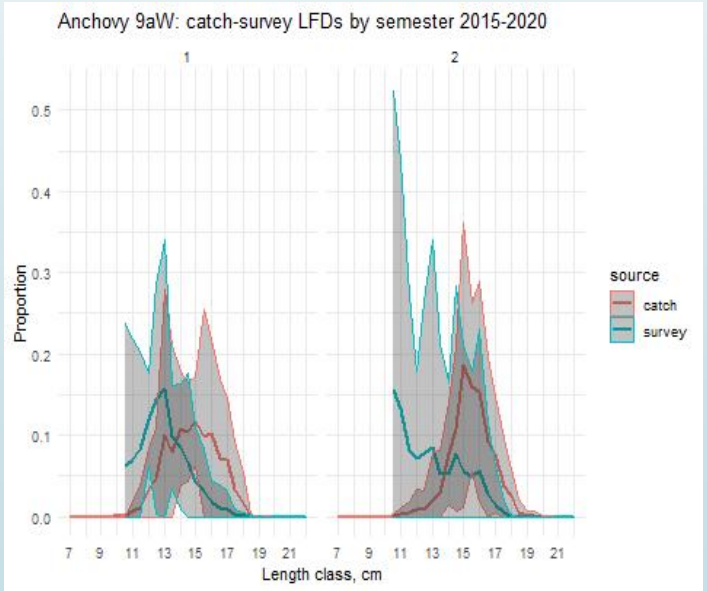




Indices of biomass

- SURVEYS
  - total biomass, PELACUS+PELAGO 1999 – 2021
  - mean biomass/hour, autumn groundfish 1991 – 2018
  - groundfish survey in year *y* correlated with acoustic survey year *y+1* (r = 0.91, p<0.001)
  - indices corrected to reflect biomass of individuals > 10 cm total length
  - standard deviation of groundfish surveys used as weighting factor
  - Indices and SD factors standardized to mean 1





- Models start in the middle of the calendar year (July 1st)
- Assessment years go from 1 July of year *y* to 30 June of year *y+1*.

Year	Time of catch observations					Time of survey observations	
	Quarterly data			Biannual data		Acoustic survey (spring)	Groundfish survey (autumn)
1991	1	1990.50	1	1990.5		1990.75	1991.25
1991	2	1990.75					
1991	3	1991.00	2	1991.0			
1991	4	1991.25					
1992	1	1991.50	1	1991.5		1991.75	1992.25
1992	2	1991.75					
1992	3	1992.00	2	1992.0			
1992	4	1992.25					
...	...	...	...	...		...	...
2021	1	2020.50	1	2020.5		2020.75	
2021	2	2020.75					
2021	**3**	**2021.00**	**2**	**2021.0**			
2021	**4**	**2021.25**					
2022	**1**	**2021.50**	**1**	**2021.5**			
2022	**2**	**2022.00**					

Modelling

Catch aggregation		Indices of biomass		n prior		B_1/K prior		r prior
Quarter	X	1 = acoustic spring	X	n.none	X	BKnone	X	r prior
		2 = acoustic +		Default				
Semester		groundfish		Schaefer		BK20		r.none
				Fox		BK50		r.Thorson
				n.Thorson		BK80		

- 4 data sets, 40 models fitted to each data set
- Influence of default priors on alfa and beta tested a-posteriori for one “good” model
- CHECKLIST
  - Convergence (initial values, parameter CI)
  - Goodness-of-fit (residuals)
  - Consistency (Mohn’s Rho between -0.22 and 0.30)
  - Survey prediction skill (MASE < 1,as low as possible)

RESULTS

- Seven models converged, showed well behaved residuals and acceptable retrospective behaviour (3 by quarter, 4 by semester)
- Two surveys improved fitting compared to one survey
- Informative priors were needed on, at least, two parameters
- The magnitude of B/B_{MSY} or F/F_{MSY} confidence intervals was higher than recommended
- Surveys showed poor predictive skill

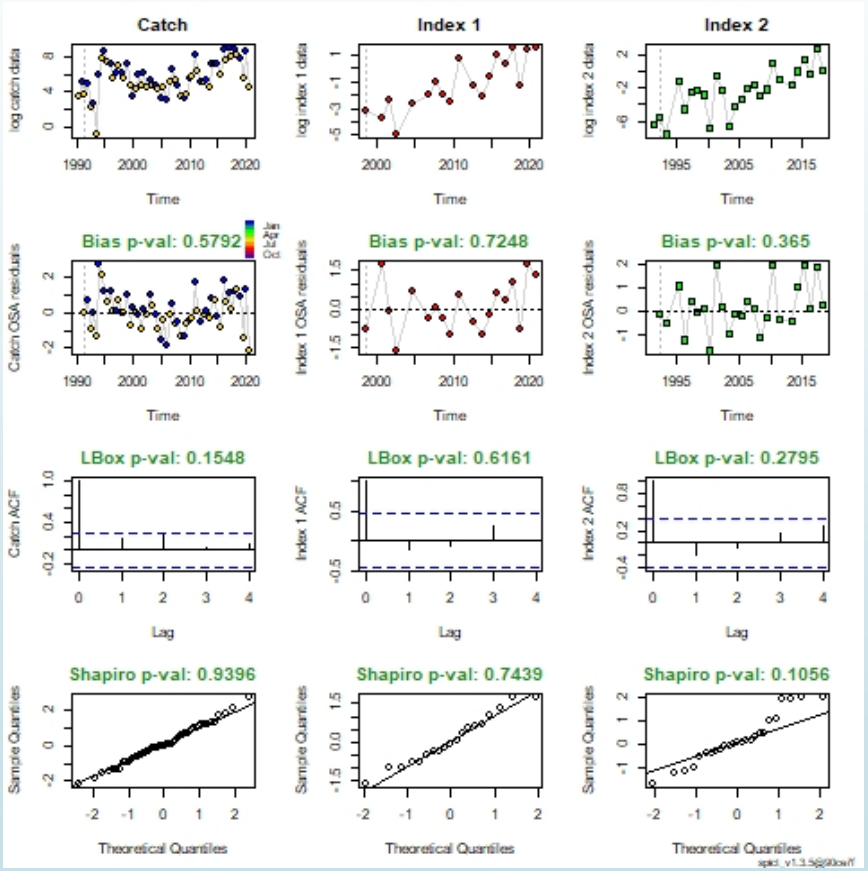
- Model 5 was considered a possible candidate:
  - Fox model, Thorson prior on r, prior of 20% on the initial biomass, default alpha and beta priors

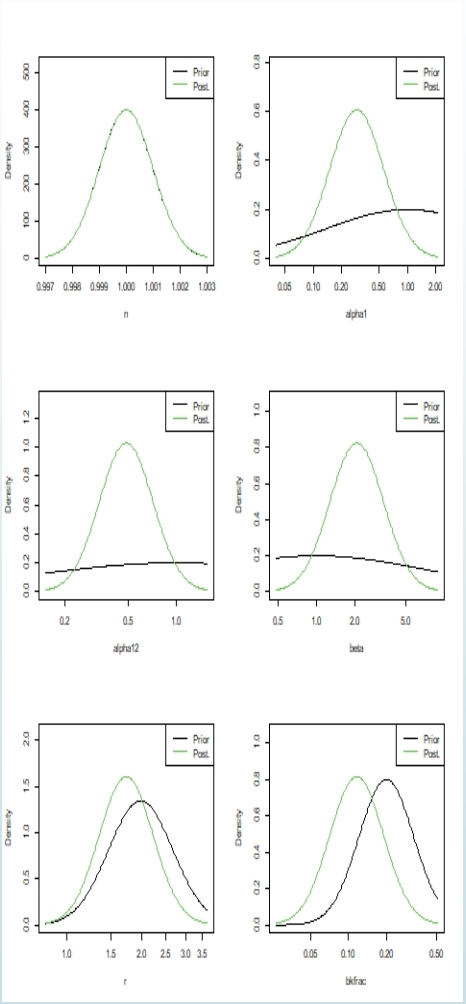
Model 5

Plots of residuals

Prior-posterior distributions

- Acceptable convergence and goodness of fit
- Data provides little information to estimate r and B_{1991}/K

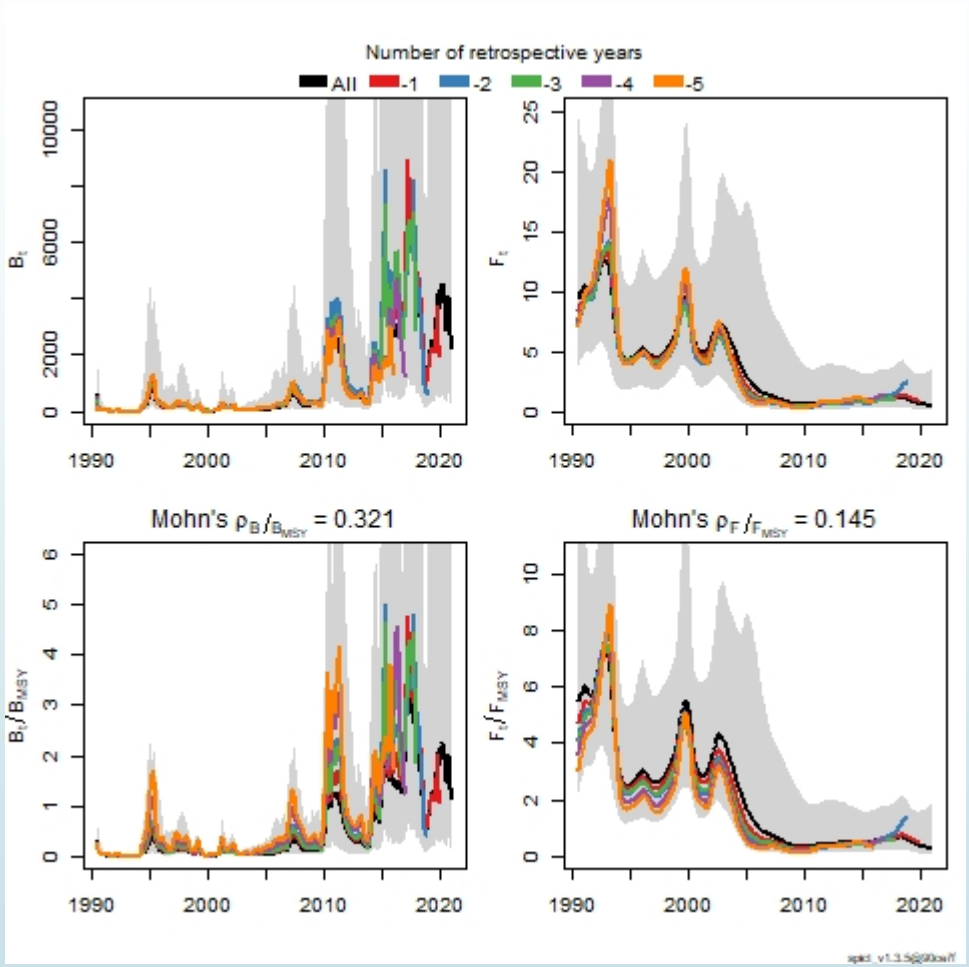




Model 5

Retrospective analysis 2016-2021

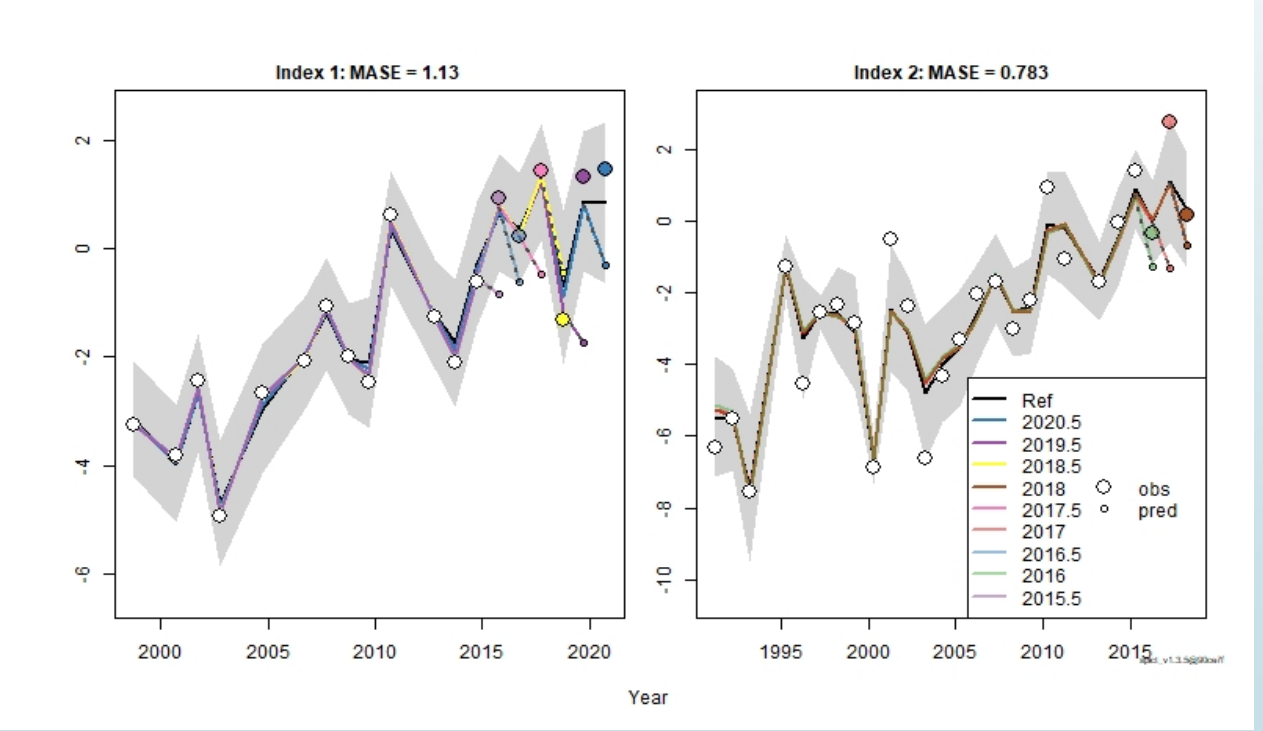
- Overestimation pattern of both B/BMSY and F/FMSY
- Stronger bias for B/BMSY, Mohn's Rho =0.32, slightly above the threshold of 0.30.
- Retrospective analysis of absolute biomass and fishing mortality look reasonable



Model 5

Hindcast cross-validation 2021-2016

- MASE close to 1 for both surveys
- groundfish survey with better prediction skill ? or just fewer number of years

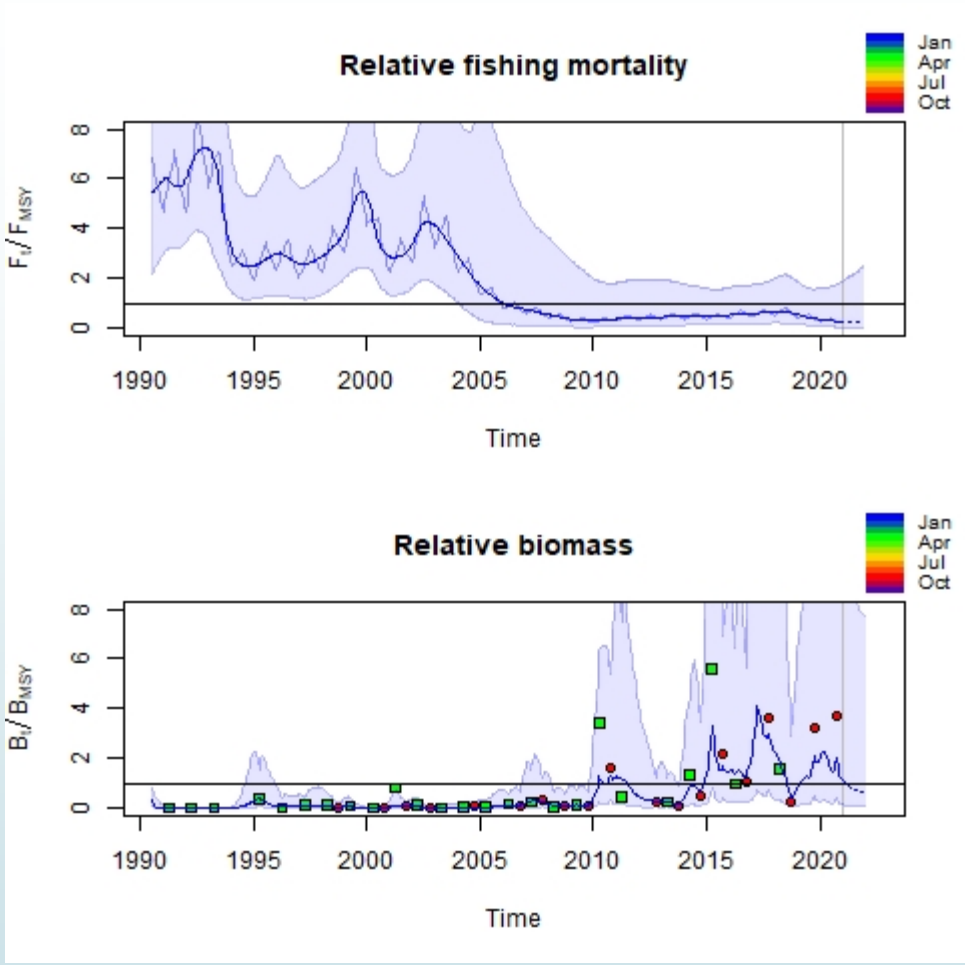


Model 5
Summary plots

- Until 2006, B/BMSY and F/FMSY well below/above one, respectively
- Since mid-2007:
  - B/BMSY fluctuated around 1 (mean=0.96, SD= 0.76)
  - F/FMSY fluctuated between 0.24 and 0.59 (mean=0.37, SD=0.10)
  - On the 1st of July 2021, the end of the assessment period:

F/FMSY = 0.21 (SD=1.10)

B/BMSY = 1.12 (SD=1.10)



Y-axis limits decreased ; 2017 point of groundfish survey not visible

Short-term management scenarios
(very preliminar results)

1. **currentCatch**: Keep the catch of the current year (i.e. the last estimated catch)
2. **currentF**: Keep the F of the current year (F_{2021}=0.21)
3. **Fmsy**: Fish at Fmsy i.e. F=Fmsy= 1.
4. **noF**: No fishing, reduce to 1% of current F.
5. **reduceF25**: Reduce F by 25%.
6. **increaseF25**: Increase F by 25%,
7. **msyHockeyStick**: Use ICES MSY hockey-stick advice rule: $B_{trigger}$ = 0.5, B_{lim}=0, F/F_{MSY}=1
8. **ices**: Use ICES MSY 35th hockey-stick advice rule: $B_{trigger}$ = 0.5, B_{lim}=0.3, F/F_{MSY}=1, $fractiles^{C,B,F}$=0.35

SPiCT timeline:

Observations 1990.50 - 2021.00 |----------| Management 2021.00 - 2022.00 |----------|

Management evaluation: 2022.00

	Scenarios	Catch, tonnes	B/Bmsy	F/Fmsy
1	Keep current catch	823.8	0.65	0.23
2	Keep current F	775.4	0.66	0.21
3	Fish at Fmsy	2304.8	0.29	1
4	No fishing	0.9	0.83	0
7	MSY hockey-stick rule	2304.8	0.29	1
8	ICES advice rule	701.2	0.68	0.19

$F_{2021}/F_{MSY} = 0.21$
$B_{2021}/B_{MSY} = 1.21$

Catch 2020: 5462 tonnes

Points for discussion

- Surveys are not truly representative of exploitable biomass; the sensitivity to cutting at a higher length may be examined
- Reasonable to assume PELACUS surveys 1999 - 2005 as zero or a very small value;
- What to use as survey errors ?: CVs of groundfish surveys ?
- Model 5 showed the best overall performance although:
  - relative biomass and fishing mortality showed wide confidence intervals
  - B/BMSY had a borderline retrospective pattern, characterized by a tendency to overestimate biomass
  - Surveys showed poor predictive skill
  - F/FMSY was estimated to be slightly above the historical harvest rate level calculated in the ICES assessment

Thank you very much