

SEDAR 91 Puerto Rico

CFMC SSC Meeting

April 8, 2026



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Outline

- Background
- S57 Assessment Approach
- S91 Assessment Approach
- S91 Sources of data
- Data & Life History Overview
- S91 Models
- Quantile Analysis
- Figures
- SSC Discussion and Next Steps



Background

- SEDAR 91 addressed the stock assessment for US Caribbean Spiny Lobster.
- The process consisted of an in-person Data Workshop, with several webinars before and after the workshop and a series of assessment webinars.
- The Stock Assessment Report (SAR) for US Caribbean Spiny Lobster – Puerto Rico was disseminated to the public in September 2025.
- The SSC is tasked with recommending whether the assessments represent Best Available Science, whether the results are useful for providing management advice and developing fishing level recommendations.



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S57 Assessment Approach

- SEDAR 57 (S57) was the first application of Stock Synthesis (SS3) in the US Caribbean (2019).
- The Puerto Rico assessment models developed during S57 were fit to catch time series and length composition information from dive and pot/trap fisheries using a data-limited to moderate implementation of SS3.
- S57 resulted in a satisfactory determination for providing management advice.
- A data-only update was conducted though 2022 to provide OFLs and ABCs through 2023-2025.



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S91 Assessment Approach

- Iterate on existing SEDAR 57 (S57), SEDAR57 Update (S57U) length-based statistical catch at age models using SS3 through 2023
- SS3 was implemented as a length-based statistical catch-at-age model. Forward-projecting, age-structured population dynamics model that is fit to landings (removals), length composition data, and *indices of abundance*.

S91 Sources of data

Puerto Rico

- Landings from self-reported fisher logbooks
- Length compositions from shore-based port sampling
- Life history parameters carried over from SEDAR 57
- (New) length compositions obtained from SEAMAP-C dive surveys conducted off of the Southwest Puerto Rico coast during 2021-2023
- (New) length compositions obtained from an HJR Reefscaping lobster trap survey conducted throughout Puerto Rico coastal waters during 2021-2022
- (New) Fishery-dependent indices of abundance from fisher logbooks

Data & Life History Overview

- Landings: lognormal error
- Composition: multinomial error
- No indices of relative abundance **Indices included for S91 sensitivity run*
- Two-sex model; 50-50 sex ratio
- Island-specific length-weight relationships
- Growth parameters estimated using VBGF
- $M = 0.34$, used for all age classes
- Fecundity relationships based on relationship from SW Cuba (SEDAR 8), maturity parameters derived by Die (2005)

- No recreational fishing ~ recreational fishing constant, ignored
- Release (discard) mortality ignored due to selective nature of trap/pot and dive fisheries
- Age structure: 0 to 15+
- Size bins: 51mm – 248mm (2 – 9.8 inches)
- One area models; single spawning population and associated stock recruitment function (Beverton-Holt)

**S57 and S57U steepness (h) = 0.95; S91 h = 0.99*

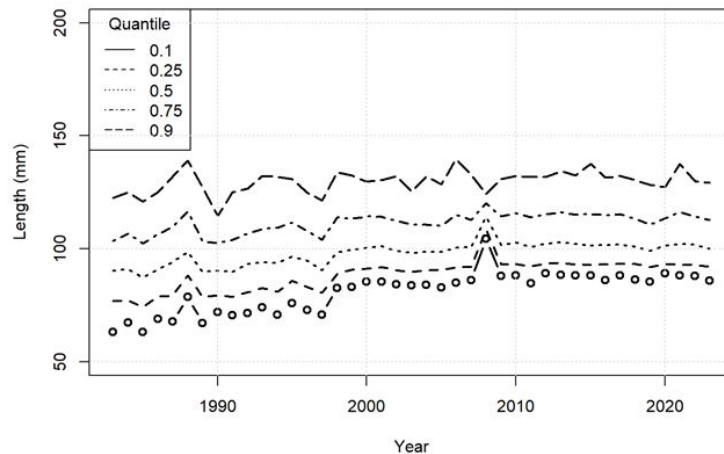
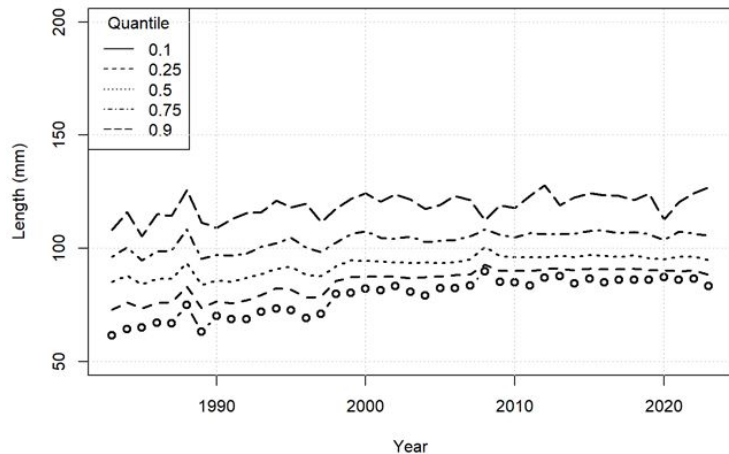
- Length-based selectivity and retention for primary fleets
- Complete catch history; assumed commercial landings known, precisely
- Catches have increased in recent years, but PR Department of Natural and Environmental Resources have reported evidence of high abundance (Matos-Caraballo et al. 2024).

Stage	Code	Model Description
Initial	<i>init</i>	<i>S57 parameters unchanged</i> + data through 2023 and <u>start year changed to 1985</u>
	<i>2initf</i>	<i>init</i> + initial fishing mortality estimated for each fleet
	<i>seamapc</i>	<i>2initf</i> + <u>SEAMAP-C data</u> fit with exponential logistic selectivity parameters
	<i>hjr</i>	<i>seamapc</i> + <u>HJR data</u> fit with exponential logistic selectivity parameters
S91 Base	<i>new_eq</i>	<i>hjr</i> + equilibrium initial catches for each fleet based on likelihood profiles
Sensitivity	<i>selex1</i>	<i>new_eq</i> + dive fishery is initialized with logistic selectivity pattern; only estimating 1st limb
	<i>selex2</i>	<i>new_eq</i> + dive fishery is initialized with logistic selectivity pattern; 3 estimated parameters
	<i>steep</i>	<i>new_eq</i> + steepness fixed to 0.8
	<i>combsex</i>	<i>new_eq</i> + male growth and L-W for females to approximate a single male sex model
	<i>lw</i>	<i>new_eq</i> + US Caribbean region length-weight parameters
	<i>eq_hi</i>	<i>hjr</i> + equilibrium initial catches for each fleet based on likelihood profile highest values
	<i>eq_lo</i>	<i>hjr</i> + equilibrium initial catches for each fleet based on likelihood profile lowest values
	<i>eq_cv_hi</i>	<i>new_eq</i> + 0.3 initial catch CV
	<i>indices</i>	<i>new_eq</i> + <u>fishery-independent indices of abundance</u>

S91 Models

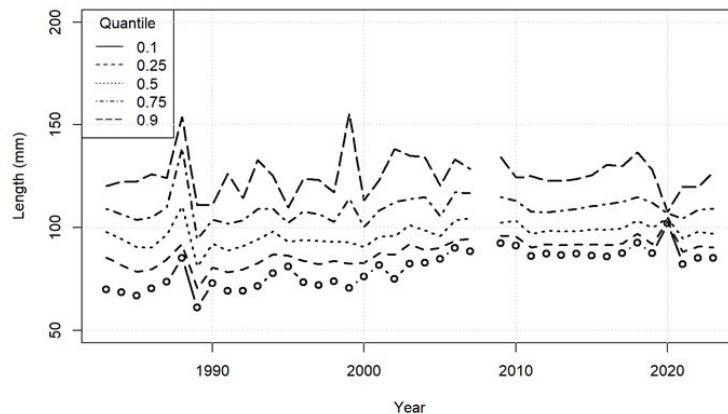
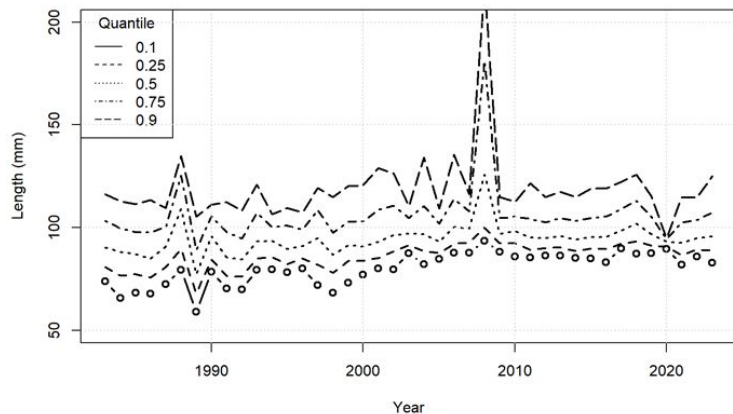
Quantile Analysis (Dive)

Median 10th, 25th, 50th, 75th, and 90th quantiles of length composition data (mm) for Puerto Rico spiny lobster in the dive fleet. Females (left) & Males (right).

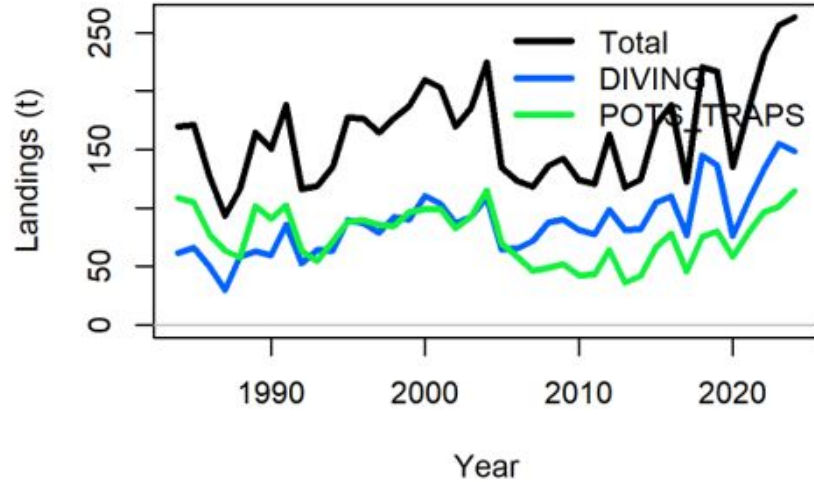


Quantile Analysis (Trap)

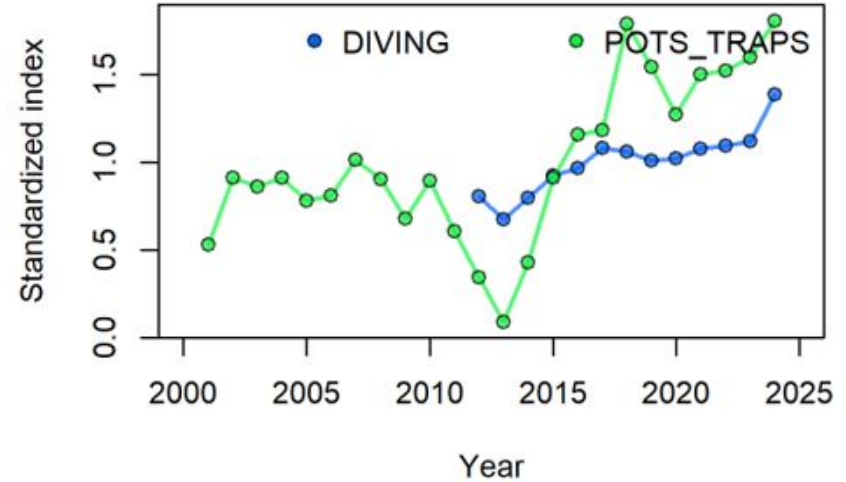
Median 10th, 25th, 50th, 75th, and 90th quantiles of length composition data (mm) for Puerto Rico spiny lobster in the trap fleet. Females (left) & Males (right).



Puerto Rico spiny lobster (a) landings (mt) during 1985-2024 by fleet: dive (blue), trap (green), total (black), and (b) standardized indices of abundance overlaid.

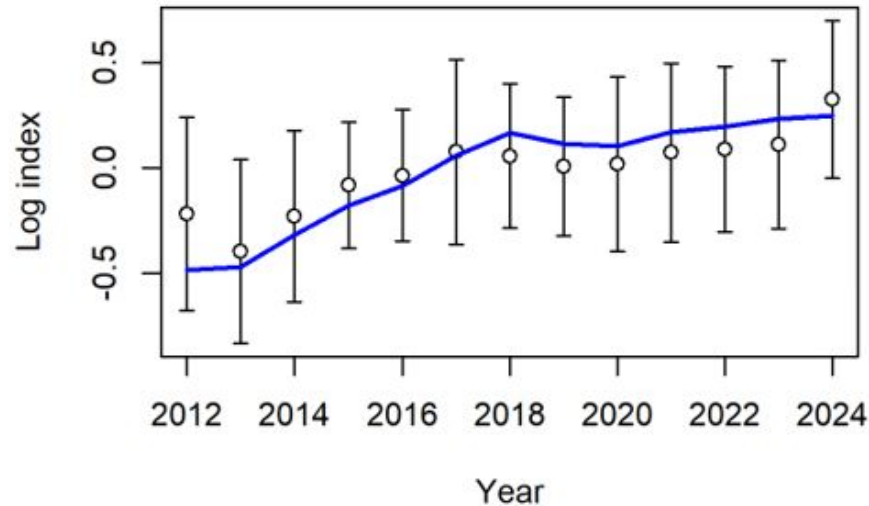


(a) Landings

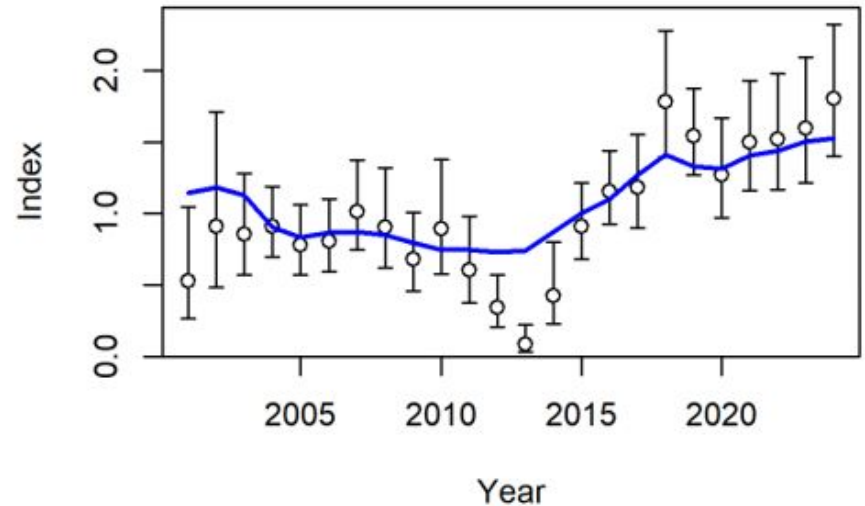


(b) Standardized indices of abundance

Puerto Rico spiny lobster observed (open circles) and predicted indices of relative abundance (blue) and 95% uncertainty interval standard errors bars for the CPUE sensitivity model scenario based on the model assumption of lognormal error.

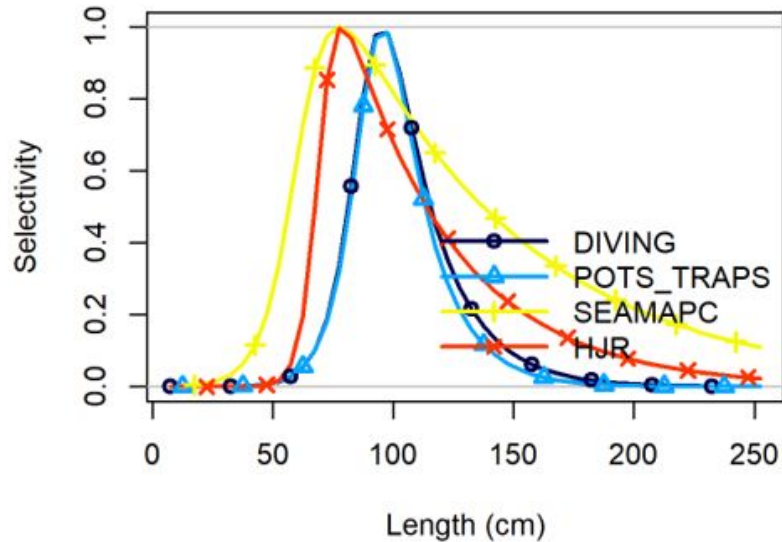


(a) Dive

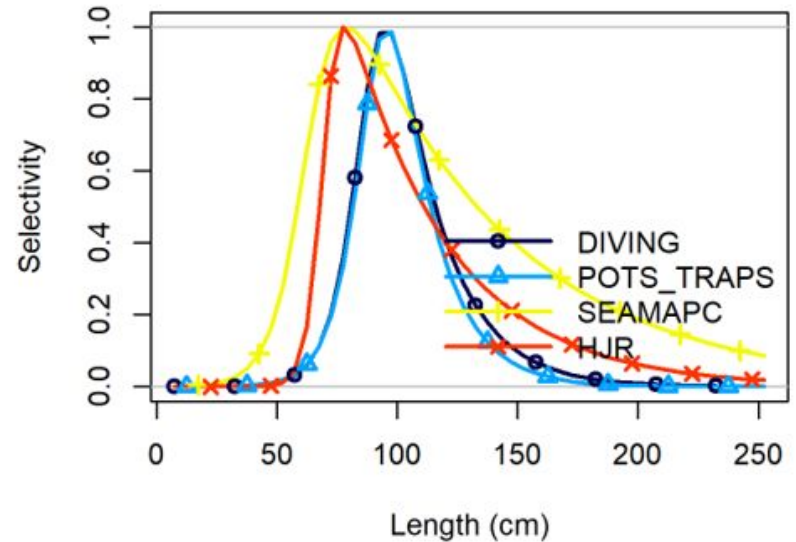


(b) Trap

Puerto spiny lobster selectivity by model scenario and by fleet for the S91 base and CPUE sensitivity model scenarios: dive (dark blue), pot/trap (light blue), SEAMAPC (yellow), and HJR Reefscaping (red).

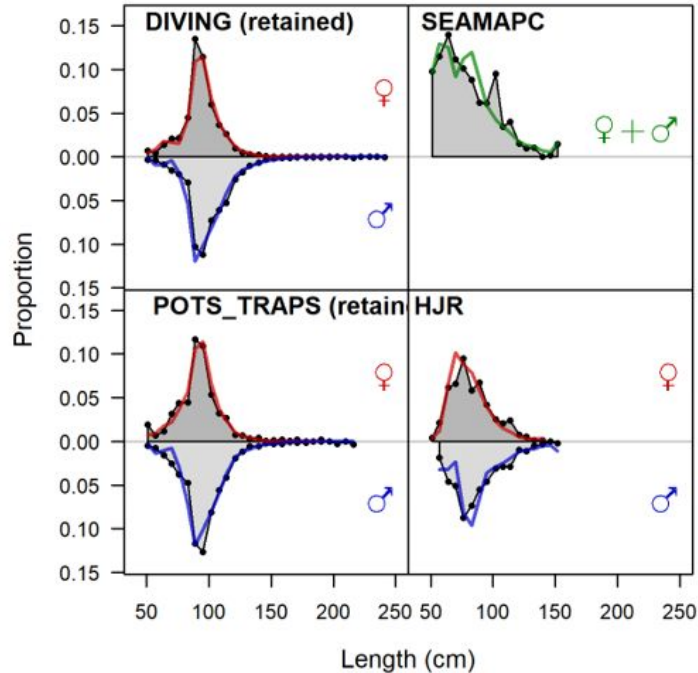


(a) SEDAR 91 Base

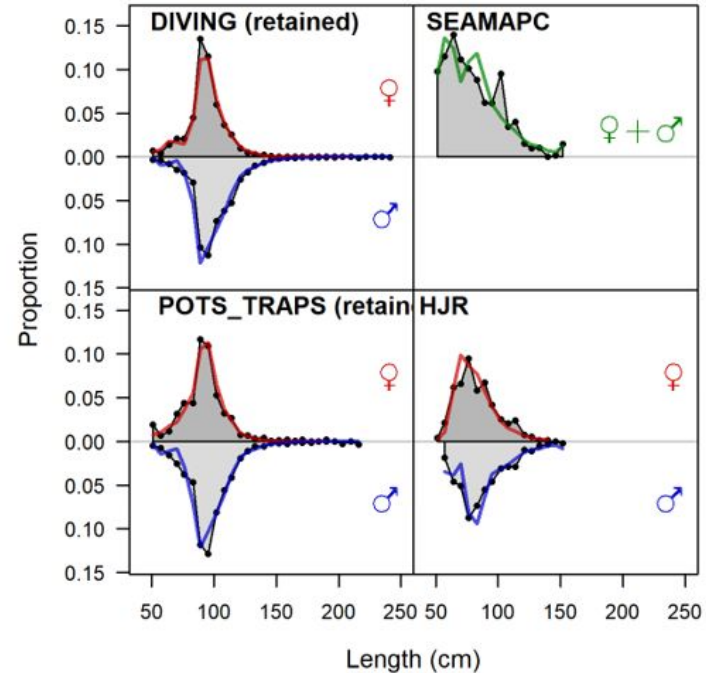


(b) CPUE Sensitivity

Puerto Rico spiny lobster observed and predicted length distributions in millimeters for the S91 base and CPUE sensitivity model scenarios. Red and blue solid lines represent predicted length compositions, while gray regions represent observed length compositions.

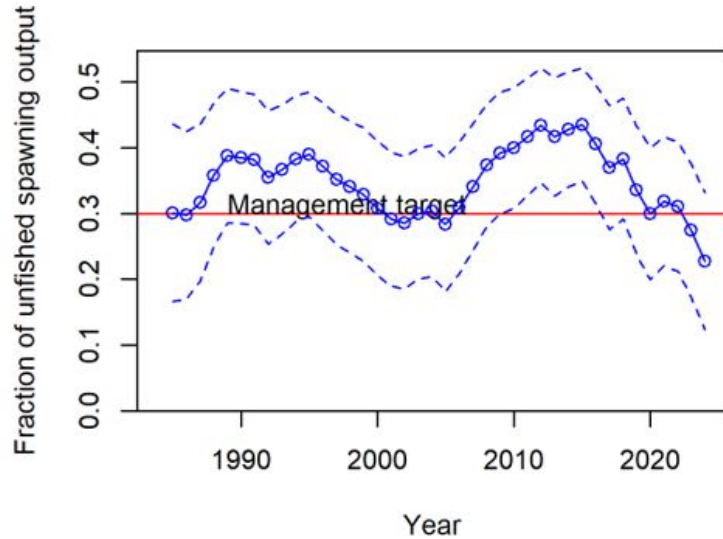


(a) SEDAR 91 Base

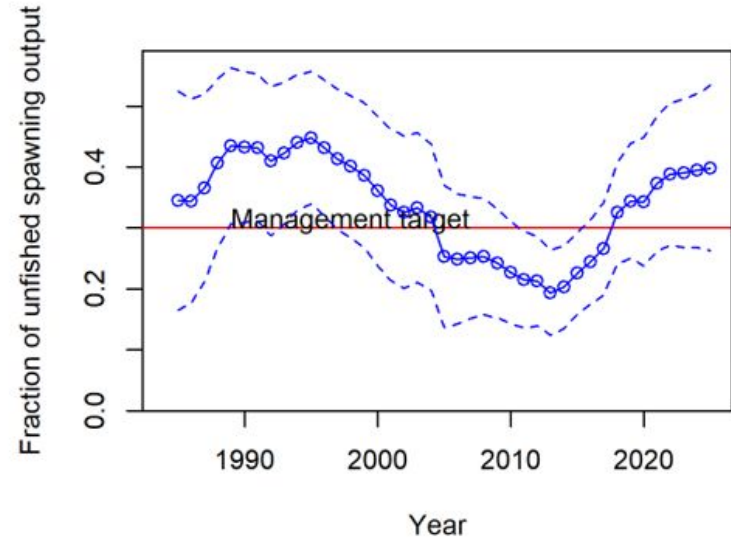


(b) CPUE Sensitivity

Puerto Rico spiny lobster spawning biomass ratio (total biomass / unfished spawning stock biomass) or the S91 base and CPUE sensitivity model scenarios. The dotted lines represent 95% confidence intervals.

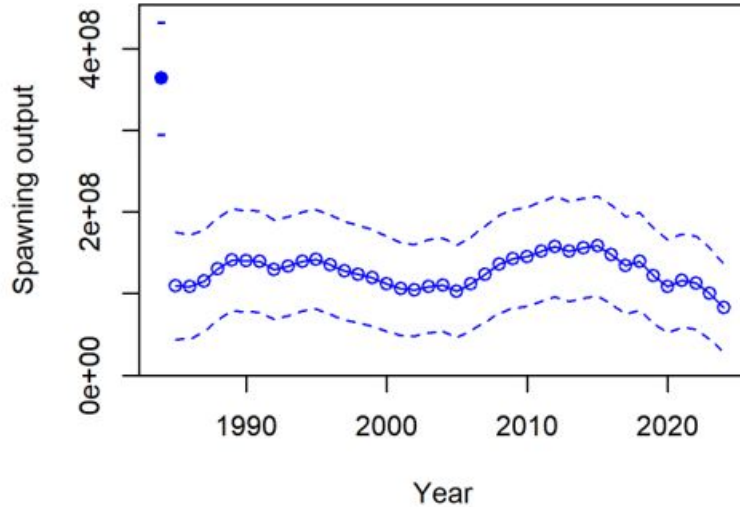


(a) SEDAR 91 Base

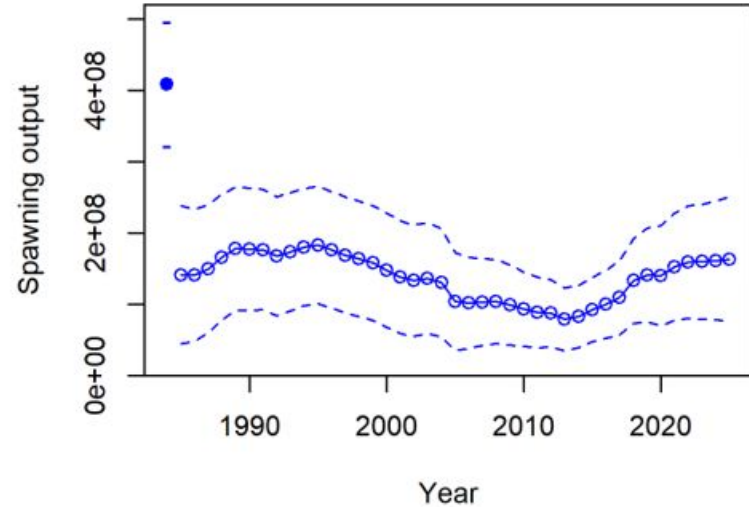


(b) CPUE Sensitivity

Puerto Rico spiny lobster spawning stock biomass in metric tons for the S91 base and CPUE Sensitivity model scenarios. The dotted lines represent 95% confidence intervals.

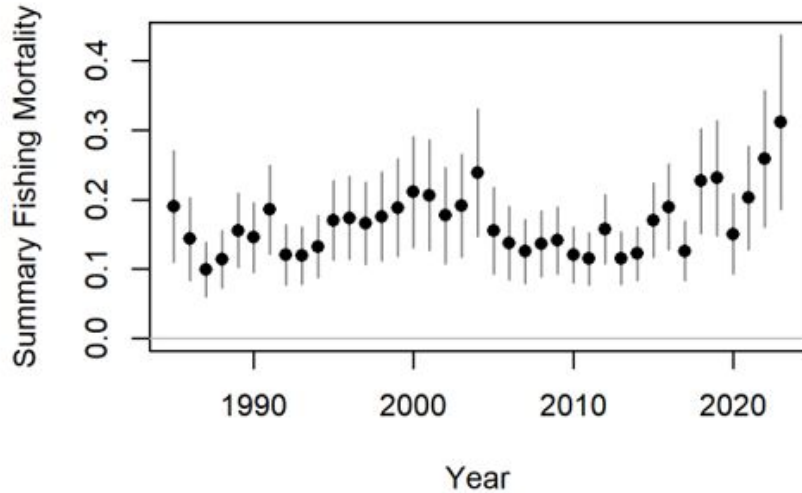


(a) SEDAR 91 Base

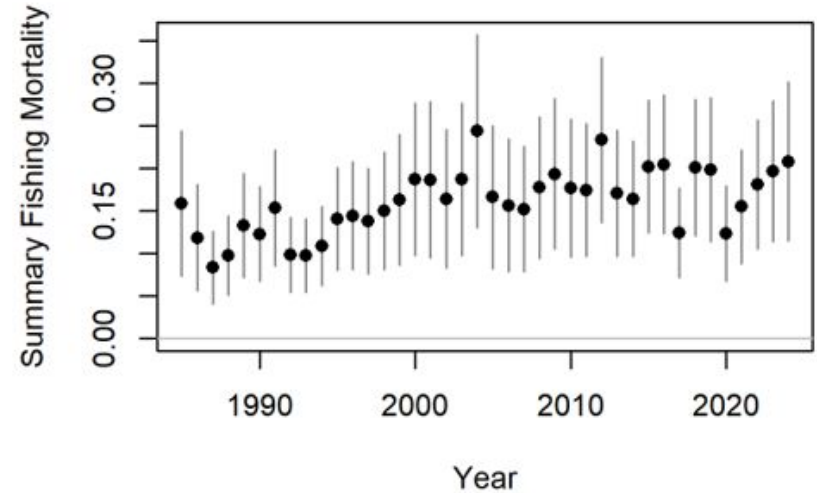


(b) CPUE Sensitivity

Puerto Rico spiny lobster fishing mortality (total biomass killed / total biomass) time series for the S91 base and CPUE Sensitivity model scenarios. The vertical lines represent 95% confidence intervals.

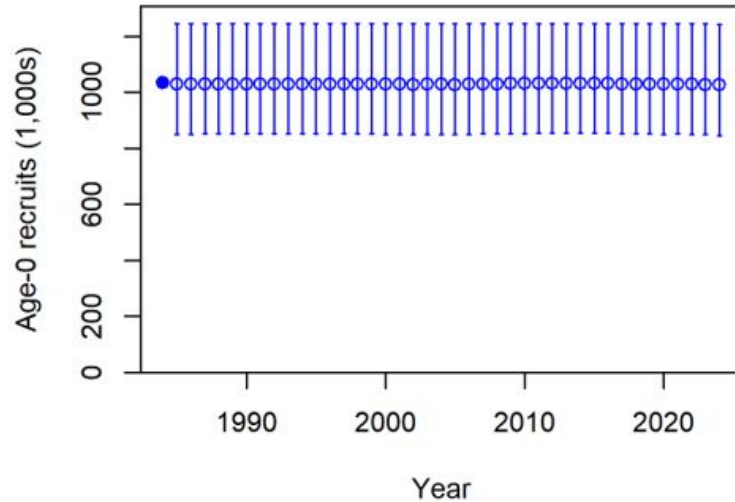


(a) SEDAR 91 Base

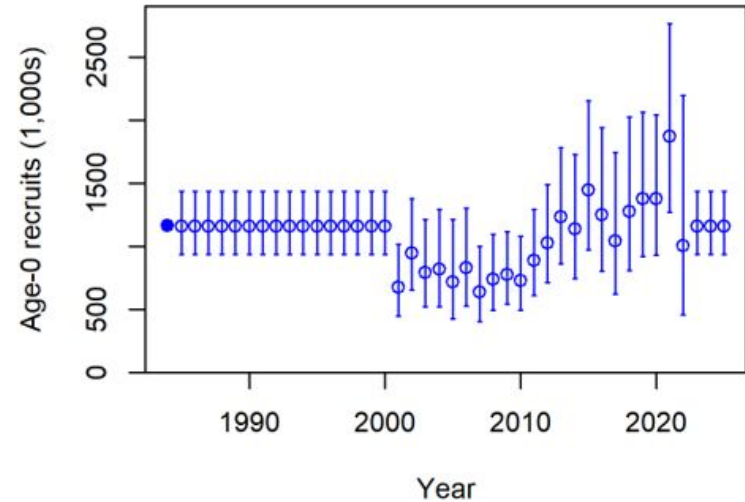


(b) CPUE Sensitivity

Puerto Rico spiny lobster recruitment in thousands of fish for the S91 base and CPUE Sensitivity model scenarios. The vertical bars represent 95% confidence intervals. For the CPUE Sensitivity model scenario, recruitment is estimated as deviations from the underlying spawner-recruit relationship. The model estimates main recruitment deviations from 2001 to 2022 and uses a bias adjustment ramp that begins in 1988.



(a) SEDAR 91 Base



(b) CPUE Sensitivity

Puerto Rico spiny lobster fishing mortality rate and spawning stock biomass ratios relative to the rate and biomass of the stock associated with the MSY proxy (based on SPR 30%).

Metric	Scenario	Value	Terminal Year
F / F SPR 30%	8523_00	1.26	2023
	8524_03g	0.96	2024
SSB / SSB SPR 30%	8523_00	0.92	2023
	8524_03g	1.32	2024

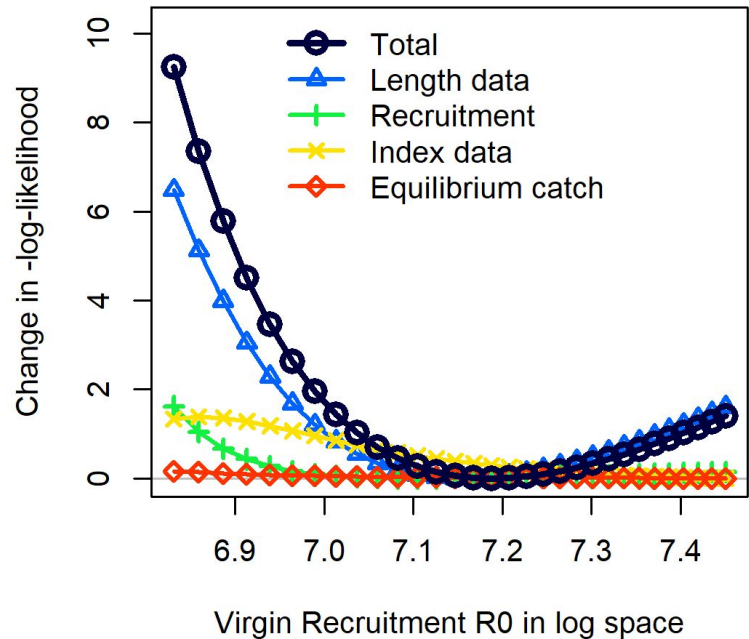
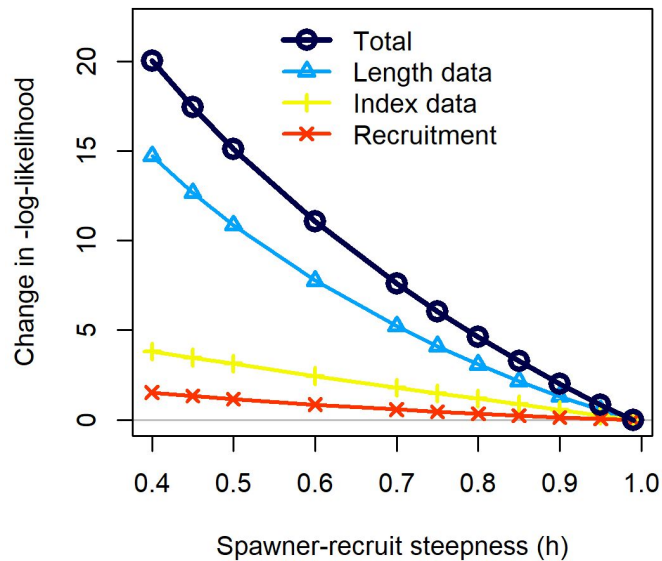
F / F SPR 30%	8524_00g	0.81	2024
SSB / SSB SPR 30%	8524_00g	1.5	2024



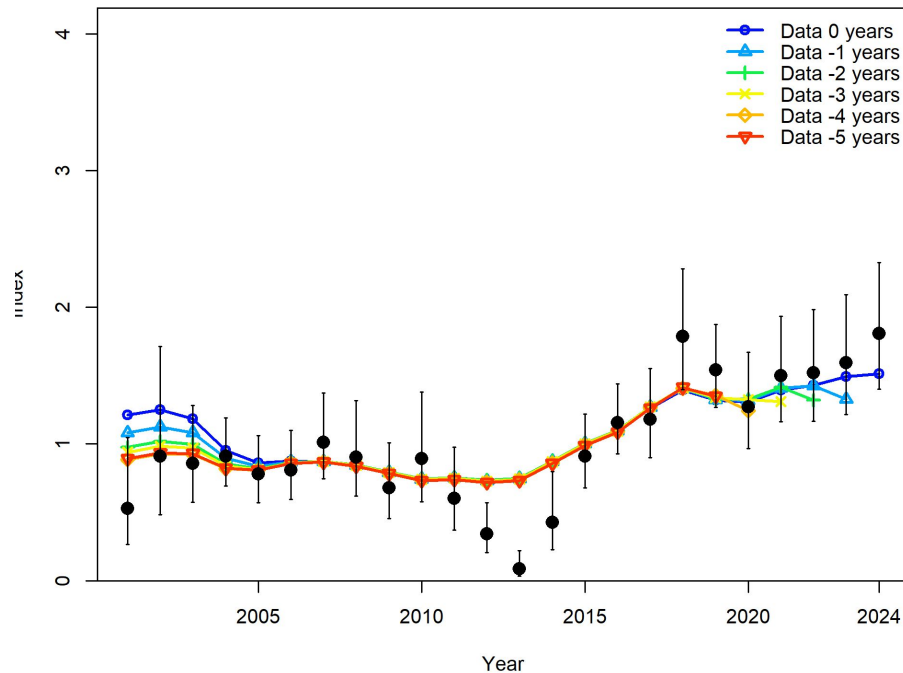
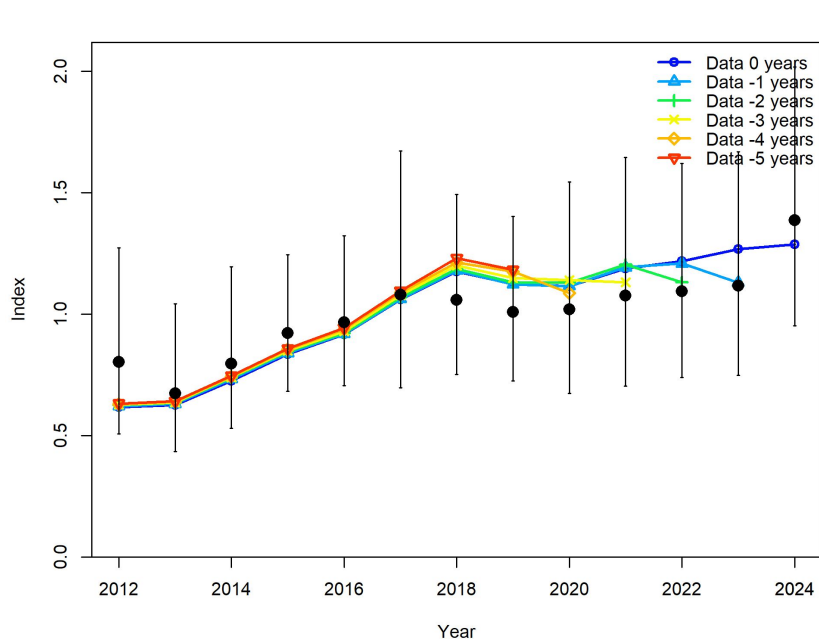
Puerto Rico spiny lobster derived quantities of the MSY proxy (based on SPR 30%) in metric tons and in pounds. CV is calculated as the SD divided by the parameter estimate.

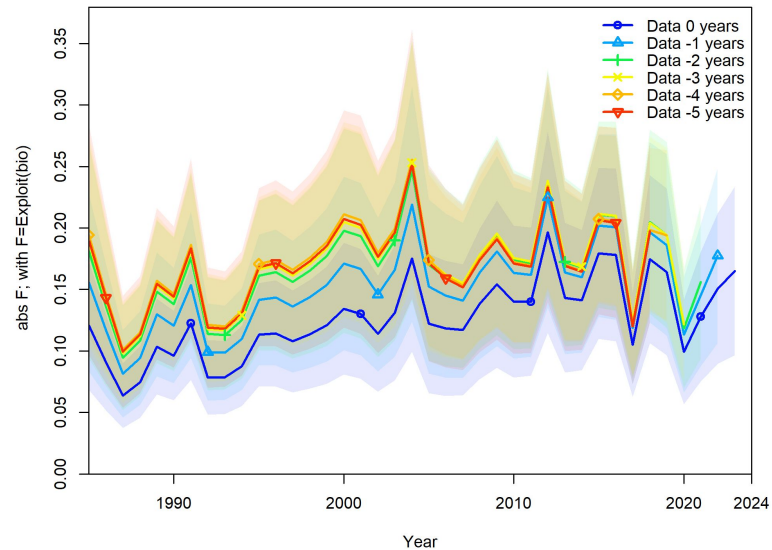
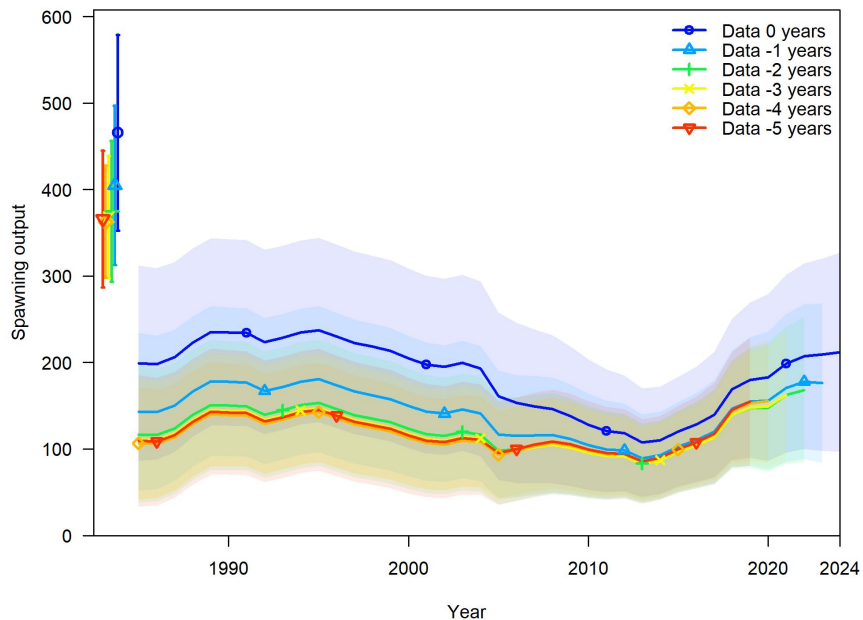
Scenario	MSY Proxy	SD	CV	MSY Proxy in Pounds
8523_00	179.68	15.38	0.09	396,133
8524_03g	202.60	19.56	0.10	446,668
8524_00g	227.87	26.14	0.11	502,374

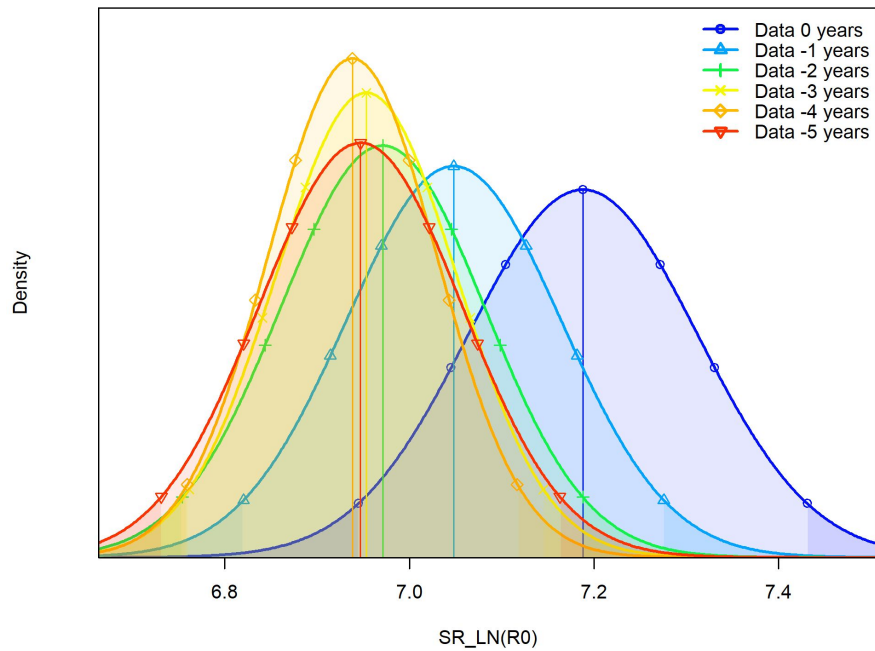
8524_00g h and R0 Profiles



8524_00g Retrospective







SSC Review and Decisions

Decisions for OFL and ABC

Necessary assumptions for recent landings (2025 & 2026)

$P^* = 0.45$ *CFMC input for management uncertainty*

$\sigma = 0.5$ *SSC input scientific uncertainty*

	Metric Tons	StdDev	Pounds
OFL 2027	317.666	49.9339	700,334
OFL 2028	265.257	35.2679	584,792
OFL 2029	245.844	30.3821	541,993
3-year average	276.256		
MSY 30% SPR	227.879		502,387

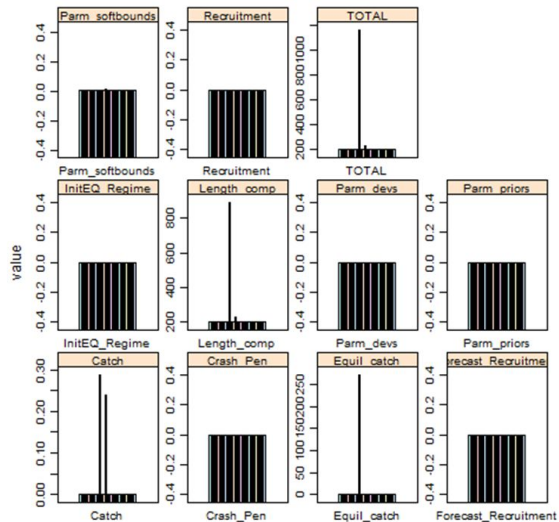


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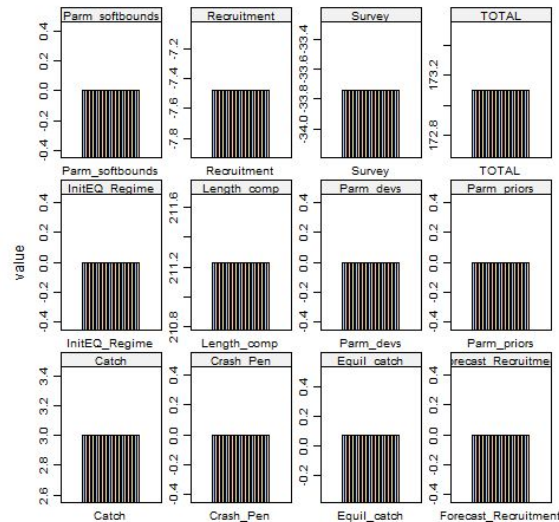


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20% Jitter

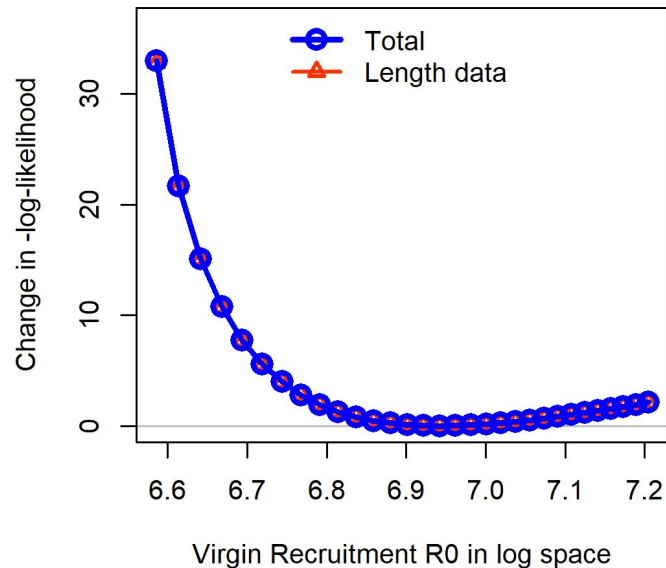


(a) SEDAR 91 Base

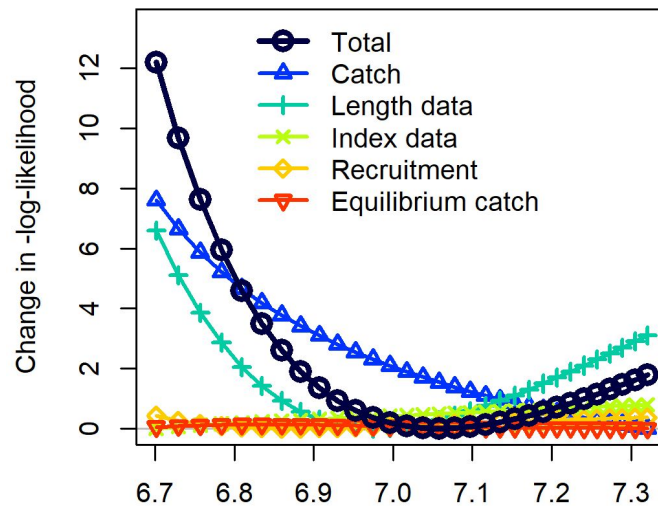


(b) CPUE Sensitivity

R0 likelihood plot

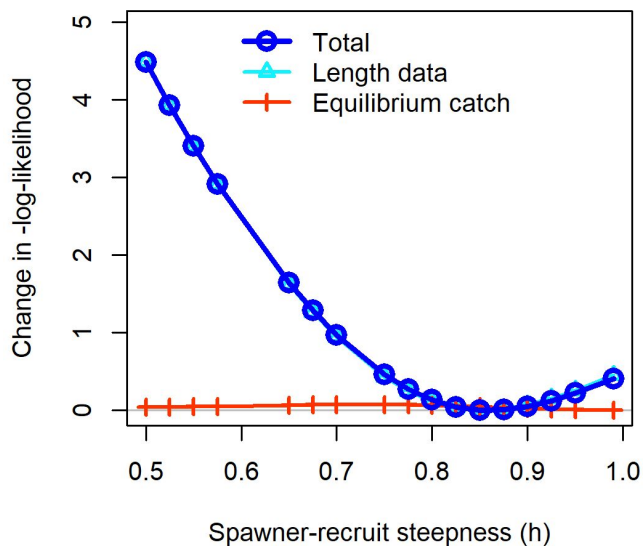


(a) SEDAR 91 Base

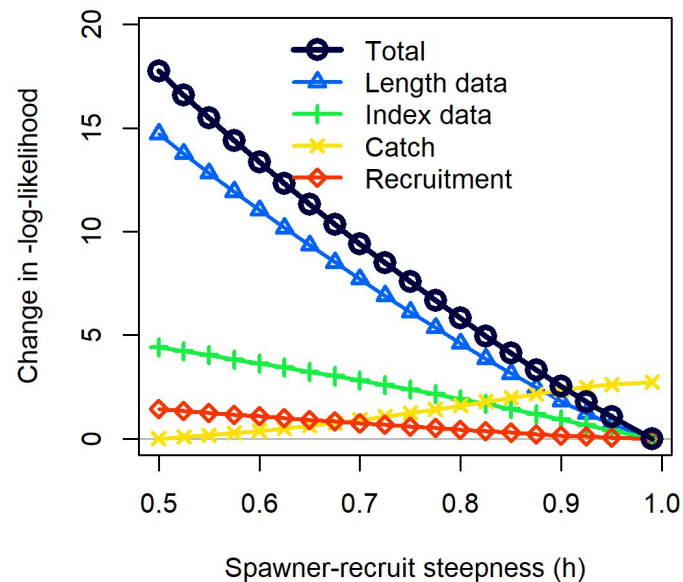


(b) CPUE Sensitivity

Steepness Profile

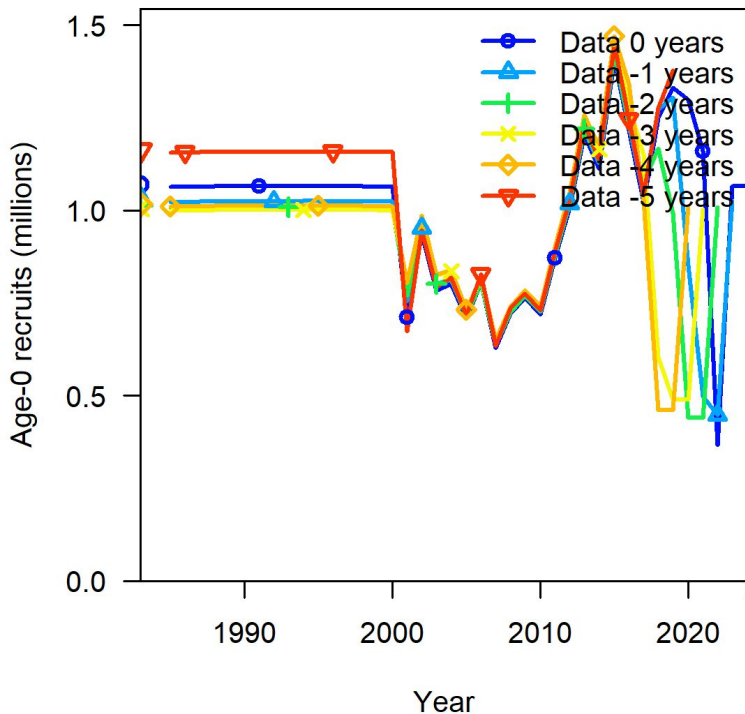
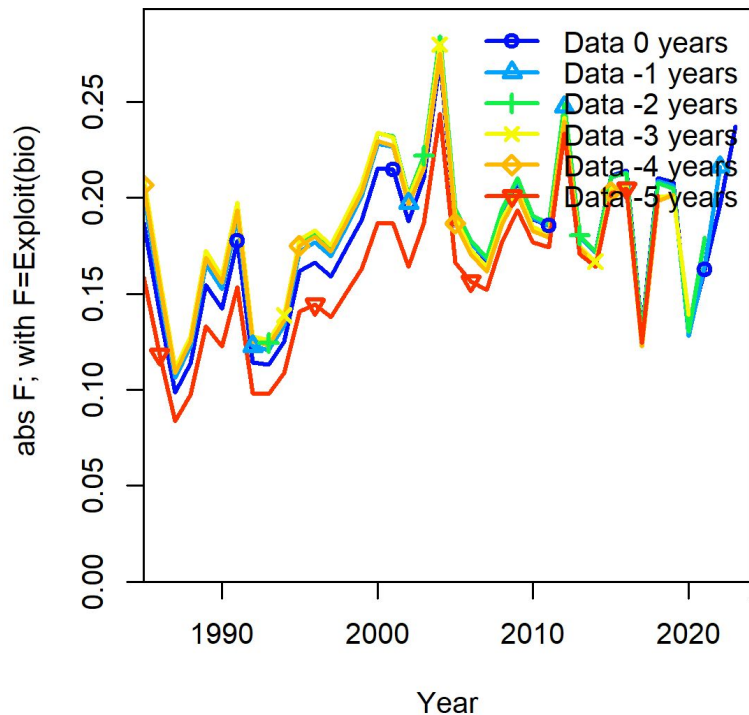


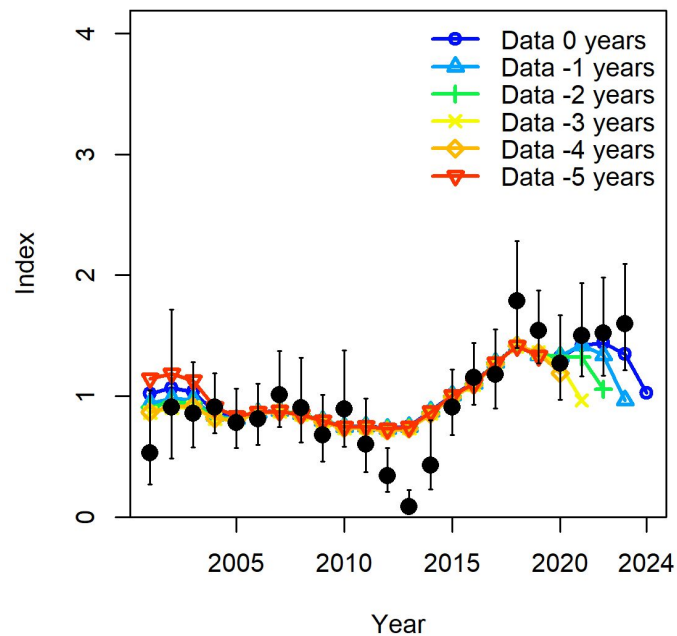
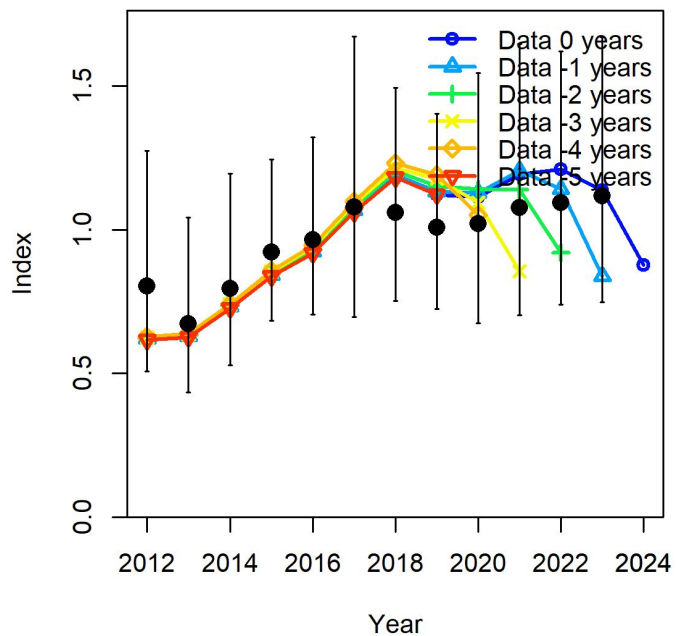
(a) SEDAR 91 Base

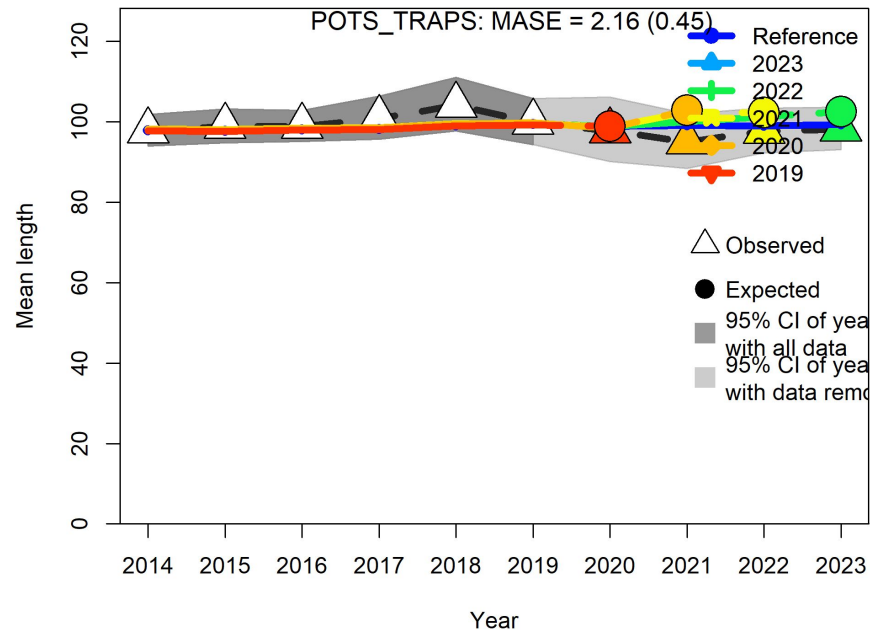
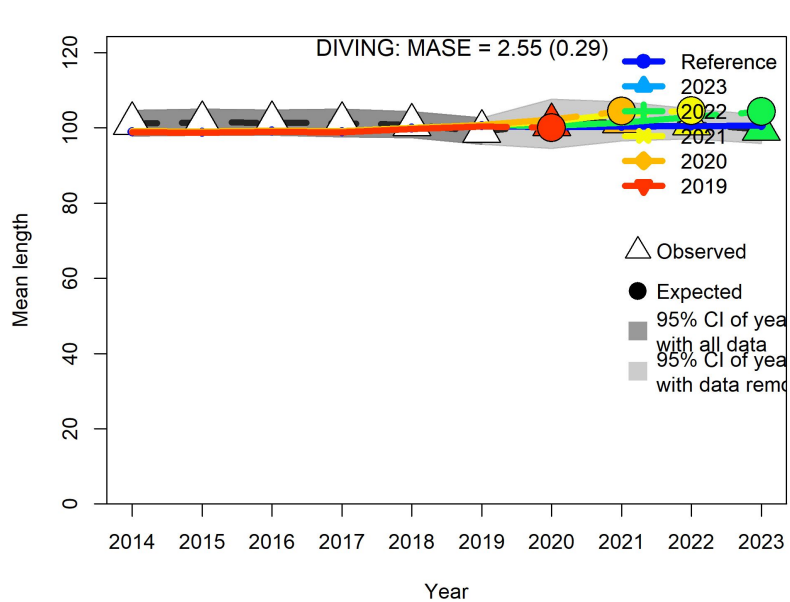


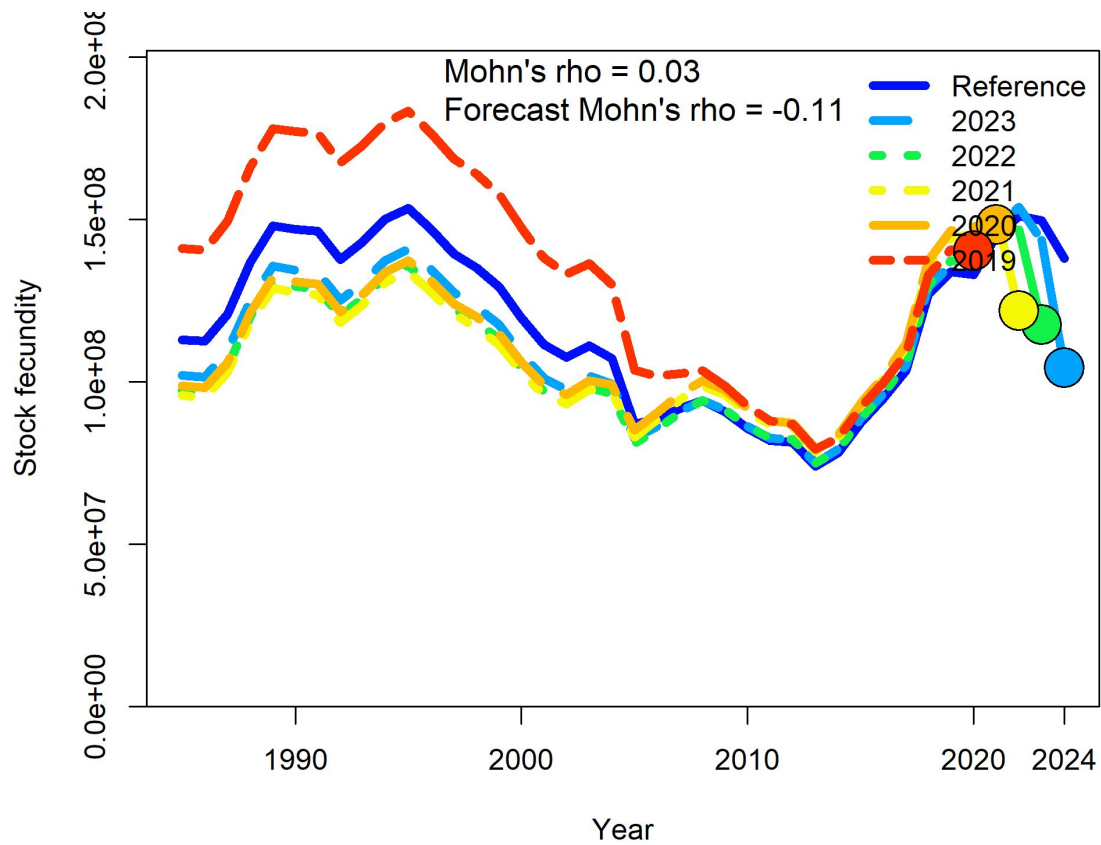
(b) CPUE Sensitivity

CPUE Sensitivity Retrospective



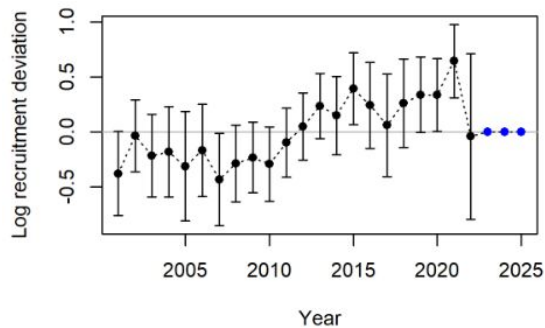




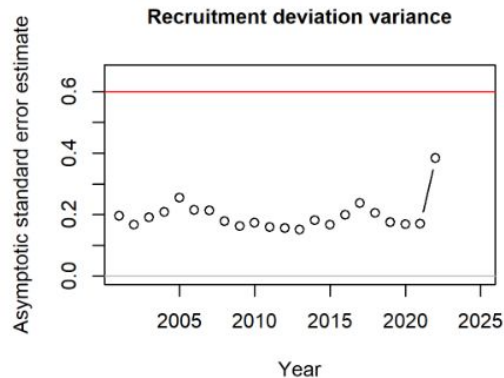


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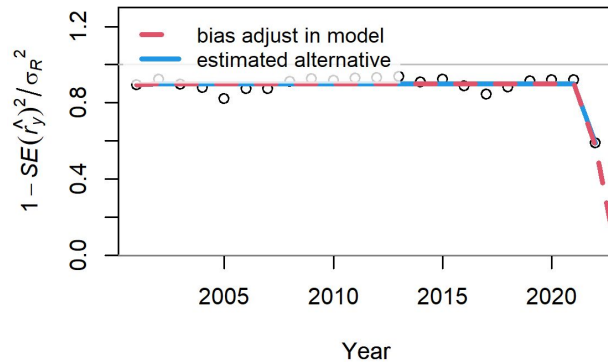
Recruitment Deviations



Recruitment deviations with 95% intervals

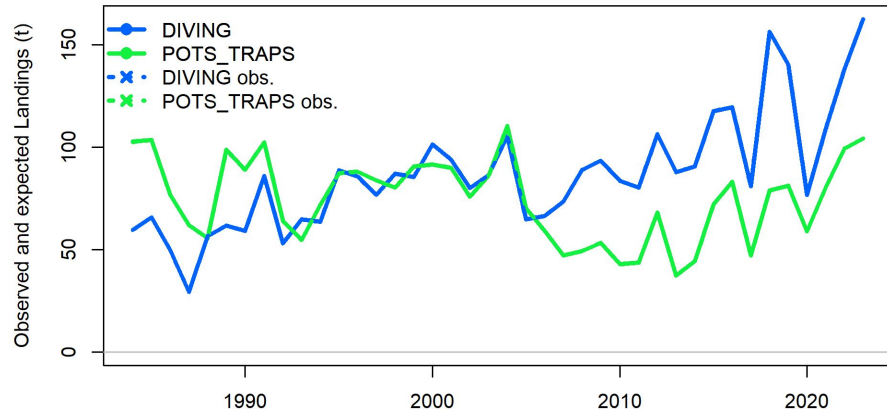


Recruitment deviations variance check.

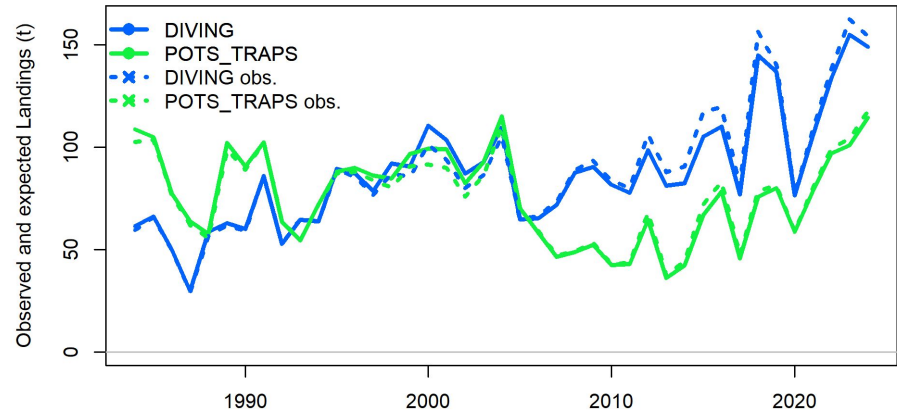


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Observed (solid line) and expected landings (dotted line) in metric tons by fleet for the S91 base and CPUE Sensitivity model scenarios. The two fleets are the diving fleet (blue) and the trap fleet (green).



(a) SEDAR 91 Base

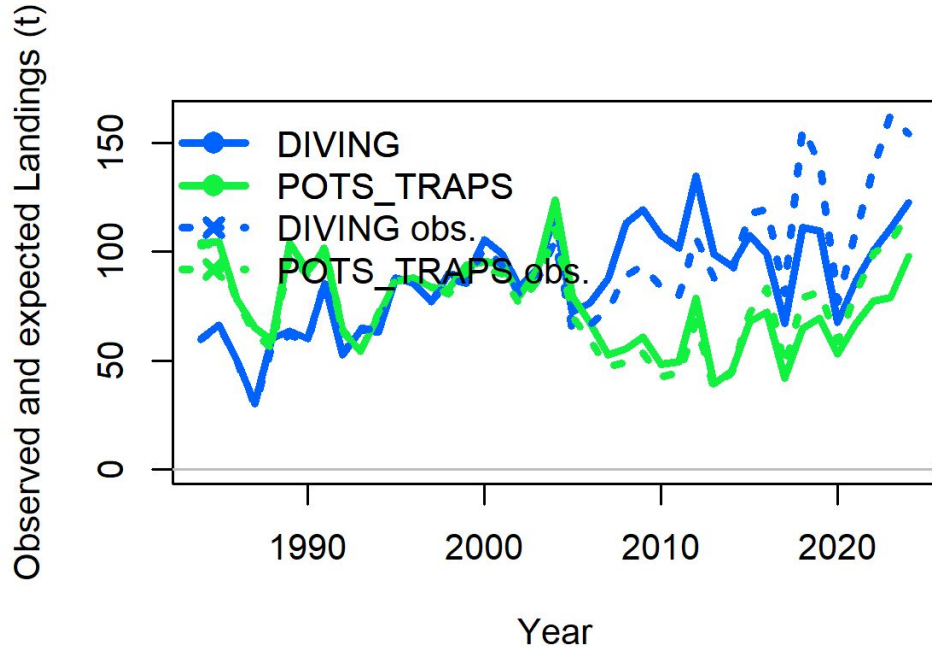


(b) CPUE Sensitivity

Stage	Code	Model Description
Base	8523_00	Base from SEDAR 91 (<i>new_eq</i>)
Update	8524_00	Updated terminal year
	8524_00g	8524_00 + Rec dev + Trap index + Dive index
Increasing Model Flexibility	8524_01	8324_00 + Transition to F parameter estimation
	8524_02	8324_01 + Increases in Catch SE (0.1)
	8524_03	8324_01 + Increases in Catch SE (0.15)
CPUE Sensitivity	8524_03a	8523_03 + Trap index
	8524_03b	8523_03 + Dive index
	8524_03c	8523_03 + Trap index + Dive index
	8524_03d	8523_03 + Rec dev
	8524_03e	8523_03 + Rec dev + Trap index
	8524_03f	8523_03 + Rec Dev + Dive index
	8524_03g	8523_03 + Rec dev + Trap index + Dive index

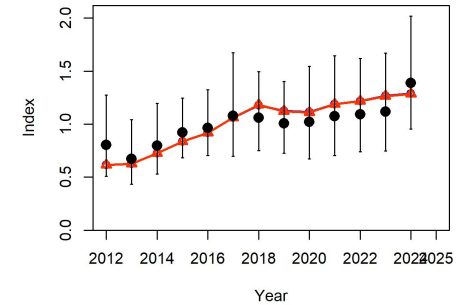
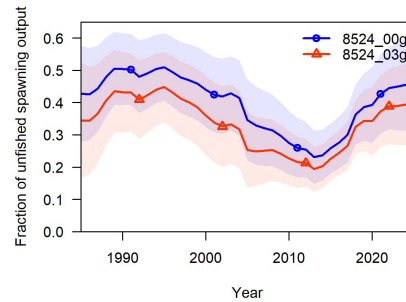
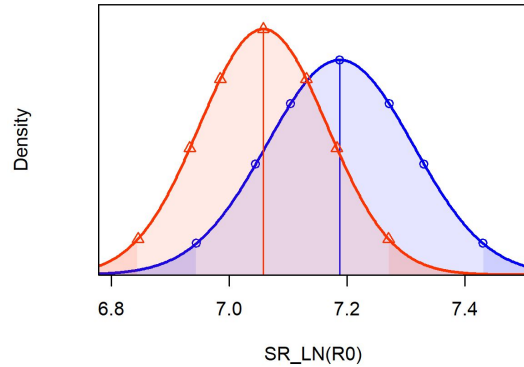
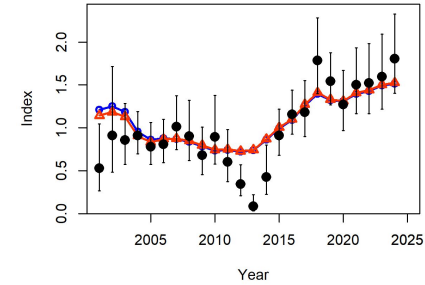
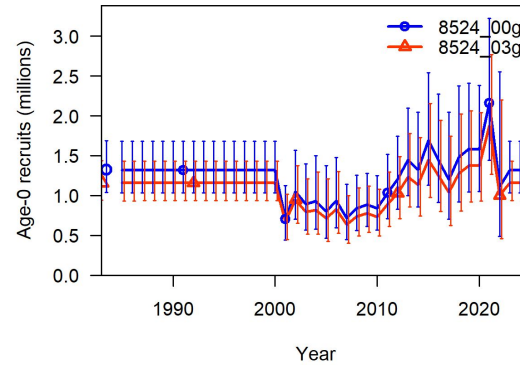
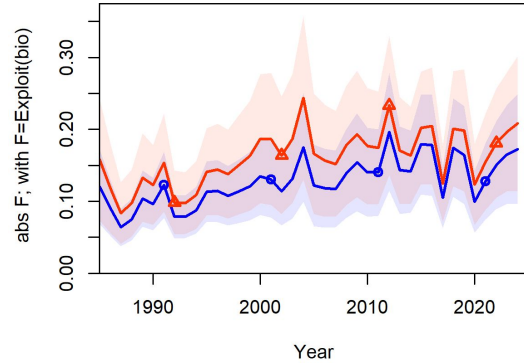
8324_03c

+ Trap index + Dive index (no rec dev)



Observed (solid line) and expected landings (dotted line) in metric tons by fleet for the CPUE Sensitivity model scenarios without recruitment deviations. The two fleets are the diving fleet (blue) and the trap fleet (green).

24_00g + indices and recruitment (No change in F Method or Catch CV)



8524_03h (estimate recruitment through 2024 terminal year)
8524_03i (estimate recruitment through 2021)

