Preliminary SS3 Results for Splendid Alfonsino

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1. Background and Rationale

Splendid alfonsino (*Beryx splendens*) presents several challenges for classical stock-assessment approaches due to its deep-water habitat, patchy distribution, and limited age-structured information. However, multiple independent data sources are available for this stock, including:

- Total catch time series
- Nominal CPUE indices from trawl and gillnet fleets
- Length composition data from both gears
- Biological information (growth, maturity, natural mortality) drawn from past studies and empirical relationships

Because these components align with the data requirements of an integrated length- and age-structured model, we explored whether Stock Synthesis (SS3**)** could be used as a unifying framework to synthesize all information and produce a coherent stock assessment.

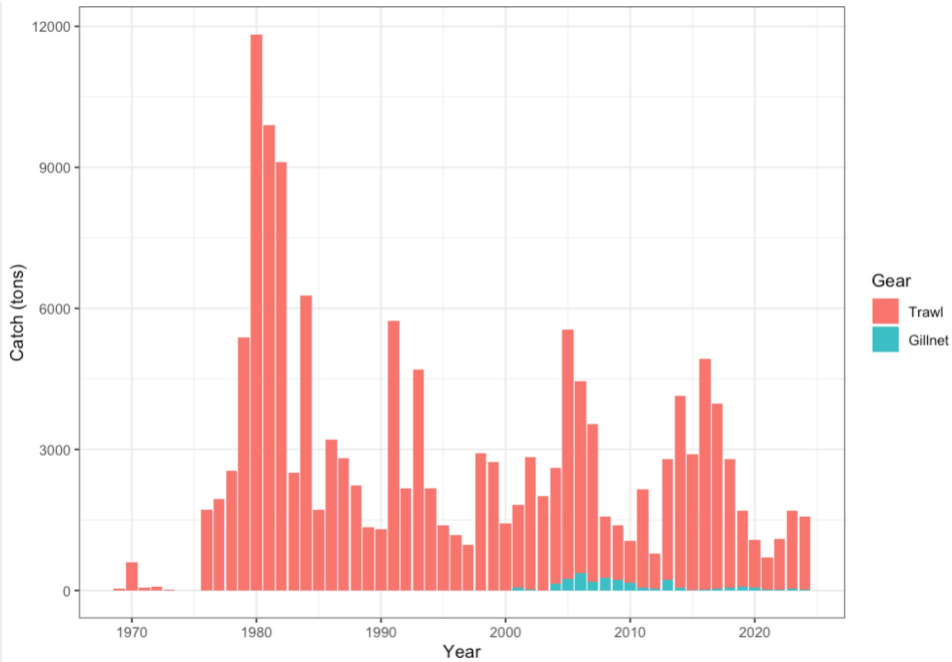
This working paper documents **the first exploratory ('preliminary') SS3 runs**, aimed at identifying:

- Whether the model can achieve stable convergence
- Which biological or data assumptions drive sensitivity
- The internal consistency across available data sources
- The magnitude and direction of potential stock signals
- Issues that must be resolved before a full assessment can be attempted

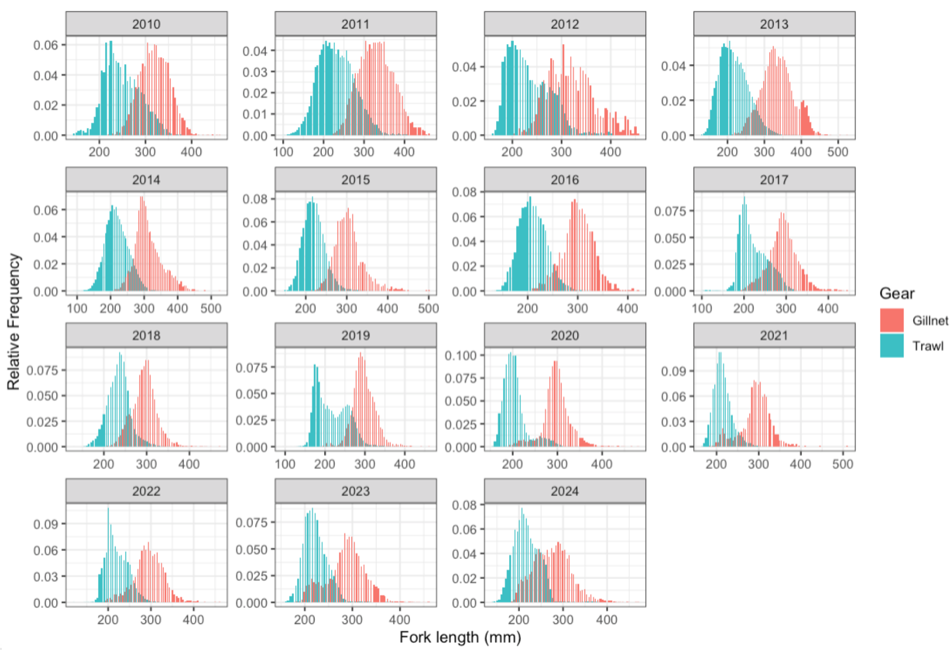
These results **should not be interpreted as a final assessment**, but rather as a diagnostic phase needed to prepare a defensible, fully tuned SS3 model.

2. Data

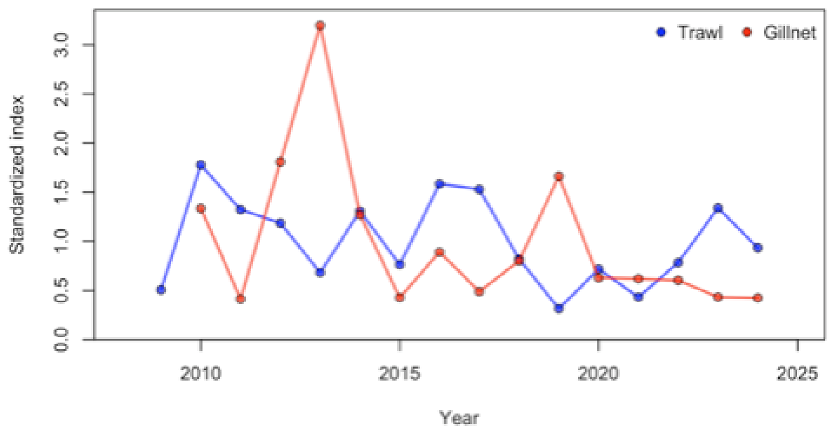
1- Catch timeseries



2- Length composition data



3- Index of abundance (Nominal)



3. Biological parameters

Natural mortality

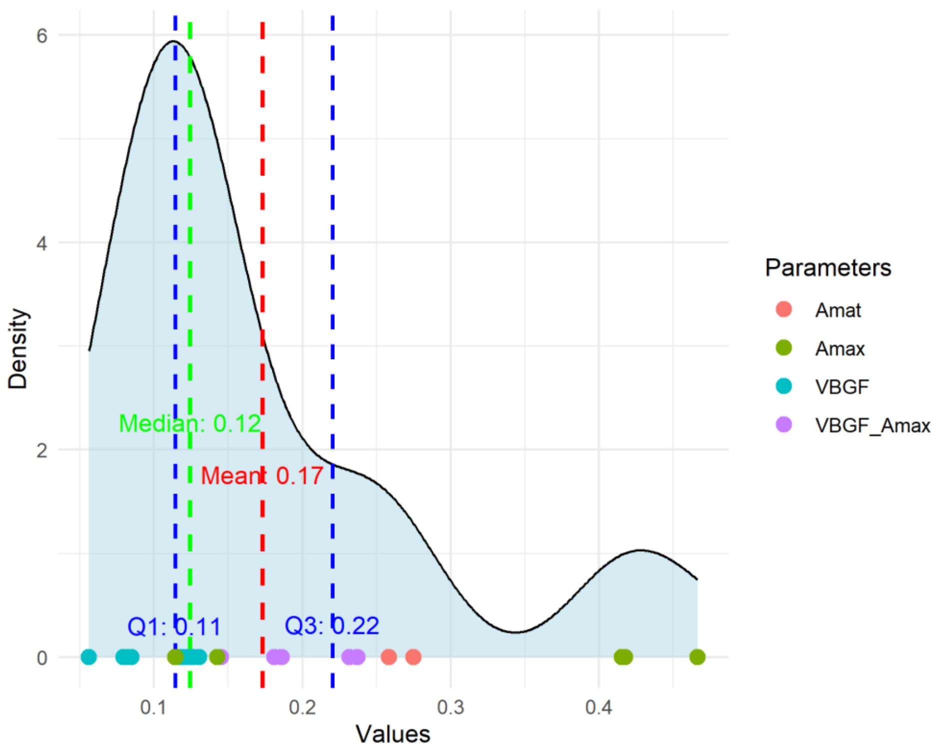
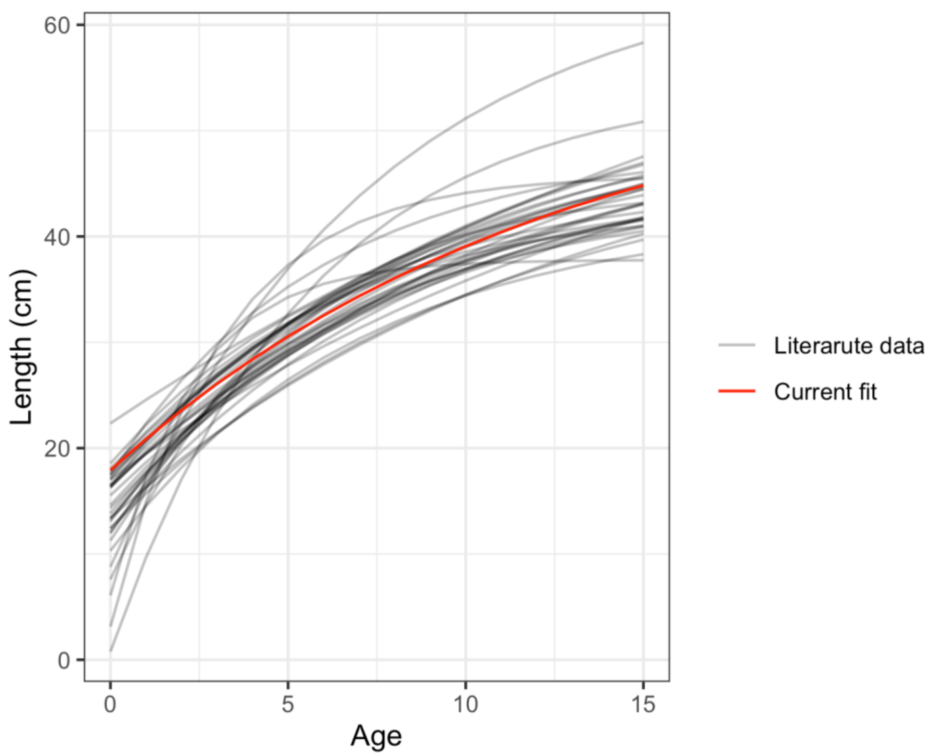


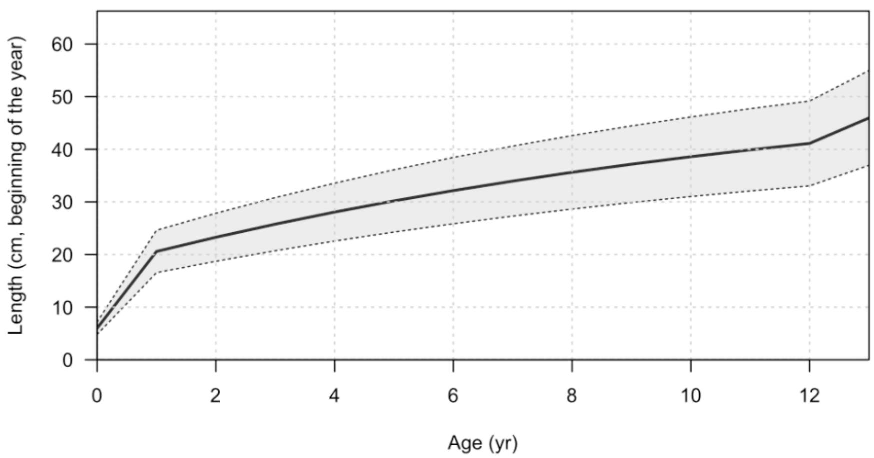
Table 2. Calculation result of M

Estimator	M
1. $M=4.889t_{max}^{-0.916}$	0.46745
2. $M = 4.118K^{-0.73}L_{\infty}^{-0.33}$	0.161961
3 $M=\frac{2.5}{t_{max}}$	0.192308

Somatic Growth



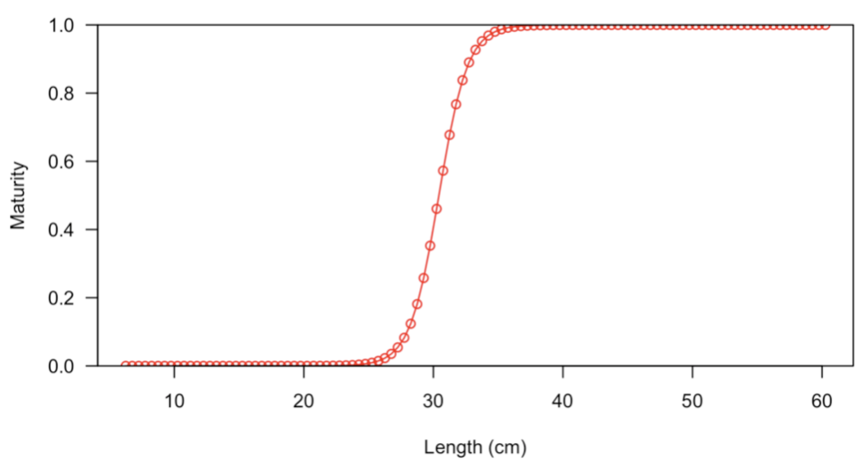
$L\infty$	556.62	Base
k	0.08	Base
t_0	-4.77	Base

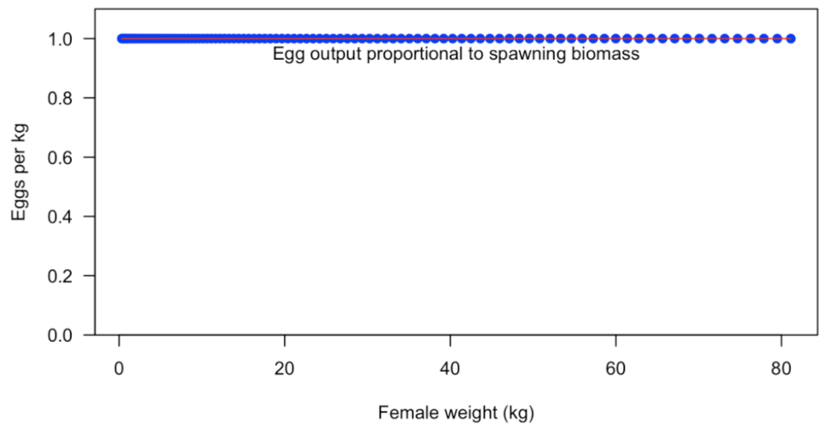


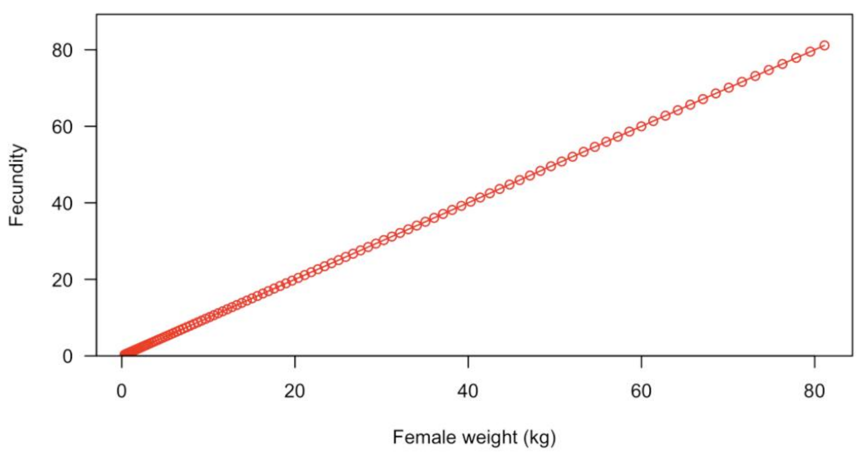
For the SS3 parametrization

- Cumulative age class = 13
- We can set the age a given Age. We used age 1. Before that, growth is assumed to be linear
- This will prove not to be a trivial decision

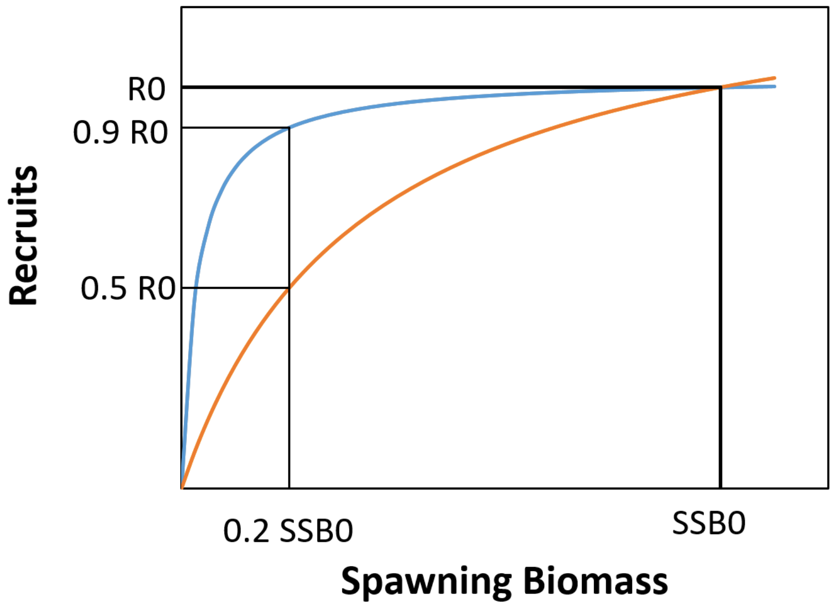
Maturity at length




Egg output proportional to spawning biomass
Eggs per kg
1.0
0.8
0.6
0.4
0.2
0.0
0
20
40
60
80
Female weight (kg)


Fecundity
80
60
40
20
0
0
20
40
60
80
Female weight (kg)

Stock recruitment relationship



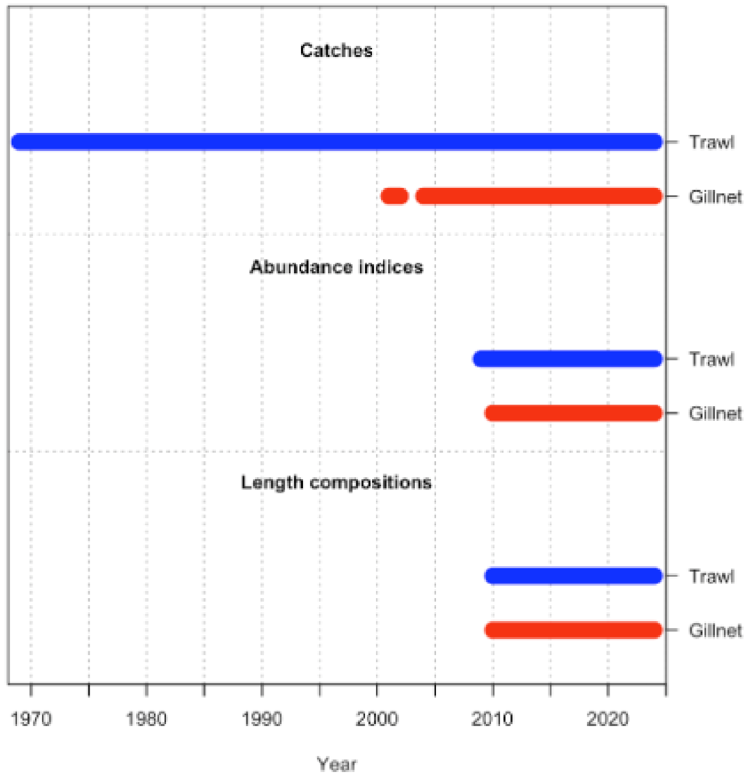
We used values consistent with other assessment (Brandão et al. 2020).

Table 3. Biological parameter values assumed for the Base case assessments conducted. Note that for simplicity, maturity is assumed to be knife-edged in age.

Parameter	West	East
Natural mortality M (yr^{-1})[1]	0.2	0.2
von Bertalanffy growth[2]		
ℓ_∞ (cm)	69.21	69.21
κ (yr^{-1})	0.05	0.05
t_0 (yr)	-6.12	-6.12
Weight (in gm) length (in cm) relationship[3]		
c	2.9×10^{-5}	2.9×10^{-5}
d	2.98	2.98
Age at maturity (yr) a_m[4]	6	6
Steepness parameter (h)	0.75	0.75

4. The SS3 model

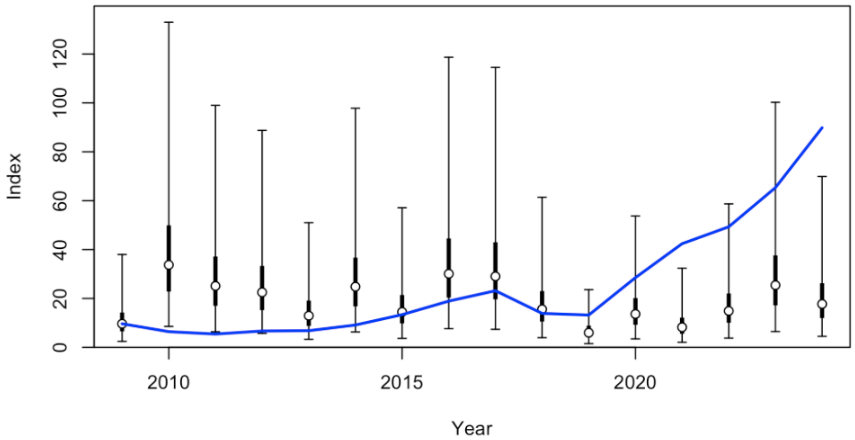
Data

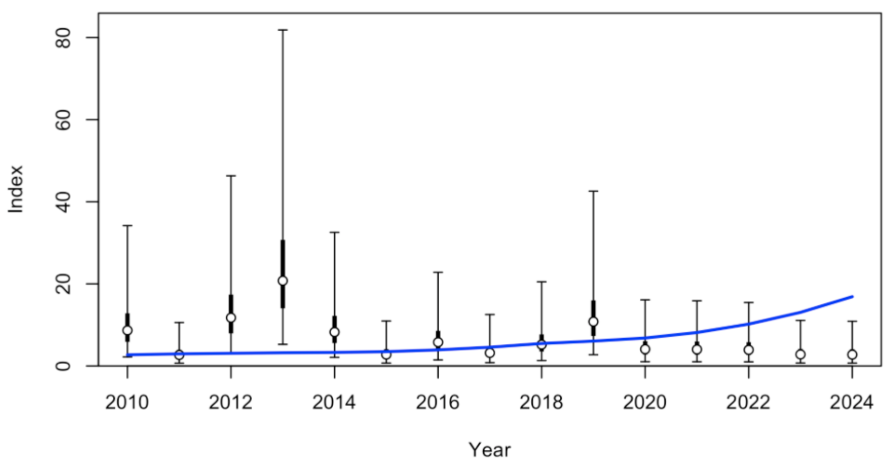


Estimates

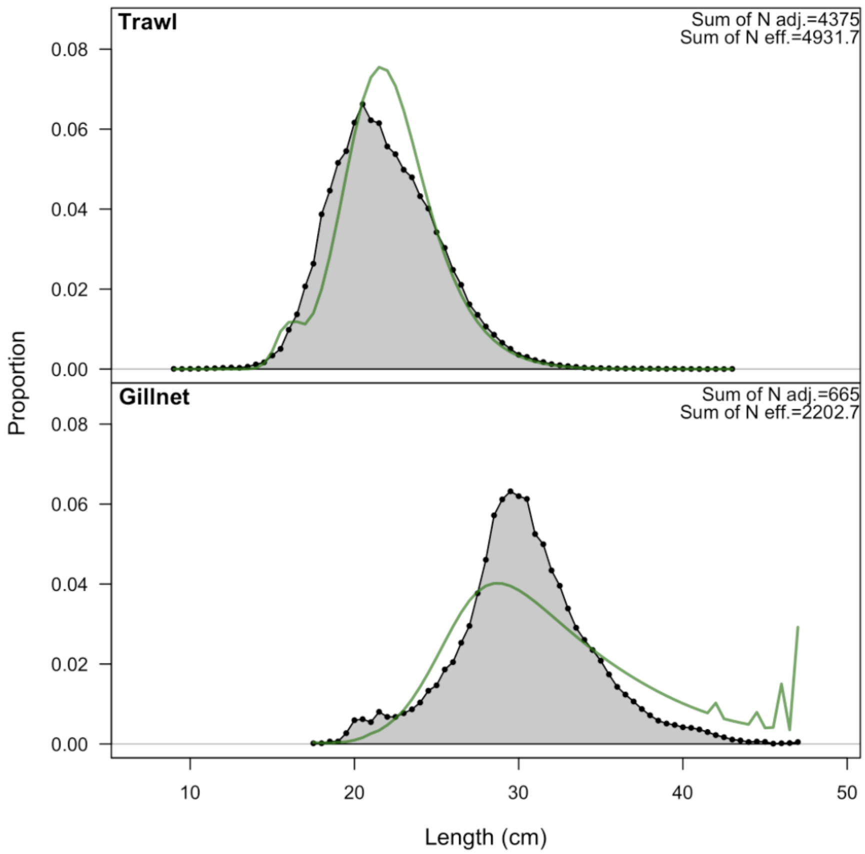
Parameter	Value	Phase	Min	Max	Init	Status	Parm_StDev	Gradient	Pr_type	Afterbound
SR_LN(R0)	7.46225	1	3.000	31.0	8.98382	OK	0.0582190	-0.000101148	No_prior	OK
Q_extraSD_Trawl(1)	0.50000	3	0.000	0.5	0.10000	HI	0.0000523	3.82932e-07	No_prior	CHECK
Q_extraSD_Gillnet(2)	0.50000	3	0.000	0.5	0.10000	HI	0.0000600	2.908e-07	No_prior	CHECK
Size_DblN_peak_Trawl(1)	17.24850	2	15.000	40.0	19.70000	OK	0.0855641	-1.04229e-05	No_prior	OK
Size_DblN_top_logit_Trawl(1)	-18.53760	2	-40.000	10.0	-35.50000	OK	258.6290000	-1.17317e-08	No_prior	OK
Size_DblN_ascend_se_Trawl(1)	0.29766	2	-5.000	10.0	3.00000	OK	0.1017420	4.80085e-06	No_prior	OK
Size_DblN_descend_se_Trawl(1)	4.02307	2	0.100	10.0	3.30000	OK	0.0406456	-5.7437e-06	No_prior	OK
Size_inflection_Gillnet(2)	26.70050	2	10.000	30.0	60.00000	OK	0.2934950	-3.64701e-06	No_prior	OK
Size_95%width_Gillnet(2)	4.42664	2	0.001	5.0	20.00000	OK	0.3094560	4.98678e-07	No_prior	OK

Fit to index

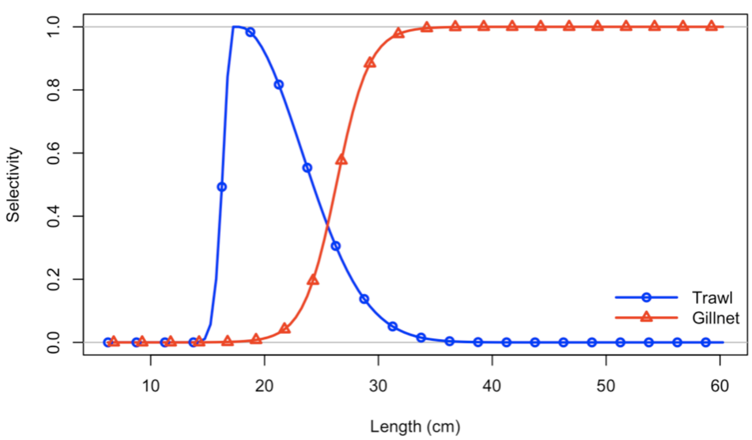




Fit to length composition



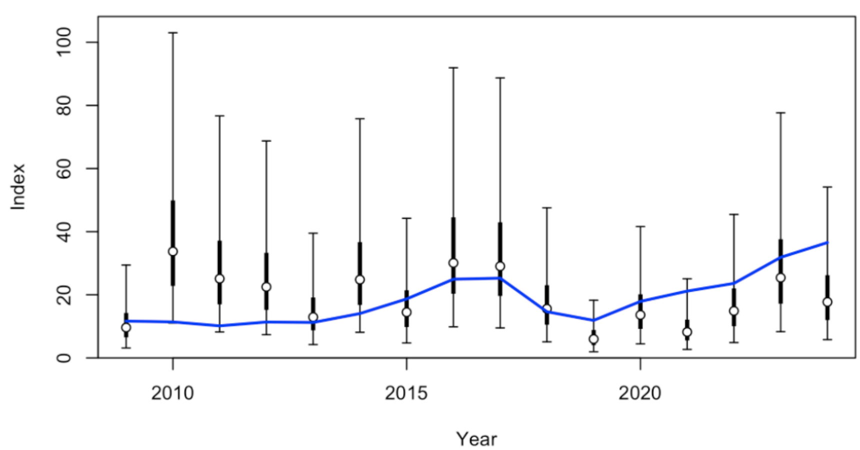
Selectivity

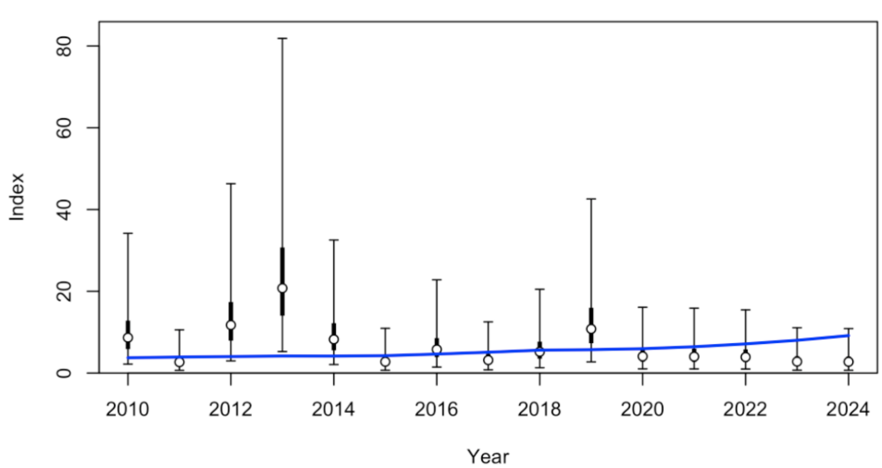


Estimates using Francis weights

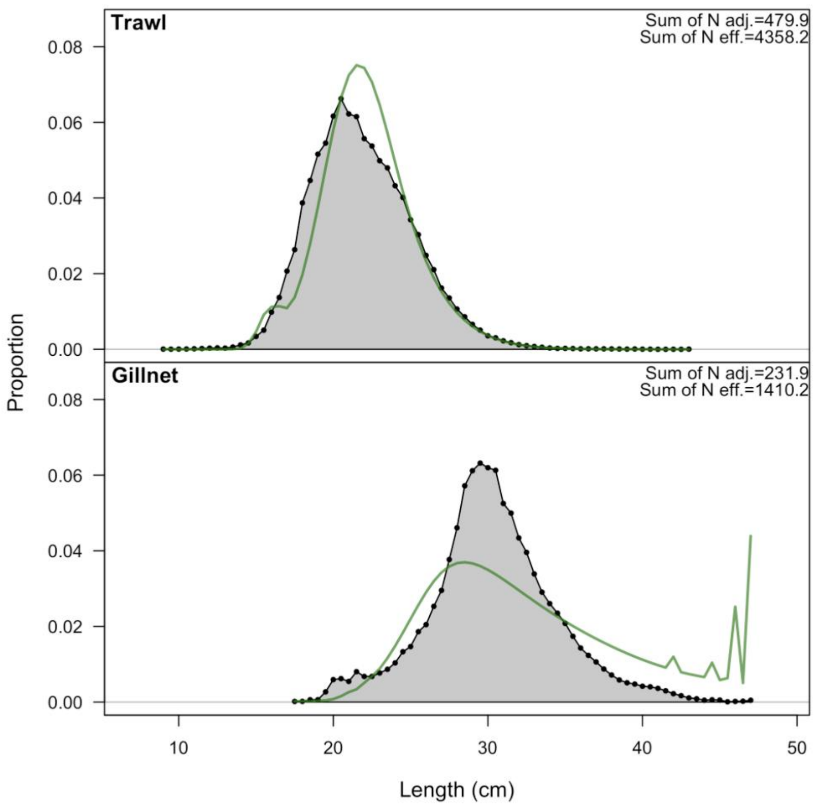
Parameter	Value	Phase	Min	Max	Init	Status	Parm_StDev	Gradient	Pr_type	Afterbound
SR_LN(R0)	7.242300	1	3.000	31.0	8.98382	OK	0.0614655	-1.85162e-06	No_prior	OK
Q_extraSD_Trawl(1)	0.369657	3	0.000	0.5	0.10000	OK	0.1463070	-7.76705e-08	No_prior	OK
Q_extraSD_Gillnet(2)	0.500000	3	0.000	0.5	0.10000	HI	0.0002686	1.0564e-08	No_prior	CHECK
Size_DblN_peak_Trawl(1)	17.236300	2	15.000	40.0	19.70000	OK	0.2706220	-1.06268e-07	No_prior	OK
Size_DblN_top_logit_Trawl(1)	-16.881000	2	-40.000	10.0	-35.50000	OK	327.7670000	-6.95447e-09	No_prior	OK
Size_DblN_ascend_se_Trawl(1)	0.318110	2	-5.000	10.0	3.00000	OK	0.3203150	-5.35114e-07	No_prior	OK
Size_DblN_descend_se_Trawl(1)	4.113310	2	0.100	10.0	3.30000	OK	0.1313270	-1.15318e-06	No_prior	OK
Size_inflection_Gillnet(2)	26.303100	2	10.000	30.0	60.00000	OK	0.4949720	3.30739e-07	No_prior	OK
Size_95%width_Gillnet(2)	4.270590	2	0.001	5.0	20.00000	OK	0.5214300	-1.2096e-09	No_prior	OK

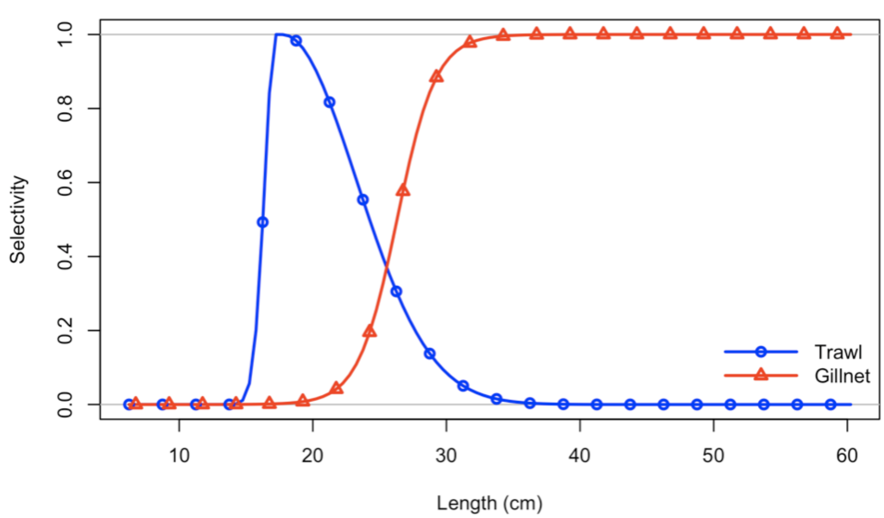
Index fit



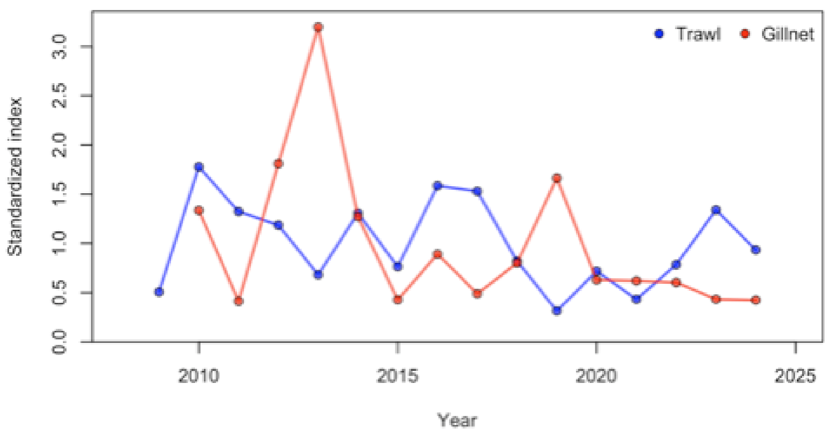


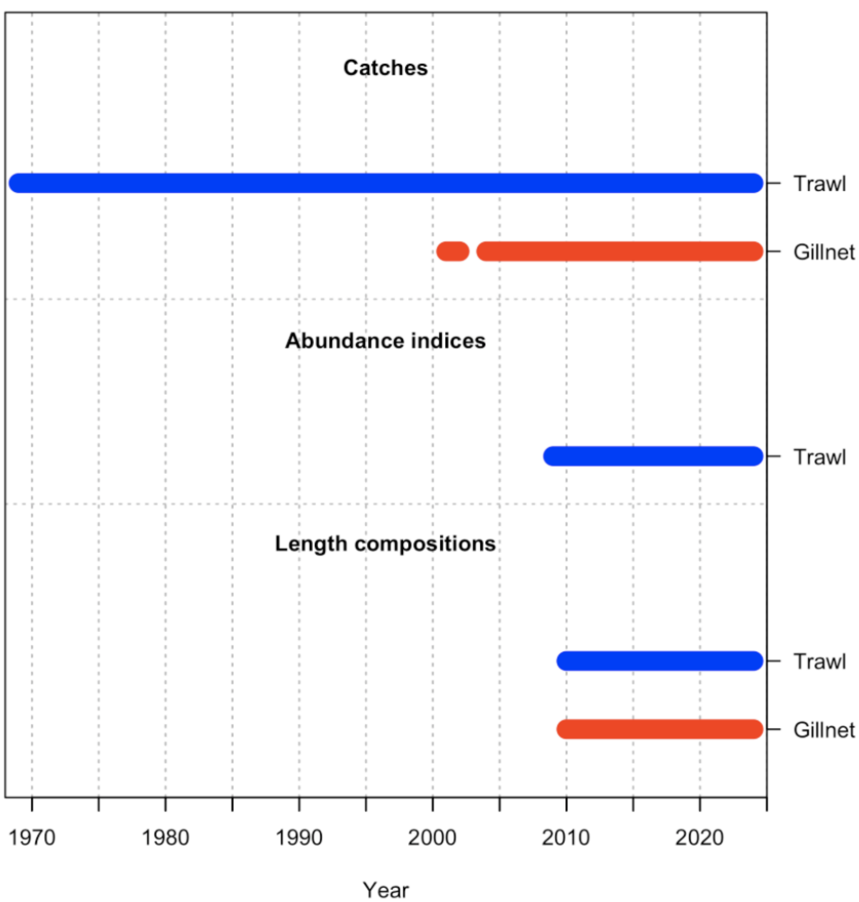
Fit to length composition

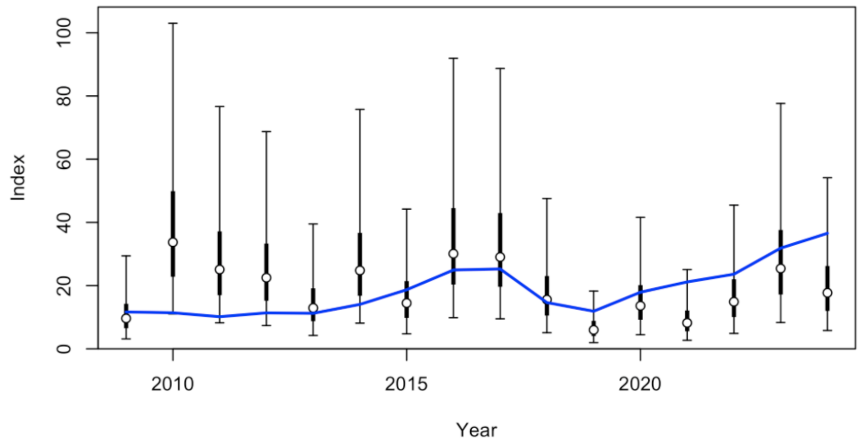




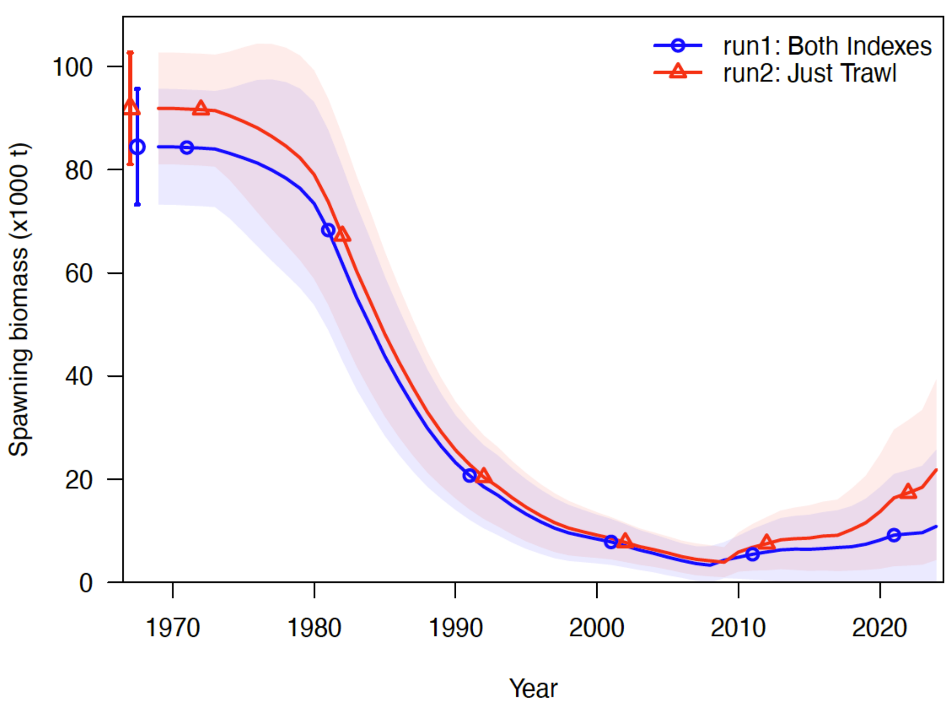
Test removing the index for the gillnet



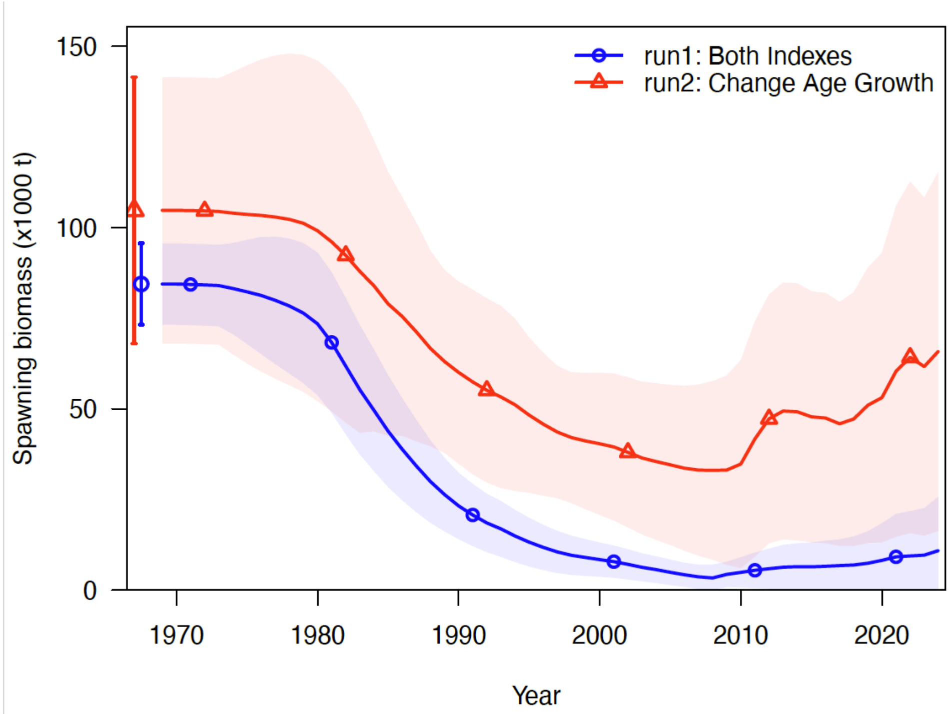




Model comparisons



Sensitivity to growth



The preliminary exploration of an SS3-based integrated stock assessment for splendid alfonsino shows that the **model framework itself is functioning correctly** and capable of accommodating the available data streams. However, several key elements are still missing before a defensible assessment can be completed.

First, the **standardized abundance indices** are essential for informing absolute and relative trends in stock size. Without these indices, the model relies almost exclusively on catch and length composition data, which limits its ability to resolve historical dynamics and increases uncertainty in depletion signals. Preliminary runs show that, in the absence of a standardized index, the model is **largely guessing the early stock trajectory**, producing unstable or weakly informed estimates of biomass and recruitment.

Second, the exploratory runs demonstrate **high sensitivity to biological parameters**, including natural mortality, growth, maturity, and selectivity formulations. This sensitivity is expected at this early stage and highlights the need for a systematic sensitivity analysis once the final biological inputs and standardized indices are available.

Finally, even a **very crude abundance index that spans for a longer period of time** would substantially improve historical reconstruction and reduce reliance on strong assumptions.

In summary, the SS3 “machinery” is ready, but the assessment cannot yet be finalized. The next critical steps are:

1. integrating the standardized CPUE indices,
2. exploring sensitivities to biological parameters, and
3. improving historical reconstruction through any additional information that can be brought into the model.

These steps will allow subsequent SS3 runs to move from diagnostic exploration toward a robust, defensible stock assessment.

References

Brandão, A., Butterworth, D. S., & Johnston, S. (2020, March 19). Age-Structured Production Model (ASPM) assessments of the Alfonsino (*Beryx splendens*) resource in the SIOFA area of the Southern Indian Ocean (5th Meeting of the Scientific Committee, SC-05-29). Marine Resource Assessment & Management Group, Department of Mathematics and Applied Mathematics, University of Cape Town. Retrieved from:

https://siofa.org/sites/default/files/documents/meetings/SC-05-29%20Age-Structured%20Production%20Model%20assessments%20of%20the%20Alfonsino.pdf