

Biological Reference points for Southern Horse Mackerel (IXa)



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2015 assessment and ICES advice

Fishing mortality: below F_{MSY} (0.11)

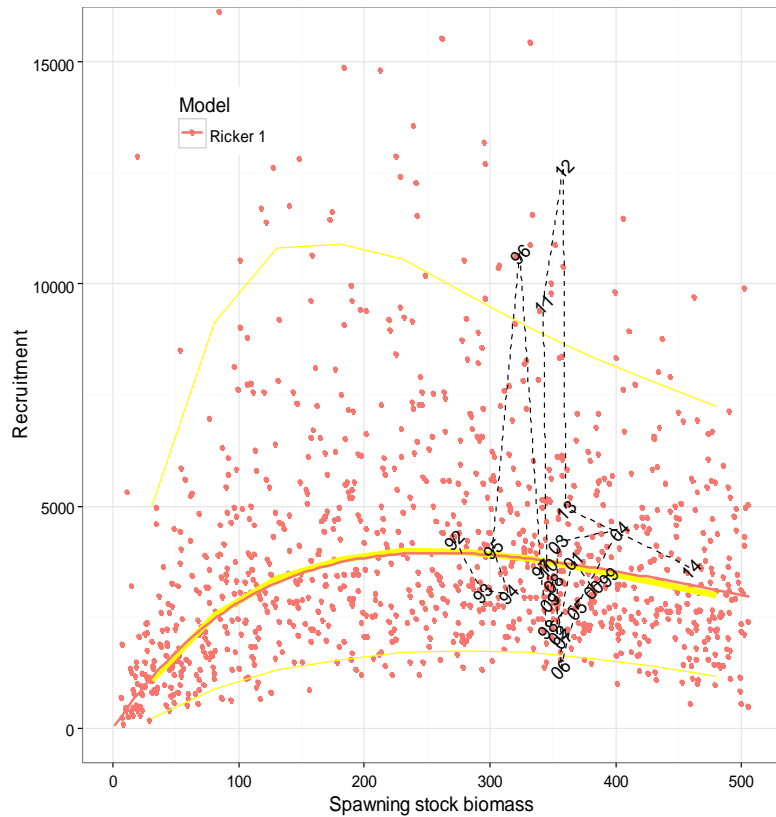
Spawning Stock Biomass: stable with recent increase

Recruitment: strong YC in 1996, 2011 & 2012

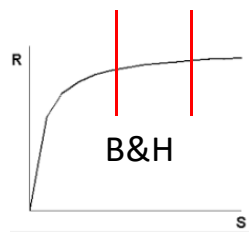
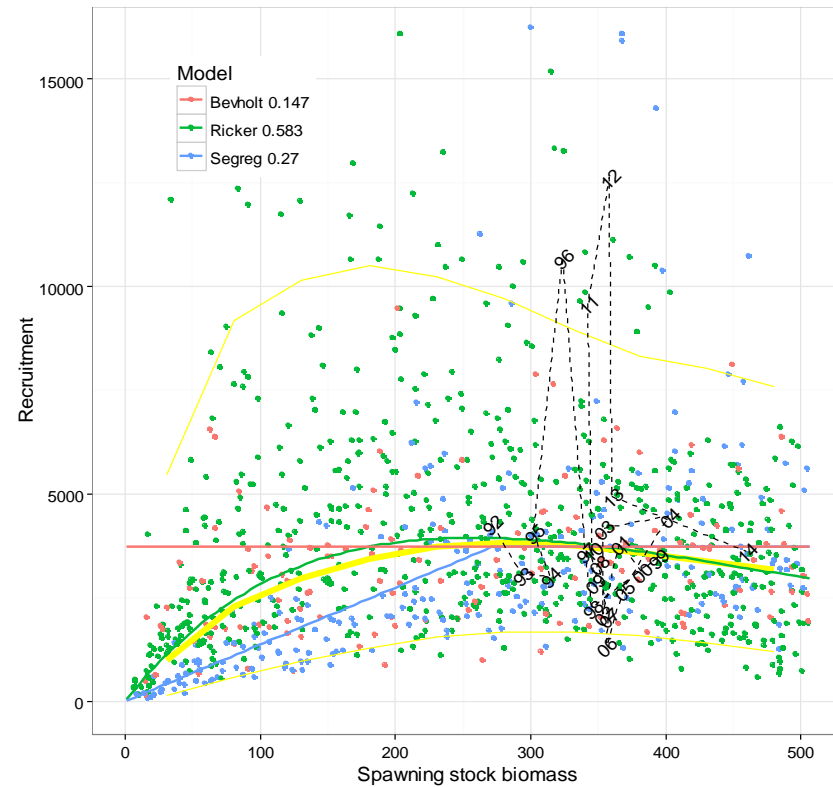


Ongoing analysis SR model

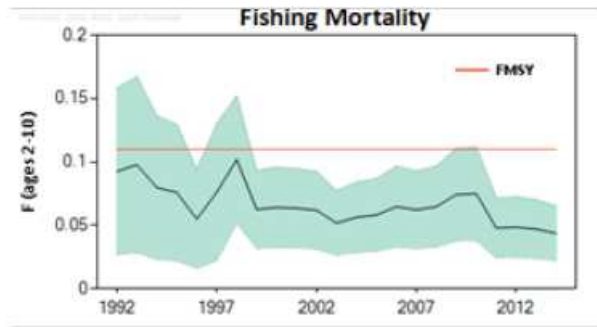
Ricker (density-dependence)



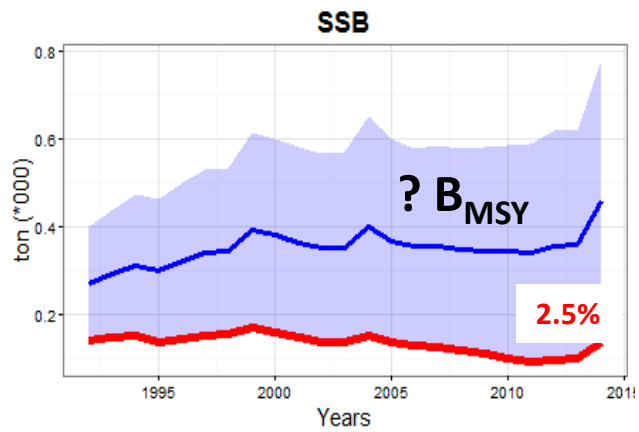
Weighting 3 models (Buckland)



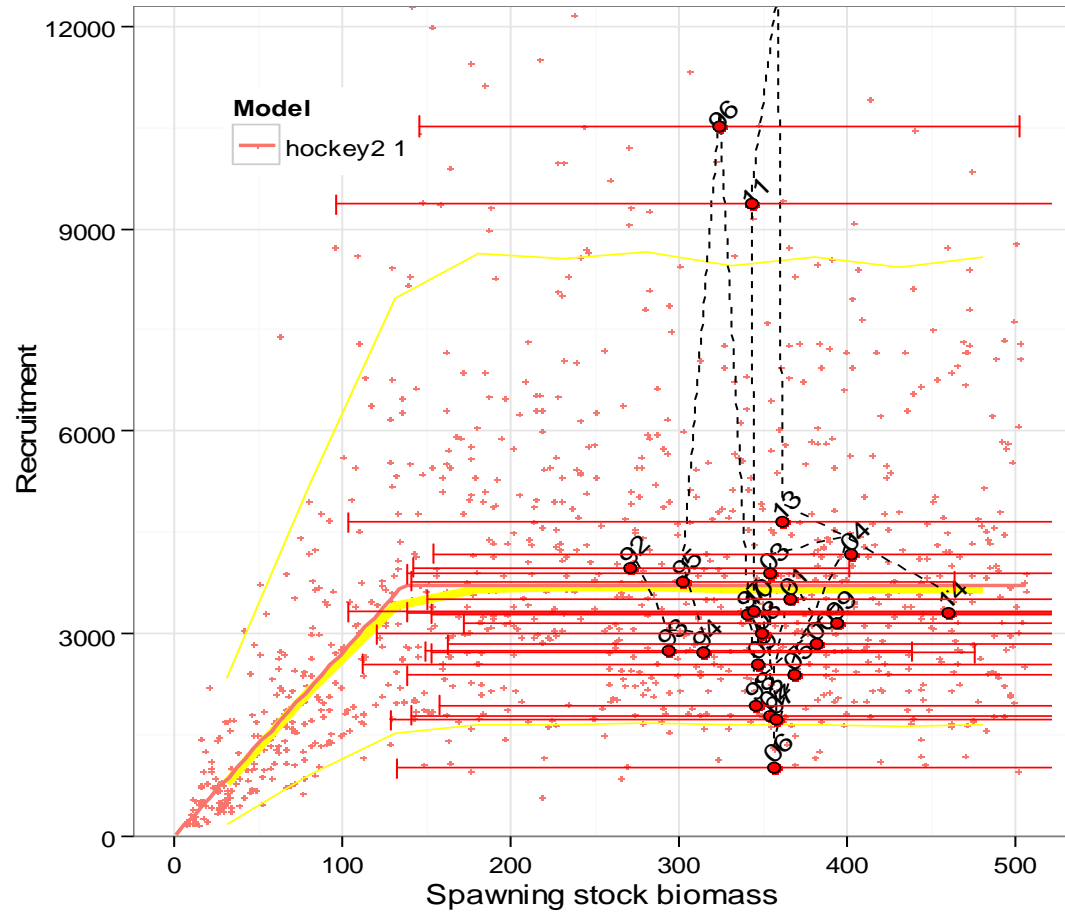
weights:
 58% Ricker;
 27% Hockey (without forced breakpoint);
 15% Beverton-Holt (B&H)



observations of SSB associated with fishing below F_{MSY}



Hockey-stick (SSB 1992-2014 with 95%CI)



Breakpoint at **136 th t** (mean lower 95%CI of SSB)

BRPs – results and discussion

Model	F_{MSY}	B_{MSY}	MSY	MSY $B_{trigger}$	B_{lim}
('000 t)					
Hockey	0.17	174	42	136	97
Ricker	0.15	205	41	148*	105
Buckland	0.16	178	37	127*	90

YPR ($F_{35\%SPR}$, ICES 2012)	0.11	262^d	38^d	136	97
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d: deterministic (assuming geomean $R_{1992-2013}$)

MSY $B_{trigger}$ = mean lower 95%CI of $SSB_{1992-2014}$

***MSY $B_{trigger}$** = SSB at F_{upper} (0.18-0.19)

B_{lim} = $MSY B_{trigger}/1.4$

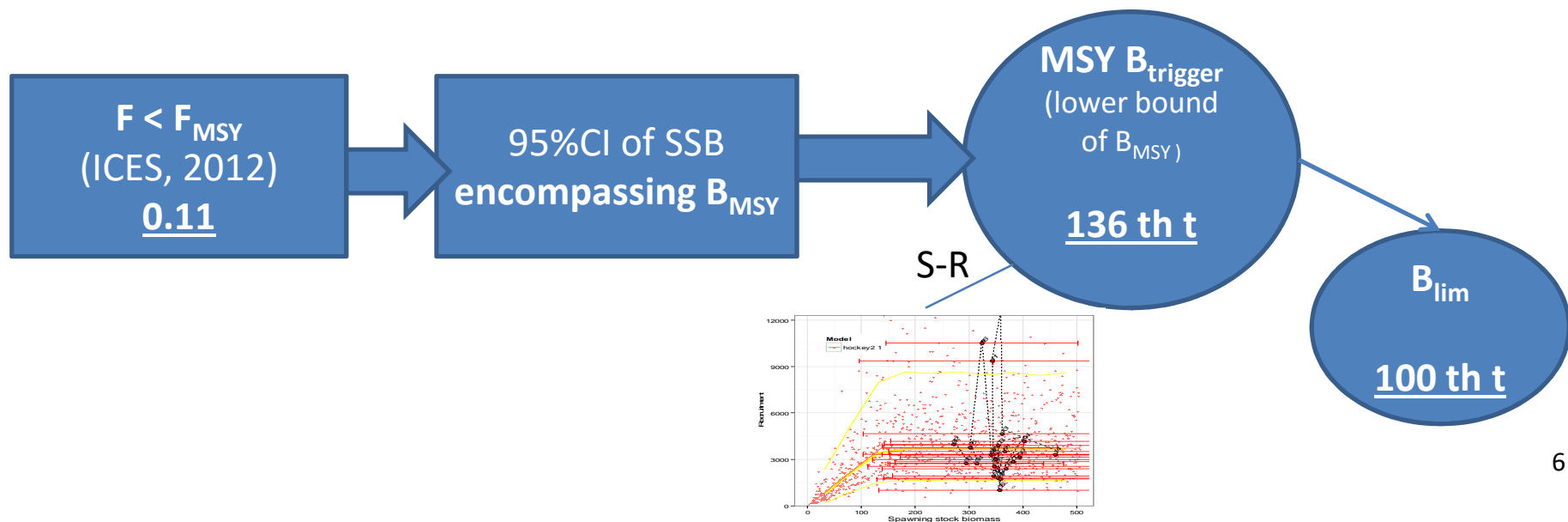
F_{MSY} : 0.15-0.17

B_{MSY} : 174-205 th t

Yield: 37-42 th t

✓ Ricker S-R assumes density-dependence effects but there is no evidence on horse mackerel (ontogenetic movement patterns ----> no competition for food & no cannibalism)

✓ Weighted S-R model has dominance of Ricker model (58%), breakpoint of the Hockey-stick model (27%) at 311 th t which is inside B_{MSY} range and a poor fit of the B&H model (15%).



Long-term simulations

	Scenario	F_{target}	F	SSB (p2.5%-p97.5%)	Y (p2.5%-p97.5%)
F reduced when SSB < MSY B_{trigger}	NO	MSY	0.17	174 (72-297)	42 (16-85)
		MSY (ICES)	0.11	272 (183-436)	38 (20-74)
	YES	MSY	0.18	164 (108-279)	43 (20-86)
		MSY (ICES)	0.11	272 (183-436)	38 (20-74)

(`000 t)

at $F_{\text{MSY}}=0.11$

- ✓ SSB is always > MSY B_{trigger} (136 th t)
- ✓ SSB is higher
- ✓ Yield is slightly lower

BRPs for southern horse mackerel: $F_{\text{MSY}}=0.11$, MSY $B_{\text{trigger}}=136$ th t, $B_{\text{lim}}=100$ th t
are consistent with the objectives of CFP

Accept for testing HCRs under a management plan ?

Thank you!



Comments and questions ?

Some concepts and definitions

MSY $B_{trigger}$: lowest boundary associated with B_{MSY}

B_{lim} : SSB associated with recruitment impairment

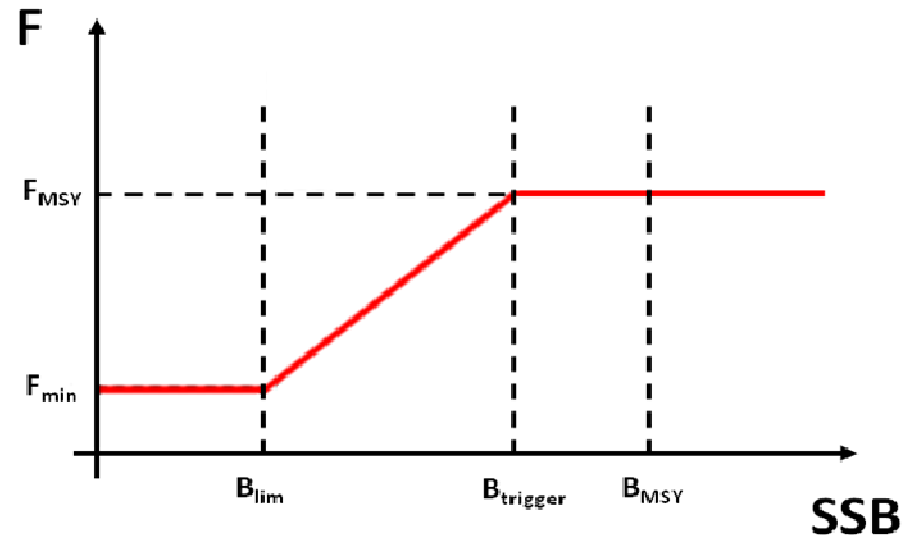
Flower & Fupper (ICES, 2015): the range of fishing mortalities corresponding to no more than 5% reduction in long-term yield compared with F_{MSY}

&

Fp.5: F corresponding to a probability $\leq 5\%$ of SSB falling below B_{lim} in a year in long-term simulations with fixed F

HCR (PELAC, Focus group meeting, Nov 2014; ADAPI Jan 2015)

F_{min} – F for by-catch



LT simulations

Model and data selection settings

✓ **Eqsim** (*stochastic equilibrium reference point software*) provides MSY reference points based on stochastic projections using:

- historical variation in stock
- recruitment resampling from the predictive distribution of the S-R model

Data and parameters	Settings	Comments
SSB-recruitment data	1992-2014	Full time series
Exploitation pattern, Mean weights-at-age	2004-2014	10yr window to reflect the current regime but also to include some variability in productivity parameters
Natural Mortality and Maturity	As defined in last Benchmark 2011	$M_{(\text{age } 0-8+)} = (0.9, 0.6, 0.4, 0.3, 0.2, 0.15, 0.15, 0.15)$ $\text{Mat}_{(\text{age } 0-8+)} = (0, 0, 0.36, 0.82, 0.95, 0.97, 0.99, 1)$

✓ The **simulated populations** were scanned:

- over 50 values of F (0.0-0.5) from 200 populations samples of S-R model → 10000 populations
- forward 200yr and the last 50yr are retained to compute the BRPs
- F_{MSY} ranges were defined as the exploitation rate giving at least 95% of the maximum yield

southern horse mackerel



- **Pelagic** and living inshore when young, more **demersal** and living offshore as it grows.
- Starts spawning at **2 years old** (~ 21 cm total length); spawning season from September-June; multiple spawner.
- Feeds mainly on crustaceans, small fish and cephalopods - diet variations with fish length and water depth; consumed by several demersal, benthic and pelagic predators.
- Caught in mixed fisheries; six fleets (PT & SP): **trawl, purse-seine, artisanal**.
- **Recruitment** with occasional strong year-classes.
- **Age-based assessment** . Negligible discards; commercial catches fairly accurate, 1 survey index (combined PT&SP); stock benchmarked in 2011.