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

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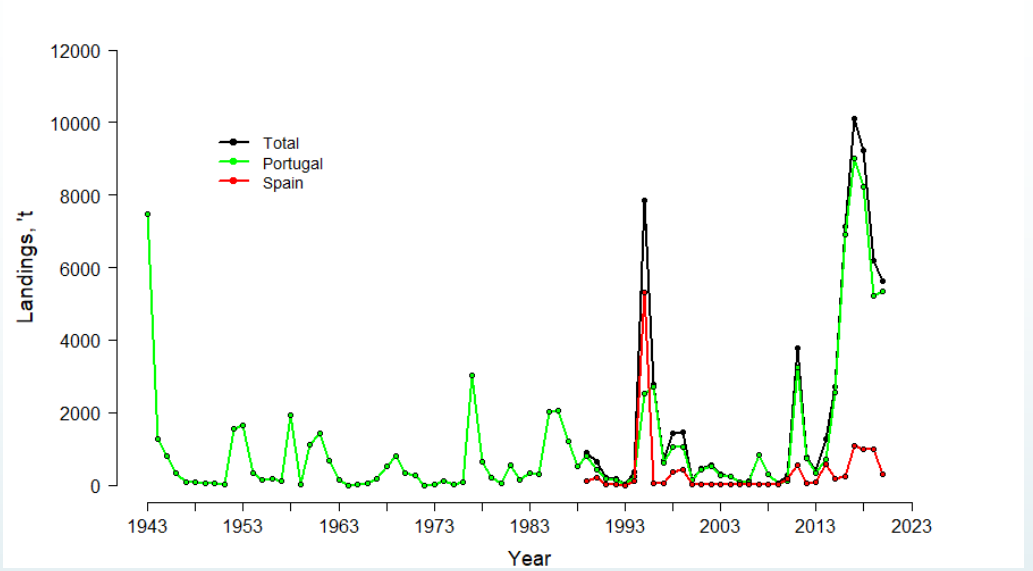
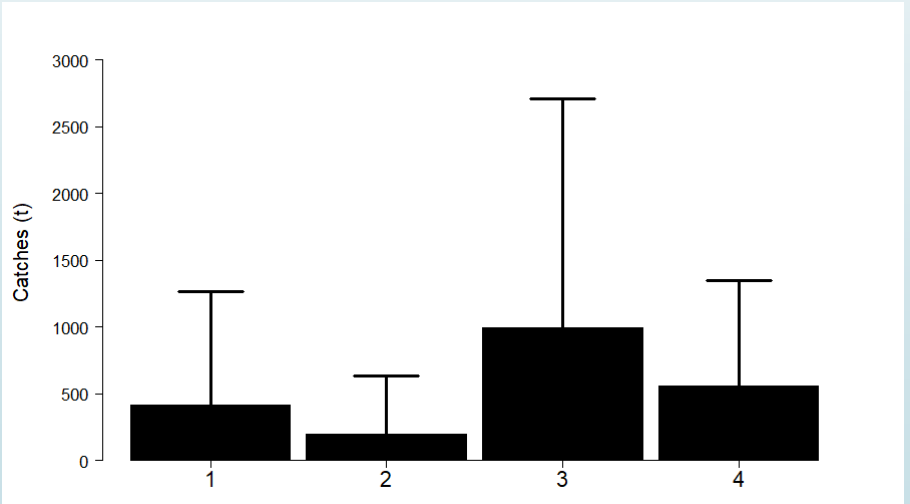
Objective

- Explore surplus production models using SPiCT to assess the anchovy 9a.west component
- several combinations of catch data and survey indices
  - Catches by quarter/semester
  - 1 survey (spring acoustic)/2 surveys (spring acoustic+autumn groundsfish)
- Several assumptions (priors): from simple to complex models
  - Shape of the production curve (n)
  - Initial depletion (B_1/K)
  - Intrinsic growth of the population (r)
  - Ratio of observation to process error (alpha, beta)

Data

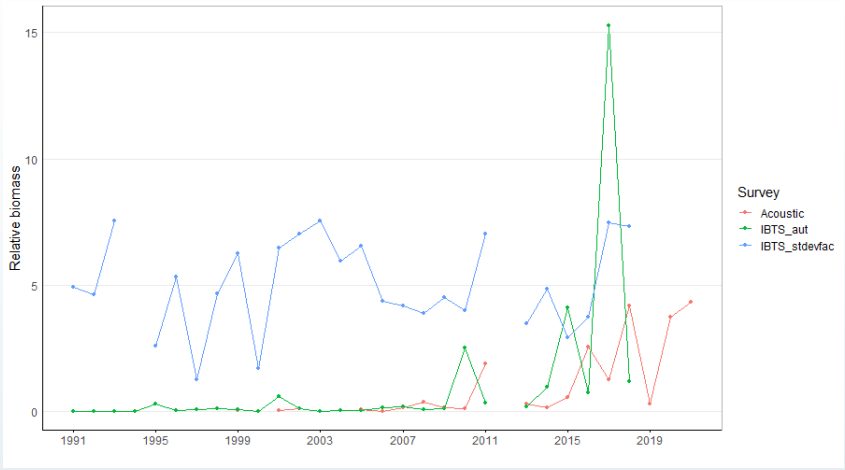
- CATCHES
  - DATA: catch biomass, t, per quarter or semester from the beginning of the first quarter of 1991 to the end of the second quarter of 2021
  - No signs of intense exploitation in the past
  - strong seasonal component; 67% of the catches in the second semester

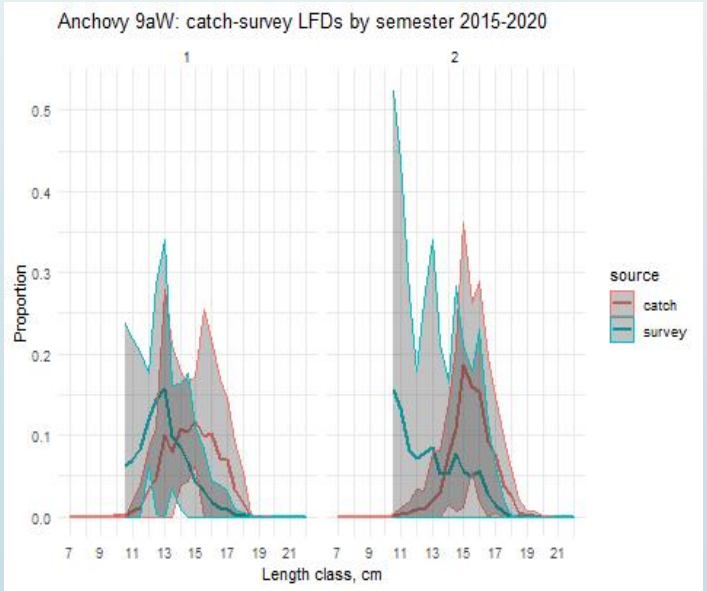




Indices of biomass

- 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 reflect biomass of individuals > 10 cm total length
  - standard deviation of groundfish surveys as weighting factors
  - 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)
  - Prediction skill (MASE < 1,as low as possible)

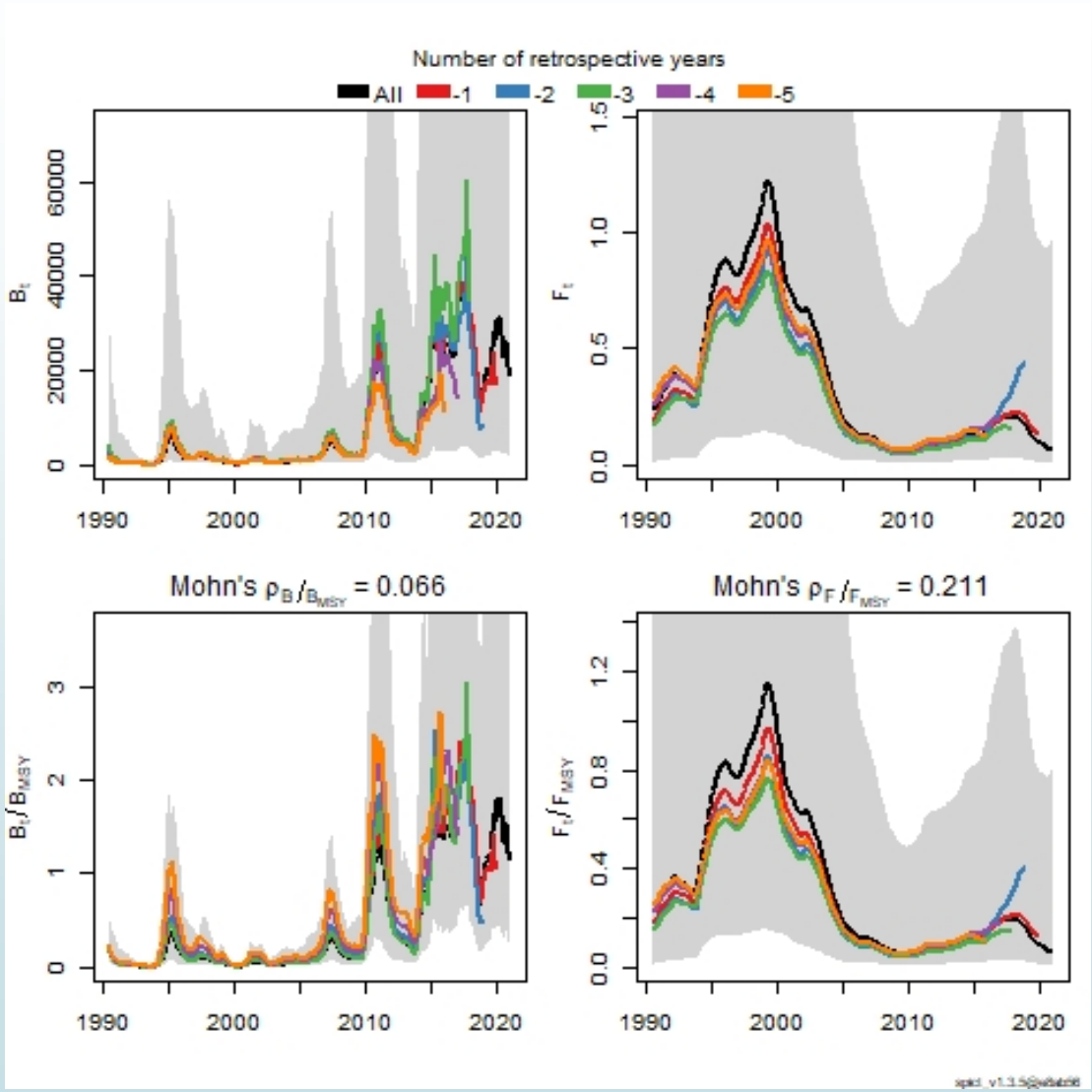
RESULTS

- Few models converged using quarterly catches and/or a single biomass index
- At least one parameter with an informative prior was needed
- Most models did not reach perfect convergence (MSY was NA)
- F/FMSY confidence limits wider than recommended for long-lived stocks
- Several possible candidate models
- Model 12: Schaefer, Thorson prior on r, prior on B1/K with slightly better retrospective, hindcast and convergence performance than other candidates

Model 12

Retrospective analysis 2016-2021

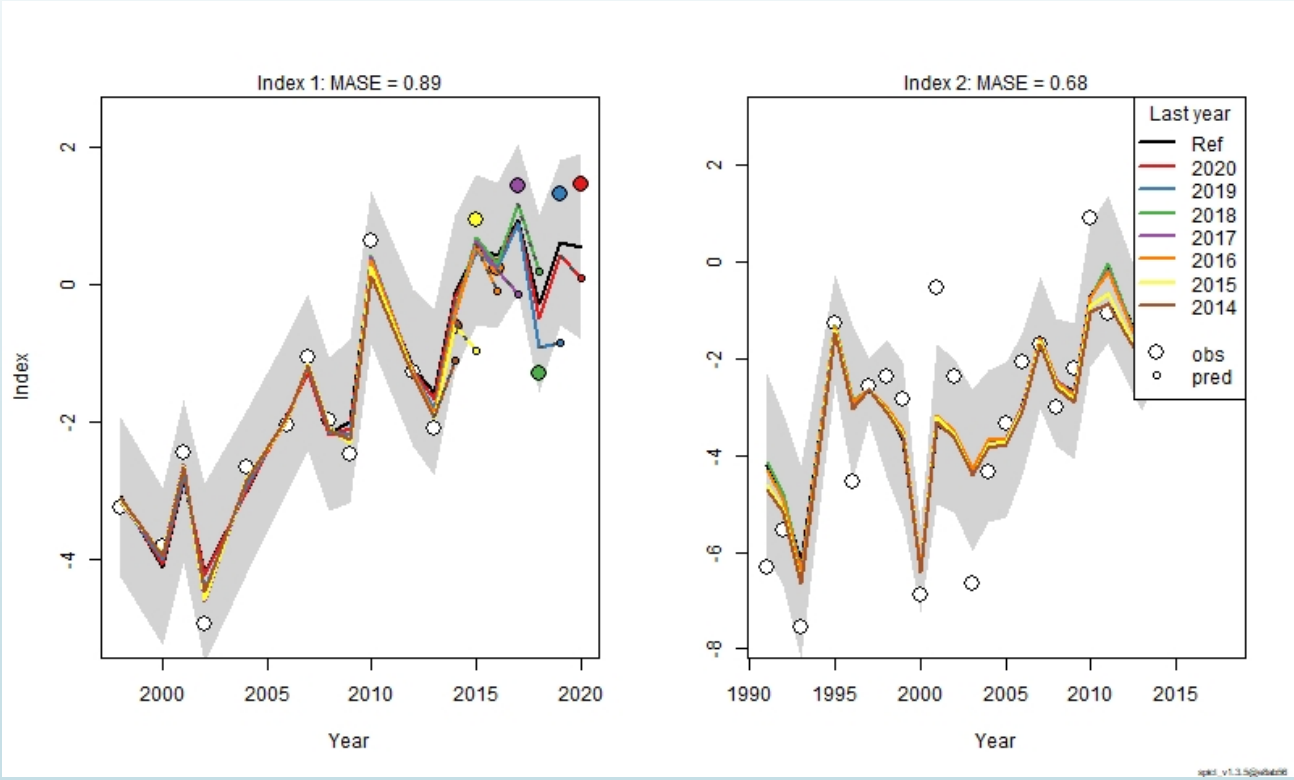
- Overestimation pattern for both B/BMSY and F/FMSY
- Stronger bias for F/FMSY, Mohn's Rho still below threshold of 0.30.
- Retro-2 stands out; last survey points are acoustic 2019 and groundfish 2018
- Retrospective analysis of absolute biomass and fishing mortality look reasonable



Model 12

Hindcast cross-validation 2021-2014

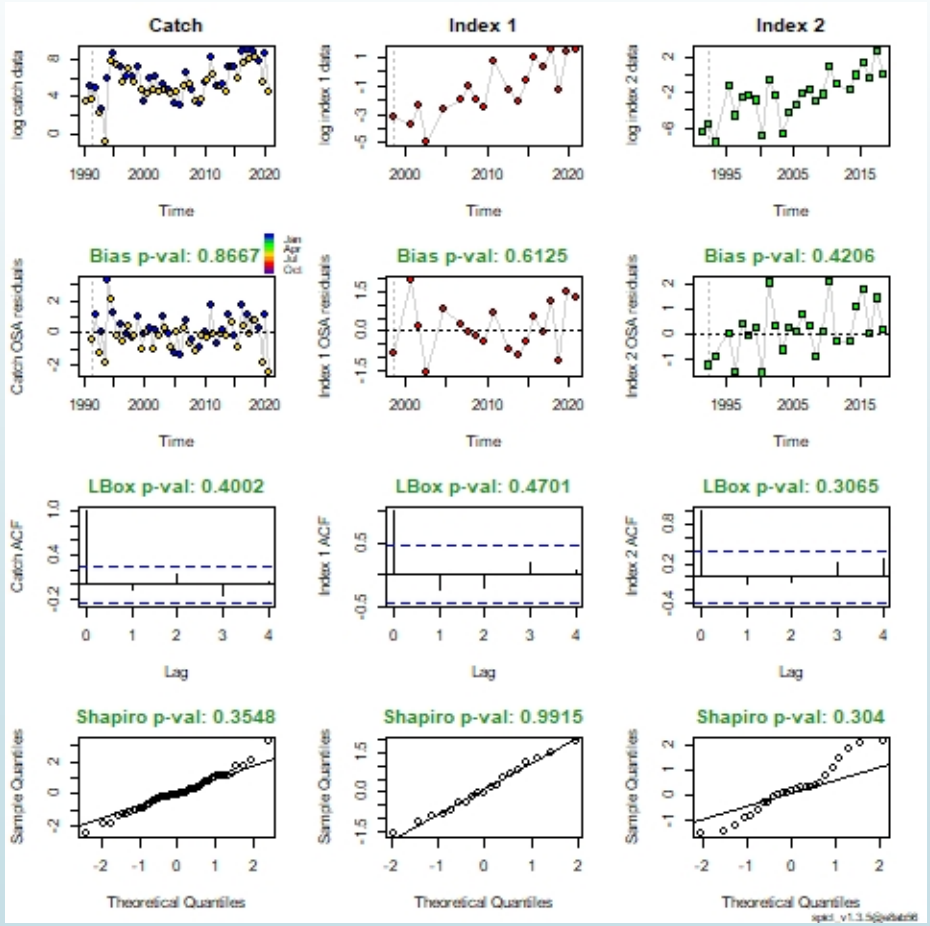
- MASE scores <1 for both surveys
- groundfish survey with better prediction skill ? or just fewer number of years

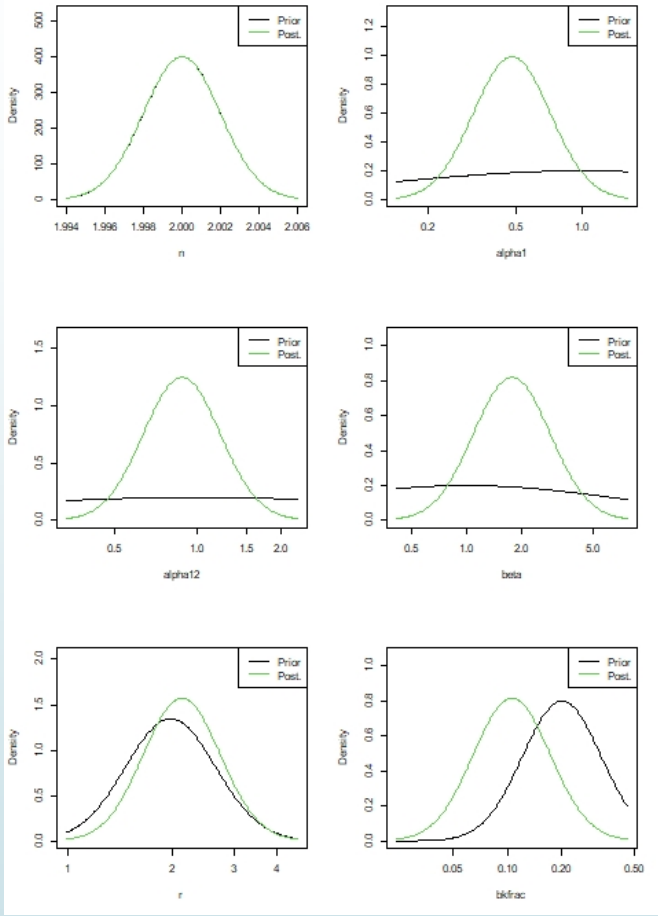


Model 12

Plots of residuals

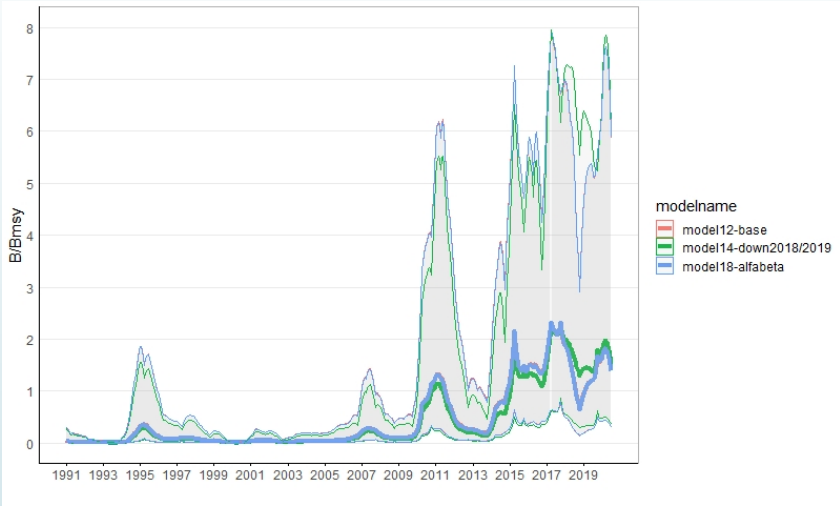
Prior-posterior distributions





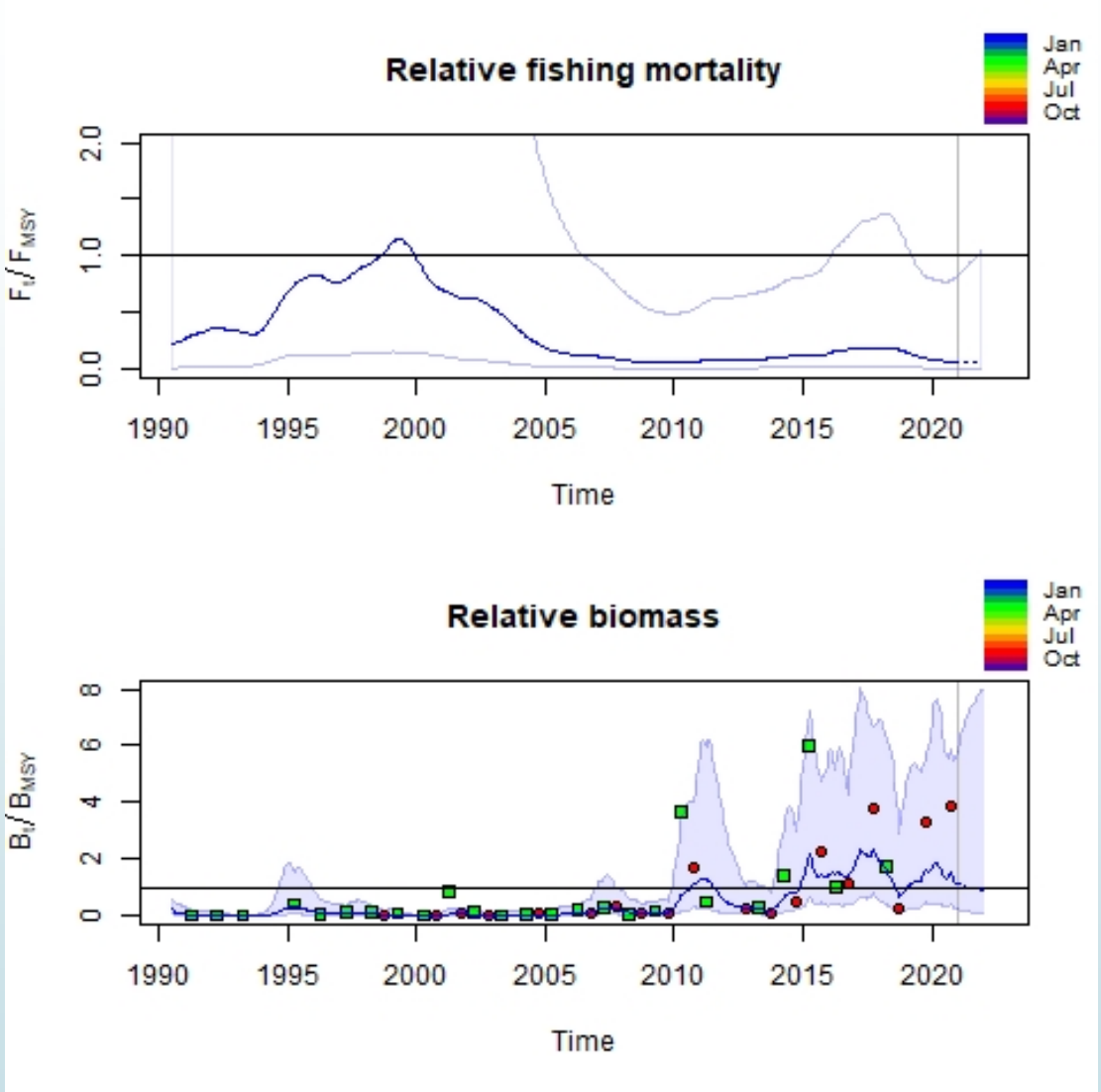
Model 12
Sensitivity analyses

- Down-weight acoustic 2019 and groundfish 2018: divergence of the second peel of the retrospective analysis decreased substantially (Mohn's Rho increased ?!)
- Effect of estimating alpha and beta: decrease of 30% on F/FMSY Mohn's Rho
- Identical summary plots



Model 12
Summary plots

- F/FMSY and B/BMSY very uncertain
- Gaps in acoustic survey and noisy exploitation rates may help to explain wide F/FMSY CI up to ~2010
- F/FMSY varied from 0.05 to 0.19 (mean=0.11,sd=0.04) from 2008 to 2021
- B/BMSY well below 1 up to ~2010 and mostly above 1 since 2015
- B/BMSY varied from 0.10 to 2.1 (mean=0.89, sd=0.62) from 2008 to 2021

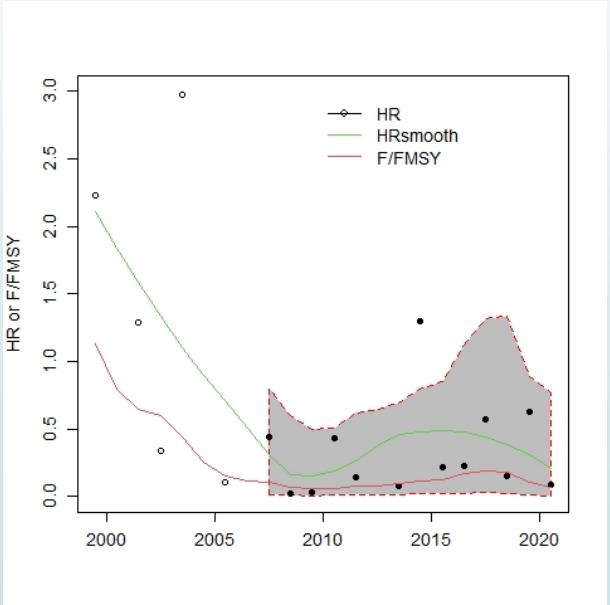


Y-axis limits decreased; 2017 point of groundfish survey not visible

Points for discussion

- Surveys are not truly representative of exploitable biomass
- Autumn groundfish survey: use, at all ?
- PELACUS surveys 1999 - 2005: can we assume estimates are zero ? Influence on F/FMSY in the earlier part of the assessment
- What to use as survey errors ?: CVs of groundfish surveys ?
- Downweight groundfish 2018-acoustic 2019 data points ? What about 2017 groundfish survey? If yes, how much?
- Absolute stochastic reference points not estimated by most models
- The seasonal F parameter was fixed =1 in bi-annual models (needs to be corrected)
- F/FMSY is estimated to be at the level of the lowest HR, well below the average of the historical series; in June 2021 F/FMSY=0.06 (model 12)

Spanish Surveys
Spanish acoustic surveys aimed at sardine have been conducted in Sub-division IXa North and Division VIIIc since 1983. Results from these surveys for the Sub-division IXa North have shown the scarce presence or even the absence of anchovy in this area (Carrera *et al*., 1999; Carrera, 1999, 2001). This situation still continues in the most recent years (surveys in the 2003-2007 period, see Porteiro *et al*., 2005; WD Iglesias *et al*., 2007). **Page 598.**



Thank you very much